Scientometric Mapping of the Research Productivity of Top NIRF-Ranked Universities in Delhi

Gnanasekaran D
Kalasalingam Academy of Research and Education (KARE). India
gsekard@gmail.com

Vineeta Jain
Teerthanker Mahaveer University (TMU). India
university.librarian@tmu.ac.in

M. Panduranga Swamy
Sri Sathya Sai Institute of Higher Learning (SSSIHL). India
mpandurangaswamy@sssihl.edu.in

Muruli N
Central University Himachal Pradesh. India
murulitarikere@hpcu.ac.in

ABSTRACT

Universities worldwide have established ranking programs to evaluate their institutions, making it crucial to study their research productivity. This study aims to map the research productivity of Delhi-based universities that rank among the top in the National Institutional Ranking Framework (NIRF) 2023. Scientometric and bibliometric methods are widely used to study research growth, publication patterns, collaborative performance, citations, etc. Published literature from Delhi Technological University, Jamia Hamdard, Jamia Millia Islamia, Jawaharlal Nehru University, and the University of Delhi was collected from the Scopus database covering the last five completed years (2019-2023). The collected data were analyzed using Microsoft Excel and visualized using VOSviewer software.

Delhi Technological University leads in publication growth with a 26.02% compound annual growth rate (CAGR) but ranks lowest in citations per paper. Jamia Millia Islamia is in the fourth positing ingrowth rate but leads in citations per paper (CPP 13.31) and h-index (111). Collaborative works dominate, with 98% of publications from Delhi Technological University and Jamia Hamdard, 94% from Jamia Millia Islamia, 89.53% from the University of Delhi, and 80% from Jawaharlal Nehru University being collaborative.

Preferences for open- access journals vary, with Jamia Hamdard (36.53%), University of Delhi (31.92%), Jamia Millia Islamia (31.59%), and Jawaharlal Nehru University (29.85%) showing higher preferences compared to Delhi Technological University (16.35%).

The University of Delhi and Delhi Technological University could focus on strategies to improve their citations per paper despite their high publication growth. Encouraging open-access publishing could enhance visibility and impact for institutions like Delhi Technological University. Continued emphasis on collaborative research is recommended to enhance research output and impact further, as demonstrated by the high collaboration rates across the universities.

1. Introduction

Due to the global academic race, educational institutions worldwide are pushed to focus on implementing various strategies to perform better in the industry (Cakir et al., 2015).Asian universities have risen in the world's rankings in recent decades (Zeng, 2024). Many agencies rank the institutions based on various parameters such as teaching, learning and resources, professional practice, outreach and inclusivity, stakeholder perception, research publications, citations, international outlook, student and faculty ratio, academic reputation, employer reputation, etc .Research is among them, and it is now one of the core elements of any university. Even though many research centres are being established globally to conduct research in different domains, universities play an important role in fulfilling the research thirst and creating knowledge due to pre-set up and infrastructure. The universities have been involved in research for more than one century.

Technological innovation and knowledge generation are crucial components of economic success, and the regions that use them can witness advancements in productivity and their overall standard of living (Broughel and Thierer, 2019; Khan, 2023).The future of science, technology, and innovation will determine how the primary issues faced by humans and society for survival on earth, freedom from fear, and want get resolved (Vessuri, 2008). Since the economic growth of any country depends on the quantum of research being carried out and the research publications are significant in ranking higher education institutions (Deka and Sarmah, 2021), the governments, universities and funding agencies spend an enormous amount towards conducting the research. To gain the insight concerning the current state of their research, it has been highly prioritized for the continual assessment of the research productivity of organizations, institutions of higher learning such as colleges and universities, and research centres (Franceschini and Maisano, 2011; Ponomariov and Boardman, 2010) and effective utilization of the financial resources towards research activities. Scientometric studies have become essential to determine the caliber and efficacy of the research outcome of these centres, and the findings can be applied to enhance the present scenario, allocate resources optimally, and support the weaker centres to perform better (Yazdani et al., 2015).

2. Related Works

Bibliometric and scientometric studies are conducted to evaluate the scientific outcomes of an institution (Mitchel, Rose and Asare, 2020)or a discipline or a journal, publication patterns, growth trend, collaborative research, citations, etc. The necessity for a nationwide assessment of the research productivity and the need for policymakers to plan for the research sector is stressed by Khanali, Malekpour and Kolahi (2023), and they advised increasing research and development spending, assisting underperforming research institutions, and fostering cross-border collaboration in Iran. Nadi-Ravandi and Batooli (2022) compared the Iranian and Turkish research outputs and found that Iranian researchers outperformed Turkish researchers in various metrics.

Many databases, including Web of Science, Scopus, PubMed, Dimensions, Lens, etc., provide scientometric study data. Many countries have started developing national databasesto maintain their research data. Indian Science Reports is among them, and the Science and Technology Innovation data was analysed by Singh et al. (2023). An evaluative study of research outputs of 19 animal science research institutions under the Indian Council of Agricultural Research (ICAR) by Krishnan et al. (2023) revealed that multi-authorship papers were significantly dominating, with the USA being a major collaborator. Tocora, Gracia-Ramos and Forero (2024) assessed research outputs on hospitals and clinics in Latin American countries. Most collaborative papers were from the United States and Europe, and the highly cited publications are open-access journals.Valentine and Williams (2024)compared the research outputs of European countries on engineering education. They revealed that Spain and the UK produced more papers in engineering education, France, Germany, and Italy produced more papers in general engineering and science domains. The non-educational resources had a high impact. Thelwall and Maflahi (2022) studied the co-authorship using 20 years' data based on Scopus broad fields (27) and narrow fields (332) and revealed that the average number of authors is increasing continuously.

In recent years, many scientometric studies were conducted all over India to evaluate the performance of higher educational institutions. Maurya et al. (2018) assessed the research outputs of Mizoram University of India based on WoS data. They found that the university produced about 93% of the research as journal articles and that current science journals hold more papers. Bapte and Gedam (2018) studied the publications of Sant Gadge Baba Amravati University in India. They revealed that around 21% of the papers were produced with international collaboration and collaborative papers gained more citations. Patel (2019) assessed the Gujarat University research papers and revealed that there was 2.14 times growth in 10 years and suggested increasing international collaboration. Keshava (2020) studied the papers produced by Tumkur University and revealed that more papers were produced in recent years. Gnanasekaran (2021) revealedthat about 98.4% of the papers were produced with collaborative research in Kalasalingam Academy of Research and Education, India, and about 25% of the papers got funding support. Mamdapur (2021) quantified the growth of research production of Karnatak University of India and indicated that about 96% of the papers were contributed by science faculty members, and the United States and South Korea were the most collaborated countries. Mahala and Singh (2021) analyzed the science publications of 5 Indian universities, namely the University of Delhi, Banaras Hindu University, Anna University, Jadavpur University and Punjab University, that were produced during 2015-19 and identified the continuous increase in the production.Mondal (2022) examined the papers produced by five Indian Institutes of Science Education and Research (IISERs) from 2006 to 2020, and the results show that 18.52% were internationally collaborated. Alagappa University in India produces 99.45% of the research papers with collaborations, and 88.45% are with international collaborations (Nishavathi

&Jeyshankar, 2022). Sokolova et al. (2023) examined the scientometric indicators of the faculty members of Ural State University using datamining technologies and the IBM SPSS data processing system by categorising them into two clusters. Akbar, Arif and Rafiq (2024) evaluated the research outputs of the Pakistan Agricultural Research Council between 2001 and 2020 using scientometric factors that show that internal collaboration within the country is dominant. No such study was conducted earlier to compare the research patterns of Delhi-based top universities, and an attempt has been made to do the same in this study.

3. Objectives

The authors started this study with the following objectives

• To examine the top universities listed in Delhi that performed well in the assessment exercise of NIRF.

• To find out the publication pattern and growth rate of publications produced by these universities in Delhi.

• To determine the research quality using various hybrid metrics based on the citations.

• To evaluate the authorship collaboration and understand the collaborative structure behind the performance

• To study the adaptation of open access publishing and how it impacts performance.

• To examine the co-authorship network and term occurrences. It will help understand the research relations and the priority expressed in terms of discipline interest.

4. Methodology

Many databases provide bibliographic details of research publications, including Scopus, Web of Science, Lens, Dimensions, PubMed, and Indian Science Abstracts. This study uses Scopus databases to retrieve the bibliographic details of the research publications produced by the universities in Delhi under study. The study aims to assess the last 5 years of research outputs, i.e. 2019-2023.After introducing the NIRF ranking system in India, higher educational institutions' production of research articles significantly increased (Deka and Sarmah, 2021). Hence, we used two-phase selection to identify the respondents' universities. In the first phase, the institutions from Delhi were selected from the NIRF 2023 ranking list. There were seven institutions listed in the list. In the second phase, the status of the institutions in the University Grants Commission (UGC) record was checked. At the end of this phase, two institutions, the Indian Institute of Technology Delhi and All India Institute of Medical Sciences, Delhi, were removed since they were not listed under the university category by UGC (UGC, 2024). The remaining institutions, such as Delhi Technological University, Jamia Hamdard, Jamia Millia Islamia, Jawaharlal Nehru University and University of Delhi, were selected for the study. The data retrieved in CSV format was analysed in MS Excel. VOSviewer software was used to visualise the co-authorship networks and term occurrence map, as Romero-Duque and Anzola Montero (2023) suggested.

5. Results and Discussion

Table 1 depicts the details about the universities. There is one state university, one deemeda university, and another three are central universities. Three universities, Delhi Technological University, Jamil Millia Islamia and University of Delhi, were established before independence. The Central Universities occupied the top positions in the NIRF list, followed by state-owned universities and the deemed-to-be universities. Jamil Hamdard, a

private university deemed the youngest among the five universities, is in the last position based on the NIRF ranking (49) and the strength of faculty and research scholars. There is a vast difference in the ratio of the number of faculty members and research scholars in the universities.

University	Year of Estd.	Type	UGC Status	NIRF Ranking (University)	Faculty Strength	Research Scholars	Scholars per Faculty	Sponsored Projects (2019-22)	Sponsored Amount in Crore (2019-22)
DTU	1941	State University	2(f) & 12(B)	40	901	1417	1.57	p164	26.04
JH	1989	Deemed to be University. Institute of Eminence	Sect. III & 12(B)	49	531	816	1.54	315	70.70
JMI	1920	Central University	2(f) & 12(B)	3	738	1512	2.05	520	192.39
JNU	1969	Central University	2(f) & 12(B)	2	598	3845	6.43	907	81.07
UD	1922	Central University	2(f) & 12(B)	11	1226	3702	3.02	1328	161.54
Total	-	-	-	-	3994	11292	2.83	3234	531.74

Table 1. Details of Universities

6. Publication Growth

The details of the publications' production of the universities and growth rate during the last five years are given in Table 2. The publication production of the universities was increasing yearly with the 13% cumulative annual growth rate (CAGR). Jamia Hamdard and Jawaharlal Nehru University showed a slight decrease in 2023.University of Delhi has produced more publications but is in third place based on the growth rate. Delhi Technological University was the third highest producer but was at the top in the growth rate. Being the least producer, Jamia Hamdard shows active research, with the second position in the growth rate at 15.66% CAGR. It seems that publication production depends highly on the number of faculty members working at the university. The research scholars' strengths and sponsored projects are not reflected in their publications.

6.1 Citations and Research Quality

Overall, 74.24% of the papers were cited at least once, and more than 70% of the papers, irrespective of the universities, were cited with an average of 10.56 citations per paper. Jamia Millia Islamia University, with 13.31 citations per paper, gained 111 h-index.

University	PublicationCount						
	2019	2020	2021	2022	2023	Total	CAGR
DTU	803	1179	1725	1911	2025	7643	0.2602
JH	494	690	743	953	885	3765	0.1566
JMI	1227	1423	1584	1736	1783	7753	0.0979
JNU	1277	1364	1429	1603	1557	7230	0.0508
UD	2428	2710	3328	3607	3906	15979	0.1262
Total	6229	7366	8809	9810	10156	42370	0.1300

Table 2. Growth of publications

University	Cited Pub	Citations	CPP	h-index	g-index	hg-index	p-index
DTU	5428 (71.02%)	73088	9.56	86	170	120.91	99.47
JH	3074 (81.85%)	47981	12.74	76	116	93.89	90.81
JMI	6049 (78.02%)	103180	13.31	111	172	138.17	120.74
JNU	5168 (71.48%)	76088	10.52	86	172	121.62	103.86
UD	11736 (73.45%)	147188	9.21	107	172	135.66	122.67
Total	31455 (74.24%)	447525	10.56	157	270	205.89	179.69

Table 3. Citations and Research Quality based on Scientometric indicators

It was found that there is a mixed performance of the old and young universities. To represent the quality and quantity of the research papers, Hirsch (2005) introduced an index called the h-index, which is the most popular among scientists. The old universities are performing better than younger ones, and it shows that the *h-index* is highly dependent on the age and history of the institutions. Even though it considers both quantity and citations of the papers, it gives more importance to the number of papers and does not give more importance to the highly cited papers. Hence, Egghe (2006) introduced the *g-index*, which gives more weight to highly cited papers. It is the number of top articles (g) that gain at least $g2$ citations together. The *g-index* also has a disadvantage in that it does not consider the total number of papers and total citations of a scientist during a period. Considering the advantages of these h and g indices and reducing the errors, the *hg-index* was introduced, which is the geometric mean of both h and g indices. Even though the values of these indices vary, the ranking of universities based on all these indices are the same and do not show much difference.

6.2 Open Access

All five universities had chosen the open access initiative to publish their papers at certain levels. The papers that are published in the open-access journals get more visibility. Table 4 shows the details of the open-access publications of these universities. All universities published 29.11% of the papers in open-access mode. Delhi Technological University deviates from other universities with only 16.35% open access papers, but other universities have published around 30% and more open access papers. Jamia Hamdard, the youngest university of all, published more papers (36.53%) in open access mode.

University	2019	2020	2021	2022	2023	Total	% in Total
DTU	148	200	269	334	299	1250	16.35%
JH	164	242	272	360	337	1375	36.53%
JMI	361	467	490	616	515	2449	31.59%
JNU	358	450	475	479	396	2158	29.85%
UD	947	834	1035	1165	1120	5101	31.92%
Total	1978	2193	2541	2954	2667	12333	29.11%

Table 4. Open Access Publications

6.3 Author Collaboration

Over the past century, co-authorship in research has become more prevalent, irrespective of the subject domains (Thelwall and Maflahi, 2022).The publications produced with external collaboration gained more citations (Deka and Sarmah, 2021). Table 5 reveals the co-authorship pattern of the publications. Only 8.93% of the publications were pursued with solo performance. Around 91.07% of the publications were the result of collaborative work.It reflects the results of the study conducted by Nishavathi and Jeyshankar (2022) for Alagappa University in India, revealing that 99.45% of papers were produced with collaboration and 88.41% were the results of cross-border collaborations. The papers with 3-5 authors (47.01%) dominated, followed by two-authored papers and 6-10-author papers. Das and Verma (2021) analysed the authorship pattern that differs from our current study in that two authored papers were more with 12.57% of the total papers.

6.4 Co-Authorship Linkages

Kumar, A., is the most productive author with 1667 documents, 18810 citations, and 3279 linkage strengths. He is followed by Kumar, S., with 1502 documents, 16993 citations, and 2705 linkage strength. Kumar, R., has produced 908 publications and attracted 10598 citations with a total of 1862 linkages. They have collaborated with all the universities.

The linkage maps were derived using the top 1000 authors with the help of VOS viewer visualisation software. Co-authorship occurred in 19 clusters. Cluster 1 consisted of 128 authors, and cluster 2 consisted of 98 authors. Top author Kumar, A., was part of cluster 2. Kumar, S., was part of cluster 17, which consisted of 21 authors.

The co-authorship linkage map is given in Fig.1.

University	Authorship Pattern							Total Publication
	1 Author	2 Authors	3-5 Authors	6-10 Authors	11-20 Authors	21-50 Authors	50+ Authors	
DTU	161	2348	4537	540	34	3	20	7643
JH	69	278	1633	1541	221	14	9	3765
JMI	459	1253	3924	1858	237	11	11	7753
JNU	1422	1394	2777	1332	230	33	42	7230
UD	1674	3121	7049	3073	466	79	517	15979
Total	3785	8394	19920	8344	1188	140	599	42370

Table 5. Co-Authorship Pattern

6.4 Co-Authorship Linkages

Kumar, A., is the most productive author with 1667 documents, 18810 citations, and 3279 linkage strengths. He is followed by Kumar, S., with 1502 documents, 16993 citations, and 2705 linkage strength. Kumar, R., has produced 908 publications and attracted 10598 citations with a total of 1862 linkages. They have collaborated with all the universities.

The linkage maps were derived using the top 1000 authors with the help of VOS viewer visualisation software. Co-authorship occurred in 19 clusters. Cluster 1 consisted of 128 authors, and cluster 2 consisted of 98 authors. Top author Kumar, A., was part of cluster 2. Kumar, S., was part of cluster 17, which consisted of 21 authors. The co-authorship linkage map is given in Fig.1.

6.5 Term Co-Occurrence

Using the words in the titles of the documents, the term co-occurrence maps were derived and shown inFig. 2. The term 'synthesis'with 988 occurrences is the highly used term that is followed by classification (382), production (371), solution (314), search (284), pandemic (282) and so on. The terms effect, classification, control, property, recognition, controller, etc are more occurrence terms of Delhi Technological University, covid, synthesis, India, optimization, detection, patient, etc are the more occurred to terms of Jamia Hamdard, synthesis, covid, characterization, control, nanocomposite, etc are the more occurred terms of Jamia Millia Islamia. Detection, synthesis, protein, property, activity, nanoparticle, etc, are the mainly occurred terms of Jawaharlal Nehru University, and synthesis, production, search, and solution are the most-occurred terms of the University of Delhi. The results show that the terms' synthesis, COVID, property, and control occurred in more than one university.
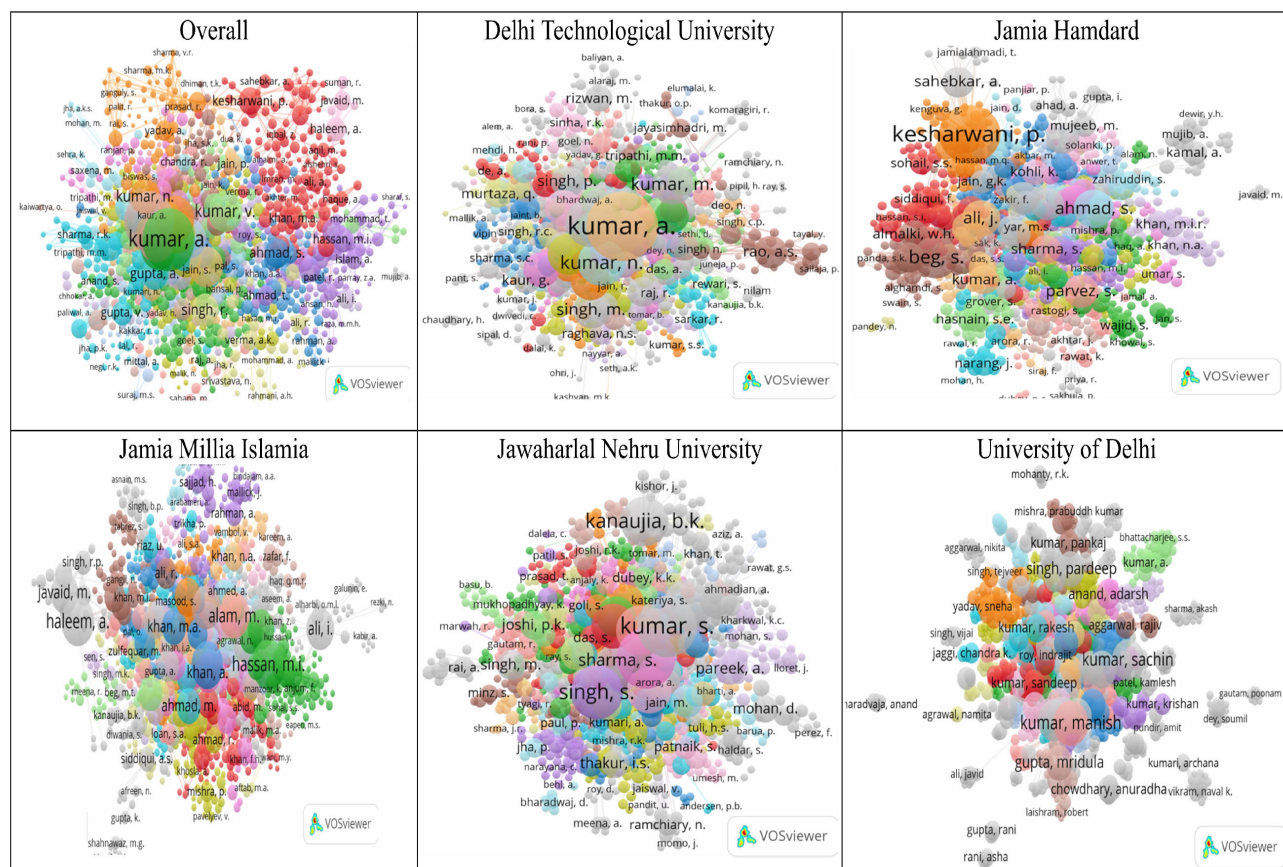
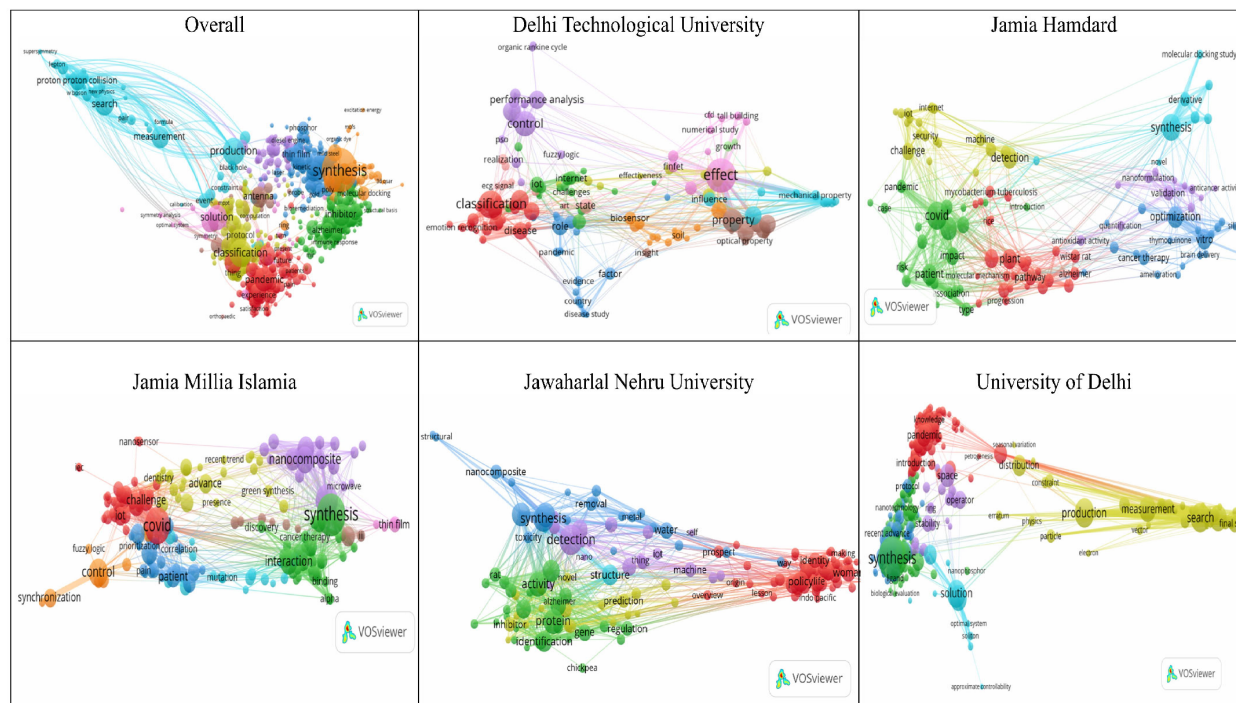Figure 1. Co-authorship Linkage

Figure 2. Term Co-occurance

7. Conclusion

The study was conducted to map the research outputs of Delhi-based universities that get higher rankings in NIRF 2023 under the university category. Five universities were taken up for the study, among them three central universities, one state university, and one private university deemed to be a university. Producing more publications does not mean that there is a high growth rate. Paper production highly depends on the number of faculty members working in the university. The funded projects and sanctioned amount are not positively reflected in paper production.

The number of citations a publication has does not relate to the age and history of the university. Jamia Millia Islamia and the young university Jamia Hamdard gained more citations. The hybrid scientometric indices (h, g, hg) differ in showing the results. The *P-index* differs from other indices. Around 30% or more of articles are produced by the universities in open access mode, except Delhi Technology University, which produces only 16.35% in open access mode.

Multi-authored papers dominate—91.07% of those produced were produced with multi-author collaboration. The papers with 3-5 authors are dominating. It shows the continuous increase in the multi-authored papers. The co-authorship occurred with 19 clusters, and the top authors have a collaboration with all universities. The terms synthesis, COVID, property, and control appeared in the papers of more than one university. It shows that interdisciplinary approach or cross-disciplinary collaborations is emerging in recent research. The performance of any organisation in all aspects is highly dependent on the infrastructure supports. The authors do not study the infrastructure facility of the universities for conducting research. This study would be helpful to policymakers in extending financial support. The researchers' previous research track record may be considered for funding decisions since the funded projects and sanctioned amounts do not yield more research either. These authors believe that the findings of this study will assist policymakers in making sound decisions to achieve better research activities.

References

[1] Cakir, M.P. et al. (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.

[2] Zeng, Y. (2024). A study on the competitiveness of Asian universities – using different university rankings as examples. *Lecture Notes in Education Psychology and Public Media,* 41(1), 162-169. https://doi.org/10.54254/2753-7048/41/20240773.

[3] Broughel, A., Thierer, A. D. (2019). Technological Innovation and Economic Growth: A Brief Report on the Evidence. *SSRN Electronic Journal.* https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3346495.

[4] Khan, M. A. (2023). A Critical Study of the Importance of Academic Research in Higher Education in Reference to India. *IRJEMS International Research Journal of Economics and Management Studies*, 2(1): 54-59. https://doi.org/10.56472/25835238/IRJEMS-V2I1P108.

[5]Vessuri, H. (2008). The Role of Research in Higher Education: Implications and Challenges for an Active Contribution to Human and Social Development. In: Higher Education in the World 3: New Challenges and Emerging Roles for Human and Social Development, pp.119-129.

[6] Deka, P., Sarmah, M. (2021). Impact of NIRF Ranking on Research Publications: A Study with Special Reference to North-East Indian Universities. *Library Philosophy and Practice (e-journal)*.5135. https://digitalcommons.unl.edu/libphilprac/5135.

[7] Franceschini, F., Maisano, D. (2011). Criticism on the hg-index. *Scientometrics*. 86(2):339-46.

[8] Ponomariov, B. L. Boardman, P.C. (2010). Influencing scientists' collaboration and productivity patterns through new institutions: University research centers and scientific and technical human capital. *Research Policy*, *39(5):613-24*.

[9] Yazdani, K. et al. (2015). A 5-year scientometric analysis of research centers affiliated to Tehran University of Medical Sciences. *Medical Journal of the Islamic Republic of Iran* (MJIRI), 29: 206.

[10] Mitchell, R., Rose, P., Asare, S. (2020). Education research in sub-Saharan Africa: Quality, visibility, and agendas. *Comparative Education Review, 64*(3), 363–383. https://www.journals.uchicago.edu/doi/10.1086/709428.

[11] Khanali, J., Malekpour, M. R., Kolahi, A. A. (2023). Assessing the research performance of the Iranian medical academics and universities: A bibliometric analysis. *Medical Journal of the Islamic Republic of Iran, 37*, 31. https://doi.org/10.47176/mjiri.37.31.

[12] Nadi-Ravandi, S., Batooli, Z. (2022). A 10-year (2010-2019) Scientometrics assessment of Iranian and Turkish scholarly outputs based on Scopus database. *Malaysian Journal of Library & Information Science, 27(3), 21-47*. https://doi.org/10.22452/mjlis.vol27no3.2.

[13] Singh, V. K., Kanaujia, A., Singh, P., Nandy, A. (2023). Indian Science Reports: A portal for Comprehensive mapping of S&T data and analytics for India at an overall and institutional level. *Journal of Scientometric Research, 12*(2), 501-504. https://doi.org/10.5530/jscires.12.2.046

[14] Krishnan, P., Hemalatha, M., Agarwal, S., Gireesh-Babu, P., Naveena, B. M., Rao, C. S. (2023). Mapping the research publication trends among ICAR-Animal Sciences Research Institutes in India: Web of Science-based scientometric study. *Indian Journal of Animal Sciences, 93*(9), 928–935. *https://doi.org/10.56093/ijans.v93i9.115679*.

[15] Tocora, J. C., Gracia-Ramos, A. E., Forero, D. A. (2024). A scientometric analysis of research productivity in clinics and hospitals from five Latin American countries. *Journal of Scientometric Research, 13(1), 103-112*. https://doi.org/10.5530/jscires.13.1.9

[16] Valentine, A., Williams, B. (2024). Scientometric analysis of the publishing behaviour of EU + UK authors in engineering education and further afield. *European Journal of Engineering Education, 49*(2), 389-410.

https://doi.org/10.1080/03043797.2023.2287126

[17] Thelwall, M., Maflahi, N. (2022). Research coauthorship 1900–2020: Continuous, universal, and ongoing expansion. *Quantitative Science Studies, 3*(2), 331–344. https://doi.org/10.1162/qss_a_00188.

[18] Maurya, S.K., Shukla, A., Ngurtinkhuma, R. K. (2018). Scholarly communications of Mizoram University on WoS in global perspective: a scientometric assessment. *Library Philosophy and Practice*, 6: 1-13, available at: http://digitalcommons.unl.edu/libphilprac/1857

[19]Bapte, V.D. Gedam, J. (2018). A scientometric profile of sant Gadge Baba Amravati university, Amravati during 1996-2017, *DESIDOC Journal of Library and Information Technology*, 38(5): 326-333.

[20] Patel, P. (2019). Quantitative synthesis of published research: a study of Gujarat university, *Library Philosophy and Practice*, 9: 1-16.

[21] Keshava, Sathish Kanth, P. L., Mamatha, V. Shanthakumari, K. (2020). Scientometric analysis of publication output of Tumkur University Faculty: A study based of Scopus database. *Journal of Indian Library Association*, 56(4): 16-28.

[22] Gnanasekaran, D. (2021). Research Contribution of Kalasalingam Academy of Research and Education, Tamil Nadu, India: A Scientometric Evaluation. *Library Philosophy and Practice (e-journal)*. 4838. https://digitalcommons.unl.edu/libphilprac/4838

[23] Mamdapur, G.M.N., Hadagali, G.S., Kaddipujar, M.D. (2021). Publications productivity of Karnatak University, Dharwad: A scientometric analysis. *International Journal of Information and Dissemination Technology*, 11(1): 1-11. http://dspace.rri.res.in/bitstream/2289/7777/1/2021_IJIDT_Vol.11_p1.pdf

[24] Mahala, A., Singh, R. (2021). Research output of Indian universities in sciences (2015–2019): A scientometric analysis. *Library Hi Tech*, 39(4), 984-1000. https://doi.org/10.1108/LHT-09-2020-0224.

[25] Mondal, D. (2022). Research emphasis of IISERs in chemical sciences from 2006 to 2020: A scientometric assessment. *Journal of Scientometric Research*, 11(1): 55-67. Retrieved from https://www.jscires.org/sites/default/files/JScientometRes-11-1-55.pdf

[26] Nishavathi, E., Jeyshankar, R. (2022). Evaluating research output using scientometric and social network analysis: A case of Alagappa University, India. *International Journal of Information Science and Management, 20(2), 325-345*. https://dorl.net/dor/20.1001.1.20088302.2022.20.2.20.5.

[27] Das, S. Verma, M. K. (2021). Authorship and collaboration pattern of *Annals of Library and Information Studies* journal during 2009-2018: Scientometrics mapping. *Library Philosophy and Practice (e-journal)*, 5605. https://digitalcommons.unl.edu/libphilprac/5605

[28] Sokolova, E. V., Begicheva, S. V., Goncharova, M. N. (2023). Advanced analysis of scientometrics indicators of university teachers. *AIP Conference Proceedings, 2812*, 020089. https://doi.org/10.1063/5.0161262.

[29] Akbar, F., Arif, M., Rafiq, M. (2024). Mapping the research productivity of Pakistan Agricultural Research Council: A scientometric study. *Global Knowledge, Memory and Communication.* https://doi.org/10.1108/GKMC-06-2023-0207.

[30] Ministry of Education, Government of India, National Institute Ranking Framework (NIRF). https://www.nirfindia.org/Rankings/2023/UniversityRanking.html

[31] University Grants Commission, Government of India. https://www.ugc.gov.in

[32] Romero-Duque, L. Q. and Anzola Montero, G. (2023). University scientific production: The case of the University of Applied and Environmental Sciences (Bogotá, Colombia). *Revista U.D.C.A News & Scientific Dissemination, 26* (2). http://doi.org/10.31910/rudca.v26.n2.2023.2478,

[33] Hirsch, JE. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences; 102(46):16569-72.*

[34] Egghe, L. (2006). Theory and practice of the g-index. Scientometrics, 69(1), 131–152.