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Research Productivity of Indian Institute of Science (I I Sc), Bangalore during 2000-2019: A Scientometric Study.

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RESEARCH PRODUCTIVITY OF INDIAN INSTITUTE OF SCIENCE (IISc), BANGALORE DURING 2000-2019: A SCIENTOMETRIC STUDY

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Abstract:

The excellence of science and technology has been instrumental in making today's world disparate. Science and Technology are generally recognized as important strategic factors determining the future development and welfare of nations. Research organizations/Universities play a vital role in the generation of new knowledge which may have an impact on the prosperity of the nation. Universities and Research Institutes must assess the research performance of the researcher and scientist for promotion, allocation of research grants, awards, planning of human resources, to know the strengths and weaknesses of the institutions and individuals and to use it in policy decisions. The scientometric study is a viable and relatively objective measure of a university and research institute's performance, particularly in science and technology. The objective of this research is to explore and develop the utility of scientometrics as a research assessment tool to gain insight into the important aspects of research activities at the Indian Institute of Science (IISc), Bangalore. A study on the generation of scientific knowledge and its resultant impact is very crucial for the progress of science and technology. This study evaluates the research productivity of IISc, Bangalore based on the data collected from the Web of Science for twenty years from 2000-2019. A total of 29580 data were downloaded and analyzed using Biblioshiny and Excel software. Parameters such as year-wise, form-wise classification of published papers, most productive authors, most preferred journal, etc. are considered for the study. The impact factor and citation received were also analyzed.

Keywords: Scientometrics, Scientometric analysis, Research Productivity and Indian Institute of Science (IISc), Bangalore.

1.Introduction

Research in common words refers to the search for new knowledge. Research is an indispensable component for any discipline for the generation of new knowledge and is a means of continuously developing a discipline, endowing capabilities to utilize the knowledge generated in other disciplines. Research plays a vital role in enhancing the knowledge of a researcher to promote the prosperity of a nation; the well-being of its society and ultimately to humankind. R & D institutions through research make an important contribution to the growth and development of industries and government businesses, thereby promoting national and

global development (Kumar, 2018). Today a huge amount of tax payer's money has been spent on different research and development work. The government being accountable to the general public for the expenditure of the public fund, it is essential to know whether the allotted funds for research have been utilized properly by the respective institutions. Thus, there is a necessity to analyze the performance of the government-funded research institutions using various performance indicators.

The scientometric study is a viable and relatively objective measure of a university and research institute's performance, particularly in science and technology. Universities and Research Institutes must assess the research performance of the researcher and scientist for promotion, allocation of research grants, awards, planning of human resources, to know the strengths and weaknesses of the institutions and individuals and to use such insightful data in policy decision. A study on the generation of scientific knowledge and its resultant impact is very crucial for the progress of science and technology. Scientometrics is the study of measurement of scientific and technological progress (Naika, 2017).

The present study deals with the research productivity of the Indian Institute of Science (IISc), Bangalore for a period of 20 years from 2000 to 2019 using scientometric techniques. IISc is one of the best institutes in the world in terms of excellence in science with 45 departments located in the city of Bangalore, Karnataka. In the 2020 NIRF(National Institutional Ranking Framework) ranking released on June 11, 2020, IISc was ranked second in the Overall category and first position in the university category (India Ranking 2020: University,2020). IISc aims to be among the world's foremost academic institutions through the pursuit of excellence in research and promotion of innovation by offering world-class education to train future leaders in science and technology and by applying science and technology breakthroughs for India's wealth creation and social welfare.

2. Review of Literature

Suresh and Thanuskodi (2019) attempted to analyze the growth and development of research activity of ICAR- Indian Institute of Horticulture, Bangalore (ICAR-IIHR). Data for the study were retrieved from the Web of Science database for a period of 30 years from 1989 to 2018. Bibliographical data were distributed in HITS software and MS Excel worksheet for statistical analysis. Web of Science indexed 1095 publications with 5952 citations for the period. Bio-Technology has been identified as the most productive research division in ICAR-IIHR with 149 papers (13.6%). Journal articles were the most published form of literature (90.13%), wherein the Indian Journal of Agricultural Sciences followed by Current Science were the top journals. The top collaborating country and institutions with ICAR-IIHR were the United States and Horticultural experiment Station respectively. The highly productive research areas were Agriculture and Plant Sciences. Thomson P had scored maximum citations thereby highest G-Index, H-Index and i10 20 Research Productivity of IISc: A Scientometric Study 20 Index among the faculties and considered as the most proficient author. Collaborating authorship pattern analysis showed that the degree of collaboration (90%) was significantly high.

Cherukodan and Mumthas (2019) examined the growth of scholarly articles produced by the University of Calicut for fifty-one years (1968-2018). A total number of 2158 scholarly articles were collected from the Scopus database. According to this study, more papers were published on Agricultural and Biological Sciences (30%) followed by Chemistry (23%) and Physics and Astronomy combination (21%). Dr. Ramesan, M. T. of the Department of Chemistry has published more scholarly articles (83 articles) wherein 14 were single-authored and received 751 citations. The publications of scholarly articles in Social Sciences, Business, Management and Accounting, Arts and Humanities, Psychology, Economics, Econometrics and Finance were found to be very less (3.7%). The majority of articles (58%) were published during the last ten years (58%).

Kumar and Kumar (2019) investigated the scientific research productivity of the Indian Institute of Science (IISc), Bangalore for a period of 05 years during 2014-2018. A total of 12,130 research papers were retrieved as SCIE publications from WoS bibliographical database and analyzed. The study is focused to find out the year-wise institutional contribution in research, compound annual growth rate, areas of interest, collaborating institutions and countries, mode of publications, research funding agencies, prolific journals, prolific authors, authorship pattern, degree of collaborations, etc. Different scientometric tools and techniques were used to analyze the data and interpretation has been done accordingly to draw out the meaningful result in the research productivity of the institute. According to this study, the most active research areas were Engineering (3054 publications), Physics (2530), Chemistry (2236) and Material Science (2161) CSIR Labs occupied the top research collaborator institutes with IISc, Bangalore. Out of top project funding agencies DST, India comes first followed by DSIR, India. RSC Advances was the most prolific journal with 191 papers. Kumar A. was the most prolific author during 2014-18 with a 3.6% contribution in total research and received 12.2 average citations per publication with H-Index 24.

3. Objectives of the study

1. To trace the year-wise distribution of publication during the period of study which ranges from 2000-2019.
2. To know the most productive authors.
3. To find-out the top-ten most collaborating countries with IISc in research.
4. To identify highly preferred journals in which authors prefer to publish their research articles.
5. To find out top-ten funding agencies for project-based research.
6. To rank the top-ten highly cited documents depicted in the Web of Science database.

4. Methodology

The present study effort to investigate the research productivity of the Indian Institute of Science, Bangalore. It aims to identify the distribution of research output based on research papers contributed by IISc and indexed by Web of Science. This study is quantitative that employed a scientometric technique to evaluate the collected data. A query of the following form was made to collect data using

WoS search string ORANGIZATION ENHANCED search = "Indian Institute of Science (IISc), Bangalore". Publication year was customized for some time from 2000-2019. The necessary data for the study were collected from the database of Science Citation Index (SCI), Social Science Citation Index (SSCI), and Arts and Humanities Citation Index (A&HCI), which is available via the Web of Science database. A total of 29580 bibliographical records were retrieved with this search syntax for research analysis. The data were downloaded in plain text format. The collected bibliographic record was distributed in Biblioshiny Software and MS Excel worksheet for statistical analysis.

5. Analysis and Interpretations

5.1 Year-wise Distribution of Publications

Year-wise distribution of publications is an important indicator of the publication productivity of an institution. Table-1 portrays the pattern of growth of research output of IISc for a period of 20 years ranging from 2000 to 2019.

Table-1: Year-Wise Distribution of Publications		
Publication Years	No: of Publications	Percentage
2000	873	2.951
2001	940	3.178
2002	975	3.296
2003	1040	3.516
2004	1056	3.57
2005	1200	4.057
2006	1199	4.053
2007	1273	4.304
2008	1341	4.533
2009	1467	4.959
2010	1458	4.929
2011	1489	5.034
2012	1594	5.389
2013	1712	5.788
2014	1833	6.197
2015	1850	6.254
2016	1870	6.322
2017	2016	6.815
2018	2194	7.417
2019	2200	7.437
Total	29580	100

As indicated in Table-1 authors from IISc have contributed as many as 29,580 papers in different disciplines during the period of study. It reveals that publications of IISc, Bangalore have progressively increased over the years. According to the tabulated data, IISc has increased its publication in comparison to its previous year's publication except in 2010.

5.2 Most Productive Authors

The scientist with a good number of publications is always an asset of an organization/institute. So it is important to know the authors having a good number of publications. The most productive authors of IISc are depicted in the table below.

Table-2: Top-Ten Most Productive Authors						
Rank	Authors	No: of publications	%	Sum of times cited	ACPP	H-Index
1	Kumar A.	736	2.488	13946	18.95	46
2	Kumar S.	667	2.255	13519	20.27	50
3	Bhattacharya S.	608	2.055	13177	21.67	61
4	Ghosh S.	543	1.836	10055	18.52	49
5	Das S	541	1.829	7440	13.75	40
6	Mukherjee S.	526	1.778	8676	16.49	47
7	Madras G.	525	1.775	15518	29.56	56
8	Sarkar S	449	1.518	8269	18.42	37
9	Kumar R	446	1.508	9697	21.74	38
10	Banerjee S	442	1.494	7033	15.91	38
Total		5483	18.536	107330		

Table 2 ranks the top-ten authors from IISc according to their number of publications. From this table, it has been found that Kumar A. was the most productive author during the period of study 2000-2019 with 2.488% (736 papers) contribution in total research. He has received 13946 citations which itself is the second highest citation among the top-ten most productive authors of IISc. His ACPP (average citation per paper) is 18.95. H-Index of Kumar A. is 46. Kumar S. is on the second rank of the most productive author's list. He has published 667 publications (2.255%) with an H-index of 50. He also received 13519 citations with 20.27 as ACPP. Bhattacharya S. (608 papers), Ghosh S.(543 papers), and Das S (541 papers) have occupied 3rd, 4th and 5th rank respectively in terms of a number of publications. H index is a useful index to characterize the scientific output of a researcher. A higher h-index indicates more publications that have been cited more often. Bhattacharya S. received the highest H-Index (61)

among the ten most productive authors and he was ranked 3rd among them. The highest H-index after Bhattacharya S. was received by Madras G. He has received an H-index of 56 and also has received more citations among these top-ten authors. He got 7th rank among the top ten most productive authors. Kumar S. (50), Ghosh S. (49), and Mukherjee S. (47) occupy 3rd, 4th, 5th positions respectively when considering the H-index value. Even though Kumar A. has become the most productive author of IISc with the number of publications, he is in 6th position in the case of H-index value. Here, it is clear that citation is the key point in addition to the publication to get the proper recognition in the field of research. Citation defines a research work of a scientist and their value in the world of research.

The top-ten prolific authors have published 5483 (18.536%) papers with a total citation of 107330 that shows the quality as well as quantity in a publication by the most productive authors. The Top-ten most productive authors of the institute have been studied and their citation and h-index were also calculated.

5.3 Most Collaborating Countries

If researchers are working together to produce new scientific knowledge and publish their work in publications with joint authorship it is called collaborative research. Collaboration may take place within the organization or with other researchers at the local, national or international level. It is assumed that scientific subjects develop most at an international research frontier and hence international collaboration is an important instrument for the advancement of science, development of national capabilities, and for raising the quality of science and technology. This study shows that IISc researchers have collaborated with researchers in different countries of the world in addition to their colleagues in India. The top-ten countries that have largely collaborated with the authors of IISc are depicted in figure 1 below.

Figure 1 Most Collaborating countries

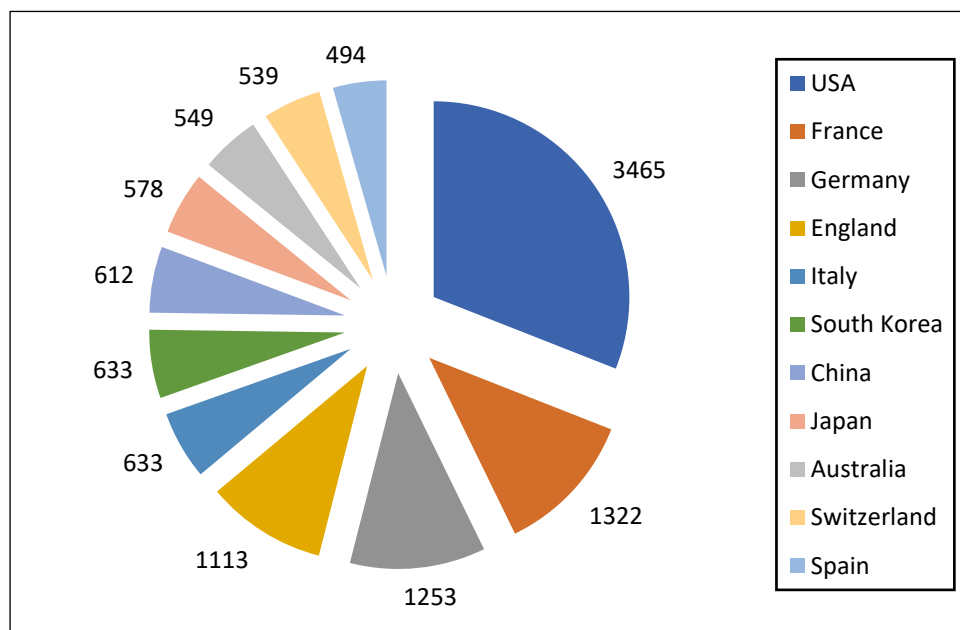


Figure-4 portrays top-ten countries whose researchers have collaborated with the researchers in IISc and have produced papers in the range of 494 to 3,465. The USA is the largest collaboration partner with 3,465 papers(11.714%) and has occupied 1st rank in the list of top-ten collaborating countries followed by France and Germany. The second and third rank is obtained by France and Germany with 1322 papers(4.469%) and 1253 (4.236%) papers respectively. England is ranked 4th in terms of collaboration with IISc and has published a number of 1113 papers(3.763%). Italy and South Korea share 5th rank with an equal number of publications. These two countries in collaboration with IISc have produced 633 papers(2.14%). China, Japan, Australia, Switzerland and Spain occupy 6th, 7th, 8th, 9th and 10th rank respectively. All other countries except Spain have produced more than 500 publications in collaboration with IISc. The 10th ranked country Spain has only produced 494 publications (1.67%). The top-ten collaborating countries with IISc have produced a total of 11191 publications which has formed 37.833% of IISc's total publications. Analyzing figure-1, it is clear that out of 10 collaborating countries 07 are from western countries and 03 countries are from Asia. The study also indicates the growing collaboration with Asian countries like Japan, China and South Korea. So it can be concluded that IISc is actively engaged in research with foreign countries.

5.4 Highly Preferred Journals

Journals are the primary source of publication that keeps the scholarly community updated with the current research and development in a field. So it is important to know the preferred journals by the institution where most of its research works are portrayed. The top-ten most preferred journals used to communicate research results are depicted in Table-3 & Figure-2.

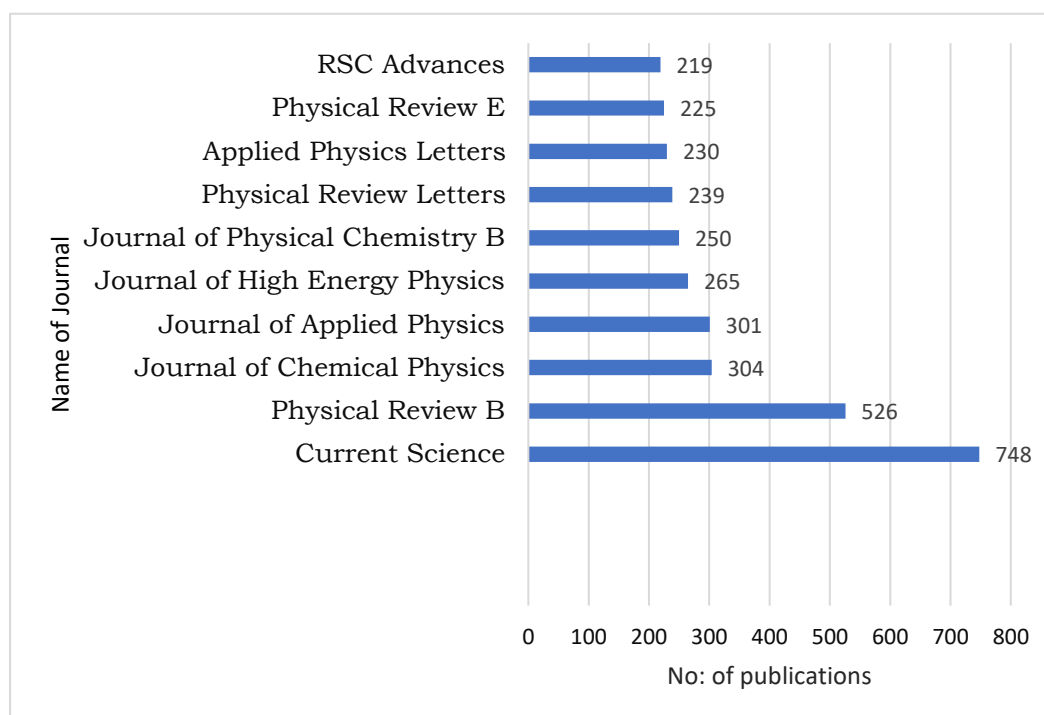
Table-3: Highly Preferred Journals								
No:	Source	NP	%	TC	ACPP	JIF	H-Ind ex	Place of Publicati on
1	Current Science	748	2.529	6526	8.72	0.725	37	INDIA
2	Physical Review B	526	1.778	14231	27.05	3.575	58	USA

3	Journal of Chemical Physics	304	1.028	5562	18.17	2.991	37	USA
4	Journal of Applied Physics	301	1.017	4937	16.4	2.286	36	USA
5	Journal of High Energy Physics	265	0.896	4449	16.78	5.875	36	USA
6	Journal of Physical Chemistry B	250	0.845	9226	36.9	2.857	50	USA
7	Physical Review Letters	239	0.808	10617	44.42	8.385	55	USA
8	Applied Physics Letters	230	0.778	4400	19.13	3.597	35	USA
9	Physical Review E	225	0.76	3579	15.9	2.294	31	USA
10	RSC Advances	219	0.74	3576	16.32	3.119	28	England
Total		3307	11.18	67103				

*NP-number of publication

*TC-Total Citation

*JIF-Journal Impact Factor

Figure 2 Highly Preferred Journals

According to table-3 *Current Science* is the highly preferred research journal at IISc, Bangalore. Out of 29580 publications produced in the period of study which ranges from the year 2000 to 2019, the journal *Current Science* has published 748 (2.529%) articles of IISc. These articles have received 6526 citations. The average citation received is 8.72 with an H-Index of 37. *Current Science* has a journal impact factor of 0.725. The Impact factor reflects the prestige and quality of a journal. The IF is not only used to measure the quality of a journal, it is also used to evaluate an individual researcher, department, or institution by considering in which journals they opt to publish their research works (Moed, 2005). Significantly, *Current Science* where most of the research works of IISc appear is an Indian journal. *Physical Review B* and *Journal of Chemical Physics* are in the second and third position of the preferred publication with 526(1.778%) and 304(1.028%) articles respectively. Both of these journals are high-quality journals where *Physical Review B* received a journal impact factor of 3.575 while *Journal of Chemical Physics* received a JIF of 2.991. *Physical Review B* has received an H-index of 58 and a citation of 14231 which are the highest among the top-ten preferred journals. Its average citation is 27.05. *Journal of Chemical Physics* has received a total citation of 5562 with an average citation of 18.17 and H-index 37. Among the top-ten journals, the second-highest citation was received by the journal *Physical Review Letters* which is positioned 7th in terms of productivity. It has obtained an average citation of 44.42.

The impact factor (IF) value of journals was taken from JCR 2019. JCR offered by International Scientific Institute (ISI) is one of the world's leading sources offering indexing services of journals and research conferences that evaluates the leading journals systematically to identify their impact factor. Journals *Physical Review Letters*, *Journal of High Energy Physics*, *Applied Physics Letters* and *Physical Review B* comes in the 1st, 2nd, 3rd and 4th position with JIF as 8.385, 5.875, 3.597 and 3.575 respectively. While in the case of publications from IISc the same were placed in 7th, 5th, 8th and 2nd positions respectively. The impact factor of the journals listed in the table reveals that the authors of IISc publish their research works in the good impact factor journals and the publications have international visibility.

In the case of the H-index, *Physical Review B* comes in first place with H-index as 58 followed by *Physical Review Letters* with H-index 55 and *Journal of Physical Chemistry B* with 50. The top-ten productive journal has altogether produced 3307 articles (11.18%) with a total citation of 67103.

Among the top-ten most productive journals, nine journals are published from foreign countries. As mentioned earlier the most productive journal (*Current Science*) is published in India. Except for *Current Science*, all other top-ten productive journals have been published in foreign countries and they altogether produced 2559 articles. Among these journals, eight journals are produced from the USA and one from England. This indicates that authors of IISc prefer to publish in foreign journals than in Indian journals. So, the study shows that authors of IISc prefer to publish their papers in foreign journals rather than in Indian journals.

5.5 Funding Agencies for Project-Based Research

The top-ten funding agencies for project-based research are studied and depicted in the table below. Funding agencies for project-based research shows that the institution is producing information that is very much value to society and their application could enhance the prosperity of the society as well as the nation.

S.No:	Research Project Funding Agencies	Country	No. of project handled articles	% of 29580
1	DEPARTMENT OF SCIENCE TECHNOLOGY DST INDIA	INDIA	5301	17.921

2	COUNCIL OF SCIENTIFIC INDUSTRIAL RESEARCH CSIR INDIA	INDIA	3185	10.767
3	DEPARTMENT OF BIOTECHNOLOGY DBT INDIA	INDIA	1282	4.334
4	UNIVERSITY GRANTS COMMISSION UGC INDIA	INDIA	1224	4.138
5	NATIONAL SCIENCE FOUNDATION NSF	USA	782	2.644
6	DEPARTMENT OF ATOMIC ENERGY DAE	INDIA	591	1.998
7	UNITED STATES DEPARTMENT OF ENERGY DOE	USA	487	1.646
8	GERMAN RESEARCH FOUNDATION DFG	GERMANY	442	1.494
9	NATIONAL INSTITUTES OF HEALTH NIH USA	USA	402	1.359
	UNITED STATES DEPARTMENT OF HEALTH HUMAN SERVICES	USA	402	1.359
10	EUROPEAN UNION EU	BELGIUM	392	1.325
Total			14490	48.99

The table-4 shows the top-ten research funding agencies/institutions of IISc and their country. DST, India is the top funding agency for project-based research followed by CSIR, India; DBT, India; UGC, India; NSF, USA and so on. Two different funding agencies are in 9th position belonging to the same country USA. DST, India-funded research has contributed 5301 articles which becomes 17.921% of the total. Funding from CSIR, India has contributed to 3185 research articles (10.767%). The funding agencies from the USA are NSF, DOE, NIH and HHS which occupies 5th, 7th and 9th position respectively. Among the top-ten funding agencies, agencies from the USA alone funded research has contributed for 2073 articles. Out of the top-

ten funding agencies, five funding agencies are from India, four from the USA, one from Germany and one from Belgium. These top-ten funding agencies funded research altogether contributed 14490 articles that is 48.99% of total publications. IISc, Bangalore is involved in research project-based publications with the world's leading research agencies that indicate the level of the research quality of the institute.

5.6 Most-Cited Document

The most cited document reveals the impact of research findings depicted in that document. The value of a research paper is of course enhanced with the citation it receives. So it is important to know the most cited document of an institution/ organization.

Table-5: Top-Ten Most Cited Documents					
Rank	Title of the work	Document Details	Times Cited	WoS Category	Authors by Inline
1	Graphene: The new two-dimensional Nanomaterial	Review, Angewandtechemie-international Edition, 2009, 48(42)	2895	Chemistry	4
2	Guidelines for the use and interpretation of assays for monitoring autophagy	Review, Autophagy, 2016, 12(1)	2756	Cell Biology	More than 20
3	Monitoring dopants by Raman scattering In an electrochemically top-gated graphene transistor	Journal Article, Nature Nanotechnology, 2008, 3(4)	2415	Material Science	11

4	Mechanical behavior of amorphous alloys	Review, ACTA Materialia, 2007, 55(12)	2183	Material Science	3
5	Recent advances and industrial applications of multilevel converters	Journal Article, IEEE Transactions on Industrial Electronics, 2010, 57(8)	2102	Engineering Instruments & Instrumentation	9
6	Supramolecular Coordination: Self-Assembly of Finite Two- and Three Dimensional Ensembles	Review, Chemical Reviews, 2011, 111(11)	1784	Chemistry	3
7	Supramolecular gels: functions and uses	Review, Chemical Society Reviews, 2005, 34(10)	1582	Chemistry	2
8	Hydrodynamics of soft active matter	Journal Article, Reviews of Modern Physics, 2013, 85(3)	1507	Physics	7
9	Vortex-induced vibrations	Review, Annual Review of Fluid Mechanics, 2004	1260	Mechanical Physics	2
10	synthesis, structure and properties of Boron-and Nitrogen-Doped Graphene	Journal Article, Advanced Materials, 2009, 21(46)	1252	Chemistry	7

The table-5 shows the bibliographic details of the highly cited documents along with the details of the document type, times cited WoS category and number of authors. The most cited document ranked one was titled 'Graphene: The new two-dimensional nanomaterial' was a review published in *Angewandtechemie-international*. It has received 2895 citations within 11 years of its publication. It belongs to the WoS category Chemistry. And was a collaborative work of four authors. 'Guidelines for the use and interpretation of assays for monitoring autophagy' is the title of the second848 most cited document with a citation of 2756. It was penned by more than 20 authors and belongs to the WoS category Cell Biology. This second most cited document is also a review published in 2016 in *Autophagy*. The third most cited document is a journal article published in *Nature Nanotechnology* in the year 2008 was entitled 'Monitoring dopants by Raman scattering in an electrochemically top-gated graphene transistor'. Authored by 11, it has received 2415 citations and belongs to the WoS category 'Material Science'.

Documents with 1st,6th,7th and 10th rank belong to WoS category Chemistry. So it can be concluded that among the top-ranked highly cited document, most of them belongs to the WoS category Chemistry. Among the highly cited ten documents, six of them belonged to the document type i.e. Review, and four were articles. It can also be noticed that among the most cited ten documents, all of them were multi-authored and no document was contributed by a single author alone.

6 Major Findings of the Study

As a result of systematic analysis and interpretation of the data obtained for the present study from WoS, the researcher observes the following specific points about the study of research productivity of IISc, Bangalore.

6.1 Year-Wise Distribution of Publications

1. The year-wise distribution of research productivity of IISc was studied for a period of 20 years from 2000-2019. The total publication count is found to be 29580.
2. More publications were counted in the year 2019 with 2200(7.437%) publications which is the highest productive year.
3. The least count of the total output was in the year 2000 with 783, which is 1.87 % of the total.
4. It is also observed that IISc, Bangalore is increasing its productivity year by year.

6.2 Most Productive Authors

1. It has been found that Kumar A. was the most productive author during the period of study with 736 (2.488%) contribution in total research with H-Index 46.
2. Kumar S. is on the second rank of the most productive author's list with 667 publications (2.255%) and with H-index 50.
3. Bhattacharya S. received the highest H-Index (61) among the ten most productive authors and he was ranked 3rd among top-ten authors based on the number of publications made.
4. Although Kumar A. become the most productive author of IISc with the number of publications, he is in 6th position in the case of H-index value.
5. The top-ten most productive authors have published 5483 (18.536%) papers with a total citation of 107330.

6.3 Most collaborating countries

1. The USA is the largest collaboration partner of IISc with 3,465 papers (11.714%) and has occupied 1st rank in the list of top-ten collaborating countries followed by France and Germany.
2. The top-ten collaborating countries with IISc produced a total of 11191 publications which has formed 37.833% of IISc's publications.

6.4 Highly preferred journals

1. *Current Science* is the highly preferred research journal at IISc, Bangalore. It has produced 748 (2.529%) articles of IISc. The journal impact factor and H-index of current Science were 0.725 and 37 respectively.
2. *Physical Review B* and *Journal of Chemical Physics* are in the second and third position of the preferred publication with 526(1.778%) and 304(1.028%) articles respectively. *Physical Review B* received a journal impact factor of 3.575 and H-Index 58 while *Journal of Chemical Physics* received JIF as 2.991 and H-Index 37.
3. Most of the research papers from IISc were published in high-quality peer-review journals having a good journal impact factor.
4. Among the top ten most productive journals, nine journals are published from foreign countries. That is eight journals are produced from the USA, one from England and one

from India. Significantly, *Current Science* where most of the research works of IISc appear is an Indian journal.

6.5 Funding Agencies For Project-Based Research

1. DST, India is the top funding agency for project-based research of IISc followed by CSIR, India; DBT, India; UGC, India; NSF, USA and so on.
2. DST-funded research has contributed 5301 articles which becomes 17.921% of the total.
3. Two different funding agencies (NIH and HHS) are in 9th position belonging to the same country USA.
4. Out of the top-ten funding agencies, five funding agencies are from India, four from the USA, one from Germany and one from Belgium.
5. Top-ten funding agencies funded research altogether contributed 14490 articles that is 48.99% of total publications.

6.6 Most Cited Document

1. The highly cited document was a review titled 'Graphene: The new two-dimensional nanomaterial' published in *Angewandtechemie-international*. It has received 2895 citations within 11 years of its publication. It belongs to the WoS category Chemistry. It was a collaborative work of four authors.
2. Among the highly cited top-ten document, most of them belong to the WoS category Chemistry.
3. Among the highly cited ten documents, six of them belonged to the document type i.e. Review, and four were articles.
4. It can also be noticed that all the highly cited top-ten publications were multi-authored and no document was contributed by a single author alone.

7. Conclusion

Research in any discipline is an important activity that produces a huge amount of information. There are a lot of institutions that are devoted to research and development activities in India. Sometimes it is necessary to evaluate the research productivity of these institutions for assessing their role in the production of information and also for ranking these institutions by various agencies. In this study, the researcher employs scientometric analysis for assessing the research productivity of the Indian Institute of Science (IISc), Bangalore. This work explores the factors of productivity of IISc in research, in terms of the year-wise production of the publication, the form of publication, productive author, preferred

journal, funding agency, most collaborating country, and most cited document. The findings in the study are based on the data obtained from the Web of Science database only.

The findings of the study revealed that the growth of publications by IISc is consistently in an increasing trend with the preferred form of publication as a research article. Kumar A. was found to be the most productive author with 736 publications and H-Index 46. The most collaborative country was found to be the USA. *Current Science* became the highly preferred journal. DST, India was the top funding agency for project-based research and the most cited document was found as review type.

It is observed that the assessment of research performance by different credit rating agencies has put pressure on universities and research institutes to increase their research impact as the weightage given for the research performance is very significant. Since 2015, the Government of India has launched its National Institutional Ranking Framework (NIRF) to rank institutes, in which research performance is an important parameter. Hence, it has become imperative that policymakers encourage scientometrics studies on all institutes and universities of national importance to gauge the knowledge creation at the national level. From the findings of the present study, it is clear that the NIRF second-ranked (as per 2020 data) institution in the country (overall category) is doing their best to produce a good amount of information which has application in various fields of life.

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