# Research Productivity and Citation Impact of Indian Institutes of Science Education and Research: An Empirical Study

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**ABSTRACT**

The paper's main objective is to investigate the trends of basic science research in India using a combination of qualitative and quantitative approaches. It examines the publication patterns and impact of research productivity of five basic science institutions, i.e., "Indian Institutes of Science Education and Research" (IISER), namely IISER Kolkata, IISER Pune, IISER Mohali, IISER Bhopal, and IISER Thiruvananthapuram. The research output indexed in the SCOPUS bibliographic database of these five established IISERs was obtained from 2015 to 2019. A total number of 7329 research publications were analysed using various scientometric dimensions. This paper makes a concerted effort to present a comprehensive picture of the assessment of research outcomes at the five older IISERs, which are ostensibly India's most active and prominent basic science research institutions. The findings reveal that these institutions are accountable for important research outcomes, such as a high number of citations, preferences towards open access (OA) publications, a rise in research publication year over year, a strong author network, a high degree of collaboration, and a high impact in terms of other scientometrics indicators. This paper discusses the findings of the research publications on the position of IISERs in basic sciences research and draws some conclusions about their effects.

**Keywords:** Research productivity; Open access publications; Scientometrics; Authors network; Focused research areas; Research in India

## 1. INTRODUCTION

Research and publications play a pivotal role in generating new knowledge and contribute to the growth of any discipline. A nation's overall capacity depends considerably on its research. Research is considered as the foundation and an important driving force for future investigation in any field of study. Universities and research institutions across the globe play an essential role as centres of knowledge production and research. An important area where significant progress has been achieved over the last few years is assessing the level of excellence of the research system. Assessing the productivity of institutional research and developmental activities highlights the contributions of the institutions and individuals engaged in research. Such assessment facilitates reviewing the faculty productivity that affects their tenure and promotion and knowing where the institution stands in national or global scenarios. The number of research publications, national and international collaborations, citation impact of research, the impact factors of the preferred journals, and the field where the research is being done is important indicators to study the overall growth of an institution and trends of a research discipline. In this context, the present study is an attempt to assess the productivity and

citation impact of five Indian Institutes of Science Education and Research (IISERs) of India, namely, IISER Kolkata, (Est.2006 ), IISER, Pune (Est.2006), IISER, Mohali (Est.2007), IISER, Bhopal (Est.2008), and IISER, Thiruvananthapuram (Est. 2008 ). The IISERs have been established broadly on the lines of the Indian Institute of Science (IISc) and declared as "Institutes of National Importance" by the Parliament in 2012. IISERs offer courses such as BS-MS, integrated PhD and PhD to aspirants. IISER was ranked 29 in the 'Overall Category' of NIRF Rankings of 2020. (www.shiksha.com). The goals of these institutes are to perform quality research and impart quality education in the basic sciences.

## 2. LITERATURE REVIEW

Assessment of research productivity of universities and other institutions of importance is a significant research area among scholars of various disciplines. Several studies are found to have been conducted on this aspect. Some notable studies are reviewed as under, befitting the current study.

Prathap and Gupta (2009)[1] suggested a more rational procedure for ranking the research performance of various Indian universities based on the quantum of output and quality of research. This new procedure identifies the indicators correlated with each other and then uses a composite

indicator that combines quality with quantity. Gupta (2010)[2] highlighted a new methodology to rank top 50 productive Indian universities employing publication data, the citations received to the publications and collaborative publication data at the international level. Baskaran (2013)[3] studied the research performance of Alagappa University from 1999-2011 and highlighted the productivity of authors. They were also focused on the collaboration pattern at the international level, collaboration among disciplines and various institutions. Results indicated an inconsistent relative growth rate (RGR) as well as doubling time (DT) during the study period. Kumar et al. (2015)[4] conducted a bibliometric analysis of research publications of Gujarat University during the period from 2004 to 2013. Results revealed that the collaboration was highest in the year 2012 at 0.70. P. S. Srivastav of Gujarat University was the most cited author, while the best average citations per paper were credited to V.K. Jain. Krishnamurthy and Awari (2015)[5] examined the research contribution of 12 Departments of social sciences of Karnatak University, Dharwad, based on the doctoral theses records available in INDCAT. In this study, the department of Economics was found as most productive with 242 doctoral theses records. Nagarkar and Kumbhar (2015)[6] analysed the research productivity of life sciences faculty members at the Savitribai Phule Pune University from 1999-2013. Results showed that the research productivity of faculty members has been increased and has received good citations. The faculty members have collaborated with prominent international researchers and have extended interdisciplinary research. Siwach and Kumar (2015)[7] carried out a study of the research contributions of Maharshi Dayanand University, Rohtak in terms of the chronological distribution pattern, citation counts, collaborations at the national and international level, top collaborating institutions, subject-wise distribution of papers, most favoured journals for publication, most prolific authors, and top-cited papers of the University. Tripathi and Kumar (2015)[8] conducted a bibliometric study of 5,007 research publications from Jawaharlal Nehru University published within a period from 1971–2010. The study revealed an impressive international collaboration in research among the faculty members and researchers. The social scientists and humanists of Jawaharlal Nehru University have published books, but these are not indexed in the Web of Science bibliographic database. Based on the publication data of 1041 research articles of Banaras Hindu University, indexed in the Indian Citation Index (ICI), Gautam and Mishra (2015)[9] carried out a bibliometric study. The results indicated that the university's research productivity is increasing at the average rate of 104.1 publications per year, a good share of the publications are by joint authors. The proportion of SCIE indexed journal publications were 404 (39 %), while non-SCIE-indexed publications were 637 (61 %). In order to explore the publication trends of the University of Delhi (DU) and Jawaharlal Nehru University (JNU) in the field of Arts and Humanities Bharti, and Meera (2017)[10] carried out a study. Findings revealed that author collaboration pattern among authors is very less. History is a highly worked-out area. Bindu Puri and Charu Gupta of DU and Romila Thapar of JNU are found as the most prolific authors in arts and humanities.

So far, specifically, IISERs are concerned, we found studies conducted by Visakhi and Gupta (2013)[11] on the impact of faculty and scholars of IISER, Mohali. Focussing on highly cited publications by IISERs in Chemistry for the period from 2008-15 by Visakhi et al., (2016)[12] arrived at the conclusion that the leading institutions in terms of Major Collaborative Index (MCI) were: IISER Pune (0.75), followed by IISER Bhopal (0.60), IISER Mohali and IISER Thiruvananthapuram (0.50 each) and IISER Kolkata (0.44) during 2008-15. Analysing the research publications of IISER, Thiruvananthapuram (Hadimani et al. 2015)[13], it was found that during the period from 2008−2013, the institute has produced 157 publications contributed by 2717 authors with an average of 17.31 authors and 13.58 per cent citations per paper. One of the most prolific authors of the centre is Datta, A. with 33 (21.02 %) contributions who stood at the 1st place and scholars of IISER-TVM preferred to collaborate internationally. To identify the growth trends, per capita output, authorship and collaboration patterns, citation impact, average citation per paper, Solanki et al. (2016)[14] carried out a study on five IISERs during a period of five years from 2010 to 2014. The authors concluded that the quantity of research output and quality of research output of IISERs is consistent and comparable to the quantum of research output from premier Indian institutions in scientific research.

## 3. OBJECTIVES OF THE STUDY

The study has been carried with the following objectives:
- To analyse the year-wise contribution of publications with citations received;
- To find out the contributions to open access literature by the IISERs;
- To identify the most productive open access sources in Basic Sciences;
- To determine the international collaborative pattern and authorship network based on citations received in Basic Sciences;
- To find out the most preferred subject areas of research.

## 4. METHODOLOGY

The source data for the present study of the five IISERs has been taken from Scopus bibliographic database. The advanced search box in the Scopus database where affiliation IDs of selective IISERs were given [AF-ID (60103626), AF-ID (60103615), AF-ID (60103627), AF-ID (60103628), and AF-ID (60103629)] to retrieve the required data. All the scientific communications are extracted, compiled and analysed using the R - Bibliometrics package. It includes approximately 7329 titles, 6526 of which are peer-reviewed journal articles, and 102733 citations. The study was carried out using various scientometric indicators along with VOSviewer open-source visualizing tool for the network analysis.

## 5. DATA ANALYSIS

Analysis was performed based on the collected dataset of IISERs using various scientometric dimensions such as publication types, authorship pattern, ranking of publication sources, Number of Publications (NP), Number of Citations

**Table 1. Total research output of corpus (5 IISERs) and basic sciences research output of India**

| Year | Research output of India | Basic Sciences Research output of India | % of Basic Sciences Research output of India | Corpus contribution to Basic Sciences | % of corpus contribution to Basic Sciences |
|---|---|---|---|---|---|
| 2019 | 200098 | 87662 | 43.8 | 1775 | 2.02 |
| 2018 | 181820 | 87170 | 47.9 | 1690 | 1.94 |
| 2017 | 157883 | 74421 | 47.1 | 1545 | 2.08 |
| 2016 | 156242 | 71094 | 45.5 | 1330 | 1.87 |
| 2015 | 145042 | 64542 | 44.5 | 989 | 1.53 |
| Total | 841085 | 384889 | 45.8 | 7329 | 1.90 |

(NC), Average Citations Per Paper (ACPP), and Citations received by Open Access Publications (COA), International Collaborative Papers (ICP), Authors Network, Focused Research Areas, etc.

## 5.1 Research Output

Out of 7329 research contributions during the period of study, the highest is "Research Papers" (6525) that accounts for 80 per cent of the total contributions, followed by "Conference Paper" (265, 3.6 %), "Review" (218, 3 %), and "Book Chapter" (124, 1.7 %). The other categories of short communications are significantly less in numbers contributing the rest 2.7 per cent of total publications. Individually, it is observed that IISER Pune (31.4 %) and IISER Kolkata (24.7 %) are better placed in terms of research papers and corresponding citation patterns.

Table 1 reflects the year-wise research output for all the five IISERs and India's research output as a whole and in the field of Basic Sciences. It is observed that a noticeable increase in the research output of the corpus (from 989 in 2015 to 1775 in 2019). In another study, Solanki et al. (2016)[14] had also observed a similar pattern (from 219 in 2010 to 728 in 2014). It is also observed that the percentage contribution of IISERs to India's total Basic Sciences research output increased from 1.53 in 2015 to 2.02 in 2019. It can be inferred that, without a doubt, this is a significant contribution in a short period of time.

## 5.2 Annual Scientific Publications, Number of Citations Received (NCR) and Average Citations per Paper (ACPP)

Table 2 reveals the year-wise distribution of publications and the citations received from 2015 to 2019. It is observed that there is a steady growth of scholarly publications during the study period from 989 to 1775, with an average growth rate (GR) of 16.12 per cent. From the citation pattern to IISER articles, it is found that a total 102733 numbers of citations were received during the five years of study. The citation range per article varies from 8.0 to 35.1, which gives a mean citation

**Table 2. Publication pattern and citations received by five prominent IISERs**

| IISERs | Year | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|---|---|---|---|---|---|---|---|
| IISER-P | NP | 297 | 394 | 493 | 539 | 519 | 2242 |
|  | NC | 7031 | 8072 | 8685 | 5648 | 1636 | 31072 |
|  | ACPP | 23.7 | 20.5 | 17.6 | 10.5 | 3.2 | 13.9 |
| IISER-K | NP | 278 | 342 | 367 | 385 | 444 | 1816 |
|  | NC | 4375 | 13996 | 326 | 2989 | 1835 | 23521 |
|  | ACPP | 15.7 | 40.9 | 0.9 | 7.8 | 4.1 | 13.0 |
| IISER-B | NP | 171 | 250 | 282 | 287 | 316 | 1306 |
|  | NC | 3083 | 4313 | 3714 | 1695 | 635 | 13440 |
|  | ACPP | 18.0 | 17.3 | 13.2 | 5.9 | 2.0 | 10.3 |
| IISER-M | NP | 168 | 197 | 244 | 312 | 345 | 1266 |
|  | NC | 2383 | 2606 | 2382 | 1948 | 822 | 10141 |
|  | ACPP | 14.2 | 13.2 | 9.8 | 6.2 | 2.4 | 8.0 |
| IISER-TVM | NP | 75 | 147 | 159 | 167 | 151 | 699 |
|  | NC | 2541 | 11887 | 8824 | 1009 | 298 | 24559 |
|  | ACPP | 33.9 | 80.9 | 55.5 | 6.0 | 2.0 | 35.1 |
| Total | NP | 989 | 1330 | 1545 | 1690 | 1775 | 7329 |
|  | GR | - | 34.48 | 16.17 | 9.39 | 5.03 | - |
|  | NC | 19413 | 40874 | 23931 | 13289 | 5226 | 102733 |
|  | ACPP | 19.6 | 30.7 | 15.5 | 7.9 | 2.9 | 14.0 |

N.B.: **NP** = *Number of Publications*; **NC** = *Number of Citations*; **ACPP** = *Average Citations per Paper*

of 14.0 for each article. It denotes that IISER publications in the field of natural sciences are of high impact.

Similarly, a declining citation trend is also observed in 2018 and 2019 as the older articles get more time to accumulate more citations. That is why there are very high citations (59 %) received for older articles (for the years 2015 and 2016) than for recent articles (18 % for 2018 and 2019). The Average Citations per Paper (ACPP) also reveals the same pattern, which

**Table 3. Citation pattern of open access publications vs non-open access publications**

| IISER | OA | P | COA | PCOA | NOA | P | CNOA | PCNOA | TP | CTP |
|---|---|---|---|---|---|---|---|---|---|---|
| IISERP | 964 | 43.0 | 21445 | 69.0 | 1278 | 57.0 | 9627 | 31.0 | 2242 | 31072 |
| IISERK | 413 | 22.7 | 21642 | 92.0 | 1403 | 77.3 | 1879 | 8.0 | 1816 | 23521 |
| IISERB | 374 | 28.6 | 5517 | 41.0 | 932 | 71.4 | 7923 | 59.0 | 1306 | 13440 |
| IISERM | 301 | 23.8 | 3193 | 31.5 | 965 | 76.2 | 6948 | 68.5 | 1266 | 10141 |
| IISERTVM | 201 | 28.8 | 19266 | 78.4 | 498 | 71.2 | 5293 | 21.6 | 699 | 24559 |
| Total | 2253 | 30.7 | 71063 | 69.2 | 5076 | 69.3 | 43395 | 42.2 | 7329 | 102733 |

*OA= Open Access Publication; P= Percentage; COA= Citations Received Open Access Publications; PCOA=Percentage of Citations Received Open Access Publications; NOA=Non-Open Access Publication; CNOA=Citations Received Non-Open Access Publication; PCNOA=Percentage of Citations Received Non-Open Access Publication; TP=Total Publications; CTP=Citations received in Total publications*
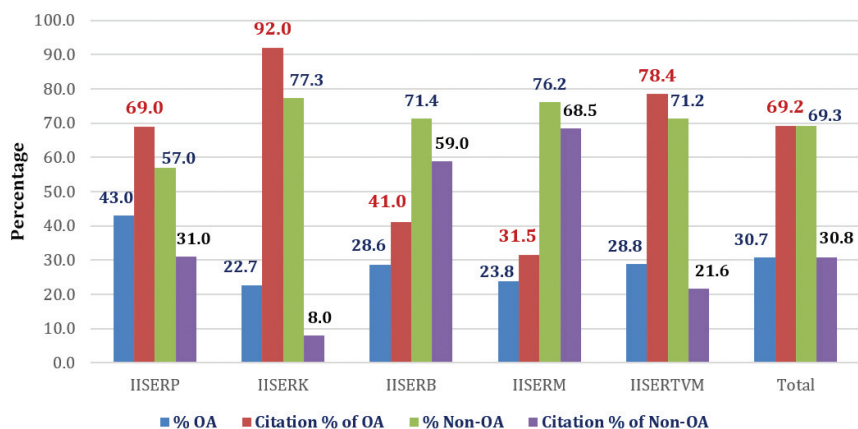


**Figure 1. Percentage of open access vs non-open access publications and respective citations.**

indicates that the un-cited ratio is significantly less in basic science papers.

## 5.3 Contributions to Open Access and Citation Pattern

By promoting the worldwide communication of research and scholarship, Open Access (OA) publishing aims to increase the speed of discovery and innovation. Open access shifts the costs of publishing so that the reader can obtain the content free of cost. The present paper also analyses the OA publications in natural science literature from the IISER dataset. As there is no barrier of open access articles to the worldwide research community,

**Table 4. Top-ranked publication sources**

| Rank | Journal | NP | Access type | Publisher | Subject area | Cite score | SJR |
|---|---|---|---|---|---|---|---|
| 1 | Journal of High Energy Physics | 249 | OA | Springer Nature | Physics and Astronomy | 4.79 | 1.016 |
| 2 | Physical Review D | 149 | H-OA | APS | Physics and Astronomy | 4.12 | 1.703 |
| 3 | Physics Letters Section B Nuclear Elementary Particle & High Energy Physics | 128 | OA | Elsevier | Physics and Astronomy: Nuclear & High Energy Physics | 3.86 | 1.806 |
| 4 | European Physical Journal C | 116 | OA | Springer Nature | Physics and Astronomy, Engineering | 4.46 | 1.972 |
| 5 | Physical Review Letters | 87 | H-OA | APS | Physics and Astronomy | 8.64 | 3.571 |
| 5 | Scientific Reports | 87 | OA | Springer Nature | Multidisciplinary | 4.29 | 1.414 |
| 6 | ACS Omega | 72 | OA | APS | Chemical Engineering | 2.54 | 0.754 |
| 7 | PLOS One | 44 | OA | Public Library of Science | Multidisciplinary | 2.97 | 1.10 |
| 8 | Journal of Chemical Sciences | 38 | OA | Springer Nature | Chemistry | 1.28 | 0.333 |
| 9 | RSC Advances | 38 | OA | RSC | Chemical Engineering | 3.16 | 0.807 |
| 9 | Chemical Science | 29 | OA | RSC | Chemistry | 8.96 | 3.895 |
| 10 | Chemical Communications | 25 | H-OA | RSC | Materials Science | 6.12 | 2.177 |
| 10 | Current Science | 25 | H-OA | Indian Academy of Sciences | Multidisciplinary | 0.64 | 0.272 |

the citations received is more than non-open access articles. The Open Access movement is gaining momentum worldwide, and India is also actively participating in this movement. Out of 7329 publications, 2253 (30.7 %) articles are published under the Open Access (OA) category. Table 3 represents the distribution of open access and non-open access publications and the citation pattern of those articles. It is observed that open access publications have received higher citations (69.2 %) compared to non-open access publications. The Average Citations per Paper (ACPP) for open access publications is 31.5, while the ACPP for non-open access publications is only 8.5. Thus, it can be inferred that a basic science researcher who prefers to publish in open access can earn four times as many citations as their counterpart.

Figure 1 presents the significant difference between the citation received by OA publications and non-OA publications. It is observed that though the total OA publications are 30.7 per cent of total publications, it received 69.2 percentage of citations during the study period. On the contrary, the total non-OA publications are 69.3 per cent, which brings only 30.8 percentage of citations in basic sciences. This inclination towards OA journals could be due to declining library budgets in many parts of the world, including India. Apart from that, proponents of the OA movement have been waging a concerted campaign to raise OA consciousness.

## 5.4 Top-Ranked Publication Sources

The top ten sources where the IISER research group prefers to publish are listed in Table 4. It is observed that out

of 13 source journals, 9 are Open Access journals, and the rest four sources are published with "hybrid open access" or "hybrid subscription journals". All articles of IISER published in the source journals (with NP) provide worldwide, barrier-free access to the full-text of articles online, immediately on publication under a creative commons license. With 729 publications (~ 10 %), "Physics and Astronomy" is at the top of the list of the top-rated source papers. Similarly, when it comes to publishers, "Springer Nature" is at the top of the list, followed by RSC (Royal Society of Chemistry). The high value of other indicators like the Cite Score and SJR displayed against each source journal indicates the popularity, and influence. During the period of study, it is further observed that out of the top 20 contributions open access journals, 13 journals are pure open access and the rest are hybrid open access. Researchers from IISERs have published more than 150+ sources in SCOPUS index journals during the study period. The top 20 source journals with the number and percentage of publications in descending order are listed herewith.

## 5.5 International Collaborations Partners and Authorship Network

Researchers are reaching out to colleagues and peers worldwide to gain access to developing new ideas or access to new sources of funding, among other things, as international collaboration gathers momentum. IISERs have collaborations with more than 80+ countries for research publications, and Table 5 provides the rank list of prolific countries according to international collaborations among the IISER authors. The

**Table 5. International collaborations with top 15 countries**

| International collaboration | IISERP | | IISERK | | IISERB | | IISERM | | IISERTVM | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NCP | % | NCP | % | NCP | % | NCP | % | NCP | % | NCP | % |
| United States | 725 | 32.4 | 235 | 12.9 | 211 | 16.2 | 172 | 13.6 | 142 | 20.3 | 1485 | 20.3 |
| Germany | 601 | 26.8 | 194 | 10.7 | 157 | 12.0 | 138 | 10.9 | 107 | 15.3 | 1197 | 16.3 |
| United Kingdom | 638 | 28.5 | 160 | 8.8 | 152 | 11.7 | 68 | 5.4 | 111 | 15.9 | 1129 | 15.4 |
| China | 550 | 24.5 | 155 | 8.5 | 126 | 9.7 | 86 | 6.8 | 81 | 11.6 | 998 | 13.6 |
| France | 577 | 25.8 | 116 | 6.4 | 130 | 10.0 | 59 | 4.7 | 88 | 12.6 | 970 | 13.2 |
| Spain | 534 | 23.8 | 136 | 7.5 | 120 | 9.2 | 78 | 6.2 | 81 | 11.6 | 949 | 12.9 |
| Italy | 550 | 24.5 | 109 | 6.0 | 123 | 9.4 | 72 | 5.7 | 83 | 11.9 | 937 | 12.8 |
| Russia | 537 | 24.0 | 116 | 6.4 | 120 | 9.2 | 82 | 6.5 | 80 | 11.4 | 935 | 12.8 |
| South Korea | 548 | 24.5 | 108 | 6.0 | 127 | 9.7 | 72 | 5.7 | 72 | 10.3 | 927 | 12.6 |
| Taiwan | 531 | 23.7 | 101 | 5.6 | 118 | 9.0 | 70 | 5.5 | 70 | 10.0 | 890 | 12.1 |
| Belgium | 532 | 23.7 | 108 | 6.0 | 117 | 9.0 | 9 | 0.7 | 79 | 11.3 | 845 | 11.5 |
| Brazil | 533 | 23.8 | 108 | 6.0 | 116 | 8.9 | 8 | 0.6 | 70 | 10.0 | 835 | 11.4 |
| Switzerland | 546 | 24.4 | 59 | 3.3 | 123 | 9.4 | 75 | 5.9 | 28 | 4.0 | 831 | 11.3 |
| Austria | 534 | 23.8 | 12 | 0.7 | 116 | 8.9 | 67 | 5.3 | 5 | 0.7 | 734 | 10.0 |
| Turkey | 531 | 23.7 | 5 | 0.3 | 121 | 9.3 | 4 | 0.3 | 1 | 0.1 | 662 | 9.0 |
| Total NP | 2242 | … | 1816 | … | 1306 | … | 1266 | … | 699 | … | 7329 | … |

NP = Number of Publications;  NCP =  Number of Collaborative Papers; % = Percentage w.r.t. total NP

**Figure 2. Authorship network map using vosviewer software.**



**Figure 3. Publications across research areas by five prominent IISERs.**

### 5.6 Most Preferred Subject Areas of Research Areas on Basic Sciences

Figure 3 depicts the various research areas covered by five IISERs during the study period. Apart from basic science subjects, IISERs are involved in a wide range of other research areas, including almost all branches of science, such as engineering, agricultural and biological sciences, energy, earth and planetary sciences, medicine, decision sciences, and environmental science etc. Based on the classification of research articles according to the theme of research, it is observed that the highest numbers of articles were published under 'Physics and Astronomy' (22.6 %) followed by Chemistry (20.1 %) and Materials Science (12.3 %).

After classifying the publications of IISERs into different subjects, the subject areas were further divided into three zones; namely, 'most focused,' 'moderately focused,' and 'least focused.' The 'Most Focused Research Areas' contains six subject areas, each having at least 5 percentage or above publications. In comparison, the 'Moderately Focused Research Areas" contains only four subject areas and each having publications between 2 to 5 percentage. The 'Least Focused Research Areas' includes as many as 16 subject areas, and each of them having less than 2 percentage of publications. "Physics and Astronomy" is the most focused research area with 2894 (22.6 %) publications. The second most concentrated research area is "Chemistry" with 2565 (20.1 %) publications, followed by "Materials Science" with 1576 (12.3 %) publications. The six most focused research areas constitute as many as 966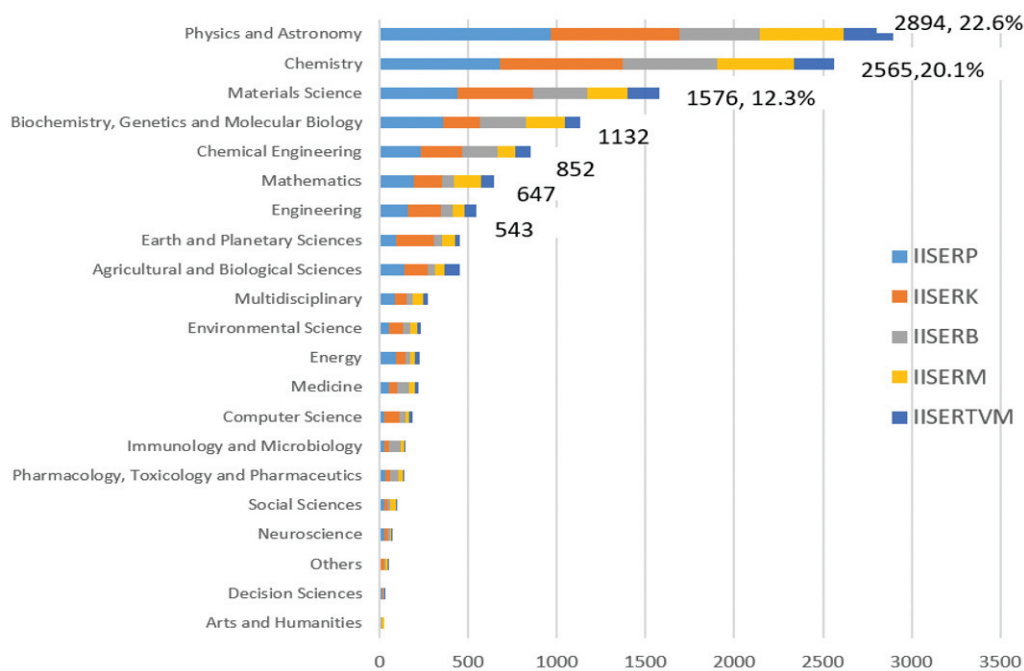6 (75.6 %) publications, while the moderately focused zone contains 1717 (13.4 %) publications. In contrast, the least focused research area, including 16 subject areas, namely Social Sciences, Arts and Humanities, Neuroscience, Computer Science, Nursing, Veterinary, etc., produced only 1409 (11 %) publications. Because IISERs are focused on providing collegiate education and research in basic sciences, the research areas in the least focused zone are expected to be less productive.

### 6. CONCLUSIONS

This paper investigated the trends of basic science research in India by applying various Scientometrics indicators. During the study period, a total of 7329 publications were produced, out of which 80 per cent are Research Papers (6525), and individually, IISER Pune and IISER Kolkata are better placed,

USA tops the list with 20.3 per cent collaboration, followed by Germany (16.3 %), and United Kingdom (15.4 %). The other major collaborating countries with above 10 per cent collaborations are China, France, Spain, Italy, Russian Federation, South Korea, Taiwan, Belgium, Brazil, and Switzerland.

The Vosviewer software is used to map the authorship network of the most prolific authors, and it is presented in Fig. 2. There are some reasonably large visual images against the top-ranked authors. In contrast, others are moderately small, representing their number of publications (NP) ranging from 21 to 142, as the threshold value is set at 20. Furthermore, the most prolific authors' ACPP (Average Citations per Paper) ranges from 17 to 81, and the h-index ranges from 20 to 42.

contributing 56 per cent in terms of research papers and corresponding citation patterns. Like the research output of Basic Sciences increased from 44.5 per cent to 47.9 per cent during the study period to India's total research output, the contribution of IISERs to India's total Basic Sciences research output have also increased from 1.53 per cent to 2.02 %, which is a significant contribution in a short time. It may be inferred that the research output would gain further momentum once all the IISERs mature and the required infrastructure becomes available.

The average citations per paper (ACPP) is found to be 14.0, and the un-cited ratio is significantly less in the case of basic science papers. It is observed that open access publications have received a much greater number of citations (69.2 %) than non-open access publications. The ACPP for open access publications (31.5) is approximately four times higher than the ACPP for non-open access publications. This indicates that the open access (OA) movement is gaining momentum, and centrally funded research institutes, including IISERs, are actively promoting the OA movement in India.

Collaboration in scientific research facilitates the generation of new knowledge and broadens the possibilities for applying research findings. Cooperation among researchers promotes mutual enrichment through scientific ideas and efficient use of skills, competencies, and resources. For research publications, IISERs have collaborations with over 80 nations across the globe, and the top collaborating countries are the USA (20.3 %), Germany (16.3 %), and United Kingdom (15.4 %). Similarly, for most of the IISERs, the international collaborative papers (ICP) instances are relatively good in such a short time of existence.

The six "most focused research areas" constitute as many as 9666 (75.6 %) publications, while the least focused research area, which includes 16 subjects, produced only 1409 (11 %) publications. Similarly, when it comes to publishers, "Springer Nature" is at the top of the list, followed by RSC (Royal Society of Chemistry). The high value of other indicators like the Cite Score and SJR displayed against each source journal indicates the IISERs publications' consistency, popularity, and influence. The subject analysis of IISERs publications will assist the researchers in identifying the active and more impactful research areas

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