



## PUBLICATION PROFILING OF INDIA'S HIGHER EDUCATION RESEARCH OUTPUT DURING THE PERIOD 2012-2016: A QUANTITATIVE STUDY

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### Abstract

The purpose of this study is to portray the publication output of the nation; India, over a period with reference to Web of Science Core collection database. This investigation aims to quantify the total higher education research output in terms of quantum of publications, year wise distribution, form wise distribution, prolific authors, collaboration pattern, productive research area, and most desired journals to publish with their citations appended. The methodology adopted to execute this research was fetching the bibliographic data from Web of Science Core Collection Databases as and when appeared on the source database; as such retrieved were analyzed with bibliometric parlance to summarize the publication pattern and productivity for the test period 2012-2016. The analysis exposes that India stands eleventh place with 3.37% (357259) papers among other emerging countries in research domain through scholarly publications and author Kumar A is been identified as the prolific author with 7282 documents and other significant finding was Royal Society of Chemistry Advance had been selected as most prepared journal holds 6629 articles as seen through the source test database. This study focuses simple quantifications of top twenty prolific institutions, authors and research areas and ends with major findings and interpretations.

**Key words:** India, Publication productivity, Ranking, Prolific authors, Prolific Institution.

### Introduction

Nations output can be measured in terms of its economic growth, educational development, employability opportunities, health care facilities etc. Educational development of any nation could further categorized into school education attainments and higher education achievements in terms of various parameters and sub parameters used, including literacy rate, teaching and research quality, infrastructure availability etc. Biblio metric indicators like publication productivity, citation analysis proved that quantitative and qualitative scales are more effective to categorize the entities like global, nation, institution and individuals etc. in terms of scholarly communications. These indicators are meaningful and helpful tools and techniques in setting standards and benchmarks for overall ranking of the authors, research areas, collaboration correlations, co-citations etc. The emergence of this mathematical and statistical analysis on information science has given rise to many metric studies including cyber metrics and socio metrics, hence sophisticated and supported tools and techniques are available today to evaluate and enumerate academic units for their performances, based on criteria chosen precisely so as to a nations publication output can be mapped accordingly.

### Literature Review

This chapter deals with the review of related literature to support the chosen field of study. Foundation of any systematic or scientific inquiry depends upon the relevant studies conducted in the past so as to path and guidance ensured of particular research. The relevant literature study led to the following headings for reporting the observations of the subject related literature:

### Scientific Productivity of Country/Group of Countries

Cole, Stephen and Phelan J, Thomas (1999) have stated that a primary goal of the sociology of science is to understand the influence social processes on the production of new scientific knowledge. There are three aspects of scientific knowledge that are generally considered important. First is its actual cognitive content. Second is the focus of scientific attention. Third is the rate of scientific advance or how social, cultural economic variables influence the amount of new knowledge. Their analysis suggests that at the end of the twentieth century the total amount of research that a nation produces is very strongly influenced by its wealth.



Fazlunnisa & Amudavalli (2015) have discussed that the ability of nations stand in terms of global scientific productivity is important to determine the country's socio – economic growth. The quantitative and qualitative dimensions of global scientific output had been assessed to identify the productivity pattern of the top ten most prolific countries in the World. The global literary output was analyzed on Language, Forms of Publication, Subject, Source Journals and Country distribution. The study revealed that there is spatial shift in the performance of developing countries (PR China and India) replacing with that of the developed countries (USA, Japan, England). There are major paradigm shift noted from the study that there is a socio-economic growth of third world nations, expansion of trans-border data flow, minimized constraints in the production, publication, dissemination and access to S&T literature.

### **Scientific Productivity of Individual Authors and Disciplines**

Gupta, K. M. et al (1998) dealt with the applicability of selected technology diffusion models to the growth of literature in Indian and World physics context. It mainly focused on the validity of two forms of Lotka's law and negative binomial distribution model to the cumulative author productivity data on Indian physics. It brought out the increase in the number of practitioners, at different productivity levels, and the emergence of core authors in Indian physics.

Greenbaum, Hannah, et al. (2016) examines the productivity of both individuals and institutions, indexed through an examination of five educational psychology journals. Productive authors, institutions, educational psychology articles were analyzed in terms of collaboration and international involvement. Their findings revealed that individual and institutional productivity in educational psychology journals has been both consistent and changing in terms of the top performers over the past 24 years.

### **Ranking Institutions**

Liu, Nian Cai & Li Liu, Ying Cheng (2004) have said that the Institute of Higher Education, Shanghai Jiao Tong University published on the web the Academic Ranking of World Universities and attracted wide attentions worldwide. 60% of their criteria are based on the databases using scientometrics. They have selected various indicators which includes HiCi indicates the number of highly cited researchers in 21 broad subject categories in life sciences, medicine, physical sciences, engineering and social sciences. Number of citations indicates the most highly cited author and paper which is one of the criteria for ranking of universities.

Ioannidis, John PA et al.(2007), focus on systems that use explicit criteria to rank universities around the world in terms of excellence, regardless of whether other institutions are also ranked or not. No other international ranking systems have had their methods described in peer-reviewed publications as of December 2006, but we also consider briefly other systems that use different criteria, based on their web description. The concordance between the two main ranking systems was evaluated in terms of their agreement for the top 200 universities based on their publicized 2006 rankings.

### **Methodology**

#### **Statement of the Research Problem**

Productivity pattern and publications are the major indicators of scientific output of a given region and period. Scientific publications and its phenomenon contribute a maximum percentage in the ranking of a country and institutions accordingly. Thus, the research problem is identified as to quantify the research publications of India the period of 2012-2016 with reference to Web of Science Core Collection Database to rank top 20 institutions with prolific authors along with all types of publications indexed by Thomson Reuters Web of Science.

#### **Goals and Objectives**

The goals for this study are framed to solve the research problem. The study assesses the publications of Indian Institutes quantitatively and qualitatively. The focus of the study is to:

1. To quantify the World Publications and India's global share on Scholarly literature.
2. To identify the quantum of publications across disciplines of India.
3. To portray the Prolific Authors and Institutions in India based on Publications productivity.



4. To observe most active research fields of Scientists and researchers.
5. To understand the prolific journals that they are being used as source for publication.

### Limitations

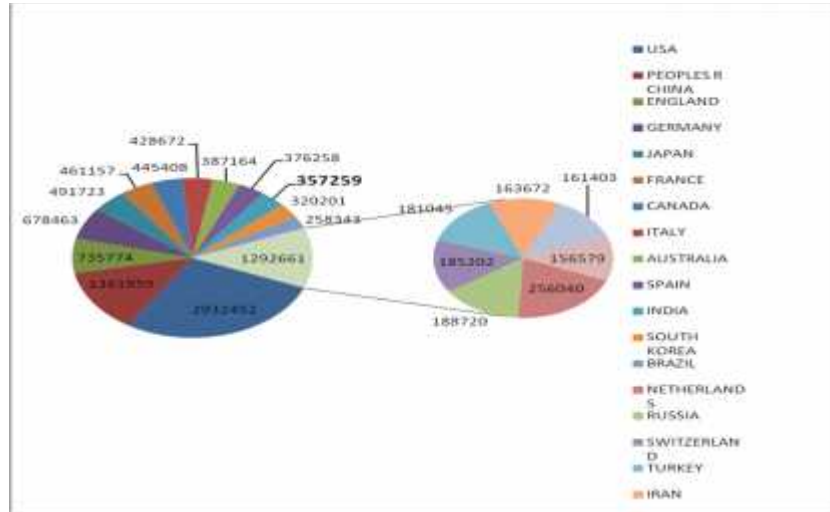
The study is carried out to understand India's research publications through Indian Institutions and research organizations through the abstract and bibliographic database-Web of science. Online database analysis over a period for a large nation's literature output limited to the data indexed by the concern database chosen for the research.

### Analysis

The data collected from the WoS database (core collection) was analyzed with respective to productivity pattern and ranking of prolific institutions' publications in India. This chapter deals with the analysis of data and interpretation of results from the source data

**Table -1 World Publication during the Year 2012-16**

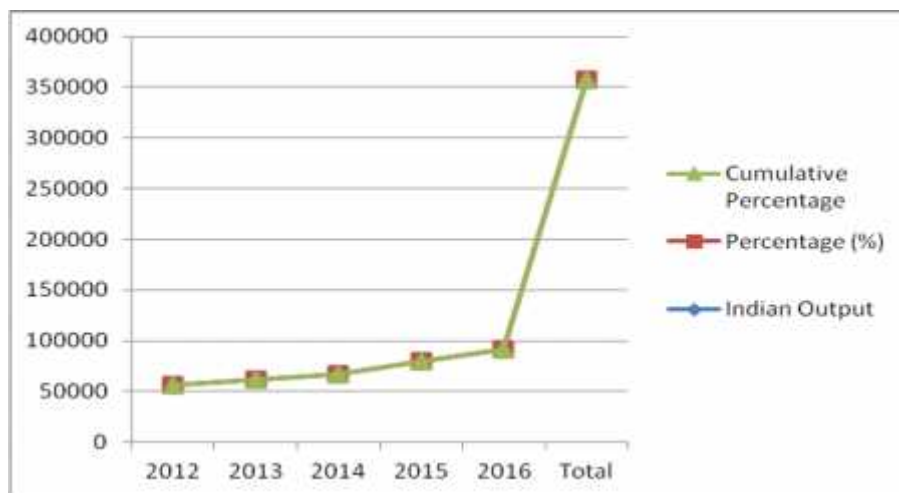
| Countries/Territoes | Records       | Percentage (%) | Rank (2012-2016) |
|---------------------|---------------|----------------|------------------|
| USA                 | 2932452       | 27.68          | 1                |
| PEOPLES R CHINA     | 1361959       | 12.85          | 2                |
| ENGLAND             | 735774        | 6.94           | 3                |
| GERMANY             | 678463        | 6.4            | 4                |
| JAPAN               | 491723        | 4.64           | 5                |
| FRANCE              | 461157        | 4.35           | 6                |
| CANADA              | 445408        | 4.2            | 7                |
| ITALY               | 428672        | 4.04           | 8                |
| AUSTRALIA           | 387164        | 3.65           | 9                |
| SPAIN               | 376258        | 3.55           | 10               |
| <b>INDIA</b>        | <b>357259</b> | <b>3.37</b>    | <b>11</b>        |
| SOUTH KOREA         | 320201        | 3.02           | 12               |
| BRAZIL              | 258343        | 2.43           | 13               |
| NETHERLANDS         | 256040        | 2.41           | 14               |
| RUSSIA              | 188720        | 1.78           | 15               |
| SWITZERLAND         | 185202        | 1.74           | 16               |
| TURKEY              | 181045        | 1.7            | 17               |
| IRAN                | 163672        | 1.54           | 18               |
| SWEDEN              | 161403        | 1.52           | 19               |
| TAIWAN              | 156579        | 1.47           | 20               |



India ranks 11<sup>th</sup> among the top 20 countries in publications across various disciplines, with its global publications share of 3.37% computed on cumulative publications output during the period 2012-2016. (Table 1). The other countries that had contributed publications and share in the 3% range were Australia, Spain and South Korea. In overall the global publications shares of the top 20 countries across disciplines range from 1% to 27%. The United States tops the list with global publication share of 27.68% and Peoples R China secures the second positions with 12.00%.

**Table 2 Year Wise Distribution of India's Publication**

| Year  | India Output | Percentage (%) | Cumulative Percentage |
|-------|--------------|----------------|-----------------------|
| 2012  | 55888        | 15.64          | 15.64                 |
| 2013  | 62188        | 17.41          | 33.05                 |
| 2014  | 67501        | 18.89          | 51.94                 |
| 2015  | 79753        | 22.32          | 74.27                 |
| 2016  | 91929        | 25.73          | 100.00                |
| Total | 357259       | 100.00         |                       |





Above table shows that the year wise publications of the Country; India, with percentage and cumulative percentages, the gradual increase is seen in every ascending year and there is a 25.73 % of share observed in the year 2016, means that the current authors in the country are very much active in their research publications.

**Table -3 Type of the Documents and its proporstions**

| Document Types         | Records | Percentage |
|------------------------|---------|------------|
| ARTICLE                | 302268  | 84.608     |
| MEETING ABSTRACT       | 19235   | 5.384      |
| REVIEW                 | 14136   | 3.957      |
| LETTER                 | 9804    | 2.744      |
| EDITORIAL MATERIAL     | 8410    | 2.354      |
| PROCEEDINGS PAPER      | 4151    | 1.162      |
| CORRECTION             | 1320    | 0.369      |
| BOOK REVIEW            | 1306    | 0.366      |
| NEWS ITEM              | 415     | 0.116      |
| BIOGRAPHICAL ITEM      | 279     | 0.078      |
| BOOK CHAPTER           | 277     | 0.078      |
| RETRACTED PUBLICATION  | 67      | 0.019      |
| RETRACTION             | 38      | 0.011      |
| POETRY                 | 19      | 0.005      |
| DATA PAPER             | 11      | 0.003      |
| SOFTWARE REVIEW        | 8       | 0.002      |
| REPRINT                | 8       | 0.002      |
| ART EXHIBIT REVIEW     | 5       | 0.001      |
| DATABASE REVIEW        | 3       | 0.001      |
| HARDWARE REVIEW        | 2       | 0.001      |
| FICTION CREATIVE PROSE | 2       | 0.001      |

Above table clearly shows that the majority of the publications are journal articles which constitute 84.61 % whereas the second most publication Meeting abstracts occupy only 5.38% shares. The inference is Science publications are journal articles compare to Social sciences and Humanities which were mostly books and monograph. Table 4. The prolific categories (Organizations, Org, Enhanced, Research Area, Source title and Authors) of research output of India: 2012-2016.



|   |                                | 2012-2016   |  |                               |  |   |                                |                         |         |         |         |
|---|--------------------------------|---|--|-------------------------------|--|---|--------------------------------|-------------------------|---------|---------|---------|
| Banaras Hindu Univ                          | Natl Inst Technol              | Univ Delhi  | All India Inst Med Sci                   | Bhabha Atom Res Ctr           | Csir                                       | Indian Inst SCI   | Indian Inst Technol            | Organizations           | Records | Records | Records |
| 5822  | 6395                           | 6472  | 6824                                     | 6832                          | 7820                                       | 8721  | 26150                          | Organizations -Enhanced |         |         |         |
| University of Delhi                         | Banaras Hindu University       | All India Institute of Medical Sciences                             | Indian Institute of Technology Kharagpur | Bhabha Atomic Research Center | Indian Institute of Science Iisc Bangalore | Council of Scientific Industrial Research Csir India      | Indian Institute of Technology |                         |         |         |         |
| 5894  | 6025                           | 6853  | 6981                                     | 7135                          | 8942                                       | 29233   | 37805                          | Records                 |         |         |         |
| General Internal Medicine                   | Biochemistry Molecular Biology | Pharmacology Pharmacy   | Science Technology Other Topics          | Materials Science             | Physics                                    | Engineering   | Chemistry                      | Research Area           |         |         |         |
| 12152                                       | 15889                          | 18196   | 22480                                    | 33380                         | 38354                                      | 38435   | 62493                          | Records                 |         |         |         |
| Journal of Clinical and Diagnostic Research | Indian Journal of Pharmacology | Spectrochimic a Acta Part A Molecular And Biomolecular Spectroscopy | Indian Journal of Psychiatry             | Current Science               | Plos One                                   | Journal of Evolution of Medical and Dental Sciences Jemds | Rsc Advances                   | Source Titles           |         |         |         |
| 1786  | 1922                           | 1924  | 2029                                     | 2997                          | 3197                                       | 4256  | 6629                           | Records                 |         |         |         |
| Kumar V                                     | Sharma A                       | Das S   | Sharma S                                 | Singh S                       | Kumar R                                    | Kumar S   | Kumar A                        | Authors                 |         |         |         |
| 3060  | 3200                           | 3226  | 3390                                     | 3760                          | 4434                                       | 6295  | 7282                           | Records                 |         |         |         |
| 0.857                                       | 0.896                          | 0.903   | 0.949                                    | 1.052                         | 1.241                                      | 1.762   | 2.038                          | % of 357259             |         |         |         |



|                            |      |  |      |                                    |       |   |      |            |      |       |
|----------------------------|------|--|------|------------------------------------|-------|---|------|------------|------|-------|
| Univ Hyderabad             | 2709 | Defence Research Development Organisation Drdo | 4097 | Energy Fuels                       | 6659  | Indian Journal of Medical Research      | 1242 | Banerjee S | 1991 | 0.557 |
| Indian Inst Technol Delhi  | 2992 | Tata Institute of Fundamental Research         | 4283 | Optics                             | 6756  | Journal of Applied Physics              | 1245 | Gupta R    | 1993 | 0.558 |
| Aligarh Muslim Univ        | 3032 | Indian Institute of Technology Roorkee         | 4386 | Oncology                           | 7509  | Indian Journal of Agricultural Sciences | 1252 | Singh Ak   | 2069 | 0.579 |
| Vit Univ                   | 3050 | Anna University                                | 4454 | Plant Sciences                     | 7630  | Optik                                   | 1263 | Kumar M    | 2199 | 0.616 |
| Postgrad Inst Med Educ Res | 3110 | Indian Institute Of Technology Kanpur          | 4528 | Neurosciences Neurology            | 7685  | Physical Review D                       | 1276 | Gupta A    | 2285 | 0.64  |
| Tata Inst Fundamental Res  | 3421 | Jadavpur University                            | 4544 | Mathematics                        | 9545  | Indian Journal of Pediatrics            | 1307 | Singh R    | 2405 | 0.673 |
| Univ Calcutta              | 3689 | Pgimer Chandigarh                              | 5015 | Biotechnology Applied Microbiology | 9561  | Indian Journal of Animal Sciences       | 1325 | Gupta S    | 2484 | 0.695 |
| Panjab Univ                | 3767 | Indian Institute of Technology Madras          | 5329 | Computer Science                   | 9966  | Indian Pediatrics                       | 1327 | Singh A    | 2663 | 0.745 |
| Anna Univ                  | 4170 | Indian Institute of Technology Delhi           | 5498 | Agriculture                        | 11434 | Journal of Alloys And Compounds         | 1361 | Ghosh S    | 2910 | 0.815 |
| Jadavpur Univ              | 4565 | Indian Institute of Technology Bombay          | 5772 | Environmental Sciences Ecology     | 11565 | Tetrahedron Letters                     | 1693 | Kumar P    | 2934 | 0.821 |



|                |      |                        |      |            |      |  |      |          |      |       |
|----------------|------|------------------------|------|------------|------|--|------|----------|------|-------|
| Manipal Univ   | 2514 | Panjab University      | 3796 | Pediatrics | 5996 | Journal of The Indian Chemical Society | 1141 | Sharma R | 1789 | 0.501 |
| Annamalai Univ | 2446 | University of Calcutta | 3740 | Surgery    | 5988 | Scientific Reports                     | 1130 | Sarkar S | 1711 | 0.479 |

**Table- 5.Highly Cited Articles with Citations**

| No. of Citations | Title  | Source Title                    |
|------------------|--|---------------------------------|
| 4361             | Planck 2013 results. I. Overview of products and scientific results  | Astronomy & Astrophysics        |
| 4201             | REVIEW OF PARTICLE PHYSICS Particle Data Group   | Chinese Physics C               |
| 3978             | Observation of a new boson at a mass of 125 GeV with the CMS experiment at the LHC   | Physics Letter B                |
| 3210             | Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010   | Lancet                          |
| 2948             | Cancer incidence and mortality worldwide: Sources, methods and major patterns in GLOBOCAN 2012   | International Journal of Cancer |
| 2912             | A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010 | Lancet                          |
| 2202             | Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010   | Lancet                          |
| 2040             | Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock: 2012   | Critical Care Medicine          |
| 1801             | Guidelines for the use and interpretation of assays for monitoring autophagy   | Autophagy                       |
| 1748             | Years lived with disability (YLDs) for 1160 sequelae of 289 diseases and injuries 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010   | Lancet                          |
| 1686             | Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013                                     | Lancet                          |





|      |  |   |
|------|--|---|
| 1167 | Planck 2013 results. XXII. Constraints on inflation  | Astronomy & Astrophysics                    |
| 1118 | Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013 | Lancet                                      |
| 1063 | Observation of Gravitational Waves from a Binary Black Hole Merger   | Physical Review Letters                     |
| 998  | Bounding the role of black carbon in the climate system: A scientific assessment   | Journal of Geophysical Research-Atmospheres |
| 962  | Saxagliptin and Cardiovascular Outcomes in Patients with Type 2 Diabetes Mellitus  | New England Journal of Medicine             |
| 934  | The tomato genome sequence provides insights into fleshy fruit evolution   | Nature                                      |
| 814  | Tissue-based map of the human proteome   | Science                                     |
| 788  | Core/Shell Nanoparticles: Classes, Properties, Synthesis Mechanisms, Characterization, and Applications  | Chemical Reviews                            |
| 772  | Graphene Quantum Dots Derived from Carbon Fibers   | Nano Letters                                |

### Major Findings and Interpretations

Followings are the major findings from this study

1. World publications share of India is 3.37% (357259 records) of the total output for the year 2012-16. This indicates that the productivity rate of India is significant among the competing countries.
2. The growth rate of the publication is gradually increasing for the year 2012 to 2016.
3. Journal Articles, Meeting Abstracts, Reviews, Letters and Editorial Materials constitute 99.05% (353853 records) of total publications and other items fill less the 1%.
4. Author Kumar A has been identified as the prolific author with the publications of 7282 documents; the second and third positions occupied by the authors Kumar S and Kumar R with 6295 and 4434 documents respectively.
5. Indian Institute of Technology's (IITs) ranks first as a organization with 26150 papers, and it is evident that the IISc Bangalore have published 8721 records as a single entity in Organization category of Web of Science Core Collection database at the same time if it is Organization Enhanced, Council of Scientific Industrial Research (CSIR) stands second with 29233 records (composite organizations). This ranking should be carefully understood by the interpreters by analyzing the WoS ranking and indexing methods.
6. It is obvious that the subject chemistry is the most prolific discipline, which occupied the first research area category with 62493 records, while engineering and physics got second and third positions with 38435 and 38354 records.
7. In source journal category Royal Society of Chemistry Advance contained 6629 articles as the frontier in the source tile (journal) category due to overwhelming research in chemistry and allied subjects in India.
8. Another important observation is to be noted that the highly cited paper in this test period is Planck 2013 results. I. Overview of products and scientific results from Astronomy and Astrophysics filed with 4361 citations as on 07-07-2017.



## Conclusion

Based on the study carried out, central universities top the ranking of institutions in India. There is more of research activity carried out in India in Chemical Science, Engineering and Technology along with Physical Science and Material Sciences. This portrays that the India strives to become a significant publisher in terms of research publications in developing countries as trend shows in major publications and collaborations with the foreign authors and organizations. Majority of top institutions are contributing to science technology discipline, it encourages other arts and humanities subjects journals also to be covered enormously in number with quality scales. There is a heavy competition between teaching institutes and research institutes in publications output which a health trend in knowledge dissemination process. Publications are to grow in social science and arts and humanities discipline, which will increase the social ties and collaborations with other countries. Growth in research productivity also increases collaborations and research volume. The hope and take away of this study leads to Indian Institutions research output in the year 2020 can step India from a developing nation to developed nation.

## References

1. Aksnes, D. W., van Leeuwen, T. N., & Sivertsen, G. (2014). The effect of booming countries on changes in the relative specialization index (RSI) on country level. *Scientometrics*, 1–11.
2. Ataie-Ashtiani, B. (2016). Chinese and Iranian Scientific Publications: Fast Growth and Poor Ethics. *Science and Engineering Ethics*, 23(1), 1–3. <https://doi.org/10.1007/s11948-016-9766-1>.
3. Basu, A. (2010). Does a country's scientific "productivity" depend critically on the number of country journals indexed? *Scientometrics*, 82(3), 507–516. <https://doi.org/10.1007/s11192-010-0186-8>.
4. Blasi, B., Romagnosi, S., & Bonaccorsi, A. (2016). Playing the ranking game: media coverage of the evaluation of the quality of research in Italy. *Higher Education*. <https://doi.org/10.1007/s10734-016-9991-1>.
5. Bornmann, L., Stefaner, M., Anegón, F. D. M., & Mutz, R. (2013). Ranking and mapping of universities and research-focused institutions worldwide based on highly-cited papers: A visualization of results from multi-level models. *Online Information Review*, 38(1), 43–58.
6. Çakır, M. P., Acartürk, C., Ala ehir, O., & Çilingir, C. (2015). A comparative analysis of global and national university ranking systems. *Scientometrics*, 103(3), 813–848. <https://doi.org/10.1007/s11192-015-1586-6>.
7. Dragos, C. M., & Dragos, S. L. (2014). Scientific productivity versus efficiency of R&D financing: Bibliometric analysis of African countries. *Current Science*, 106(7), 942–945.
8. Fazlunnisa, H. (2015). Productivity Pattern of Global Scientific Literature. *Asian Journal of Library and Information Science*, 7(December), 3–4.
9. García, J. A., Rodríguez-Sánchez, R., Fdez-Valdivia, J., Torres-Salinas, D., & Herrera, F. (2012). Ranking of research output of universities on the basis of the multidimensional prestige of influential fields: Spanish universities as a case of study. *Scientometrics*, 93(3), 1081–1099. <https://doi.org/10.1007/s11192-012-0740-7>.
10. Greenbaum, H., Meyer, L., Smith, M. C., Barber, A., Henderson, H., Riel, D., & Robinson, D. H. (2016). Individual and Institutional Productivity in Educational Psychology Journals from 2009 to 2014. *Educational Psychology Review*, 28(2), 215–223. <https://doi.org/10.1007/s10648-016-9360-8>.
11. Gupta, B. M. (2012). Measurement of Indian Science and Technology using publications output data during 1996-2010. *Indian Journal of Science and Technology*, 5(6), 2896–2911.
12. Gupta, B. M., Sharma, L., & Kumar, S. (1998). Literature growth and author productivity patterns in Indian Physics. *Information Processing & Management*, 34(1), 121–131. [https://doi.org/10.1016/S0306-4573\(97\)00043-5](https://doi.org/10.1016/S0306-4573(97)00043-5).
13. Horta, H., & Santos, J. M. (2016). The Impact of Publishing During PhD Studies on Career Research Publication, Visibility, and Collaborations. *Research in Higher Education*, 57(1), 28–50. <https://doi.org/10.1007/s11162-015-9380-0>.



14. Ioannidis, J. P. A., Patsopoulos, N. A., Kavvoura, F. K., Tatsioni, A., Evangelou, E., Kouri, I., ... Liberopoulos, G. (2007). International ranking systems for universities and institutions: a critical appraisal. *BMC Medicine*, 5, 30. <https://doi.org/10.1186/1741-7015-5-30>.
15. Jeremic, V., Bulajic, M., Martic, M., & Radojicic, Z. (2011). A fresh approach to evaluating the academic ranking of world universities. *Scientometrics*, 87(3), 587– 596. <https://doi.org/10.1007/s11192-011-0361-6>.
16. Leta, J., Lannes, D., & Meis, L. (1998). Human resources and scientific productivity in Brazil. *Scientometrics*, 41(3), 313–324. <https://doi.org/10.1007/BF02459048>.
17. Liu, N. C., Cheng, Y., & Liu, L. (2005). Academic ranking of world universities using scientometrics - A comment to the “fatal Attraction.” *Scientometrics*, 64(1), 101– 112. <https://doi.org/10.1007/s11192-005-0241-z>.
18. Porter, S. R., & Toutkoushian, R. K. (2006). Institutional research productivity and the connection to average student quality and overall reputation. *Economics of Education Review*, 25(6), 605– 617. <https://doi.org/10.1016/j.econedurev.2005.06.003>.
19. India Rankings 2017. (n.d.). Retrieved March 30, 2017, from National Institutional Ranking Framework Website, [https://www.nirfindia.org/Docs/Ranking\\_Methodology\\_And\\_Metrics\\_2017.pdf](https://www.nirfindia.org/Docs/Ranking_Methodology_And_Metrics_2017.pdf).
20. Rosborough, A., Miner, A. B., Wilcox, B., & Morrison, T. G. (2015). Institutional Productivity Ratings and Publishing Trends in Nine Literacy Journals: 1972–2012. *Reading Psychology*, 36(7), 579–594. <https://doi.org/10.1080/02702711.2014.952465>.
21. Singh, V. K. (2015). a Scientometric Analysis of Research Output of Indian Institute of Technology Mandi. *Indian J.Sci.Res*, 11(2), 193–196.
22. Scimago Institutions Ranking. (n.d.). Retrieved March 30, 2017, from Scimago Journal Ranking Website, <http://www.scimagoir.com>.
23. Sujatha, R. (2015, April 04). Ranking an effort to improve quality, say officials. *The Hindu*, p.2.
24. Times Higher Education World University Rankings. (n.d.). Retrieved March 30, 2017, from Times Higher education website, <https://www.timeshighereducation.com>.
25. Wu, D., Li, M., Zhu, X., Song, H., & Li, J. (2015). Ranking the research productivity of business and management institutions in Asia???. Pacific region: empirical research in leading ABS journals. *Scientometrics*, 105(2), 1253–1272. <https://doi.org/10.1007/s11192-015-1752-x>.