

Ranking of Indian universities for their research output and quality using a new performance index

Gangan Prathap and B. M. Gupta

In this commentary we have proposed a more rational procedure for ranking the research performance of universities by identifying the indicators that are best correlated with each other and then using a composite indicator emerging as a product of these.

Very few Indian universities make it to the several ranking schemes that exist internationally¹⁻³. Most of these international schemes are complex exercises and assess for both quantity and quality of scientific research. In the present exercise, a proposal is presented for a ranking of research performance based on quantum of output and quality of research of various Indian universities, using data from SCOPUS (<http://www.scopus.com>). The procedure proposed identifies the indicators that are best correlated with each other and then uses a composite indicator emerging as a product of these as a single indicator that combines quality with quantity.

A total of 25 universities with high output of publications during a 10-year period from 1999 to 2008 were identi-

fied. These universities had each published more than 1,200 papers during this period, according to publication data downloaded from the Scopus International multidisciplinary bibliographical database. Together, they contributed 59,685 papers, constituting 18% papers to the total cumulative research output by India during 1999–2008. The publication share of these 25 universities to the total output by India showed an increase from 17.48% (22,173 papers) in 1999–03 to 18.31% (37,512 papers) in 2004–08.

The citations received by papers are considered for first three years (three-year citation window) from the date of their publications (C). This allows the average number of citations per paper (C/P) to be computed for each of these universities for the three-year citation

window. h -indices for these universities for the same period (i.e. 1999–2008) were determined from the SCOPUS database. Similarly, the number of papers which resulted from international collaboration could also be determined (TICP) and from this the percentage share of papers from international collaboration to the total number of papers published (%TICP) could be established.

Table 1 shows the scientometric data for ranking these 25 universities. The 25 universities were first chosen using the total number of papers published (P) during 1999–2008 according to the SCOPUS database. We can notice the multidimensionality of the problem, leading to several ways of ranking performance, e.g. by quantity of output (papers or citations) or by quality (mean citation

Table 1. Scientometric data for top 25 universities based on papers published during 1999–2008 according to the SCOPUS database

Sl. no.	Affiliation	P	C	C/P	h -Index	p -Index	TICP	% TICP
1	University of Hyderabad	2371	10968	4.6	49	37.0	591	24.9
2	Delhi University	4784	12962	2.7	45	32.7	1082	22.6
3	Panjab University	2603	9528	3.7	44	32.7	773	29.7
4	Jadavpur University	4807	11565	2.4	43	30.3	872	18.1
5	Banaras Hindu University	4870	10097	2.1	42	27.6	718	14.7
6	University of Madras	3060	7813	2.6	34	27.1	604	19.7
7	Sanjay Gandhi PGIMS	2207	6068	2.8	32	25.6	202	9.2
8	Jawaharlal Nehru University	2044	5547	2.7	35	24.7	411	20.1
9	Pune University	1758	5113	2.9	35	24.6	420	23.9
10	Anna University	3687	7381	2.0	35	24.5	691	18.7
11	Annamalai University	2384	5878	2.5	32	24.4	232	9.7
12	University of Rajasthan	1909	4958	2.6	27	23.4	307	16.1
13	Guru Nanak Dev University	1555	4089	2.6	27	22.1	293	18.8
14	CMC Vellore	2244	4860	2.2	34	21.9	367	16.4
15	University of Calutta	2381	4630	1.9	32	20.8	380	16.0
16	Aligarh Muslim University	2522	4693	1.9	32	20.6	370	14.7
17	University of Mumbai	1835	4002	2.2	32	20.6	182	9.9
18	Madurai Kamaraj University	1246	2974	2.4	25	19.2	142	11.4
19	Shri Venkateswara University	1465	3131	2.1	27	18.8	182	12.4
20	Cochin University of S&T	1625	3252	2.0	26	18.7	218	13.4
21	University of Mysore	1912	3480	1.8	23	18.5	431	22.5
22	Osmania University	1547	2391	1.6	24	15.5	188	12.2
23	Andhra University	1630	2443	1.5	24	15.4	259	15.9
24	CCS Haryana Agricultural University	1554	1616	1.0	24	11.9	190	12.2
25	Punjab Agricultural University	1685	1633	1.0	22	11.7	202	12.0

Table 2. Top 25 universities ranked using various schemes

Sl. no.	Ranking using p	Ranking using h	Ranking using P
1	University of Hyderabad	University of Hyderabad	Banaras Hindu University
2	Delhi University	Delhi University	Jadavpur University
3	Panjab University	Panjab University	Delhi University
4	Jadavpur University	Jadavpur University	Anna University
5	Banaras Hindu University	Banaras Hindu University	University of Madras
6	University of Madras	Anna University	Panjab University
7	Sanjay Gandhi PGIMS	Jawaharlal Nehru University	Aligarh Muslim University
8	Jawaharlal Nehru University	Pune University	Annamalai University
9	Pune University	University of Madras	University of Calcutta
10	Anna University	CMC Vellore	University of Hyderabad
11	Annamalai University	Sanjay Gandhi PGIMS	CMC Vellore
12	University of Rajasthan	Annamalai University	Sanjay Gandhi PGIMS
13	Guru Nanak Dev University	Aligarh Muslim University	Jawaharlal Nehru University
14	CMC Vellore	University of Calcutta	University of Mysore
15	University of Calcutta	University of Mumbai	University of Rajasthan
16	Aligarh Muslim University	University of Rajasthan	University of Mumbai
17	University of Mumbai	Guru Nanak Dev University	Pune University
18	Madurai Kamaraj University	Shri Venkateswara University	Punjab Agricultural University
19	Shri Venkateswara University	Cochin University of S&T	Andhra University
20	Cochin University of S&T	Madurai Kamaraj University	Cochin University of S&T
21	University of Mysore	Andhra University	Guru Nanak Dev University
22	Osmania University	Osmania University	CCS Haryana Agricultural University
23	Andhra University	CCS Haryana Agricultural University	Osmania University
24	CCS Haryana Agri University	University of Mysore	Shri Venkateswara University
25	Punjab Agricultural University	Punjab Agricultural University	Madurai Kamaraj University

Table 3. Both h - and p -indices give a good indicative balance between impact and quality

	h	p
C	0.94	0.93
C/P	0.73	0.87

rate = C/P), or by a performance index combining quantity and quality, e.g. the h -index. Some of the various possibilities are shown in Table 2. Viewing the problem of ranking research performance of universities as one belonging to the domain of random multiplicative processes as is usually the case in most nonlinear problems, perhaps the best single indicator to be used for ranking using quality and quantity is a geometric mean of C and C/P . However, by dimensional analysis⁴⁻⁶, one can show that this has the dimensions of $h^{3/2}$. Some recent stu-

dies have indicated that a mock h -index defined as $h_m = (C^2P)^{(1/3)}$ is the best indicator for performance⁴⁻⁶, having the correct dimensionality, that of h . We may henceforth call it the p -index.

Some other interesting insights emerge. When we adopt a more rational indicator taking performance (a composite of quantity and quality) into account (as in the first column of Table 2) instead of the simplest count of papers (as in the last column of Table 2), many universities change position. Hyderabad moves up on the basis of quality whereas Banaras moves down. Tamil Nadu is seen to have two universities in the top 10; indeed 3 in the top 12. Also, no private university has made it into this elite list. Another interesting finding that emerges is that there is a reasonably high correlation between the quality of papers published (C/P) and degree of international collaboration (%TICP). It confirms the popular perception that by inviting international co-authors, one would get better

impact. Table 3 is a correlation matrix that confirms that the h - and p -indices are good proxies that combine quantity and quality in a single figure of merit.

1. Balam, P., *Curr. Sci.*, 2004, **86**, 1347-1348.
2. <http://www.arwu.org/>
3. Virk, H. S., *Curr. Sci.*, 2004, **87**, 416.
4. Prathap, G., *Scientometrics*, 2009 (in press); DOI: 10.1007/S11192-009-0066-2.
5. Prathap, G., *Scientometrics*, 2009 (in press); DOI: 10.1007/S11192-009-0067-1.
6. Prathap, G., *Scientometrics*, 2009 (in press); DOI: 10.1007/S11192-009-0068-0.

Gangan Prathap* is in the National Institute of Science Communication and Information Resources, New Delhi 110 012, India; B. M. Gupta is in the National Institute of Science, Technology and Development Studies, New Delhi 110 012, India. *e-mail: gp@niscair.res.in