



## The Research Landscape of Central Universities in Northeast India: A Bibliometric Analysis

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*Received 22 October 2023; Accepted 05 December 2023*

The study examines the research productivity of 10 central universities in the Northeastern states of India by analyzing data on research publications indexed by the Web of Science database between 1989 and 2021. The data is analyzed based on parameters such as the year-wise distribution of publications, citations, funding sources, and preferred sources for publications. The results reveal that the ten central universities in the Northeastern states attempted to improve their research publications. Tezpur University was identified as the most dynamic university in the region with the highest publications and citations, leading to the highest h-index values during the selected period. The study also found that most central universities in Northeast India published their research papers in the journal "Current Science." The study recommends that Central Agricultural University improve its research publications by publishing in reputed, high-impact journals to increase visibility within the scientific community.

**Keywords:** Research Productivity; Bibliometrics; North East India; Web of Science; Biblioshiny

### Introduction

Excellence in research is increasingly in demand, and performance expectations are much more significant. Universities are regarded as settings for learning, research, and innovation worldwide. Therefore, a suitable infrastructure for higher learning and research is crucial for a nation's growth and advancement. As part of a government initiative to support higher education and research in India, the Government of India established 56 Central Universities (CUs) in every state and region of India. Central universities in India play a significant role in the higher education system by providing quality education, conducting research, and promoting intellectual and cultural development<sup>1</sup>. They are established and funded by the central government and offer various undergraduate and postgraduate programs in various disciplines. They also strongly emphasize research, and many collaborate with other universities and research institutions in India and

abroad<sup>2</sup>. These universities also produce many highly skilled and knowledgeable professionals who contribute to the growth and development of the country. They also play an essential role in promoting national integration by educating students from different regions and backgrounds<sup>3</sup>.

In this context, universities have been considered significant contributors to research publications. Prior to the independence of India, the North East region lacked quality university education, and no universities were present in the area. To rapidly improve this situation and support from the Indian government, various states in the North East established several recognized universities under state or central acts. These universities have been focusing on research and innovation, which is why the universities in the Northeast region were chosen for this study to analyze their research outputs. There are 56 central universities in India, of which 11 are from the northeastern states of India. The Central universities of the North Eastern states of India are relatively new and have a limited number of research publications

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compared to other universities in the country. Studies on research productivity constitute an essential aspect of bibliometric studies in Library and Information Science. Therefore, conducting a bibliometric analysis of their research output can be an important way to measure their scientific output and impact and identify research gaps. The popularity of bibliometric methodology has grown in recent years due to the availability of bibliometric software and databases<sup>4,5</sup>. Bibliometric methodologies help decide research priorities, track science and technology's evolution, allocate funding, and recognize scientific excellence. Furthermore, bibliometric analysis can also be used to evaluate these universities' research performance and identify their strengths and weaknesses with other universities in the country. This can help the university management, researchers, and policymakers develop plans and strategies to improve these universities' research productivity and impact.

### Literature Review

A sizeable number of bibliometric studies are carried out analyzing the research outputs. However, such studies based on the productivity of universities are not much. Some studies conducted in the recent past have shown us different clues on the significance of such studies. Such a study was made by Pandya et al.<sup>6</sup>, which analyzed 3927 articles published by 12 newly established central universities of India retrieved from the Scopus database and revealed that the Central University of Rajasthan had contributed the highest number of 765 articles among the universities and the highest growth of publications in Chemistry. Muthuraja et al.<sup>7</sup> evaluated the selected universities of Karnataka's website traffic using webometrics tools of Alexa Internet, which revealed that most of the university's downloading speed and bounce rates are unsatisfactory, and only a few universities' downloading speed is high. Sahoo et al.<sup>8</sup> investigated trends in basic science research at the Indian Institutes of Science Education and Research (IISER) over five years. The findings reveal that this institution has a high number of citations, a preference for open-access publications, increasing research output, strong author networks, and high levels of collaboration. The Sonkar et al.<sup>9</sup> study found that Banaras Hindu University was the most productive, contributing 23.4% of the total publications among the nine central universities in India in the field of science. Verma et al.<sup>10</sup> highlighted that U. K. Sahoo from the Department of Forestry, with 25 publications, was found to be the most productive author at Mizoram University,

while the highest rank publication was Current Science, with 16 publications. Alhibshi et al.<sup>11</sup> reported on the state of neuroscientific research in Saudi Arabia, noting that the country ranks 39<sup>th</sup> in the world regarding the number of articles published. Saudi Arabian neuroscientists have a high level of collaboration with scientists from other countries, and the top journals in the field are all international.

Pradhan and Sahu<sup>12</sup> examined the research output of five Indian Institutes of Technology (IITs) - IIT Bombay, IIT Kanpur, IIT Kharagpur, IIT Delhi, and IIT Madras - during the period 2007 to 2016, as reflected in the SCOPUS database. A total of 10,583 research publications of the IITs' research output on various parameters, such as the growth rate of research publications, authorship pattern, productivity per capita, and degree of collaboration, were analyzed. While analyzing the research performance of 39 central universities of India for 25 years indexed in the Web of Science, Marisha et al.<sup>13</sup> found that Delhi University and Banaras Hindu University performed best. However, even the best-performing Indian Central Universities were far behind top-ranking world universities' research performance levels. The study by Siwach and Satish Kumar<sup>14</sup> on research publication outputs of Maharshi Dayanand University revealed that two institutes in South Korea, i.e., Korea Institute of Energy Research and Yonsei University, collaborated maximum. Gautam and Mishra<sup>15</sup> found that the average rate of research publications at Banaras Hindu University has increased to 104.1 publications per year. Also, most of them were collaboration work. Researchers conducted many bibliometric and scientometrics studies on the institution's research productivity<sup>16,17</sup>. Recently, such studies have occupied an important place in library and information science research.

### Objectives of the Study

The present study has been taken up with the following objectives:

- (a) Analyze the growth and development of research outputs produced by universities
- (b) Determine the various types of contributions by universities.
- (c) Examine the authorship patterns of the documents or publications.
- (d) Identify the authors and universities with the highest citation rates.
- (e) Investigate the leading research funding agencies.
- (f) Discover the primary sources/journals through which researchers share their findings.

**Scope and methods**

**Data collection**

The current study focuses on the research outputs of ten central universities in India’s North Eastern States region. These ten universities, which are included in the study, are Tezpur University (TZU), North-Eastern Hill University (NEHU), Assam University (AU), Manipur University (MU), Mizoram University (MZU), Tripura University (TU), Rajiv Gandhi University (RGU), Sikkim University (SKU), Nagaland University (NLU), and Central Agricultural University (CAU). However, it is worth noting that the National Sports University in Manipur has been excluded from the study due to a lack of available data in the Web of Science (WoS) database. Table 1 lists the selected universities for the study and is provided for reference. The research output data of these ten universities were indexed in the WoS Core Collection database, which serves as the primary source for this study. The data were retrieved and collected from the database for analysis and study purposes. The study period, specified as 1989 to 2021, covers a significant amount of time and allows for a thorough examination of the research outputs of these universities. The data collection process was carried out using the advanced search technique of the WoS database, specifically the “Affiliation” search, which involved searching for the university or institution names.

**Analysis tool**

Analyzing the data collected from the initial search required various tools and techniques to ensure that the information was adequately cleaned, filtered, and understood. To achieve this, Microsoft Excel 2019 (v16.0.) was utilized for data cleaning and filtration. This powerful software is widely used in various fields. It is known for its ability to organize, sort, and filter

large data sets efficiently. It cleaned and prepared the data for further analysis by removing duplicates, inconsistencies, and errors. Once the data had been cleaned, Bibliometrix R-package Biblioshiny (v 4.0.0)<sup>18</sup> and BibExcel (v 2017)<sup>19</sup> were used to analyze the data. These two tools are widely used for bibliometric analysis and provide a wide range of functionalities for data analysis.

**Inclusion and exclusion criteria**

The process of retrieving data for analysis began with an initial search of a database of 13,453 documents from 10 universities. However, screening and filtering the data was necessary to ensure that only relevant information was included in the analysis. As a result, 252 irrelevant documents were removed from the analysis. After applying inclusion and exclusion criteria, 13,201 documents were deemed suitable for analysis (as shown in Fig. 1). The

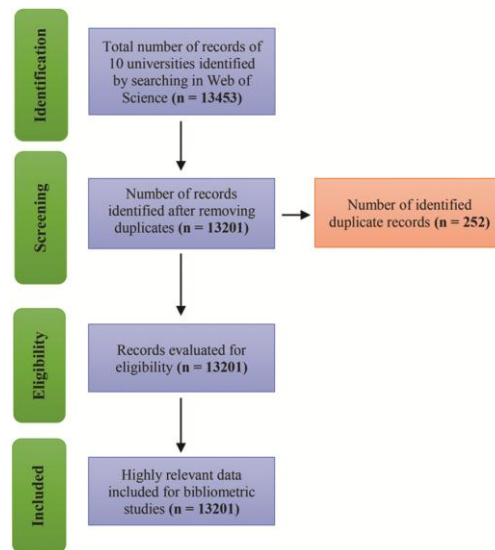


Fig. 1 — PRISMA flowchart showing the filtration and cleaning of data of the 10 universities

Table 1 — List of central universities in the North-Eastern States of India

Sl. No.	Name of the University	State	Year of Established
1	Tezpur University (TZU)	Assam	1994
2	North-Eastern Hill University (NEHU)	Meghalaya	1973
3	Assam University (AU)	Assam	1994
4	Manipur University (MU)	Manipur	1980
5	Mizoram University (MZU)	Mizoram	2001
6	Tripura University (TU)	Tripura	1987
7	Rajiv Gandhi University (RGU)	Arunachal Pradesh	1984
8	Sikkim University (SKU)	Sikkim	2007
9	Nagaland University (NLU)	Nagaland	1989
10	Central Agricultural University (CAU)	Manipur	1992

\*Manipur University upgraded to central university status in 2005

\*Rajiv Gandhi University upgraded to central university status in 2007

\*TP = Total Number of Publications; TC = Total Citations

Table 2 — The Growth pattern of research outputs of each university (1989-2021)

UNIVERSITY	TZU		NEHU		AU		MU		MZU		TU		SKU		RGU		NLU		CAU	
	TP	TC	TP	TC	TP	TC	TP	TC	TP	TC	TP	TC	TP	TC	TP	TC	TP	TC	TP	TC
1989	0	0	84	873	0	0	35	212	6	15	8	44	0	0	0	0	2	26	0	0
1990	0	0	93	1482	0	0	25	235	4	2	6	18	0	0	0	0	0	0	0	0
1991	0	0	95	689	0	0	27	141	0	0	4	18	0	0	0	0	4	6	0	0
1992	0	0	75	789	0	0	21	71	0	0	11	93	0	0	0	0	0	0	0	0
1993	0	0	93	1118	0	0	19	72	2	9	10	116	0	0	0	0	0	0	0	0
1994	0	0	71	628	0	0	19	88	2	14	8	32	0	0	0	0	0	0	0	0
1995	1	0	69	740	0	0	15	45	1	2	8	42	0	0	0	0	0	0	3	8
1996	1	1	72	1647	0	0	14	81	2	4	7	38	0	0	0	0	0	0	0	0
1997	2	16	75	1477	0	0	18	92	4	26	9	68	0	0	1	5	1	0	0	0
1998	3	62	86	1550	4	64	19	262	1	0	10	121	0	0	3	2	1	0	1	1
1999	6	66	77	870	3	38	9	209	1	12	12	321	0	0	2	23	2	28	0	0
2000	9	192	56	1122	3	12	13	83	2	4	6	206	0	0	6	36	0	0	0	0
2001	10	308	60	1078	6	90	11	116	1	6	11	246	0	0	14	213	5	48	0	0
2002	20	319	55	1091	9	290	5	119	1	3	12	201	0	0	5	43	2	4	0	0
2003	20	706	75	1083	8	255	14	103	3	39	8	118	0	0	16	242	10	110	0	0
2004	24	842	66	1137	14	323	19	209	1	1	6	60	0	0	4	40	6	149	1	2
2005	47	1164	86	1280	8	280	22	213	5	17	9	81	0	0	2	43	9	186	3	16
2006	44	1011	74	812	10	153	20	399	1	1	23	880	0	0	2	5	10	558	2	6
2007	58	2187	84	1389	18	361	32	372	15	381	14	428	0	0	4	25	7	50	0	0
2008	80	1940	82	1409	24	696	43	704	25	657	16	251	0	0	5	188	7	83	0	0
2009	81	2330	88	1064	36	602	48	793	34	788	21	225	8	197	12	260	11	114	1	1
2010	119	3028	97	1123	62	1275	60	996	29	491	28	349	4	84	9	48	11	92	1	22
2011	152	4085	105	1740	83	1609	53	797	36	462	35	337	7	89	15	398	11	145	8	271
2012	206	4914	126	1606	92	1542	68	934	44	991	26	135	10	138	17	288	19	92	5	12
2013	251	6839	155	1977	110	1506	65	789	44	643	45	430	12	243	31	323	14	108	6	130
2014	339	9044	133	1354	147	1776	70	820	45	1049	52	471	8	113	22	217	15	194	2	11
2015	288	5986	145	1577	135	1908	47	422	59	997	45	555	26	411	12	37	10	85	5	37
2016	293	4586	145	1467	150	2420	44	352	98	1130	58	1199	29	1373	21	139	9	78	6	37
2017	349	5534	164	1619	146	1742	62	355	86	1181	85	1226	39	677	29	178	25	277	15	53
2018	304	3427	192	1878	164	1775	43	356	79	824	66	649	45	749	24	192	17	180	13	51
2019	299	2817	195	1124	137	1147	51	286	105	1341	84	771	60	482	37	428	26	98	33	87
2020	273	1436	188	876	174	936	57	166	155	1175	89	529	70	292	39	258	21	90	23	77
2021	312	466	196	332	235	470	83	82	199	477	105	184	72	123	39	67	34	18	46	42
Total	3591	63306	3457	40001	1778	21270	1151	10974	1090	12742	937	10442	390	4971	371	3698	289	2819	174	864

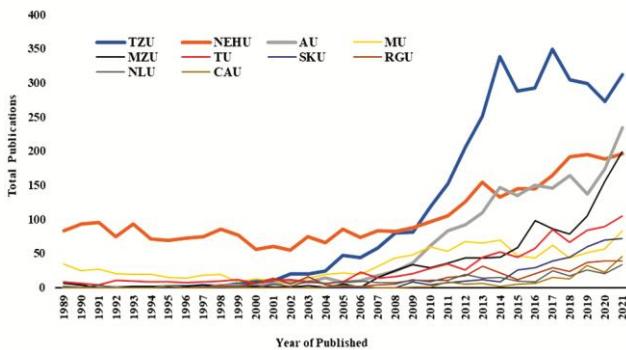


Fig. 2 — Yearly growth trend of publications of the Universities

data was retrieved in plain text (.txt) format and then converted to a comma-separated value (.csv) format for analysis. This conversion was necessary to make the data usable for statistical analysis and visualization. The search for relevant documents was carried out and retrieved from the WoS (Web of Science) database on the 27<sup>th</sup> of February, 2022.

**Results and discussion**

**University research output: The growth pattern**

Table 2 and Figure 2 provide a comparative analysis of the research growth and citation trends among ten central universities in North East India. Mainly, this study introduces a novel perspective by examining the evolution of research outputs over time for these institutions. The data highlights a consistent upward trajectory in the publication outputs of these

universities. Collectively, they have contributed 13,268 publications to the academic landscape. TZU leads the pack with 3,591 publications, commencing its research journey with a single publication in 1995. Notably, 2017 witnessed a peak in TZU’s productivity, with 349 publications. NEHU, securing the second position in terms of regional research contributions with 3,457 publications, began its journey in 1989, characterized by fluctuations in its output. AU, embarking on its research endeavors in 1998, currently stands third among the universities, boasting 1,778 publications. It is worth mentioning that 2021 was its most prolific year, with 235 publications. MU, holding the fourth position, has amassed 1,151 publications over 33 years. Notably, it consistently produced research, although it did not surpass 100 publications in any single year. SKU, RGU, NLU, and CAU mirror this trend. Despite ranking fifth overall, Mizoram University (MZU) stands out for its consistent growth, surpassing 100 publications in 2019, 2020, and 2021. This highlights the university’s dedication to enhancing its research output and establishing itself as a leading academic institution.

The analysis reveals a positive correlation between the age of the university and its research output. TZU and NEHU, the two oldest universities in the study, have consistently maintained a leading position in research publications. However, despite its relatively young age, AU’s remarkable growth demonstrates the potential for newer universities to emerge as research

Table 3 — Citations received and their impact on the Universities

University	Total Publication (TP)	Total Citations (TC)	C/P
TZU	3591	63306	17.63
NEHU	3457	40001	11.57
AU	1778	21270	11.96
MU	1151	10974	9.53
MZU	1090	12742	11.69
TU	937	10442	11.14
SKU	390	4971	12.75
RGU	371	3698	9.97
NLU	289	2819	9.75
CAU	147	864	5.88

\*C/P = Average Citation Per Paper

powerhouses. MZU has exhibited a remarkable upswing in recent years. This suggests a shift in regional research dynamics, highlighting MZU's potential to contribute to the Northeast's research landscape significantly. The comparative analysis underscores the growing research prowess of central universities in Northeast India. While TZU, NEHU, and AU continue to lead the pack, MZU's recent publication surge signals a promising trend. Continued support and investment in research infrastructure and capacity building will further elevate the region's research stature.

#### Citations and their impact

Table 3 unveils a comparative landscape of citation metrics for various universities, revealing their citation counts and average citations per paper. TZU emerged as the citation leader, amassing a remarkable 63,306 citations. Notably, TZU also claims the highest average citation impact, with 17.63 citations per paper, underscoring its influential contributions to academia. NEHU closely follows with a noteworthy 40,001 citations and an average of 11.57 citations per paper, solidifying its status as a prominent research hub. AU garners significant attention with 21,270 citations and 11.96 citations per paper. MU also holds a notable position with 10,974 citations and 9.53 citations per paper, demonstrating its impactful contributions. SKU distinguishes itself with the highest average citations per paper at an impressive 12.75. Conversely, CAU exhibits the lowest average citations per paper during the study period, amounting to 5.88. TZU emerges as the undisputed citation leader, demonstrating its research excellence and impact. NEHU and AU closely follow TZU, highlighting their strong research presence. MU and SKU also hold notable positions, showcasing their impactful academic contributions. CAU exhibits the lowest average citations per paper, suggesting a need for further research enhancement. The analysis reveals a diverse citation landscape among universities, with

TZU, NEHU, and AU leading the way. MU and SKU also demonstrate notable citation impact, while CAU presents an opportunity for research growth.

#### Publications by document types

Table 4 reveals how universities publish different types of documents. When we compare TZU with other universities, we see that TZU leads in "articles" and "article-early access" with 3317 and 133 publications, which is a lot more than the second-place university, NEHU, which has 3096 "articles." Following closely are AU with 1529, MU with 1039, MZU with 980, and TU with 831 articles.

However, there is room for improvement in some universities like SKU, RGU, NLU, and CAU, as fewer "articles" have been published than others. SKU has only 337, RGU 322, NLU 249, and CAU 154 articles. It is suggested that these universities work on increasing their research article contributions. As for "proceedings paper," NEHU is the leader with 92 publications, followed by TZU with 66. NEHU also has the highest number of "retracted publications" with 74, followed by MU with 21, TU with 15, MZU with 3, and CAU with 2. Researchers mostly prefer to publish "articles," while other document types like "review," "book chapter," "news item," "poetry," and "biographical item" are less common across universities.

#### Authorship pattern

Table 5 presents a comparative analysis of ten universities, focusing on their publication contributions. TZU stands out with the most authors, 3540, followed closely by NEHU with 3441, AU with 2933, MZU with 2914, and MU with 1477 authors. What is novel here is that TZU has the highest number of single-authored documents at 56, showcasing individual research efforts. Regarding international collaboration, CAU, SKU, and MZU lead the way, while TZU has the lowest collaborative index. NEHU contributes the most single-authored documents at 242. Interestingly, CAU has no single-authored documents, highlighting its robust collaborative approach. Furthermore, TZU has the highest documents per author ratio at 1.2, indicating prolific output per author. On the other hand, CAU has the highest author-per-document ratio at 3.61, showing a different focus. Lastly, CAU boasts the highest co-authors per document ratio at 5.39, revealing its extensive collaborative network. This comparative study sheds light on these universities' unique strengths and characteristics in research output and collaboration.

University	TZU	NEHU	AU	MU	MZU	TU	SKU	RGU	NLU	CAU
Document Types	Total Number of Publications (TP)									
article	3317	3096	1529	1039	980	831	337	322	249	154
early access	133	86	119	29	46	55	24	10	11	9
proceedings paper	66	92	18	36	26	6	3	18	8	0
book review	35	32	23	8	30	24	8	11	6	5
correction	20	22	10	6	7	4	5	8	3	3
editorial material	17	15	7	2	9	4	2	1	1	1
letter	16	18	30	8	4	8	7	11	0	1
meeting abstract	13	28	31	7	13	10	2	1	13	1
news item	6	14	4	2	1	3	4	0	2	1
poetry	3	0	3	0	3	4	2	0	0	4
review	2	1	1	0	0	1	0	0	0	1
book chapter	1	2	0	0	0	0	2	0	0	0
review-early access	0	2	1	1	0	0	3	0	2	0
biographical-item	0	2	2	0	0	0	0	0	0	0
editorial material-early access	0	3	0	0	0	0	0	0	0	1
note	0	0	0	0	0	0	0	0	0	1
retracted publication	0	74	0	21	3	15	0	0	0	2
article; book chapter	0	2	0	0	1	0	1	0	0	0
Total	3629	3489	1778	1159	1123	965	400	382	295	184

University	TZU	NEHU	AU	MU	MZU	TU	SKU	RGU	NLU	CAU
AUTHORS										
Authors	3540	3441	2933	1477	2914	1252	766	777	767	650
Author Appearances	13580	12962	8547	4208	6804	4350	1674	1713	1319	1058
Authors of single-authored documents	56	102	37	38	28	19	18	16	14	1
AUTHORS COLLABORATION										
Single-authored docs	137	257	52	61	60	29	40	41	25	1
Documents per Author	1.03	1.01	0.606	0.785	0.385	0.771	0.522	0.492	0.385	0.283
Co-Authors per Doc	3.74	3.72	4.81	3.63	6.06	4.51	4.18	4.48	4.47	5.75
International Co-Authorships %	14.94	20.32	21.54	10.96	32.95	18.03	26.75	33.77	13.9	11.96

### Author impact

The data in Table 6 delves into the impact of the top three authors from each of the ten central universities in India's North Eastern States region, considering their total citations (TC) and total publications (TP). TZU stands out with its researchers consistently demonstrating exceptional research impact. "Karak N" of TZU emerges as the most influential researcher, boasting the highest TC (6875), TP (215), and h-index (41). His colleagues, "Deka RC" and "Kumar A," follow closely, solidifying TZU's overall dominance in research impact. Authors with the highest TC from other universities include TSB Baul (NEHU, TC = 2518), SK Ghosh (AU, TC = 1169), SD Singh (MU, TC = 1121), DP Rai (MZU, TC = 1132), B Dinda (TU, TC = 1620), B Hazarika (RGU, TC = 859), JP Tamang (SKU, TC = 1140), and D Sinha (NLU, TC = 447). While these authors have significantly impacted their respective universities, their impact is lower than those from TZU.

"Das S" from Central Agricultural University (CAU), with TC = 291, TP = 8, and h-index = 3, has the lowest impact among the analyzed authors. This indicates that despite his relatively recent start in

publishing, his research has not gained the same level of recognition as others in the region. This study unveils a captivating insight into the research landscape of North Eastern India's central universities. The remarkable impact of TZU's researchers, particularly "Karak N," highlights the institution's research prowess. The study underscores the importance of recognizing and nurturing research talent across institutions. It also emphasizes the need for continuous evaluation of research impact to identify and support emerging researchers, ensuring a thriving regional research ecosystem.

### Highly-cited papers

When analyzing the data presented in Table 7, it is clear that the paper entitled "*Network Anomaly Detection: Methods, Systems and Tools*" by Bhuyan et al. of TZU, published in the journal "*IEEE Communications Surveys & Tutorials*," stands out as the most highly-cited research paper amongst the universities studied. This is evidenced by the Total Citation (TC) and Total Citation per Year (TCPY) metrics, which indicate that this paper has received a TC of 535 and a TCPY of 59.44. This paper is followed closely by "*Some Physico-chemical aspects*

Table 6 — Top three authors from each with their citation impact on the universities

University	Author	h-index	g-index	m-index	TC	TP	PY-Start
TZU	Karak N	44	70	1.83	6875	215	1999
	Deka RC	28	43	1.40	2857	165	2003
	Kumar A	34	50	1.55	3569	165	2001
NEHU	Baul TSB	26	42	0.77	2518	143	1989
	Mahanti MK	16	24	0.47	777	95	1989
	Kollipara MR	18	26	0.90	1114	86	2003
AU	Ghosh SK	19	28	1.462	1169	89	2010
	Chakraborty S	16	31	1.455	1166	80	2012
	Bhattacharjee A	13	17	1	522	71	2010
MU	Singh NR	17	28	0.5	1069	92	1989
	Gartia RK	16	20	0.471	584	60	1989
	Singh SD	16	32	0.516	1121	60	1992
MZU	Rai DP	19	25	1.462	1132	98	2010
	Thapa RK	19	23	0.633	964	88	1993
	Kumar NS	16	29	-	1014	76	-
TU	Bhattacharjee D	18	23	-	968	96	-
	Hussain SA	17	23	0.944	907	84	2005
	Dinda B	18	39	0.529	1620	69	1989
RGU	Hazarika B	16	26	1.067	859	65	2008
	Dwivedi KK	15	21	0.625	524	35	1999
	Ghosh S	14	22	0.583	523	27	1999
SKU	Tamang JP	16	33	1.143	1140	48	2009
	Ray PP	12	31	1.714	1021	39	2016
	Tiwari A	10	15	0.909	273	28	2012
NLU	Sinha D	12	20	0.545	447	29	2001
	Deb CR	6	8	0.273	109	18	2001
	Sinha UB	9	16	0.474	259	16	2004
CAU	Parhi J	4	6	0.500	39	9	2015
	Choudhury TG	5	8	0.625	68	8	2015
	Das S	3	4	0.500	21	8	2017

\*TC = Total Citations; TP=Total number of Publications; PY-Start = Publication Year-Start

Table 7 — Highly cited papers among universities

University	Title	Author (s), Year and Journal	TC	TCPY	NTC
TZU	Network Anomaly Detection: Methods, Systems and Tools <sup>20</sup>	Bhuyan et al., 2014 and IEEE Communications Surveys & Tutorials	535	59.44	20.05
NEHU	Some Physico-chemical aspects of hydroxylapatite <sup>21</sup>	Narasaraju & Phebe, 1996 and Journal of Materials Science	425	15.74	18.58
AU	$\alpha$ -Synuclein binds to TOM20 and inhibits mitochondrial protein import in Parkinson's disease <sup>22</sup>	Di Maio et al., 2016 and Science Translational Medicine	258	36.86	15.99
MU	Effects of Ce <sup>3+</sup> Codoping and Annealing on Phase Transformation and Luminescence of Eu <sup>3+</sup> -Doped YPO <sub>4</sub> Nanorods: D <sub>2</sub> O Solvent Effect <sup>23</sup>	Luwang et al., 2010 and Journal of the American Chemical Society	153	11.77	9.22
MZU	Towards a More Complete and Accurate Experimental Nuclear Reaction Data Library (EXFOR): International Collaboration Between Nuclear Reaction Data Centres (NRDC) <sup>24</sup>	Otuka et al., 2014 and Nuclear Data Sheets	408	45.33	17.5
TU	Cultural and leadership predictors of corporate social responsibility values of top management: a GLOBE study of 15 countries <sup>25</sup>	Waldman et al., 2006 and Journal of International Business Studies	384	22.59	10.04
RGU	Use of some essential oils as post-harvest botanical fungicides in the management of grey mould of grapes caused by Botrytis cinerea <sup>26</sup>	Tripathi et al., 2008 and World Journal of Microbiology and Biotechnology	120	8	3.192

(Contd.)

Table 7 — Highly cited papers among universities

University	Title	Author (s), Year and Journal	TC	TCPY	NTC
SKU	A survey on Internet of Things architectures <sup>27</sup>	Ray, 2018 and Journal of King Saud University-Computer and Information Sciences	384	76.8	23.07
NLU	Cultural and leadership predictors of corporate social responsibility values of top management: a GLOBE study of 15 countries <sup>25</sup>	Waldman et al., 2006 and Journal of International Business Studies	384	22.59	10.04
CAU	Engineering Cold Stress Tolerance in Crop Plants <sup>28</sup>	Sanghera et al., 2011 and Current Genomics	248	20.67	7.321

\*TC= Total Citations; TCPY= Total Citation Per Year; NTC = Normalized Total Citation

Table 8 — Top funders in university research

Rank	UNIVERSITY									
	TZU	NEHU	AU	MU	MZU	TU	RGU	SKU	NLU	CAU
	(TP)	(TP)	(TP)	(TP)	(TP)	(TP)	(TP)	(TP)	(TP)	(TP)
1	UGC	UGC	DST	UGC	DST	DST	UGC	DST	DST	DBT
	(974)	(654)	(327)	(151)	(238)	(239)	(50)	(85)	(58)	(15)
2	DST	DST	UGC	DST	UGC	UGC	DST	UGC	UGC	ICAR
	(647)	(461)	(314)	(149)	(151)	(132)	(42)	(48)	(27)	(11)
3	CSIR	DBT	DBT	CSIR	DBT	CSIR	CSIR	DBT	CSIR	CAU
	(400)	(276)	(238)	(108)	(151)	(86)	(30)	(47)	(24)	(9)
4	DBT	CSIR	CSIR	DBT	CSIR	DBT	SERB	SERB	DBT	COE
	(312)	(245)	(76)	(82)	(82)	(68)	(26)	(29)	(18)	(3)
5	TZU	DAE	DAE	MU	MoST	ICMR	DBT	CSIR	SERB	DST
	(237)	(64)	(25)	(36)	(15)	(25)	(17)	(25)	(16)	(3)

\*TP=Total number of Publications; UGC = University Grants Commission; DST = Department of Science & Technology; CSIR=Council of Scientific and Industrial Research; DBT=Department of Biotechnology; ICMR = Indian Council of Medical Research; SERB=Science and Engineering Research Board; ICAR = Indian Council of Agricultural Research; COE = Centre of Excellence; MoST = Ministry of Education, Science and Technology Republic of Korea; MU=Manipur University; TZU=Tezpur University; CAU = Central Agricultural University, Imphal

of hydroxylapatite,” written by Narasaraju and Phebe of NEHU and published in the “*Journal of Materials Science*.” This paper has a TC of 425 and a TCPY of 15.74. The third highest-cited paper is “*Towards a More Complete and Accurate Experimental Nuclear Reaction Data Library (EXFOR): International Collaboration Between Nuclear Reaction Data Centres (NRDC)*” from MZU, which was published in “*Nuclear Data Sheets*” and had a TC of 408 and a TCPY of 45.33.

On the other hand, the paper from RGU receives the lowest TC and TCPY with 120 and 8, respectively, compared to the other articles. Furthermore, regarding the Normalised Citation score (NTC), the paper of SKU got the maximum NTC score of 23.07. It is worth noting that the TC and TCPY metrics are important indicators of a research paper’s impact and significance within the academic community. These metrics are calculated by measuring the number of times other researchers do their work. A higher TC and TCPY generally indicate that a paper is considered more valuable and influential in its field.

**Top 5 funders in the universities for the research outputs**

The landscape of funding agencies for published works in universities is diverse and dynamic. A

comparative analysis of funding patterns reveals interesting insights in Table 8. The University Grants Commission (UGC) emerges as the leading funding agency for TZU, NEHU, and MU, supporting 974, 654, and 151 research activities, respectively. This highlights UGC’s significant contribution to fostering research in these institutions. The Department of Science and Technology (DST) takes the top spot for AU, MZU, TU, SKU, and NLU, providing 327, 238, 239, 85, and 58 funding, respectively. This underscores DST’s pivotal role in promoting research across various universities. Among foreign funding agencies, the Ministry of Science and Technology (MoST) of South Korea stands out as the top agency for MZU, with 15 funding. This suggests a growing international collaboration and recognition for MZU’s research endeavors. Taking a broader view of Indian funding agencies, UGC maintains its dominance with 2501 funding, followed closely by DST with 2249, DBT with 1224, and CSIR with 1076. This reaffirms the crucial role of these agencies in propelling India’s research landscape. The choice of top funding agencies often aligns with each university’s specific research focus and expertise. This tailored approach

Table 9 — Most Prolific Journals of the ten universities

University	Journal	TP	TC	C/P	TCP	h-index	PY Start	JIF 2020
	RSC Advances	72	2341	32.51	72	26	2011	3.361
TZU	Indian Journal of Physics	44	392	8.91	33	10	2004	1.947
	Current Science	41	141	3.44	26	5	2003	1.102
	Oxidation Communications	104	311	2.99	69	10	1996	-
NEHU	Current Science	79	486	6.15	58	12	1989	1.102
	Journal of Organometallic Chemistry	76	1545	20.33	71	22	1993	2.369
AU	Current Science	46	287	6.24	32	8	1999	1.102
	Liquid Crystals	35	407	11.63	34	12	2002	6.214
	Indian Journal of Traditional Knowledge	24	162	6.75	22	8	2008	0.757
MU	Astrophysics and Space Science	45	150	3.33	34	6	1989	1.83
	Zootaxa	31	140	4.52	24	7	2007	1.091
	Indian Journal of Chemistry Section B	29	107	3.69	21	7	1989	0.592
MZU	Zootaxa	28	160	5.71	24	7	2010	1.091
	Journal of Environmental Biology	21	136	6.48	12	4	2008	-
	Environmental Science and Pollution Research	20	242	12.10	18	9	2013	4.223
TU	Journal of the Indian Chemical Society	28	104	3.71	22	6	1990	0.284
	Current Science	24	156	6.50	18	6	1994	1.102
	Spectrochimica Acta Part A	22	311	14.14	22	12	1989	4.098
RGU	Radiation Measurements	21	314	14.95	20	12	1999	1.898
	Current Science	17	28	1.65	12	3	2000	1.102
	Journal of Intelligent & Fuzzy Systems	13	106	8.15	13	6	2013	-
SKU	Indian Journal of Traditional Knowledge	15	186	12.40	13	8	2009	0.757
	Frontiers in Microbiology	14	549	39.21	13	8	2016	5.64
	Current Science	13	47	3.62	10	5	2012	1.102
NLU	Current Science	12	33	2.75	6	4	2005	1.102
	Indian Journal of Animal Sciences	9	8	0.89	4	2	2014	0.316
	Radiation effects and defects in Solids	8	130	16.25	7	6	2003	1.141
CAU	Indian Journal of Agricultural Sciences	11	17	1.55	4	3	2005	0.371
	Indian Journal of Animal Sciences	8	8	1.00	3	2	2005	0.316
	Legume Research	7	11	1.57	3	2	2016	0.589

\*TP=Total number of Publications; TC= Total Citations; PY-Start= Publication Year-Start; JIF= Journal Impact Factor

ensures that funding is directed towards areas with the most significant potential for impact.

#### Most prolific journal

Table 9 lists the comparative analysis of the top three journals for each university and reveals interesting patterns in researchers' publishing preferences. While "Current Science" emerged as the most favored journal, appearing seven times among the top three choices, "RSC Advances" was the most preferred journal for TZU researchers, boasting a remarkable citation per publication ratio of 32.51. Notably, "Liquid Crystals" stood out with the highest Impact Factor of 6.214 among the top three journals of each university.

The analysis unveils a novel trend in journal preferences among researchers. While "Current Science" enjoys widespread popularity, researchers from TZU exhibit a distinct inclination towards "RSC Advances," indicating a potential shift in research focus towards newer journals with a growing impact. Additionally, the prominence of "Liquid Crystals"

among AU researchers underscores the growing significance of specialized journals with high-impact factors. These findings hold valuable insights for researchers and academic institutions. The observed patterns suggest that researchers should consider the evolving landscape of journal preferences and Impact Factors when selecting publication venues for their work. Universities, in turn, can tailor their research support and publication guidance to reflect these trends, ensuring that their faculty remains at the forefront of scholarly communication.

#### Discussion

This study delves into the research output of these central universities, highlighting their contributions to scholarly communication. A comprehensive analysis of publications indexed in the Web of Science Core Collection database reveals intriguing insights into publication patterns, authorship trends, collaboration among authors, author impact, and various citation metrics. The study further examines the most relevant sources for the authors and the funding agencies that

have played a pivotal role in supporting research and publications. Among the ten central universities in the Northeastern region, TZU (Tezpur University) and NEHU (North-Eastern Hill University) stand out as frontrunners in multiple aspects of research productivity. AU (Assam University) and MU (Mizoram University) also demonstrate commendable performance, exhibiting encouraging growth trajectories. Interestingly, researchers from these universities exhibit a proclivity towards high-level contributions in the form of articles, as opposed to other document types. While collaboration among authors within the same university is prevalent, inter-university collaboration remains relatively limited. An examination of citation perspectives, measured by h-index, g-index, and m-index, reveals variations among the top contributors from different universities. Karak N of TZU has emerged as a leading figure among regional researchers since 1999, excelling in citation indices, total publications, and total citations.

### Conclusion

Research productivity among central universities in Northeast India varies significantly. While some universities excel in research output and citations, others fall behind. This disparity can be attributed to factors like funding, faculty expertise, and infrastructure. Despite recent advancements in research output, overall productivity levels remain relatively low compared to other Indian universities. The findings underscore the need for funding agencies to support scientific research and publication activities in the Northeastern region, further bolstering the existing publication patterns. With the anticipated enhancement in research output, these universities are poised to contribute even more to the global research landscape in the coming years. This, in turn, will propel their ascent in global university rankings.

Ongoing efforts to improve research productivity include increased collaborations and enhanced support for faculty and students. Despite the challenges, there is potential for growth and improvement. Continued investment in research infrastructure, faculty and student support, and collaborations with other institutions, both regionally and internationally, can further enhance research productivity. This study is relevant for organizations evaluating the quality of university research internationally. It highlights the journals in which faculty members publish their research. If they do not publish in top-ranking journals, it suggests a need for institutional improvement in research quality. Financial

and infrastructure support can aid in achieving this. The study can also help identify institutions producing high-quality research and those that do not, leading to more effective use of public research funds. High-performing institutions should be recognized as examples for others to follow. The originality of this study lies in its emphasis on the potential of Northeastern universities to emerge as global research powerhouses. By highlighting their strengths and identifying areas for improvement, the study provides a roadmap for these institutions to achieve greater research prominence.

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