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Research Landscape/Performance of India during 2010-2018: An Exploration through Scopus

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Abstract

Presently total number of universities in the country is 907, (UGC (n.d.)) and these universities vary in terms of number of publications they produce. This study aims to identify the leading research institutions in India. To measure the performance of leading institutions multiple indicators have been applied, such as number of publications, total and average citations received, etc. IISc. Bangalore (15,948) produced most number of papers and BARC (32.21) received highest average citations per paper. BARC, CSIR India and University of Delhi had overall good performance in all the categories taken for the measurement.

Keywords: Gross Enrollment Ratio (GER), H-index, Higher Education in India, Research Landscape of India, Research Performance, Scopus

1. Introduction

"Higher education is critical for developing a modern economy, a just society and a vibrant polity. It equips young people with skills relevant for the labour market and the opportunity for social mobility. It provides people already in employment with skills to negotiate with rapidly evolving career requirements. It prepares all to be responsible citizens who value a democratic and pluralistic society. Thus, the nation creates an intellectual repository of human capital to meet the country's needs and shapes its future. Indeed, higher education is the principal site at which our national goals, developmental priorities and civic values can be examined and refined" (Higher Education (n.d.)).

Since independence, higher education in India has observed a phenomenal advancement both in quantitative and qualitative terms. Governments play a key role in the development of education by funding. A report of current five-year plan mentions that during 11th plan only one fifth of the estimated 120 million potential students are enrolled in higher education in India, which was well below the world average of 26 percent. The main aim of current 12th five-year plan is to bridge this gap.

Gross Enrolment Ratio (GER) is the measure of general participation of students in a particular level of education. Generally, a high rate of GER expresses high degree of participation at a particular level of education. UNESCO defines GER as "number of students enrolled in a given level of education, regardless of age, expressed as a percentage of the official school-age population corresponding to the same level of education. For the tertiary level, the population used is the 5-year age group starting from the official secondary school graduation age" (Gross Enrolment Ratio, UNESCO UIS (n.d.)). According to AISHE (2017-18 (n.d.)), "GER in Higher education in India is 25.8%, which is calculated for 18-23 years of age group".

A report of 12th five-year plan by Planning Commission, Government of India reveals the enrolment target for the twelfth plan, according to this report, "additional enrolment capacity of 10 million students including 1 million in open and distance learning would be created by the end of the Twelfth Plan. This would enable roughly 3 million more students in each age cohort to enter higher education and raise the country's GER from 17.9 per cent (estimated for 2011–12) to 25.2 per cent by 2017–18 and reach the target of 30 per cent GER by 2020–21 which would be broadly in line with world average" (Five Year Plans (n.d.)).

According to the planning commission expansion strategy of the twelfth plan "should not only mean having more institutions of the same kind, but also developing new kinds of institutions. First, the country must have some globally competitive research-intensive institutions which should: 1. keep India abreast of the international scientific

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frontier; 2. ensure that educational content and curricula is of world standards and updated regularly; 3. ensure that research is actively used to solve India's own problems; and 4. engage the best researchers in the country in teaching the next generation of students both within and outside their institution" (Five Year Plans (n.d.)).

Research performance of a country is a multi dimensional concept which cannot be measured by a single indicator. This evaluation can be made using productivity indicators such as the number of publications produced by the researchers or institutions and the citations these publications have received average citations per paper, share of international collaborative paper, publications in foreign or national journals, etc.

2. Review of Related Literature

To describe the role and growth of higher education in India, Gupta (2010) ranked top fifty productive universities using parameters like publications, citations of papers and international collaborations. During the study period (1999-08), largest three universities were identified in terms of number of papers published, i.e. Banaras Hindu University (4870), followed by Jadavpur University (4807), and University of Delhi (4784), and the largest impact (4.63) among 50 universities is scored by University of Hyderabad, followed by Punjab University (3.68) and Jammu University (3.12). This study also finds the H-index of these universities and largest H-index (49) during 1999-08 is scored by University of Hyderabad.

A study was carried out to analyze the performance of education and research institutes in India in medical sciences during 1999-2008. In this study ranking of top 30 medical colleges has been done based on their publications which gives an idea of how the medical higher education system is performing as a generator of new knowledge (Prathap & Gupta, 2011).

A case study of research output of University of Mysore was carried out in the field of science and technology to measure the growth and impact of the university research and its growth rate in terms of average citations received and analyzed. An average growth rate of 23% per annum was found based on the publication data comprising of 1518 research papers during the study period (Kumbar, et al., 2008).

3. Objectives

1. To identify the leading research institutions in India.
2. To identify the best institutions in terms of citation rates.
3. To analyze the research performance of research institutions and universities based on their research output during 2010-2018.

4. Methodology

A total of 40 Indian Universities and Research Institutes with comparatively high research output of publications during a nine year period from 2010-18 were identified, based on their publications data downloaded from Elsevier's Scopus, the international multidisciplinary bibliographical database which covers more than 22,000 journal titles from more than 5,000 international publishers of the world. To identify the leading research institutions in India, this study looked at the number of publications in Scopus database for institutes that had produced more than 3500 papers between 2010 and 2018. Then various statistical methods are applied to show different aspects related to research performance of these forty Institutes.

5. Data Analysis and Discussions

Top fourteen in terms of total publications, Universities and Research institutions are shown in the map below. It is seen that the top institutions are distributed in different parts of the country (Table 1).

A total of 40 Indian Universities and Research Institutes with comparatively high research output of publications during a nine year period from 2010-18 were identified, based on their publications data downloaded from the Scopus. The citations are calculated considering first three years (three-year citation window) from the date of their publication. This helps to calculate the average number of citations per paper (C/P) of these institutes for the three years citation window. H-Index for the nine-year period (i.e. 2010-2018) of these institutes was also determined from the Scopus database (Figure 1).

A total of 298028 publications were produced by these 40 institutions during the period. Among these 40 institutions, the first 15 account for more than half of the total, i.e. 166884 publications (55.99% of total publication), percentage share of the remaining 25 institutions is only 44.01%. IISC Bangalore (5.35%), IIT Kharagpur (4.41%), BARC (4.11%), IIT Madras (3.82%), and Anna University (3.81) account for a major share of total publications. Interestingly six of the top 15 institutions are IITs, viz. IIT Kharagpur, IIT Madras, IIT Bombay, IIT Delhi, IIT Roorkee and IIT Kanpur.

Table 1. Ranking of top 40 universities in India based on different perspectives

Rank	Name of the University / Institute	Total Publica-tions (P)	Total Citations (C)	Avg. Citation/ per paper (C/P)	H-Index	Rank based on Avg. Citation
1.	IISc. Bangalore	15948	189273	11.87	117	10
2.	IIT Kharagpur	13139	131257	9.99	88	18
3.	BARC	12245	394435	32.21	222	1
4.	IIT Madras	11399	110747	9.72	95	22
5.	Anna University	11365	66995	5.89	70	34
6.	CSIR, India	11348	155727	13.72	104	6
7.	University of Delhi	11333	134675	11.89	110	8
8.	Vellore Institute of Tech-nology	11310	53886	4.76	62	35
9.	IIT Bombay	11098	121271	10.93	102	11
10.	IIT Delhi	10654	109139	10.24	87	14
11.	AIIMS, New Delhi	10061	106134	10.54	91	13
12.	Banaras Hindu University	10028	101336	10.11	88	15
13.	IIT Roorkee	9468	101361	10.71	94	12
14.	Jadavpur University	9285	87593	9.43	81	23
15.	IIT Kanpur	8203	82549	10.06	79	16
16.	Postgraduate Institute of Medical Education and Research	7038	56693	8.06	69	28
17.	University of Calcutta	6861	56438	8.23	64	27
18.	Tata Institute of Funda-mental Research	6809	117379	17.24	116	2
19.	Aligarh Muslim Univer-sity	6795	66327	9.76	82	21
20.	Punjab University	6709	103779	15.47	110	3
21.	IIT Guwahati	6706	65607	9.78	78	20
22.	Annamalai University	6334	49234	7.77	65	29
23.	SRM Institute of Science and Technology	6240	26344	4.22	54	38
24.	Manipal Academy of Higher Education	5979	25305	4.23	44	37
25.	Indian Institute of Chemi-cal Technology	5652	70723	12.51	75	7

26.	Indian Council of Agricultural Research	5513	17150	3.11	37	39
27.	SASTRA University	5293	23589	4.46	47	36
28.	Bharathiar University	4834	35642	7.37	65	30
29.	Indian Agricultural Research Institute	4728	31796	6.72	58	32
30.	University of Hyderabad	4660	46690	10.02	67	17
31.	IIT Dhanbad	4638	30910	6.66	56	33
32.	Sathyabama Institute of Science & Technology	4480	10331	2.31	31	40
33.	National Chemical Laboratory India	4346	60037	13.81	81	5
34.	Jawaharlal Nehru University	4292	36794	8.57	63	25
35.	NIT Rourkela	4102	34566	8.43	55	26
36.	Sabitribai Phule Pune University	4057	48189	11.88	61	9
37.	Indian Association for the Cultivation Of Science	3891	56046	14.40	79	4
38.	University of Madras	3826	32874	8.59	58	24
39.	Thapar University	3763	26900	7.15	54	31
40.	National Institute of Technology Tiruchirapalli	3598	35286	9.81	65	19

Table 2. Ranking comparison, based on total publications and avg. citation received/paper

Rank (Total Publication)	Total Publications		Universities/ Research Institutes in India		Avg. Citation Received/ Paper	Rank (Avg. Citation Received)
1.	15948	⟸	IISc. Bangalore	⟹	11.87	10
2.	13139	⟸	IIT Kharagpur	⟹	9.99	18
3.	12245	⟸	BARC	⟹	32.21	1
4.	11399	⟸	IIT Madras	⟹	9.72	22
5.	11365	⟸	Anna University	⟹	5.89	34
6.	11348	⟸	CSIR, India	⟹	13.72	6

7.	11333		University of Delhi		11.89	8
8.	11310		Vellore Institute of Technology		4.76	35
9.	11098		IIT Bombay		10.93	11
10.	10654		IIT Delhi		10.24	14
11.	10061		AIIMS, New Delhi		10.54	13
12.	10028		Banaras Hindu University		10.11	15
13.	9468		IIT Roorkee		10.71	12
14.	9285		Jadavpur University		9.43	23
15.	8203		IIT Kanpur		10.06	16
16.	7038		PGIMER		8.06	28
17.	6861		University of Calcutta		8.23	27
18.	6809		TIFR		17.24	2
19.	6795		Aligarh Muslim University		9.76	21
20.	6709		Punjab University		15.47	3

Bhabha Atomic Research Centre (BARC) was found to be the top ranked institution in terms of total and average citations received/paper. It received 394435 citations for 12245 publications at an average of 32.21 citations per paper. Other major institutions that received good citations are Tata Institute of Fundamental Research (17.24 citations/paper), Punjab University (15.47 citations/paper) and Indian Association for the Cultivation of Science (14.40 citations/paper).

There are many kinds of indexes available to measure the impact and productivity of published work of a researcher or scientist. In Scopus, the h-index is a dynamic value which is calculated live each time a scholar looks for it. The calculation was suggested by Jorge E. Hirsch in 2005 and it can be stated as:

"A scientist has an index h if h of his/her Np papers has at least h citation each, and the other (Np h) papers have no more than h citations each" (H-index Elsevier Scopus Blog (n.d.).

Table 1 it is determined that a positive correlation is seen between average citation received/paper and h-index, that means if the value of average citation is high then the value of h-index is also on the higher side, viz. BARC (Avg. Citation/paper-32.21 and h-index-222), but such a relation is not seen between total publications and h-index. In many cases the total publication may be high but the value of h-index is not necessarily so.

Research performance of any University or Research Institution can be measured in several ways; viz. ranking of the institutions by total number of publications, ranking by average citation received/paper (C/P). Table 2 shows a comparison of ranking of top twenty institutions (based on total output) and average citations received/paper. That the rank of an institution based on these two different parameters varies can be seen, except in one case, i.e. for CSIR India where the rank is 6 in both the cases. Table 2

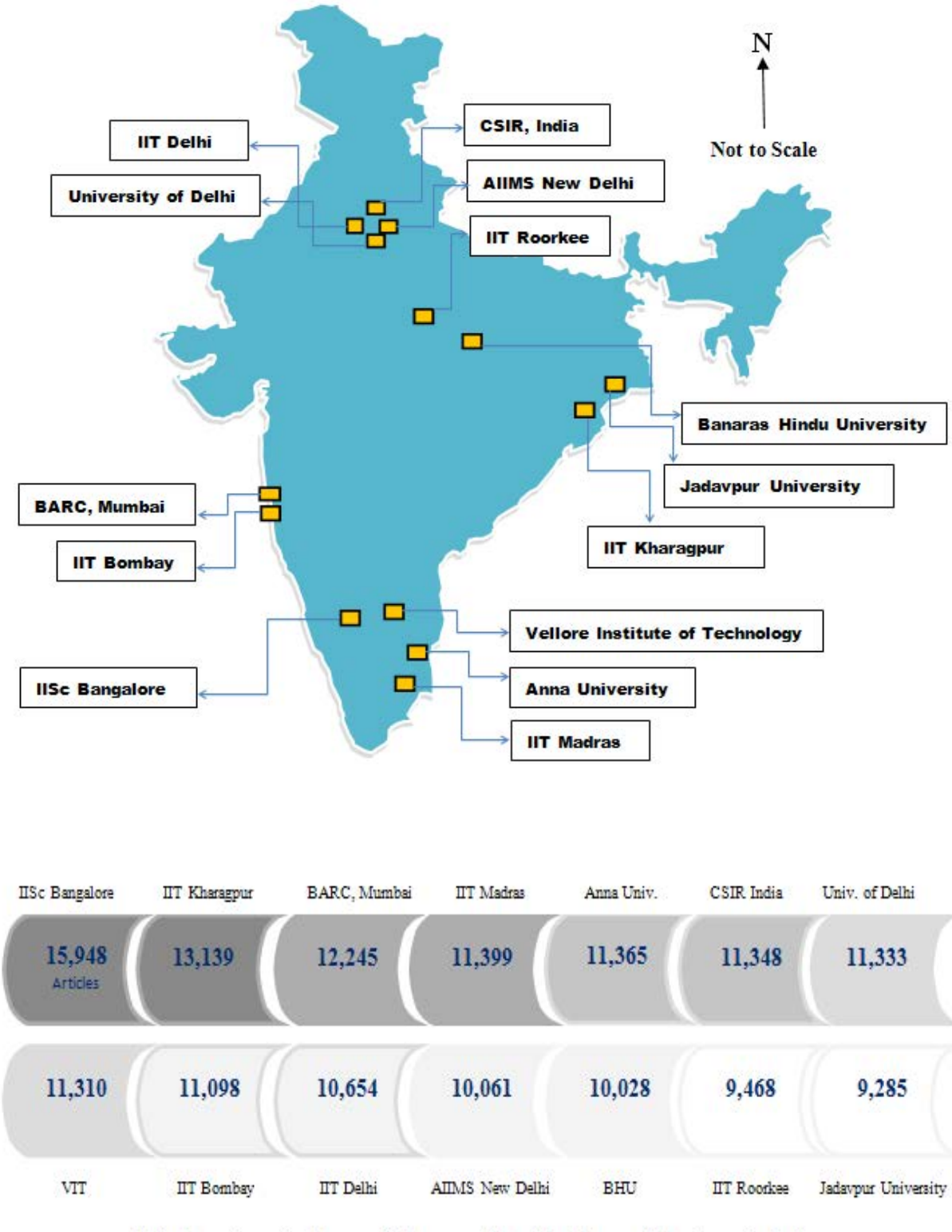

Figure 1. Location wise research outputs of leading research institutes in India.

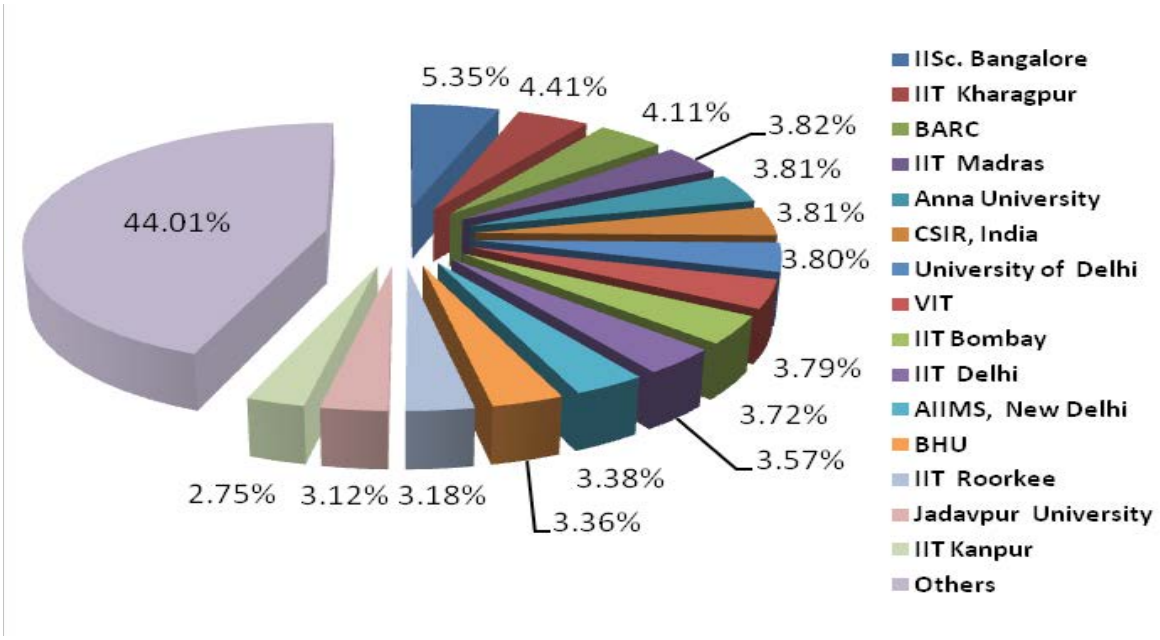

Figure 2. Percentage sharing of top 15 institutions in terms of total publication.

also indicates that if an institution rank is on the higher side based on its total publication, the rank of that same institution may vary significantly when calculated based on the mean citations for each paper. For example the rank of IISc, Bangalore and IIT Kharagpur is 1 and 2 respectively based on total publications, but the rank is different when the basis for ranking is average number of citations/paper, i.e. 10 and 18 respectively for these top two institutions. BARC, CSIR and University of Delhi appear to have good rank in terms of these parameters, viz., number of publications and average number of citations per paper.

6. Conclusion

This paper has identified the top research institutions in India based on data obtained from SCOPUS. It also finds that the rank of an institution based on number of publications it produces is not necessarily the same as its rank measured in terms of average number of citations per paper received by the institution.

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