RANKING INDIAN UNIVERSITIES THROUGH RESEARCH AND PROFESSIONAL PRACTICES OF NATIONAL INSTITUTIONAL RANKING FRAMEWORK (NIRF): A CASE STUDY OF SELECT CENTRAL UNIVERSITIES IN INDIA

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Ranking of institutions of higher education has become a benchmark with the increasing globalization of higher education. The Ministry of Human Resources Development, Government of India has recently introduced a ranking mechanism called 'National Institutional Ranking Framework' (NIRF) for indicating the relative quality of Indian academic institutions and for improving the quality of higher education [1]. In NIRF few parameters have been identified which include 'Teaching, Learning and Resources', 'Research and Professional Practices', 'Graduation Outcomes', 'Outreach and Inclusivity' and 'Perception'. The main purpose of the present study is to understand the viability of the facet 'research and professional practice' in NIRF ranking by exploring research output of scientists of Five Central Universities in India during last three years. We excavated data directly from Web of Science (WoS), SCOPUS and Indian Citation Index (ICI). The results of the study indicate that quantity of research output, as reflected in any international databases to consider as an indicator of measuring research performance of an institute, is not exhaustive and seems to be implausible. No database seems to have complete coverage of total research output of an institute. Overall, an international database includes only 80% articles of an institute and only shows output that are generated from Sciences and Applied sciences only. Fields in Social Sciences, Arts & Humanities are ignored in these databases. Inter-country collaboration is found as more prominent than international collaboration among these institutes. However, the research output mostly appeared in the journals having impact factor (JCR) in the range of 1-3. Although the citation per article by JNU authors found the least, they are in the top rank in NIRF ranking, which suggests citations do not have much influence on NIRF ranking.

INTRODUCTION

With the expansion of higher education, university ranking has become an instrument in the academia. Since higher education has so many internal and external stakeholders, ranking of universities has become common in many countries. Ranking of academic institutions of India has attracted the attention of policy makers and media. In the BRICS Summit (2015) the President of India said: "Being Visitor to 114 institutions of higher learning, I had been regularly emphasizing on how to improve rankings. I refused to believe that not a single university could come up to the standard required for being in the top two hundred Universities in the international rankings". While talking on the quality education the President said: "the quality of education has a direct co-relation with inclusive growth and development. Emerging economies facing the challenge of meeting the developmental aspirations of their citizens must build an educational system comparable to the best in the world". Undoubtedly, quality education has impact on internationalization of higher education, prestige of the educational institute of the country as well as socio-economic development.

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The last few years have witnessed systems for comparing and ranking universities. In the process, national ranking systems have received attention in many countries. The initiative by French government in 2008 to create 10 centers of excellence in higher education is an example. The intension to create 10 centers of excellence was to regroup several higher education institutions and research organizations, so as to consolidate and extend the research capacity of French institutions. Similarly, with its "Excellence Initiative" Germany wants to focus on cutting-edge research and make German research more visible on the world stage. International organizations have made progress in developing composite indicators and ranking systems [2]. Mention could be made of exercises in Turkey to develop a ranking system for the world Universities based on academic performance [http://www.urapcenter.org/2014/index.php].

Globally, a number of mechanisms are available for ranking academic institutes. Among them, most popular are Times Higher Education World University Rankings (THES), QS World University Ranking, United States National Research Council rankings and Shanghai Jiao Tong University Academic Ranking of World University (ARWU). The criteria to rank Universities in Shanghai Jiao Tong University Rankings are: Alumni of an institution winning Nobel Prizes and Fields Medals (10%), Staff of an institution winning Nobel Prizes and Fields Medals (20%), Highly cited researchers in 21 broad subject categories (20%), Articles published in Nature and Science (20%), Articles in Science Citation Index Expanded, Social Science Citation Index (20%), and Academic performance with respect to the size of an institution (10%). On the other hand in Times Higher Education Supplement Rankings the criteria are: Academic opinion: peer review (40%), Citations per faculty: total citation/full time equivalent faculty (20%), Recruiter review: employers' opinion (10%), International faculty: percentage of full-time international staff (5%), International students: percentage of full-time international students (5%) and Student faculty: full-time equivalent faculty/student ratio (20%).

Similarly, the Center for World University Rankings (CWUR), Saudi Arabia, started in 2012, released its annual rankings of the 1000 best Universities of the world recently. The rankings were based on eight parameters: Quality of Education, Alumni Employment and Quality of Faculty each contribute 25 per cent to the overall score, while, Publications, Influence, Citations, Broad Impact and Patents each contribute 5 per cent. The Russian Academic Excellence Project, known as Project 5-100 is designed to build a group of world-class Universities in Russia. The initiative aims to see five Russian Universities enter the top 100 globally ranked higher education institutions by 2020.

On the other hand, Institutional rankings have been criticized on several grounds. Most common criticism relates to methodology. For example, it is claimed that the rankings by the Shanghai Jiao Tong are heavily weighted towards the sciences. United States National Research Council rankings did not provide exact ranks for any university or doctoral program; rather, a statistical range was given. This was because "the committee felt strongly that assigning to each program a single number and ranking them accordingly would be misleading, since there are significant uncertainties and variability in any ranking process" (Wikipedia). Several researchers have also pointed out that the parameters adopted by leading global ranking agencies are not suitable and do not reflect the key issues of higher education system [3]. Some of the indicators used by global agencies, such as the number of Nobel Prizes and Fields Medals winners educated at a given institution, or the particular weight given to articles published in Nature and Science, are debatable [4].

India recently launched a new mechanism for ranking Indian academic institutions. National Institute Ranking Framework, launched in 2015, is an India-centric approach to enable Indian institutes of higher learning to realize their potential so that they can emerge as world-class institutions [5].

Ranking mechanism in National Institute Ranking Framework (NIRF)

NIRF outlines a methodology to rank institutions across the country using a few parameters for identification of Research & Training Institutes as well as Teaching Institutes. The parameters broadly cover: 'Teaching, Learning and Resources', 'Research and Professional Practices',

'Graduation Outcomes', 'Outreach and Inclusivity', and 'Perception'; however, different weights have been allotted depending on the nature of the institutes and for different disciplines like Engineering, Management, Pharmacy, Architecture. In NIRF 2016, higher weightage (40%) was assigned to Research Productivity, Impact factor and Intellectual property, while 30% weightage was given to 'Teaching, Learning and Resources', 5% weightage to 'Graduation Outcomes', 5% weightage to 'Outreach and Inclusivity' and lastly 10% weightage to 'Perception'. Recently for 2017 ranking, NIRF has adopted a modified formula and termed it as combined metric for Publications (PU) (for counting publications) of an institute and combined metric for Quality of Publications (QP) (for citations). Among these parameters, Research and Professional Practices deal with the scholarship of the faculty and students of the institution and measure the quantity and quality of research output as seen through international databases, Intellectual property generation and interaction with industry and fellow professionals. In NIRF, highest weightage has been assigned to this indicator. For the purpose of the present study, NIRF 2016 formula has been adopted to evaluate select Indian Universities.

Central Universities in India

India has a large educational base with 47 central Universities (data as in 2016). Of these, 17 have been established/upgraded after 2009 and 4 Universities have been established after 2000. Two Universities have over 100 years of existence. In the latest report released in April 2016 of NIRF, the top ten academic institutes are: Indian Institute of Science (IISc), Bengaluru (rank 1), Institute of Chemical Technology, Mumbai (rank 2), Jawaharlal Nehru University, (rank 3), University of Hyderabad (rank 4), Tezpur University (rank 5), University of Delhi (rank 6), Banaras Hindu University (rank 7), Indian Institute of Space Science and Technology (rank 8), Birla Institute of Technology and Sciences (BITS, Pilani) (rank 9) and Aligarh Muslim University (rank 10). Of these top ten Universities, the basic details of selected five central Universities are as follow:

Table 1: Basic detail of selected Universities

Name of Institution, Figure in bracket shows Year of Establishment	Age in years	NAAC Grading & Score*	Number of Schools/ Institutes etc. [Depts.]	Percentage of Departments				Total Teaching Staff
				Sciences	Applied Sciences	Social Sciences	Arts, Humanities	
Jawaharlal Nehru University [1969]	47	A [3.91]	13 [2, 8, 28, 13]	5.88%	15.68%	54.90%	25.49%	565Ω
University of Hyderabad [1974]	42	A [3.72]	10 [4, 7, 13, 17]	9.75%	17.07%	31.70%	41.46%	399$^{\infty}$
Tezpur University [1994]	22	B [2.76]	4 [4, 7, 4, 4]	21.05%	36.84%	21.05%	21.04%	213$^{\$}$
Banaras Hindu University [1916]	100	A [86.05%]	5 [13, 74, 9, 36]	9.84%	56.06%	6.81%	27.27%	1252$^{\beta}$
Aligarh Muslim University[1920]	96	A [3.35]	12 [20, 44, 15,12]	22.98%	50.57%	17.24%	13.79%	1342 $^{\pi}$

Note:

**= http://www.naac.gov.in/docs/Status%20-%20Universities%20-5%203%2014.pdf*
Under Column 4, the numbers in bracket indicates the departments in Sciences, Applied Science, Social Sciences and Arts & Humanities, respectively. Classification of Departments is based on Dewey Decimal Classification Schedule.
Π= http://www.jnu.ac.in/AnnualReports/45AnnualReport_Eng.pdf;
∞=http://www.uohyd.ac.in/images/pdf/faculty_list _311215.pdf;
$=http://www.tezu.ernet.in/ugc_data/ANNEXUREVI.pdf; β=http://www.bhu.ac.in/ugc/;
π=http://www. amu.ac.in /fact.jsp

From among the top 10 of NIRF ranking 2016, the above-mentioned five Universities have been chosen for the present study to perform a cross-institutional analysis of research and professional practices. While choosing Universities, considerations have been given to geographic location so that they can represent an acceptable sample.

OBJECTIVES

The purpose of this study is to analyze the issues related to attribute and weight selection as well as the determination of the domain of study in NIRF ranking for measuring research and professional practices of Universities, so as to understand whether these parameters really reflect the quality of research performance. The objectives of this paper are:

- To understand whether quantity of research output as reflected in international databases really shows the research performance of an institute; and
- To understand whether subject, authorship, journal preference, and citation have any significant role to play in the 'academic performance' of a university.

Earlier Studies

The existing literature on ranking may be grouped into a few groups: first group discusses the academic quality in teaching of higher education and second one measurement of academic quality by using various available ranking systems. In the context of former group, Astin's work on ''talent development model' is quite appropriate [6]. Astin argues that the major purpose of a university is to develop the talents of its students to their maximum potential. This development is achieved by facilitating changes in students' intellectual capacities and skills, values, attitudes, interests, habits, and mental health. Therefore, in Astin's view, institutions that provide the largest amount of developmental benefits to students possess the highest academic quality [7].

According to Taylor and Braddock:

"One of the difficulties that arises with systems that attempt to rank Universities according to their excellence is that genuine criteria of excellence can get confused with the mere symptoms of it, 'symptoms' being understood here as features associated with excellence without being a necessary condition for it. In university context reputation is in this sense a symptom, for although a university with a good reputation is often genuinely excellent—as excellence helps to establish a good reputation—reputation is clearly no guarantee of excellence. It remains a surface feature, as we know from the fact that reputations often last for long past the time when they were actually deserved and can be maintained by astute attention to appearances, while conversely, a university may achieve standards of excellence long before this excellence is generally recognised. One important difference between good and bad ranking systems is that the former tend to focus on genuine criteria of excellence, whereas the latter give undue attention to mere symptoms" [8].

Recent years have seen a considerable literature output related to the second group discussing fundamental lacuna that exists [9] [10]) in ranking of higher education and some alternative measures. The main argument against ranking is that different Universities fulfill different roles, which a single monotonic scale cannot capture [11] [12]. Cherchye *et al.*, commented: "there is no recipe for building composite indicators that is universally applicable and sufficiently detailed" [13]. Pusser and Marginson addressed global postsecondary ranking systems and suggest that "rankings are at once a useful lens for studying power in higher education and an important instrument for the exercise of power in service of dominant norms in global higher education" [14].

Regarding individual ranking tool, Billaut *et al.* commented that the criteria that are used in Shanghai ranking are not relevant, the aggregation methodology is flawed, and the overall analysis suffers from an insufficient attention to fundamental structuring issues. They concluded: "the Shanghai ranking, in spite of the media coverage it receives, does not qualify as a useful and pertinent tool to discuss the 'quality' of academic institutions, let alone to guide the choice of students and families, or to promote reforms of higher education systems." Dill and Soo conducted a comparative analysis of university rankings in Australia, Canada, the UK, and the US to understand

the questions, like: Is there an emerging international consensus on the measurement of academic quality as reflected in various ranking systems? Or, what impact are the different ranking systems having on university and academic behavior in their respective countries? And, are there important public interests that are, thus far, not reflected in these rankings? Their paper suggests that the definitions of academic quality used in league tables are converging [15]. Charon and Wauters compared the Shanghai Jiao Tong University (SJTU) ranking with the Times Higher Education Supplement (THES) ranking and explained the risk of ranking by using examples with European Universities [16]. Similarly, Saisana, d'Hombres, and Saltelli tested the validity of the inference about the rankings produced in the Shanghai Jiao Tong University's ARWU and UK's THES in terms of reliability of individual university ranks and on relative country or macro regional performance (e.g., Europe versus USA versus China) in terms of the number of top performing institutions. They found that while university and country level statistical inferences are unsound, the inference on macro regions is more robust [17]. In an another study David Hand, mentioned that "League tables […] are not perfect, and they can never be [...] but they are certainly better than nothing [...]" [18].

Studies also indicate that efforts have been taken worldwide to overcome shortcomings in existing ranking systems. The European Commission has charged the CHERPA network (Consortium for Higher Education and Research Performance Assessment) to design and test "a new multi-dimensional" ranking system which would constitute an alternative to and overcome the limits of the ARWU and THES rankings. Similarly, Lukman, Krajnc, Glavic developed an analytic hierarchy process (AHP) model, which helps to compare between Universities regarding research, educational and environmental performances. This model helps quick detection of the weaknesses, strengths and opportunities for Universities. Results of the AHP have shown that the most important are research-oriented indicators, followed by social and environmental ones [19]. *Basu el al.* propose a multidimensional 'Quality–Quantity' Composite Index for a group of institutions using bibliometric data, that can be used for ranking and for decision making or policy purposes at the national or regional level [20]. In context of NIRF ranking, Aithal *et. al*, analyzed the NIRF as a novel performance evaluation system using their 'Advantages, Benefits, Constraints and Disadvantages (ABCD) framework technique'.

Whether the ranking have some correlation with teaching is another area of study. Astin in his study found research performance, which includes financial resources, numbers of faculty and research activity, student selectivity, as well as university reputation negatively correlated with student learning. His study specifically explored that a department that has a strong research orientation (i.e. a department that publishes many books and articles, spends a substantial amount of time on research, and attaches high personal priority to engaging in research) has a negative correlation with factors having to do with teaching: hours spent on teaching and advising, commitment to student development, use of active learning techniques in the classroom, and the percentage of faculty engaged in teaching general education courses [21].

METHODOLOGY

Since this study was designed to measure the research and professional practices of select central Universities in India, 'Institutional Search' was conducted at Scopus & Indian Citation Index (ICI) and 'Organization-enhanced search' at Web of Science. Furthermore, under year field tag we choose single year at a time. In other words, while searching publications of Jawaharlal Nehru University, for instance, from 2013 to 2015 we execute '2013' or '2014', etc separately under year field tag instead of 2013 to 2015 under from/to field tag of year. This has enabled us to overcome the problem of overlapping of results between years and to get exact number of publications in an individual year. We downloaded/saved the search results. On incorporating the data from three databases in Excel, we identify common and unique articles of these three databases. The searching was conducted during April-May 2016.

A publication is treated as 'productivity' of that institution if that institution's name appears at least once with author's name section of the article, regardless

of whether or not that author is the first author or co-author. If for any reason, an author used different name forms for different articles, those articles were treated as written by one author under different names. If any author group consists of more than one of these institutes, we categorized the work under that institute in which the higher ranked author belongs. However, each institution of a joint paper was credited with having received an equal share of the total number of citations to that paper. For example, if a joint paper by 4 authors for four different institutions, and received a total of 20 citations, each of the 4 institutions was credited with 20 citations, because it was difficult to ascertain the extent of each individual's contribution. A major limitation is that only publications indexed in the three databases have been considered and literature not indexed in these is left out. Therefore, the numbers are possibly less than the actual number of papers of an institute during this period.

RESULTS & DISCUSSION

Research Output

The research output during the last three years (2013 to 2015) is shown in table 2. BHU had the highest number of publications in all three databases followed by AMU, and HU. TU had the lowest publications in all three databases. Although all Universities reveal increasing trends of publications from 2013 to 2015, WoS has less coverage of research output than Scopus. This may be because of the fact that Journal coverage by Scopus or Thomson-ISI is not the same and still not satisfactory for Social Sciences and Humanities. From table 2, it is also clear that the total number of articles that are indexed in ICI is quite low. If it is true that ICI mostly indexed Indian journals, it is then evident that authors of these Universities mostly prefer to publish their articles in foreign journals.

Table 2: Quantity of Articles Indexed Across Databases

Name	WoS			Scopus			ICI		
	2013	2014	2015	2013	2014	2015	2013	2014	2015
JNU	341	452	540	577	726	772	108	120	129
HU	542	562	589	672	743	717	65	81	67
TU	250	291	335	336	431	363	27	35	34
BHU	1131	1179	1237	1177	1272	1263	163	183	143
AMU	573	593	614	814	828	751	97	103	88

Note: *JNU=Jawaharlal Nehru University, HU=University of Hyderabad, TU=Tezpur University, BHU=Banaras Hindu University, AMU=Aligarh Muslim University, WoS=Web of Science, ICI=Indian Citation Index.*

On the basis of data, it is appropriate to say that to consider the quantity of research output as reflected in any international database as an indicator of measuring research performance of an institute, is not adequate and exhaustive. No database seems to have complete coverage of total research output of an institute, therefore, it is difficult to ascertain the actual research performance of any institute going only by international databases.

In order to have a better picture of research productivity, we mixed the results of all three databases into a single sheet and tried to identify unique articles. Table 3 shows the actual research output of these Universities during the last three years. Comparing our results with NIRF data sheet, it is fair to say that in NIRF, while counting research performance more or less the output as indicated in table 2 is considered. However, the actual output for all Universities is a bit more as indicated in table 3. It is worth noting that almost 70% of research output is generally covered in WoS while almost 90% output are covered by Scopus. This finding is in accordance with the findings of Vieira and Gomes wherein they observed that Scopus provides 20% more coverage than WoS [22]. Therefore, while considering research performance giving equal weightage for publications in both the databases is not justified.

Table 3: Actual Research Output of University Authors

Name	Actual Articles			Total	Articles per Staff	% WoS Share	% Scopus Share
	2013	2014	2015				
JNU	599	773	842	2214	3.92	60.2	93.7
HU	760	802	784	2346	5.88	72.2	90.9
TU	354	442	382	1178	5.53	74.4	95.9
BHU	1447	1574	1582	4603	3.67	76.1	80.6
AMU	896	895	863	2654	1.98	67.1	90.2

Further, while considering actual output we observed that although BHU had the highest papers during 2013 to 2015, the research output per staff was highest in HU (5.88 article/staff) followed by TU (5.53 articles/staff) and JNU (3.92 article/staff). In NIRF ranking, because the absolute figures have been considered (all output), the research and professional practice score of TU is higher than BHU. If a ranking system predominantly uses absolute figures, its scores are size-dependent, i.e. the ranking favours large Universities. If relative values prevail, universities, which are not necessarily large, will score better. BHU have 132 departments while the Tezpur University have only 19 departments (66% Science and Engineering and 33% Arts, Humanities and Social Sciences). There are diversified fields of studies under Arts, Humanities and Social Sciences in at BHU which do not exist at the Tezpur University. It is also well documented that Arts and Humanities (A&H) and Social Sciences (SS) are both underrepresented in WoS and Scopus as compared to Health Sciences, Natural Sciences and Engineering. While both databases have subject biases, their coverage differs substantially. Therefore, "the use of either WoS or Scopus for research evaluation may introduce biases that favor Natural Sciences and Engineering as well as Biomedical Research to the detriment of Social Sciences and Arts and Humanities" [23]. This may suggest that considering output per staff instead of gross research output as a criterion of ranking improperly translated into actual quality of an institute.

In order to justify our understanding we have further analysed the research output by subjects. The same is displayed in table 4.

Table 4: Prolific Subject of Research in Selected Universities

Subject of Study	Percentage of Contributions				
	JNU	HU	TU	BHU	AMU
Natural Sciences					
Chemistry	5.56	20.67	19.19	14.45	8.55
Physics	9.58	12.87	16.30	11.51	10.55
Biological Science	6.37	4.18	1.61	2.69	4.56
Earth Science, Geology etc.	4.02	3.67	3.48	4.21	2.03
Mathematics & Statistics	0.95	1.83	4.24	1.50	5.05
Applied Science					
Medicine & allied disciplines	10.61	9.89	0.51	13.86	5.80
Engineering (Electronics, Electrical, Chemical)	4.56	6.39	13.07	4.95	7.50
Materials Science	2.12	9.29	9.85	7.45	3.17
Biochemistry, Molecular Biology & Genetics	9.12	7.20	4.58	4.28	1.92
Microbiology & Immunology	4.79	4.09	2.89	3.24	1.36
Environmental Sciences & Ecology	4.16	1.07	1.87	3.71	1.92
Pharmacology & Pharmaceutics	2.57	3.07	1.36	2.65	2.11

Agriculture	1.67	0.34	1.70	3.26	2.49
Computer Sciences	2.48	1.92	2.21	0.83	0.83
Social Sciences	10.25	1.79	0.85	0.70	0.38
Sociology & Social Work	0.99	0.72	-	0.26	-
Economics, Business Management & Accounting	7.50	0.00	0.51	0.20	0.15
Psychology	0.00	0.34	-	0.04	0.11
History	1.13	0.00	-	0.00	0.11
Arts & Humanities	2.66	1.28		0.04	0.41

We have categorized the subject of research into four major categories: Natural Sciences, Applied Science, Social Sciences and Arts & Humanities. The sub-fields of the four fields are further grouped as per Dewey Decimal Classification Scheme. In table 4, we have displayed only selected subjects, wherein a considerable number of research papers were generated. It is necessary to share our observation here that, in Scopus, Agricultural sciences and Biological sciences are kept together while categorizing subjects. However, in almost all Universities these two subjects are under separate departments.

As per the last Global Research Report India (2009), of Thomson Reuter, chemistry has the predominant share (5.71%) in global research. Similar trend of research is also observed in HU, TU and BHU. In JNU, Medical Sciences have highest share and in AMU, Physics was having highest share. Although, in ARWU ranking, the ISI's 21 broad subjects are considered, in NIRF the subject of research has not been taken into account while measuring research performance of institute. Furthermore, as indicated in table 4, overall, JNU have almost 68%, HU have 86%, TU have 82%, BHU have 78% and AMU have 58% research output in the selected fields of sciences and applied sciences while Social Sciences are underrepresented and Humanities are simply ignored. This may be because of various subjects have different publication and citation cultures, it also seems that research output in Social Sciences, Arts and Humanities of India have little covered in main databases – WoS and Scopus. It is well documented that there are more publications and more citations per publication in natural sciences and especially in medicine, in particular because the main citations databases – WoS and Scopus – have little coverage of books though which most of Humanities literature are published [24].

Authorship & Collaboration

Table 5 shows the authorship pattern; column 2 shows the percentage of authors (of total potential authors) (as indicated in table 1) who have contributed papers; columns 3 and 4 show the nature of authorship: solo or joint. It may be revealed from table 5 that, overall only 25% to 30% authors of these institutes are active and contribute to the total research performance of the institute. In larger universities like BHU, percentage of active contributors is even lower, i.e. almost 27% and in moderate and small universities like TU the percentage is higher, i.e. 35%. The percentage of authors that contributed articles individually was higher for JNU as compared to other institutes under consideration. This may be because of the fact that JNU have strong research base in Social Sciences subjects like Economics, while others have strong research base in natural and applied sciences. In science, as the scientific work has become more complex, more often the authorship is more collaborative - the visibility of individuals' performance is not clear. This is reflected in the number of multi-authored papers. McDowell also pointed out that increasing specialization and changes in institutional incentives for publication are likely to be major factors explaining the trend towards co-authorship [25].

Members of the Modern Language Association usually write alone. Psychologists and chemists often write with others, particularly as it pertains to research articles. Engineers, city managers, and professional and technical writers often engage in collaborative writings [26]. Furthermore, studies indicate that in finance, collaboration does lead to articles of higher impact but there is no significant marginal value for collaboration beyond three authors; high impact articles are not monopolized by high impact authors; collaboration and the average author impact of high-impact articles are positively associated [27].

Table 5: Authorship Trends

Institution Name	% of total authors contributed articles	% of articles in Solo Authorship	As corresponding / First Author (excluding Solo authorship)		Other than First/Corresponding Author	
JNU	29.54%	559 [25.24%]	798	[36.04%]	857	[38.71%]
HU	28.69%	136 [5.79%]	1245	[53.07%]	965	[41.13%]
TU	35.19%	60 [5.09%]	762	[64.69%]	356	[30.22%]
BHU	27.05%	158 [3.43%]	2805	[60.94%]	1640	[35.63%]
AMU	32.82%	131 [4.93%]	1385	[52.19%]	1138	[42.88%]

It is also reveals in table 5 that authors of TU and BHU mostly prefer to contribute articles in the capacity of first/corresponding author while authors of JNU have contributed articles either in solo authorship or participated as members of team. Authors of HU and AMU have almost equal preference of contribution. This shows that the scientists are more likely to work together with more than one collaborators of same country or different country.

In any ranking system each article, whether that article has one or a hundred authors, that has at least one author from that institution has considered as research performance of that institute. It means that the same articles are considered as research performance of multiple institutes. Therefore, to remove the possibility of counting articles more than once, it may be better to consider fractional count, which takes into account the relative contribution of each author to an article, while counting the research performance of said institute.

It is clear in the table 5 that with rapid development in science, extensive collaboration is the current trend among different academic research groups. The impression can be partially explained that because of the electronic communication facility, it has become easier for authors to communicate with one another, no matter where they are located. In addition, scientists from all over the world have more and more recognized that the collaboration with fruitful exchange of ideas, research techniques, and knowledge can help them to obtain research outputs faster and go ahead of the field in such "Big Science" environment. As such, the extensive collaboration can also be enhanced the international visibility of scientists. So, it may be an interesting subject to explore the collaboration patterns among institutions of India. The result of our study displayed in table 6. According to different collaboration institutions, papers have been divided into three categories: papers published in collaboration of at least two different countries are treated as international papers [column 5]; papers accomplished by several different institutions of the India are treated as domestic papers [column 4]; and papers finished by at least two authors of a single university address are treated as local papers [column 2].

Table 6: Collaboration Pattern

Year Publication	Percentage of Collaboration with local Institutes	Percentage of Collaboration with remaining four Institutes	Percentage of Collaboration with domestic institutes	Percentage of Collaboration with Foreign Institutes
JNU	18.26%	2.80%	55.30%	23.64%
HU	18.68%	1.44%	58.66%	21.22%
TU	16.44%	1.10%	72.78%	9.68%
BHU	20.91%	1.28%	51.67%	26.14%
AMU	19.07%	1.58%	40.37%	38.98%

As indicated in table 6, intra-country collaboration is more prevalent than international collaboration, averaged across all the institutions included in this study, 24% of the publications were produced in an international collaboration. The percentage of international collaboration is highest in AMU (39%) followed by BHU (26%), JNU (23%) and HU (21%). TU among all five Universities had lowest international collaboration during our study period. It seems that scientists' of these institutes preference for collaboration is mostly within the country in this stage, probably for convenient reasons. It may also suggest that a harmonious environment for scientists in various organizations to cooperate is yet to form in India. Additionally, there is also need to increase foreign collaboration because foreign collaboration does contribute a lot to the improvement of the mainstream connectivity and international visibility. Lancho-Barrantes, Guerrero-Bote, and Moya-Anegón on studies which have investigated the influence of collaborations on the citation impact of publications shows, we can expect publications produced in an international collaboration to have more impact than those which were not [28].

Journal Preferentiality and Citations

In the previous sections we were attempted to explain the research and professional practices at selected Indian Universities by using indicators of publication count and author-level indicators. In this section our attempt is to explain research and professional practices by using indicators that qualify output (on the level of the researcher and journal), indicators of the effect of output (effect as citations) and indicators of impact over time (h-index).

For several decades, journals are primarily used for "scientific" purposes, such as assessing knowledge accumulation and describing patterns of knowledge production within academic disciplines. However, with the practice taken up by Shanghai Jiao Tong University since 2003, the ranking organizations assess the research productivity of Universities through statistics that aggregate the quality and quantity of journal articles published by faculty members [29].

Table 7: Distribution of Articles in Journals

	JNU	HY	TU	BHU	AMU
No. of Journals	1057	914	571	1707	1139
% of Journals where article came only once	66.51	60.61	59.82	55.04	61.78
% of Journals where article came 2-5 times	28.10	30.31	34.39	34.99	30.49
% of Journals where article came 6-10 times	3.50	5.36	5.26	6.74	4.66
% of Journals where article came <10 times	1.89	3.72	0.70	3.28	3.16

During our analysis we found that the research outputs of all these five Universities were appeared in large number of journals. However, a major portion of these, i.e. almost 60%, where articles appeared only once. There are only few journals where articles appeared more than 5 times.

In table 8, we have shown the number of journals and articles under various impact factor range of JCR-2016.

Table 8: Number of Journals under Various Impact Factor Ranges

Univ	Wt IF		Below 1		1-<2		2 - <3		3-<5		5-<10		10-<20		20 & above		Total Jr./ Total Art.	
	Jr.	Art.	Jr.	Art.	Jr.	Art.	Jr.	Art.	Jr.	Art.	Jr.	Art.	Jr.	Art.	Jr.	Art.		
JNU	502	1107	90	194	139	235	122	214	151	356	46	97	3	3	3	8	1056	2214
HU	381	879	90	194	134	280	127	370	124	481	45	127	7	8	6	7	914	2346
TU	254	466	54	101	100	181	66	167	66	214	27	45	3	3	1	1	571	1178
BHU	735	1663	211	656	275	722	231	654	181	721	64	176	5	5	5	6	1707	4603
AMU	575	1199	185	425	192	425	101	231	68	327	17	46	1	1	0	0	1139	2654

Note: Wt IF= Journals without any Impact Factor of JCR 2016, Jr**.**= Journals, Art.= Articles

From this table, it is also clear that a considerable number of articles of JNU, HU & BHU authors have appeared in journals having impact factor (JCR) in the range of 20 and above. Mostly these journals are either *Nature, The Lancet, or Cell*. On the other hand, *RSC Advances, PLoS ONE, Current Science, Economic and Political Weekly* were the most preferential journals among authors of most of the Universities. Needless to mention that although in ARWU, publication in journals like Nature, Science have been considered as a criteria of measuring the publishing quality, in NIRF such provision is not seen. From experience, it can be said that for performance assessments and reward of university faculty, giving more potency to those articles published in journals having impact factor, promotes precarious world of journal publishing. Establishing connection between university rankings and journal rankings therefore, may lead the publication patterns of scholars towards those journals that are included in the relevant indices. This will further develop a lack of transparency in assessing university quality.

While a reference is the recognition that one document gives to another, a citation is the recognition that one document receives from another. A scientific paper and its citations in other papers represent two quantities: "the increment of new Science and the credit for its discovery" [30]. In spite of several criticisms, the popular method for measuring the impact on the scientific community of an article or a researcher is the citation rating. The number of citations an article receives after its publication reflects its recognition in the scientific community. Table 9, demonstrates the citation pattern of articles by authors of five selected Universities.

Table 9: Citation Pattern

Inst.	Total citation Received			Citation per article [Median]				Percentage of Articles received citations 1-5			Percentage of non-cited articles		
	2013	2014	2015	2013	2014	2015	Avg.	2013	2014	2015	2013	2014	2015
JNU	2690	2434	946	4.49	3.15	1.12	2.92	40.07	43.47	35.15	33.89	41.79	60.45
				[4]	[2]	[1]							
HU	4715	2991	1297	6.20	3.73	1.65	3.86	38.16	45.14	46.30	26.18	33.17	47.07
				[5]	[3]	[2]							
TU	2441	2086	634	6.90	4.72	1.66	4.42	38.70	41.86	47.38	23.45	27.83	46.34
				[5]	[4]	[2]							

BHU	7972	5730	2713	5.51 [4]	3.64 [3]	1.71 [1]	3.62	45.06	44.47	41.97	23.08	34.37	52.91
AMU	5345	3250	1410	5.97 [4]	3.63 [3]	1.63 [2]	3.74	38.17	42.79	35.69	33.59	36.54	55.16

As per Table 9, during the last three years, articles of TU authors received on average 4.42 citations per article followed by HU (3.86 citations/article), AMU (3.74 citations/article). While almost 25% articles by TU [highest] authors and 15% articles by JNU [lowest] author received more than 5 citations, 44% articles of BHU [highest] and 39% articles of AMU [lowest] received utmost 5 citations. Interestingly, although 44% articles authored by JNU scholars did not receive any citations, yet they are on the top of five Universities in NIRF ranking. This is because the distribution of citations over publications is not equal; the value calculated for a reference set is skewed by a few highly cited publications and is, therefore, not an appropriate normalization of citations that is used in NIRF ranking.

Internationally, citation is considered as an indicator of research quality and treated as a benchmark in measuring scientific value of one's research. However, "it must be remembered that, while it is true that science that is not visible does not exist, visibility alone is not enough. Effective presence requires being in such a state of visibility that anyone neglecting it will be faulted for carelessness, incompetence or ignorance" [31].

Towards Better Ranking Mechanism

Like other ranking mechanism, NIRF ranking has evolved as an indicator of measuring quality by using quantified data. However, till date, like India, the higher education system has tremendous diversity and divergence in terms of objectives, therefore, efforts should be made to have representation from all sectors of higher education so as to avoid the ranking framework being skewed in favour of elite institution that are engaged in selective areas of expertise. The available systems of ranking is slanted towards certain criteria. While the ARWU ranking is mainly based on research performance with no attempt to take other dimensions into consideration, the THES ranking relies heavily on reputation indicators derived from expert opinion without giving much weightage to research performance. In NIRF ranking, current research has given more attention than earlier research performance, alumni of the institution, year of existence, diversity in education system etc. Such indicators may be real "symptoms" of excellence for a university with 100 years of existence. In this context Salmi also pointed out that "because university rankings define what "world-class" is to the broadest audience, these measures cannot be ignored by anyone interested in measuring the performance of tertiary education institutions" [32].

Considering that higher education has expanded significantly and resource mobilization has not been able to cater the needs of providing quality infrastructure for delivering quality higher education, needless to say that policy priority should be focused primarily on key challenges facing the higher education system and also on developing quality infrastructure in the existing Universities or institutes rather than taking cosmetic measures of artificially improving the ranking. It is therefore, essential that while designing the ranking framework, the following consideration should be given adequate weightage:

a. The locational disadvantage in several institutes does not allow internationalization. Institute well connected with roads and state infrastructure are always in advantage than others serving in far-flange area. The programmes launched to fulfill the regional needs / aspirations should be given extra weightage as these are the additional commitment of higher education to support national aspirations.

b. Institutes providing higher education to vulnerable section of the society or the educationally challenged areas require additional efforts. Such activities should not be undermined while ranking.

c. In any ranking mechanism, research, in terms of quantity of publications is considered. The teaching capabilities of the faculty go unnoticed when same parameters are followed to judge the students' achievements. A framework should be

devised where relative improvement or gain of students is measured, reflecting the relative efficiency rather than the absolute achievements.

d. There should be separate ranking framework for those institutions that are involved in teaching and for those that are having research and development as their major component.

e. Community involvement/ vocational programmes and outreach activities, other than those that are normal parts of the syllabi should be adequately reflected in the ranking framework.

f. The coverage of journals in various databases for different subjects is not equal. Therefore, the academic performance of an institute that is measured through quantity of articles in international databases like Scopus, Web of Science and local database of India like Indian Citation Index never reflects the actual productivity of that institute. Further, large institutions do not give information on the real productivity of the staff of the institution, it is also difficult to ascertain the exact figure. So, while ranking, special attention is needed to know the scientific output of the institute manually too.

g. It is widely documented that citation habits in the various scientific disciplines vary greatly, with a bias in favour of hard sciences. An institution having strong emphasis on Social Sciences, Arts and Humanities subject therefore, never compete with an institute having special emphasis on Science. Therefore, separate ranking for separate nature of institute is more realistic.

CONCLUSION

Cassim Monte, the President of a Japanese university once said: 'a farmer wanting to breed a big cow should focus more on nutrition than the weighing scales'. With the globalization of higher education, ranking of institute has become a global benchmark. However, a rank position of a university cannot be taken for granted. Highly ranked Universities have to make great additional efforts to maintain their high positions [33].

The NIRF ranking launched by the Indian Government is a new initiative to understand relative quality of Indian academic institutions and improving the quality of higher education up to global standards. However, using only figures in calculating academic ranking sometimes leads to inaccurate results. It is the same problem as, for instance, comparing the average performance of two cricketers A & B with their average score of 54.20 and 53.78, respectively—the average is gained by player A in 17 test matches whereas the player B gets it after 200 test matches. Further, Bougnol and Dula´ in their work quoted that "From the viewpoint of two entities, X and Y, if have identical values for all the attributes except for one input, then X is considered more efficient than Y if the value for this input is smaller. A pitfall occurs when inputs and outcomes in a ranking scheme are treated in the same way by assigning them positive weights. It then becomes a problem from a strictly efficiency perspective that one way to climb in the rankings is to increase the values for input attributes. One way to address the problems resulting from input measures in a ranking scheme is not to use them" [9]. It also seems unrealistic to compare scientists from different fields that have been published during different time periods in a single window.

In the present study it has been observed that the research performance of most of the selected Universities were in the fields of Science and Applied Science. Therefore, the weight shown in research and professional score of these Universities is actually the weight of the hard Sciences, while Humanities, the Arts and Social Sciences are not represented. This may be because of the fact that measuring ranking in India using international databases like WoS, Scopus may be an act to show the bias against non-English articles and/or non-journal publications in the form of book chapters, national reports, conference-proceedings, etc. Also our study indicates that not a single database comprehensively covers the research output of our institutions even in the sciences. Therefore, ranking based on available number may lead to inaccurate conclusions. Additionally, considering 'faculty number' as divisor to get a quotient also seems problematic because of the possibility of heterogeneity in the number of 'faculty staff' from year to year. Considerable literature also discusses the difficulties of using faculty strength in ranking.

Therefore for measuring quality in higher education, it is better to focus policy priority on key challenges facing the higher education system and

focus on developing quality infrastructure in the existing Universities or institutes. Organizational performance largely depends upon the level of infrastructural supports, quality of human resource imparting the teaching and research, academic ambiance, knowledge exchange, international orientation, regional involvement and autonomy in academy affairs. While translating the institute's achievement in teaching and research, the level of such support should be weighted adequately.

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