

RESEARCH ARTICLE

## Scientometric Analysis and Collaboration Trends of Published Literature by State Universities from West Bengal

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### Abstract

The study examines the analysis of research output by the Universities of West Bengal from 2002 to 2021. Journal articles are the most preferred form of publication type of documents by the Universities of West Bengal. It shows the highest RGR value among seven universities is obtained by Vidyasagar University in the year 2021 and the lowest value is obtained by the University of Calcutta in the year 2021. The study used Domestic Collaboration and International Collaboration and it shows the highest paper 11529 (38.38%) was published at the domestic level and international level 3140 (43.87%) by Jadavpur University. It found that 16.82 % of the total publications are open access research articles with 6255. It is quite interesting to know that Jadavpur University has a significant lead towards encouraging the researcher to publish in open access journals with 33.78%. The most productive author is Subhadeep Das, Department of Life Sci. & Biotechnology, Jadavpur University with 908 articles ranked in first place among the universities studied.

**Keywords:** Scientometrics; Exponential growth rate; Domestic collaboration; International collaboration; Relative citation impact; Impact factor

### Introduction

Higher education means different things to various people. In terms of level, higher education entails obtaining a higher educational qualification through the teaching-learning process in higher educational institutions such as colleges and universities. Higher education is considered as an opportunity to engage in the individual's development process through a flexible education method, as well as an input to the growth and development of the industry.

The higher education system is important to the country's entire growth, including industrial, social, and economic development. India's higher education system is the world's third-largest. At present time, the role of Indian higher educational institutes such as colleges and universities is to give quality-based education in the fields of education, research, and other areas to equip youth for self-sufficiency.

The vision of the Government of India in the field of higher education is to make institutions of higher learning emerge as centers of innovation, excellence, and development. The main focus is on quality. The mission is to provide world-class quality education, opening higher education portals for students from rural and backward areas and marginalized families.

The indexes of Scopus, owned by Elsevier, and the indexed Web of Science owned by Clarivate Analytics are two scientometric collections that can be accessed

both directly and through secondary data sources. Scopus and WoS have theoretical, practical, and empirical-analytical functions. They define the boundaries of acknowledged global knowledge, supply content for networked epistemic collaboration and interchange, and serve as a source for university research output. Scientometric enables the categorization and analyze papers, authors, scientific groups, and citations based on discipline, topic, institutional affiliation, demographics, and geographic location. This enormous data set is used for a variety of scientific and performance applications.

### Literature review

(Shariatmadari & Mahdi, 2012) analyzed the research output of research productivity in Islamic Azad University. This paper is aimed to explore the existing barriers to research productivity based on faculty members' perspectives. The collect data was used of the relationship between study variables and survey method. The study included a population of students, 4500 faculty members; working in campuses of 8<sup>th</sup> district, Islamic Azad University. The study was found 60% have participated in males and 40% from females. The majority of the participants (67.4% of females and 61.5% of males) have never subscribed to any national Journals. (Goswami, 2016) examined the research productivity of Assam University from 2000 to 2015, the data was collected by Web of Science database and found a total

of 714 publications and exported to MS-Excel Worksheet. Out of a total of 714 publications, 143 were the maximum recorded in the year 2014, followed by 131, constituting of publications were published in the year 2015 and the minimum 2 of publications recorded in the year 2000. Karimganj College has the highest shared articles. A total of 357 journal titles are found for the research output of Assam University among these, the Current Science has the highest number of articles published. (Malik, 2016) analyzed the research output of study of Political Science Ph.D. thesis, Vikram University from 2009 to 2012. The study was found 43 Ph.D. thesis of Political Science from Vikram University. Out of a total of 43 Ph.D. thesis of Political Science highest number of the Ph.D. thesis has been submitted in the year 2012 (19) whereas fewer thesis has been submitted in the year 2011 (5). (Verma & Shukla, 2019) conducted research output on information literacy of selected countries between 2008 and 2017. The study examines various scientometric parameters i.e. year-wise publications, annual growth rate, compound annual growth rate, RGR and doubling time, most productive authors, country-wise distributions, and found that a maximum of 12.99 % were published in 2016. The researcher found the most prolific authors were Wolf, M.S with 65 publications, followed by 31 publications by Pinto, M. The maximum citations were recorded in the 2010 minimum citation in 2017.(Gourikeremath et al., 2020) studied a comparative study of Mysore and Karnatak University in science. The present study reveals the growth of research in science faculties from both the University of Mysore and the Karnatak University were 3,316 and 1,912 respectively between 2002 and 2016. the maximum number of research papers were published in 2007 (University of Mysore, no-304) and in (Karnatak University, no-172), and the relative growth rate were decreasing from 2003 to 2006 (University of Mysore) and the relative growth rate were decreasing from 2003 to 2013 Karnatak University. (J et al., 2020) analyzed the research productivity of Tumkur University of faculties, based on bibliographic data extracted from the Scopus database published from 2005 to 2019 using bibliometric techniques and an excel sheet for analysis and tabulation as per the objectives of the study. 646 records were analyzed and the maximum number of publications was published in the year 2015 and very less number of publications (1) in the year 2005 to 2007. The findings of the study reveal that the Average Growth Rate was 1.15 years and the mean doubling time was 0.88 years. Prof. S.C. Sharma former Vice-Chancellor has the highest citations received. (Radha, 2020) examined the research contribution of the Thiagarajar College of Engineering for the period from 2014 to 2018 based on the data retrieved from the Scopus databases (136) and Web of Science database (101). This paper studied how to use an excel sheet for calculating the h-index, i-10 index, average citation per year, cited rate, percentage of cited and non-cited paper, real average citation, and the researcher were not used

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any tools for study. The researcher also considered the citation count, h-index, and i10 index of both Scopus and Web of Science; it was found that Web of Science is more visible than the Scopus database.(Mahala & Singh, 2021) performed a metric-based study for quantitative analysis or research publications of Indian universities in sciences. The bibliographic database, WoS was used to gather the data for research and evaluated 26173 publications in the last five years. The University of Delhi has the maximum number of science publications among the top five universities. The top Indian Universities have a major collaboration with Anna University, the Indian Institute of Technology, Center for Scientific and Industrial Research (CSIR) of India, among the top Indian Universities. (Mamdapur et al., 2021) conducted at Karnatak University based on the Scopus database for the period from 1960 to 2019. A total of 4990 publications were extracted from the Scopus database for Karnatak University and the block period 2015-19 has produced the highest number of 1202 publications. The results of the study reveal that the Indian Institute of Science, Bangalore in Karnatak State had published 55770 research publications with the highest 992666 citations received. The USA was the most collaborated country with 258 publications and 8104 citations, followed by South Korea with 161 publications and 3300 citations.

### **Objectives of the study**

- a) To identify Year-wise distribution and growth of publications of West Bengal Universities;
- b) To identify Domestic and International collaboration trends of the Universities of West Bengal;
- c) To identify the most productive authors and impact from the Universities of West Bengal;
- d) To find out the leading journals and to observe the citation impact through Citation per paper (CPP) and Relative Citation Impact (RCI) of Universities of West Bengal.

### **Methodology**

The present study evaluates the research productivity of West Bengal University based on the data collected from the Web of Science over the last two decades i.e. 2002 to 2021. This study attempts to analyze the overall performance of the West Bengal University (Jadavpur University, Kalyani University, Presidency University, University of Burdwan, University of Calcutta, University of North Bengal, and Vidyasagar University) in research productivity. The parameters such as year-wise, subject-wise classification of published papers, most productive authors, the most preferred sources, etc. are considered for the study. To conduct the study, the research data was retrieved from the Web of Science (Core Collection Online) database on June 3, 2021. Science Citation Index Expanded (SCI-EXPANDED),

Social Science Citation Index (SSCI), Arts & Humanities Citation Index (A & HCI), and Emerging Sources Citation Index (ESCI) were used as a data source for the study.

The 20 years is chosen to get sufficient results of studies productiveness to investigate facts to get a clear photograph of studies output. The data was downloaded from the Web of Science of West Bengal universities, Jadavpur University (14669 papers), Kalyani University (3360 papers), Presidency University (1470 papers), University of Burdwan (3286 papers), University of Calcutta (10856 papers), University of North Bengal (1647 papers), and Vidyasagar University (1907 papers) were published in Web of Science. The retrieved data has been recorded and interpreted using bibexcel (software tool for Scientometric analysis) and Microsoft Excel for further detailed analysis to meet the objective of the study.

**Exponential growth rate**

It can be used to predict future publication of any species of Universities. This formula is used globally to predict the human population. If you know the period of publication i.e., the number of years through which the

growth rate is to be calculated and the original publication, you can calculate exponential growth rate with ease. The formula for calculating exponential growth is given as:

$$N(t) = N(0) e^{rt}$$

Where N (t) is the population when the time elapsed is “t” years

N (0) is the initial population

“r” is the growth rate

“t” is the number of years

“e” is the natural base of logarithms whose value is 2.711828.

**Relative citation impact**

It has been calculated in two portions. The first portion is dividing citation received by a particular journal with total citation received by all journals and the second portion is particular journal records divided by total journals records.

**Results and Discussion**

**Year-wise distribution of Publications of West Bengal Universities**

**Table 1.** Year-wise distribution of Publications of West Bengal Universities

Year	JU		KU		PU		BU		CU		UNB		VU	
	Recs.	%	Recs.	%	Recs.	%	Recs.	%	Recs.	%	Recs.	%	Recs.	%
2002	280	1.91	89	2.65	21	1.43	78	2.37	210	1.93	26	1.58	17	0.89
2003	363	2.47	91	2.71	29	1.97	73	2.22	221	2.04	34	2.06	25	1.31
2004	407	2.77	85	2.53	32	2.18	93	2.83	246	2.27	39	2.37	27	1.42
2005	436	2.97	90	2.68	39	2.65	126	3.83	248	2.28	44	2.67	38	1.99
2006	504	3.44	112	3.33	56	3.81	104	3.16	285	2.63	61	3.7	57	2.99
2007	554	3.78	116	3.45	34	2.31	101	3.07	342	3.15	55	3.34	71	3.72
2008	620	4.23	143	4.26	52	3.54	103	3.13	370	3.41	45	2.73	69	3.62
2009	714	4.87	161	4.79	46	3.13	118	3.59	461	4.25	79	4.8	98	5.14
2010	670	4.57	173	5.15	52	3.54	154	4.69	455	4.19	109	6.62	63	3.3
2011	742	5.06	172	5.12	58	3.95	182	5.54	583	5.37	74	4.49	74	3.88
2012	779	5.31	169	5.03	75	5.1	192	5.84	630	5.8	84	5.1	97	5.09
2013	840	5.73	234	6.96	71	4.83	221	6.73	713	6.57	98	5.95	129	6.76
2014	911	6.21	237	7.05	80	5.44	236	7.18	771	7.1	118	7.16	125	6.55
2015	968	6.6	199	5.92	84	5.71	244	7.43	779	7.18	109	6.62	115	6.03
2016	988	6.74	214	6.37	82	5.58	179	5.45	785	7.23	117	7.1	142	7.45
2017	1000	6.82	220	6.55	86	5.85	211	6.42	823	7.58	102	6.19	117	6.14
2018	1093	7.45	216	6.43	91	6.19	204	6.21	779	7.18	137	8.32	140	7.34
2019	1130	7.7	250	7.44	172	11.7	247	7.52	823	7.58	115	6.98	190	9.96
2020	1135	7.74	267	7.95	207	14.1	285	8.67	947	8.72	133	8.08	220	11.5
2021	535	3.65	122	3.63	103	7.01	135	4.11	385	3.55	68	4.13	93	4.88
<b>Total</b>	<b>14669</b>	<b>100</b>	<b>3360</b>	<b>100</b>	<b>1470</b>	<b>100</b>	<b>3286</b>	<b>100</b>	<b>10856</b>	<b>100</b>	<b>1647</b>	<b>100</b>	<b>1907</b>	<b>100</b>

(JU= Jadavpur University, KU = Kalyani University, PU = Presidency University, BU = University of Burdwan, CU = University of Calcutta, UNB = University of North Bengal, VU = Vidyasagar University, Recs.= Record)

During the study period 2002 to 2021, a total of 14669 publications were published by Jadavpur University. The highest number of publications 1135 was the year 2020. The average number of publications produced per year was 733. In the case of the University of Kalyani, a total

of 3360 publications were published during the study period, the average number of publications produced per year was 168. The highest number of publications (267) was produced in 2020. In the case of Presidency University, a total of 1470 publications were published during the study period, the average number of

publications produced per year was 74. The highest number of publications (207) was produced in 2020. About the University of Burdwan, the totals of 3286 publications were published during the study period; the average number of publications produced per year was 164. The highest number of publications (285) was produced in 2020. A total of 10856 publications were published by the University of Calcutta during the study period. The average number of publications produced per year was 543. The highest number of publications 947 was produced in 2020. About the 261 University of North Bengal, a total of 1647 publications were

published during the study period, the average number of publications produced per year was 82. The highest number of publications (137) was produced in 2018. About Vidyasagar University, a total of 1907 publications were published during the study period, and the average number of publications produced per year was 95. The highest number of publications (220) was produced in 2020.

**Document wise distribution of Publications by the Universities of West Bengal**

**Table 2.** Document wise distribution of Publications by the Universities of West Bengal

Document Type	JU		KU		PU		BU		CU		UNB		VU	
	Recs.	%	Recs.	%	Recs.	%	Recs.	%	Recs.	%	Recs.	%	Recs.	%
Article	13523	92.2	3085	91.82	1298	88.3	3093	94.1	9864	90.86	1511	91.74	1746	91.56
Review	352	2.4	122	3.63	74	5.03	82	2.5	273	2.51	38	2.31	35	1.84
Early Access	144	0.98	28	0.83	20	1.36	31	0.94	133	1.23	31	1.88	29	1.52
Proceedings Paper	298	2.03	43	1.28	15	1.02	23	0.7	153	1.41	27	1.64	43	2.25
Editorial Material	91	0.62	16	0.48	8	0.54	19	0.58	71	0.65	10	0.61	4	0.21
Correction	62	0.42	19	0.57	9	0.61	15	0.46	40	0.37	3	0.18	8	0.42
Meeting Abstract	94	0.64	23	0.68	11	0.75	11	0.33	148	1.36	5	0.3	15	0.79
Letter	35	0.24	8	0.24	11	0.75	5	0.15	73	0.67	2	0.12	18	0.94
News Item	1	0.01	1	0.03	0	0	3	0.09	6	0.06	4	0.24	1	0.05
Book Chapter	11	0.07	3	0.09	0	0	2	0.06	5	0.05	1	0.06	1	0.05
Book Review	45	0.31	0	0	24	1.63	2	0.06	60	0.55	13	0.79	7	0.37
Biographical-Item	7	0.05	2	0.06	0	0	0	0	15	0.14	0	0	0	0
Retracted Publication	5	0.03	10	0.3	0	0	0	0	14	0.13	2	0.12	0	0
Fiction	1	0.01	0	0	0	0	0	0	1	0.01	0	0	0	0
<b>Total</b>	<b>14669</b>	<b>100</b>	<b>3360</b>	<b>100</b>	<b>1470</b>	<b>100</b>	<b>3286</b>	<b>100</b>	<b>10856</b>	<b>100</b>	<b>1647</b>	<b>100</b>	<b>1907</b>	<b>100</b>

(JU = Jadavpur University, KU = Kalyani University, PU = Presidency University, BU = University of Burdwan, CU = University of Calcutta, UNB = University of North Bengal, VU = Vidyasagar University, Recs.= Record)

Table 2 shows the distribution of publications in various types of documents. Journal articles are the most preferred form of publication type of documents by the Universities of West Bengal. More than 90 percent of the documents were published as journal articles except for Presidency University. A maximum of 94.13 percent of the publications of articles was published by Burdwan University, Jadavpur University with 92.19, followed by the University of Kalyani (91.82 percent) University of

North Bengal (91.74), Vidyasagar University (91.56 percent). It is followed by the University of Calcutta (90.86 percent), and Presidency University, with 88.30 percent. The other forms of publications such as conference proceedings, reviews, letters, meetings, and editorial items were published below 10 percent.

**Exponential Growth Rate of research output by the Universities of West Bengal**

**Table 3.** Exponential Growth Rate of research output by the Universities of West Bengal

Year	JU		KU		PU		BU		CU		UNB		VU	
	RECS	EGR	RECS	EGR	RECS	EGR	RECS	EGR	RECS	EGR	RECS	EGR	RECS	EGR
2002	280	-	89	-	21	-	78	-	210	-	26	-	17	-
2003	363	0.26	91	0.02	29	0.32	73	-0.07	221	0.05	34	0.27	25	0.39
2004	407	0.11	85	-0.07	32	0.1	93	0.24	246	0.11	39	0.14	27	0.08
2005	436	0.07	90	0.06	39	0.2	126	0.3	248	0.01	44	0.12	38	0.34
2006	504	0.14	112	0.22	56	0.36	104	-0.19	285	0.14	61	0.33	57	0.41
2007	554	0.09	116	0.04	34	-0.5	101	-0.03	342	0.18	55	-0.1	71	0.22
2008	620	0.11	143	0.21	52	0.42	103	0.02	370	0.08	45	-0.2	69	-0.03
2009	714	0.14	161	0.12	46	-0.12	118	0.14	461	0.22	79	0.56	98	0.35

2010	670	-0.06	173	0.07	52	0.12	154	0.27	455	-0.01	109	0.32	63	-0.44
2011	742	0.1	172	-0.01	58	0.11	182	0.17	583	0.25	74	-0.39	74	0.16
2012	779	0.05	169	-0.02	75	0.26	192	0.05	630	0.08	84	0.13	97	0.27
2013	840	0.08	234	0.33	71	-0.05	221	0.14	713	0.12	98	0.15	129	0.29
2014	911	0.08	237	0.01	80	0.12	236	0.07	771	0.08	118	0.19	125	-0.03
2015	968	0.06	199	-0.17	84	0.05	244	0.03	779	0.01	109	-0.08	115	-0.08
2016	988	0.02	214	0.07	82	-0.02	179	-0.31	785	0.01	117	0.07	142	0.21
2017	1000	0.01	220	0.03	86	0.05	211	0.16	823	0.05	102	-0.14	117	-0.19
2018	1093	0.09	216	-0.02	91	0.06	204	-0.03	779	-0.05	137	0.3	140	0.18
2019	1130	0.03	250	0.15	172	0.64	247	0.19	823	0.05	115	-0.18	190	0.31
2020	1135	0	267	0.07	207	0.19	285	0.14	947	0.14	133	0.15	220	0.15
2021	535	-0.75	122	-0.78	103	-0.7	135	-0.75	385	-0.9	68	-0.67	93	-0.86
<b>Total</b>	<b>14669</b>	<b>-</b>	<b>3360</b>	<b>-</b>	<b>1470</b>	<b>-</b>	<b>3286</b>	<b>-</b>	<b>10856</b>	<b>-</b>	<b>1647</b>	<b>-</b>	<b>1907</b>	<b>-</b>

(JU = Jadavpur University, KU = Kalyani University, PU = Presidency University, UB = University of Burdwan, UC = University of Calcutta, UNB = University of North Bengal, VU = Vidyasagar University, RECS= Records, EGR= Exponential Growth Rate)

Table 3 shows the exponential growth rate of the publication made by Universities of West Bengal, during a period of 20 years of study (2002-2021). In the case of Jadavpur University, it was found that the growth rate was highest in 2003 and lowest in 2021. The study also found that the exponential growth rate of research publication of Jadavpur University output was negative in the years 2010 and 2021. The table shows that the EGR of Kalyani University published research output was at a maximum in the year 2013 and a minimum in 2021. The study found that there is negative research literature output in the following years 2004, 2011,2012,2015,2018, and 2021. In the case of Presidency University published research output, EGR was found highest in the year 2019 and lowest in 2021. The growth rate was within the range at the time of the study was 0.32 to -0.70, which has very low productivity and trends with very low margins. The table shows that the EGR of the University of Burdwan published research output was at a maximum in the year 2005 and a minimum in 2021. The study found that there is negative research literature output in the following years 2003, 2006, 2007, 2015, 2016, 2018, and 2021. The

University of Burdwan has very low productivity. In the case of the University of Calcutta published research output, EGR was found highest in the year 2011 and lowest in 2021. The growth rate was within the range at the time of the study was 0.05 to -0.90, which has very low productivity and trends with very low margins.

It was found from the table that the exponential growth rate of the University of North Bengal published research output was at a maximum in the year 2009 and a minimum in 2021. The study found that there is negative research literature output in the following years 2007, 2008,2011,2015,2017, 2019, and 2021. In the case of Vidyasagar University published research output, EGR was found highest in the year 2006 and lowest in 2021. The growth rate was within the range at the time of the study was 0.39 to -0.86, which has very low productivity and trends with very low margins.

In conclusion during the study, it has found that the publication trend of published literature of Universities of West Bengal has very low.

**Relative Growth Rate of research output by the Universities of West Bengal**

**Table 4:** Relative Growth Rate of research output by the Universities of West Bengal

S. No.	Year	JU	KU	PU	BU	CU	UNB	VU
		RGR	RGR	RGR	RGR	RGR	RGR	RGR
1	2002	-	-	-	-	-	-	-
2	2003	0.831	0.704	0.868	0.661	0.719	0.836	0.519
3	2004	0.49	0.387	0.495	0.48	0.452	0.501	0.938
4	2005	0.347	0.292	0.389	0.416	0.312	0.368	1.035
5	2006	0.292	0.274	0.38	0.248	0.269	0.355	1.057
6	2007	0.246	0.222	0.176	0.193	0.249	0.239	1.197
7	2008	0.218	0.219	0.22	0.165	0.214	0.16	1.483
8	2009	0.203	0.2	0.161	0.16	0.215	0.231	1.411
9	2010	0.159	0.178	0.156	0.177	0.175	0.25	1.999
10	2011	0.151	0.15	0.149	0.175	0.187	0.14	1.986
11	2012	0.137	0.129	0.165	0.157	0.169	0.138	1.88
12	2013	0.13	0.154	0.134	0.154	0.162	0.14	1.78
13	2014	0.124	0.135	0.132	0.142	0.15	0.146	1.963
14	2015	0.117	0.101	0.122	0.128	0.132	0.119	2.168
15	2016	0.107	0.098	0.107	0.085	0.117	0.113	2.089
16	2017	0.097	0.092	0.101	0.091	0.11	0.089	2.38



17	2018	0.097	0.083	0.097	0.081	0.094	0.109	2.305
18	2019	0.091	0.088	0.16	0.09	0.09	0.083	2.127
19	2020	0.084	0.086	0.164	0.095	0.095	0.088	2.11
20	2021	0.037	0.037	0.073	0.042	0.036	0.042	3.021
<b>Mean</b>		<b>0.198</b>	<b>0.181</b>	<b>0.212</b>	<b>0.187</b>	<b>0.197</b>	<b>0.207</b>	<b>1.672</b>

JU = Jadavpur University, KU = Kalyani University, PU = Presidency University, BU = University of Burdwan, CU = University of Calcutta, UNB = University of North Bengal, VU = Vidyasagar University, RGR = Relative Growth Rate

Table 4 presents the Relative Growth Rate for the publications productivity of the University of Burdwan. The Relative Growth Rate starts from 0.661 in the year 2003 and reaches 0.042 in the year 2021. It means decreasing the nature of RGR found in the University of Burdwan. It indicates for the next ten years (2012-2021) the growth rate was decreased to 0.107. During the period 2002 to 2011, the Relative Growth Rate was high compared to the other ten years. The Relative Growth Rate for the publications productivity of the University of Calcutta starts from 0.719 in the year 2003 to 0.036 in the year 2021. It means decreasing the nature of RGR found in the University of Calcutta. The mean of RGR of ten years (2002-2011) was high as compared to the next ten years (2012-2021). The Relative Growth Rate for the publications productivity of Jadavpur University starts from 0.831 in the year 2003 to 0.037 in the year 2021. It means decreasing trend of RGR found in the Jadavpur University. The mean of RGR of ten years (2002-2011) was high as compared to the next ten years (2012-2021). The Relative Growth Rate for the publications productivity of Kalyani University starts from 0.704 in the year 2003 to 0.037 in the year 2021. It means decreasing the nature of RGR found in the Kalyani University. The mean of RGR of ten years (2002-2011) was high as compared to the next ten years (2012-2021).

The Relative Growth Rate for the publications productivity of Presidency University starts from 0.868 in the year 2003 to 0.073 in the year 2021. It means decreasing the nature of RGR found in the Presidency University. The mean of RGR of ten years (2002-2011) was high as compared to the next ten years (2012-2021). The Relative Growth Rate for the publications productivity of the University of North Bengal starts from 0.836 in the year 2003 to 0.042 in the year 2021. It means decreasing the nature of RGR found in the University of North Bengal. The mean of RGR of ten years (2002-2011) was high as compared to the next ten years (2012-2021).

The Relative Growth Rate for the publications productivity of Vidyasagar University starts from 0.519 in the year 2003 to 3.021 in the year 2021. It means increasing the nature of RGR found in the Vidyasagar University. The mean of RGR of ten years (2002-2011) was low as compared to the next ten years (2012-2021). In conclusion, the highest RGR value among seven universities is obtained by Vidyasagar University in the year 2021 and the lowest value is obtained by the University of Calcutta in the year 2021.

**Doubling Time of research output by the Universities of West Bengal**

**Table 5.** Doubling Time of research output by the Universities of West Bengal

S. No.	Year	JU	KU	PU	UB	UC	UNB	VU
		DT	DT	DT	DT	DT	DT	DT
1	2002	-	-	-	-	-	-	-
2	2003	0.834	0.984	0.799	1.049	0.964	0.829	1.336
3	2004	1.413	1.792	1.401	1.444	1.535	1.384	0.739
4	2005	1.995	2.37	1.781	1.665	2.22	1.885	0.669
5	2006	2.373	2.527	1.822	2.798	2.58	1.951	0.656
6	2007	2.822	3.124	3.944	3.588	2.784	2.903	0.579
7	2008	3.177	3.159	3.146	4.206	3.241	4.326	0.467
8	2009	3.406	3.46	4.299	4.319	3.223	3	0.491
9	2010	4.348	3.889	4.456	3.918	3.966	2.767	0.347
10	2011	4.585	4.609	4.651	3.954	3.709	4.946	0.349
11	2012	5.045	5.391	4.209	4.423	4.1	5.008	0.369
12	2013	5.346	4.487	5.16	4.489	4.275	4.935	0.389
13	2014	5.595	5.12	5.233	4.875	4.62	4.731	0.353
14	2015	5.938	6.86	5.661	5.397	5.263	5.846	0.32
15	2016	6.504	7.047	6.501	8.181	5.914	6.115	0.332
16	2017	7.116	7.539	6.876	7.58	6.318	7.761	0.291
17	2018	7.173	8.379	7.172	8.546	7.389	6.38	0.301
18	2019	7.62	7.884	4.318	7.689	7.668	8.362	0.326
19	2020	8.279	8.053	4.221	7.31	7.311	7.876	0.328

20	2021	18.653	18.737	9.54	16.519	19.192	16.436	0.229
<b>Mean</b>		<b>5.111</b>	<b>5.271</b>	<b>4.26</b>	<b>5.098</b>	<b>4.814</b>	<b>4.872</b>	<b>0.444</b>

JU = Jadavpur University, KU = Kalyani University, PU = Presidency University, BU = University of Burdwan, CU = University of Calcutta, UNB = University of North Bengal, VU = Vidyasagar University, DT = Doubling Time

Table 5 shows the Doubling Time of publications of Universities in West Bengal. The lowest Doubling Time of the University of Burdwan is 1.049 in the year 2003 and it was slowly increased over the period and reached 16.519 in 2021. The average Doubling Time for the publications is 2.694 during 2002-2011 and it was increased by 7.501 during 2012-2021. The Doubling Time for the publications productivity of the University of Calcutta starts from 0.964 in the year 2003 and gradually it was increased to 19.192 in the year 2021. The average Doubling Time for the publications is 2.422 during 2002-2011 and it was increased by 7.205 during 2012-2021. The Doubling Time for the publications productivity of Jadavpur University starts from 0.834 in the year 2003 to 18.653 in the year 2021. It means increasing nature of Doubling Time found in the Jadavpur University. The mean of Doubling Time of ten years (2002-2011) was 2.495 low as compared to the next ten years (2012-2021). The lowest Doubling Time of Kalyani University is 0.984 in the year 2003 and it was slowly increased over the period and reached 18.737 in 2021. The average Doubling Time for the publications is 2.591 during 2002-2011 and it was increased by 7.950 during 2012-2021.

The Doubling Time for the publications productivity of Presidency University starts from 0.799 in the year 2003 to 9.540 in the year 2021. It means increasing nature of Doubling Time found in the Presidency University. The mean of Doubling Time of ten years (2002-2011) was low (2.630) as compared to the next ten years (2012-2021). The Doubling Time for the publications productivity of the University of North Bengal starts from 0.829 in the year 2003 to 16.436 in the year 2021. It means increasing nature of Doubling Time found in the University of North Bengal. The mean of Doubling Time of ten years (2002-2011) was (2.399) low as compared to the next ten years (2012-2021). The lowest Doubling Time of Vidyasagar University is 1.336 in the year 2003 and it was slowly decreased over the period and reached 0.229 in 2021. The average Doubling Time for the publications is 0.563 during 2002-2011 and it was decreased by 0.324 during 2012-2021.

It is found from the analysis that all the universities of West Bengal understudy found that the University of Calcutta has the highest Doubling Time 19.192 in the year 2021 and the lowest value is obtained by Vidyasagar University in the year 2021.

**Collaboration trends among the researchers in Universities of West Bengal**

**Table 6:** Collaboration trends among the researchers in Universities of West Bengal

S. No.	Name of the University	Total Paper	Paper in Domestic Collaboration	%	Papers in International Collaboration	%
1	JU	14669	11529	38.38	3140	43.87
2	KU	3360	3108	10.35	252	3.52
3	PU	1470	1246	4.15	224	3.13
4	UB	3286	2553	8.5	733	10.24
5	CU	10856	8508	28.32	2348	32.81
6	UNB	1647	1397	4.65	250	3.49
7	VU	1907	1697	5.65	210	2.93
	<b>Total</b>	<b>37195</b>	<b>30038</b>	<b>100</b>	<b>7157</b>	<b>100</b>

JU = Jadavpur University, KU = Kalyani University, PU = Presidency University, UB = University of Burdwan, UC = University of Calcutta, UNB = University of North Bengal, VU = Vidyasagar University,

Table 6 shows the domestic and international collaborative work done by the author of West Bengal Universities. The highest paper 11529(38.38%) was published at the domestic level and international level 3140(43.87%) by Jadavpur University, followed by the University of Calcutta’s published paper at the domestic level 8508(28.32%) and international level 2348(32.81%). In the case of Kalyani University, papers

publish in domestic level 3108(10.35%) and international level 252(3.52%), followed by the University of Burdwan Contributors publish their research work in domestic level 2553(8.50%) and 733(10.24%) in international level. Presidency University, University of North Bengal, and Vidyasagar University author published most of their research paper at the domestic level with 4.15%, 4.65%, and 5.65%.

**Block Year-wise Author Productivity of Universities of West Bengal**

**Table 7.** Block Year-wise Author Productivity of Universities of West Bengal

	2002-05	2006-09	2010-13	2014-17	2018-21	Total
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JU	NP	1486	2392	3031	3867	3893	<b>14669</b>
	TA	2805	4180	5110	8758	9593	<b>30446</b>
	AAPP	1.89	1.75	1.69	2.26	2.46	<b>2.08</b>
	APPA	0.53	0.57	0.59	0.44	0.41	<b>0.48</b>
KU	NP	355	532	748	870	855	<b>3360</b>
	TA	589	1029	1377	1977	2093	<b>7065</b>
	AAPP	1.66	1.93	1.84	2.27	2.45	<b>2.1</b>
	APPA	0.6	0.52	0.54	0.44	0.41	<b>0.48</b>
PU	NP	121	188	256	332	573	<b>1470</b>
	TA	249	399	646	1077	1750	<b>4121</b>
	AAPP	2.06	2.12	2.52	3.24	3.05	<b>2.8</b>
	APPA	0.49	0.47	0.4	0.31	0.33	<b>0.36</b>
BU	NP	370	426	749	870	871	<b>3286</b>
	TA	923	1929	1271	1774	1988	<b>7885</b>
	AAPP	2.49	4.53	1.7	2.04	2.28	<b>2.4</b>
	APPA	0.4	0.22	0.59	0.49	0.44	<b>0.42</b>
CU	NP	925	1458	2381	3158	2934	<b>10856</b>
	TA	1914	2850	4136	8988	12849	<b>30737</b>
	AAPP	2.07	1.95	1.74	2.85	4.38	<b>2.83</b>
	APPA	0.48	0.51	0.58	0.35	0.23	<b>0.35</b>
UNB	NP	143	240	365	446	453	<b>1647</b>
	TA	281	510	768	950	1204	<b>3713</b>
	AAPP	1.97	2.13	2.1	2.13	2.66	<b>2.25</b>
	APPA	0.51	0.47	0.48	0.47	0.38	<b>0.44</b>
VU	NP	107	295	363	499	643	<b>1907</b>
	TA	239	611	785	1218	1653	<b>4506</b>
	AAPP	2.23	2.07	2.16	2.44	2.57	<b>2.36</b>
	APPA	0.45	0.48	0.46	0.41	0.39	<b>0.42</b>

(JU= Jadavpur University, KU = Kalyani University, PU = Presidency University, BU = University of Burdwan, CU = University of Calcutta, UNB = University of North Bengal, VU = Vidyasagar University, NP= Number of publication, TA=Total author, AAPP= Average author per publication, APPA= Average publication per author)

Table 7 shows average Values, a number of authors, average author per publica and,tion average publication per author values, and the values are calculated block year-wise research publications of Universities of West Bengal. It could be noticed that from Jadavpur University 30446 authors publish their research work in different disciplines during the period of the study. The year 2018-21 has the highest 9593 contributors published 3893 papers with average author per publication 2.46 and 0.41 Average Productivity Per Author. In 2014-17 3867 papers were published by 8758 authors with AAPP 2.26 and 0.44 APPA. 3031 papers were published by 5110 authors in 2010-13 with AAPP 1.69 and APPA 0.59 and it is the highest APPA of Jadavpur University among the period of the study. Total 14669 papers were published by Jadavpur University by 30446 authors with AAPP 2.08 and APPA 0.48. Results is shown in table those University of Calcutta total 10856 papers published by 30737 authors during

the period of the study with AAPP 2.83 and APPA 0.35. In 2018-21 has the highest contributor with AAPP 4.38 and APPA 0.23. In total 2381 papers were published by 4136 authors with AAPP 1.74 and APPA 0.58. In the case of the University of Burdwan, total of 7885 authors contribute their research work in the different subject areas with AAPP 2.40 and APPA 0.42. 2006-09 has the highest author with AAPP 4.53 and 0.22 APPA. 7065 authors were contributed from Kalyani University in different research areas during the study period with AAPP 2.10 and 0.48 APPA. The highest contributor has found in the year 2018-21 with 2.45AAPP and 0.41 APPA. In the case of Presidency University, total of 4121 contributors published their research work on the different subjects during the period of the study with 2.80 AAPP and 0.36 APPA. In 2018-21 has the highest author with AAPP 3.05 and 0.33 APPA.

#### Open Access articles published by Universities of West Bengal

**Table 8.** Open Access articles published by Universities of West Bengal

S. No.	Name of the University	Number of Publications	Open Access	% of Open Access
1	Jadavpur University	14669	2113	33.78
2	Presidency University	1470	466	7.45
3	University of Burdwan	3286	436	6.97
4	University of Calcutta	10856	2058	32.9
5	University of Kalyani	3360	497	7.95
6	University of North Bengal	1647	363	5.8



7	Vidyasagar University	1907	322	5.15
	<b>Total</b>	<b>37195</b>	<b>6255</b>	

Table 8 shows the open-access journal articles of the publication productivity of West Bengal Universities. It found that 16.82 % of the total publications are open access research articles with 6255. It is quite interesting to know that Jadavpur University has a significant lead towards encouraging the researcher to publish in open access journals with 33.78%, it is followed by the

University of Calcutta with 2058 (32.90%) and the University of Kalyani with 497 (7.95%) publications respectively.

**Subject wise distribution records in the Universities of West Bengal**

**Table 9.** Subject-wise distribution records in the Universities of West Bengal (In percentage to total publications)

Subject	Jadavpur University	University of Kalyani	Presidency University	University of Burdwan	University of Calcutta	University of North Bengal	Vidyasagar University
Chemistry	28.33	40.36	56.17	37.07	24.82	42.87	24.54
Engineering	20.8	7.86	14.68	9.25	11.04	6.31	10.28
Physics	19.05	11.76	70.21	18.14	18.16	22.83	10.96
Materials Science	12.37	5.95	22.34	7.85	7.47	5.46	7.66
Computer Science	7.54	3.54	3.4	1.86	3.09	0.61	11.69
Biophysics	1.23	2.86	2.34	0.7	2.11	0.91	1.36
Pharmacology Pharmacy	5.95	1.9	7.87	1.49	2.84	2.25	2.83
Environmental Sciences							
Ecology	3.84	7.98	13.4	5.93	5.7	2.43	6.24
Mathematics	3.6	4.85	10.43	6.09	4.4	2	6.24
Biotechnology Applied							
Microbiology	1.32	2.41	5.96	1.7	2.18	3.58	3.78
Plant Science	0	3.48	11.49	2.5	3.37	3.7	1.05

Table 9 reveals the subject-wise productivity of Universities of West Bengal research output during the period of the study is given in the Table. The research papers published during 2002-2021 are classified into 11 main subjects. Chemistry is the area under which the researcher published more number works in Jadavpur University (28.33%), University of Burdwan (37.07%), University of Calcutta (24.82%), University of Kalyani (40.36%), University of North Bengal (42.87%),

Vidyasagar University (24.54%). The subject Physics is (25.56%) has produced a large number of papers published by Presidency University (70.21%). The least productive subject is Biophysics, Plant Science, and Biotechnology in the above Universities of West Bengal.

**Most Productive Authors in the Universities of West Bengal**

**Table 10.** Most Productive Authors in the Universities of West Bengal

Author Name	Universities	Departments	No. of Articles	Total Citations	H-index	Rank
Subhadeep Das	Jadavpur University	Life Sci.& Biotechnology	908	21669	65	1
Saswati Ghosh	University of Calcutta	Inst. Radio Phys. & Elect.	640	7967	43	2
K. C. Majumdar	Kalyani University	Chemistry	283	5248	35	3
Debasis Das	University of Burdwan	Chemistry	182	3492	32	4
Mahendra Nath Roy	University Of North Bengal	Chemistry	176	2303	26	5
Sumita Roy	Vidyasagar University	Chemistry	156	2638	29	6
Sanjib Ghosh	Presidency University	Chemistry	86	1087	18	7

Table 10 shows the most productive author is Subhadeep Das, Department of Life Sci. & Biotechnology, Jadavpur

University with 908 articles ranked in first place among the universities studied. Next to this is Saswati Ghosh from the Department of Inst. Radio Phys. & Elect.,

University of Calcutta ranked in second place with 640 articles.

### Distribution of articles in the leading Journals by the Universities of West Bengal

**Table 11.** Distribution of articles in the leading Journals by the Universities of West Bengal

Source Title	University Name	Articles	TC	CPP	RCI	h-index	If
Polyhedron (ISSN: 0277-5387)	Jadavpur University	284	5648	19.89	1.16	36	2.108
Journal of the Indian Chemical Society (ISSN: 0019-4522)	University of Calcutta	228	348	1.53	0.12	8	0.284
Tetrahedron Letters (ISSN: 0040-4039)	Kalyani University	110	2572	23.38	1.7	31	2.379
Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy (ISSN: 1386-1425)	University of Burdwan	87	927	10.66	0.77	16	4.098
CARBOHYDRATE RESEARCH, (ISSN: 0008-6215)	Vidyasagar University	58	1690	29.14	2.12	26	1.929
Journal of Molecular Liquids (ISSN: 0167-7322)	University Of North Bengal	49	401	8.18	0.76	10	6.165
Monthly Notices of the Royal Astronomical Society (ISSN: 0035-8711)	Presidency University	46	605	12.87	1.12	14	5.356

TC = Total Citation, CPP = Citation Per Paper, RCI = Relative Citation Impact and If = Impact Factor

It is found from the above table 11 that the most productive journal is Polyhedron (ISSN: 0277-5387), in which the highest numbers of 284 articles were published by Jadavpur University and 228 articles were published in Journal of the Indian Chemical Society (ISSN: 0019-4522) by University of Calcutta stood in second place, followed by 110 articles by Kalyani University during the study period. Next to this, 87 articles were published in Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy (ISSN: 1386-1425), by the University of Burdwan. It is found from the above table that the least productive journal is Monthly Notices of the Royal Astronomical Society (ISSN: 0035-8711), in which the lowest number of 46 articles were published by Presidency University. The preferred publications of articles by the Universities of West Bengal were above 90 percent of most of the journals.

### Conclusion

In the present situation, scientometrics and bibliometrics have become an important field of study for examination

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to evaluate the research performance of researchers, a department, a university etc. The study shows University's strength and weaknesses of research policies. The study shows that University of West Bengal has published 90% of articles except for Presidency University. Universities of West Bengal have shown continuous year-wise productivity in publications and the highest publications 14669 were published by Jadavpur University. The highest research paper in domestic or international collaboration was published by Jadavpur University among other universities of West Bengal. It was found from the study that Jadavpur University is the leading university of West Bengal that has published 2113(33.78%) articles in open access journals. Subhadeep Das is the most productive author from the Department of Life Sci. & Biotechnology, Jadavpur University published 908 articles and received 21669 citations with 65 h-index ranked in first place among the universities study. Polyhedron (ISSN: 0277-5387) is the highest preferred by Universities of West Bengal researchers with 284 articles. Journal of Molecular Liquids (ISSN: 0167-7322) have the highest Impact factor with a 10 h-index.

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