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Manoj Kumar Verma Dr.
Mizoram University, manojdlis@mzu.edu.in

Saumen Das
Mizoram University, saumendas1990@gmail.com

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Verma, Manoj Kumar Dr. and Das, Saumen, "Authorship and Collaboration Pattern of Research Output Published by Researchers of Tripura University during 2010-2019: A Scientometric Analysis" (2020). *Library Philosophy and Practice (e-journal)*. 4359. <https://digitalcommons.unl.edu/libphilprac/4359>

Authorship and Collaboration Pattern of Research Output Published by Researchers of Tripura University during 2010-2019: A Scientometric Analysis

Saumen Das¹ and Manoj Kumar Verma^{2*}

¹Research Scholar, Department of Library and Information Science, Mizoram University, Aizawl, Email: saumendas1990@gmail.com

² Associate Professor, Department of Library and Information Science, Mizoram University, Aizawl-796004 Email: manojdlis@mzu.edu.in

***(Corresponding Author)**

Abstract

The present paper is a scientometric enquiry of research publications of Tripura University for a period of 10 years (i.e. from 2010-2019) and based on the secondary data collected from Web of Science databases and found that the total 503 papers published during this study period which index in web of science database. The study endeavours to analyse the pattern of publications, annual growth in publications, authorship pattern, types of documents, collaboration patterns, collaborative index, collaboration coefficient, modified collaboration coefficient, prolific author etc. based on collected data and found that 2017 and 2019 were the most productive year for this university with 84 (16.7%) publications. The maximum documents published during the study period are in the form of research article 445(88.46%). Bhattacharjee, D and Hussain S,A was the top most prolific authors having 68 and 62 publications respectively and Jadavpur University has highest collaboration with Tripura University having 48 publication which is 9.54% of total publications.

Keywords: Bibliometric, Tripura University, Research Productivity, Publication Pattern, Authorship Pattern, etc.

1. INTRODUCTION

The research output analysis of the university in the form of research articles is being considered as one of the foremost yardsticks for calculating the research performance of the university. The generation and dissemination of knowledge through research is one of the important basic functions of the universities and it is essential for the long term growth and competitiveness. This process also helped the universities to creating a capacity to solve educational and social problems. Thus the universities' faculty members are encouraging the growth of research by the creation of a research team involving of junior and senior scholars.

Scientometric studies are used to measure the scientific productivity of departments, institutions/organizations ant regional, national and international level on the basis of publications patterns, authorship patterns, collaboration patterns, citations etc. The aim of Scientometrics is to measure of science communication and is therefore concerned with the growth, structure, interrelationship and productivity of scientific disciplines. It is gradually increasing day by day to show ones visibility worldwide. The different indicators used in scientometric studies provide policy-makers with authentic information that goes beyond

observations and reports. These indicators have been taken as the constraints of assessment and analysis relating to the area of science policymaking.

2. ABOUT TRIPURA UNIVERSITY

Tripura University started in 2nd October 1987 as a state university and converted to a Central University since 2nd July, 2007 under the Tripura University Act, 2006 as enacted by the Parliament. It is situated at Suryamaninagar, West Tripura District of Tripura. A large number of colleges are affiliated to the university. As of now it has 52 affiliated colleges out of which General Degree colleges are 27, Professional Degree colleges are 19, 2 Technical Colleges and 4 Polytechnic Institutes. The University is running numerous courses under Science and Arts & Commerce Faculty. A total number of 44 courses run under the University, which includes Certificate Courses, Under Graduate, Post Graduate Diploma and Post Graduate Studies. In addition to these, Ph.D programmes are also offered in 34 subjects. Presently there are total 175 faculty members and 313 research scholars in Tripura University.

3. REVIEW OF LITERATURE

Siwach and Parmar (2018) conducted a bibliometric study to discover the publishing pattern of researchers of CCS Haryana Agricultural University, Hisar during 2001-2015 which was ranked fourth in the ICAR ranking of Agricultural University in 2016-2017. In this particular study, the researcher focused on year-wise research productivity, key subject categories, national and international collaboration, leading journals for publications, etc. A total of 2649 articles were found during the study by using Scopus database. The average publication was 177 per year and an average citation was 5.77 per articles during the study period. Annals of Biology having 325 publications was the most favoured journal and N. Khetarpaul, department of Food and Nutrition with 63 publications was the most prolific author. The publications having two or more than two authored articles are 97.17%. Collaboration coefficient was found 0.668 during the period of study.

Singh (2015) investigated research publications of Indian Institute of Technology Delhi (IITD) during 1990 to 2014. The data were collected from Web of Science database. The growth pattern displayed an increasing inclination except in some years. It was also found that collaboration also increased among researchers during the period of study.

Siwach and Kumar (2015) examined the research productivity of Maharshi Dayanand University, Rohtak during 2000-2013 through Scopus database. The study investigates the year-wise research productivity, its citations impact, national and international collaborations, top collaborating institutions, subject-wise distribution of papers, journals used for communication, most preferred journals for publication, most prolific authors, number of citations received, and top cited papers of the University during the period of study. Student shows a sharp rise in the research publications during the last four years of the study. Also found that the university has carried out many major and minor research project during the period of study.

Vellaichamy and Ramalingam (2015) assessed the research productivity of Pondicherry university indexed in Scopus. In this study, they observed that 84.8% of research outputs are

having joint authorship pattern. Physics and astronomy have maximum number of papers compared to other subjects.

Aswathy and Gopikuttan (2014) observed the research productivity of University of Kerala during 2000 to 2012. The database used by the researchers was Web of Science as the source of data. During the study period they have found total number of 1068 papers, where biology as the most prolific field of research followed by chemistry. Highest numbers of the articles were published in Current Science.

Balasubramani and Parameswaran (2014) studied the research output of Banaras Hindu University and found that Annual average publication of BHU was 578. The authors mostly preferred to work collaboratively. “Current Science” is one of the most preferred journals of the researchers of BHU.

Baskaran (2013) investigated a bibliometric study on the research productivity of Alagappa University during 1999-2011 based on Web of Science database. It was found that the growth of publication was increasing during the study period. The relative growth rate and doubling time was inconsistent. Multi-authored articles were maximum which is 750 (96.64%) and single-authored papers were only 26 (3.35%) out of total 776 published articles. Degree of collaboration was changing from 0.92 to 0.98 and the mean observed was 0.96 during the study period. South Korea was the most collaborative country with 7.61% articles out of total publications. Central Electrochemical Research Institute was the leading institutions with 129 (16.62%) publications and Material Science with 172 (22.26%) publications was the most leading subject during the period of study.

4. SCOPE OF THE STUDY

The scope of present study is limited to analyse the research productivity of Tripura University, index in Web of Science database on the basis of scientometric parameters. The study further limited to the period of 10 years (i.e. 2010-2019) and only papers index in web of science database were considered under this study.

5. OBJECTIVES OF THE STUDY

The objectives of present study are to:

1. Identify the authorship pattern of the research output published by Tripura University
2. Determine the annual growth rate, authorship pattern in publications
3. Analyse the co-authorship index and collaborative measures in publications
4. Determine the citation impact on the research outputs.
5. Identify the most prolific authors among the researchers

6. METHODOLOGY

The present study aims to measure the research productivity of Tripura University by the source of Web of Science database. The data was retrieved from an online database Web of Science (WOS) (<https://www.webofknowledge.com/>). Data were retrieved on 20th March 2020 by using search syntax OO=TRIPURA UNIVERSITY Timespan: 2010-2019. Indexes: SCI-EXPANDED, SSCI, A&HCI.” Total 503 articles were found and then the collected data were scrutinized with the help of MS-Excel. The calculated data has been

scrutinised by the scintometrics tools and techniques to find out the desired result to fulfil the research objectives.

6.1 Formulae used

- a. **Degree of collaboration (DC):** (Subramanyam, 1980) propounded the DC, a measure to calculate the proportion of single and multi-author papers and to interpret it as a degree. According to Subramanyam,

$$DC = Nm / (Ns + Nm)$$

Where,

Nm = the number of multi-authored papers

Ns = the number of single-author papers

DC varies from 0 when all the papers have a single author to 1 when all the papers have more than one author. It can be easily calculated and can also be easily interpreted.

- b. **Collaborative coefficient**

Ajiferuke et al. (1988) put forward the formula for collaboration coefficient (CC) as

$$CC = 1 - \frac{\sum_{j=1}^A \left(\frac{1}{j}\right) f_j}{N}$$

F_j denotes the number of j authored research papers

N denotes the total number of research papers published

k is the greatest number of authors per paper

It is detected by Ajiferuke, that the value of CC will be zero when single-authored papers dominant. This implication shows that higher the value of CC, means higher the probability of multi-authored papers.

- c. **Modified collaborative coefficient (MCC)**

CC differentiates single and multiple authors. But it fails to yield 1 for maximal collaboration except when a number of authors is infinite. It was rectified by Savanur and Srikanth, (2010) by the factor (1 – 1/A) with CC and enunciated as

$$MCC = (A/A-1) * \left\{ 1 - \frac{\sum_{j=1}^A \left(\frac{1}{j}\right) f_j}{N} \right\}$$

- d. **Collaboration index (CI):** Collaboration Index has been calculated by using the formula given by Lawani (1980). The Collaboration Index (CI) is the simplest index presently used to explore the literature, which is to be interpreted as the mean number of authors per paper.

$$CI = \frac{\sum_{j=1}^A j f_j}{N}$$

Where,

f_j is the number of J authored papers published in discipline during a certain period of time

N is the total number of research papers published in discipline during a certain period of time

- e. **Co-authorship index**

Schubert and Braun (1986) elaborated CAI for the first time. Garg and Padhi (1999) suggested formula to computer CAI

$$CAI = \frac{N_{ij}/N_{io}}{N_{oj}/N_{oo}} * 100$$

Where

N_{ij} = Number of publications having j author for a particular block

N_{io} = Total output for the particular block

N_{oj} = Number of papers having j authors for all blocks

N_{oo} = Total number of papers for all authors and all blocks

CAI = 100 The number of publications corresponds to the average within a co-authorship pattern.

CAI >100 The number of publications are higher than the average

CAI <100 The number of publications are lower than the average

7. DATA ANALYSIS

7.1 Distribution of publication with annual growth rate

Table-1 shows the distribution of publication of Tripura University during 2002-2018. It resolved that there are total of 503 publications with an average annual growth rate 17.67 during the mentioned period of study. The publication growths were not in uniform in all the years. The highest publications numbers are recorded in 2017 and 2019 followed by 2018 and 2016. The annual growth rate of Tripura University publications were also shown in the table and it varies by year to years. The highest positive growth rate was in 2013 while the highest negative growth rate was recorded in 2018.

Table-1: Distribution of publication with annual growth Rate

Year	No. of publications	Percentage	Annual growth rate (%)
2010	28	5.56	-----
2011	29	5.75	3.57
2012	23	4.57	-20.69
2013	43	8.54	86.95
2014	48	9.54	11.62
2015	44	8.74	-8.33
2016	58	11.53	31.81
2017	84	16.7	44.83
2018	62	12.32	-26.19
2019	84	16.7	35.48
Total	503	Average Annual growth rate	17.67

7.2 Authorship pattern in publications

Table-2 states the complete summary of period-wise authorship pattern of papers published during the period under study i.e. 2010-2019. It was found that out of 503 publications, the majority of publications in a collaborative way rather than single publications. The highest number of publications (29.62%) was authored by \geq five authors, followed by four authors

(20.67%), two authors and three authors having same number of publications (16.5%) respectively. There are very fewer contributions were in the form of single authorship i.e. 2.58% only.

Table-2: Authorship pattern in publications

Year	1 Author	2 Authors	3 Authors	4 Authors	5 Authors	More than 5 Authors	No. of publications
2010	3	5	3	8	4	5	28
2011	0	5	2	9	4	9	29
2012	0	2	4	10	3	4	23
2013	2	8	10	10	8	5	43
2014	2	7	10	10	10	9	48
2015	0	6	7	12	6	13	44
2016	3	10	8	7	11	19	58
2017	0	16	16	14	9	29	84
2018	1	11	10	10	5	25	62
2019	2	13	13	14	11	31	84
Grand Total	13 (2.58%)	83 (16.5%)	83 (16.5%)	104 (20.67%)	71 (14.11%)	149 (29.62%)	503

7.3 Co-authorship index

Table-3 specifies the calculated values of Co-authorship Index (CAI) for publications having single author, two-authors, three authors, four authors, five authors and more than five authors.

Table-3: Co-authorship index

Year	1 Author	CAI for 1 Author	2 Authors	CAI for 2 Authors	3 Authors	CAI for 3 Authors	4 Authors	CAI for 4 Authors	5 Authors	CAI for 5 Authors	Mega Authors	CAI for Mega Authors	No. of publications
2010	3	414.5	5	108.2	3	64.9	8	138.1	4	101.2	5	60.2	28
2011	0	0	5	104.4	2	41.7	9	150.0	4	97.7	9	104.7	29
2012	0	0	2	52.69	4	105.3	10	210.2	3	92.4	4	58.7	23
2013	2	179.9	8	112.7	10	140.9	10	112.4	8	131.8	5	39.2	43
2014	2	161.2	7	88.37	10	126.2	10	100.7	10	147.5	9	63.2	48
2015	0	0	6	82.63	7	96.4	12	131.9	6	96.6	13	99.7	44
2016	3	200.1	10	104.4	8	83.5	7	58.3	11	134.3	19	110.5	58
2017	0	0	16	115.4	16	115.4	14	80.6	9	75.9	29	116.5	84
2018	1	62.4	11	107.5	10	97.7	10	78.0	5	57.1	25	136.1	62
2019	2	92.1	13	93.78	13	93.7	14	80.6	11	92.7	31	124.5	84
Grand Total	13		83		83		104		71		149		503

CAI measures the tendency of co-authorship and was proposed by Garg and Padhi. It is calculated by the formula mentioned in the methodology numbered ‘e’. CAI = 100 indicates that the co-authorship effort for a specific type of authorship corresponds to the overall average, CAI > 100 reflects higher than average co-authorship effort and CAI < 100 shows lower than average co-authorship effort for a given type of authorship pattern.

Analysis of table shows that the value of CAI for single authors have decreased from 414.5 to 92.1 which means there is a large decrease in the single authorship with respect to overall output. In case of double authorship, CAI has decreased from 108.2 to 93.78. For three authors, it was increased from 64.9 to 93.7. In case of four authorship and five authorship it was below average for most of the years except in some years. For more than 5 authors working in collaboration, value is more than average only during last 4 years of the study. Highest collaborative effort has been observed among the single authors (414.5).

7.4 Collaboration pattern

Degree of collaboration, Collaborative Index, Modified collaborative co-efficient, and Collaboration co-efficient for each year is shown in table 4.

Table 4: Collaboration pattern wise distribution

Year	Single authored paper (N _S)	Multi authored Paper (N _M)	No. of publications (N _S +N _M)	DC	CI	CC	MCC
2010	3	25	28	0.89	3.96	0.64	0.66
2011	0	29	29	1	4.79	0.74	0.76
2012	0	23	23	1	4.35	0.73	0.77
2013	2	41	43	0.95	3.72	0.66	0.68
2014	2	46	48	0.95	4.35	0.69	0.71
2015	0	44	44	1	4.73	0.74	0.75
2016	3	55	58	0.94	4.84	0.70	0.71
2017	0	84	84	1	4.87	0.72	0.73
2018	1	61	62	0.98	5.39	0.73	0.74
2019	2	82	84	0.97	5.04	0.72	0.73
Total	13	490	503	0.96	4.60	0.70	0.72
Average							

DC, CC, MCC, and CI was calculated using the formulas mentioned in methodology “a”, “b”, “c” and “d” respectively. The years 2011,2012,2015,2017 has the highest DC (1) while the lowest DC(0.89) was recorded in the year 2010. The highest CI (5.39) was observed in

the year 2018 while the lowest CI (3.72) was in 2013. Highest CC (0.74) was observed in the years 2011 and 2015, while the lowest CC (0.64) was observed in the year 2010. The highest MCC (0.77) was found in 2012 and the lowest MCC (0.66) was found in 2010. The overall value of the Degree of collaboration is 0.96, Collaboration Index is 4.60, Collaboration co-efficient is 0.70 and the Modified collaboration co-efficient is 0.72.

7.5 Citation wise distribution of papers

Citation refers to the number of documents cited to a particular study. Table-5 supported by figure-1 shows the number of documents cited year wise in the total documents of 503.

Table-5: Citation wise distribution

Year	Paper	Citation	Citation per paper
2010	28	286	10.21
2011	29	208	7.17
2012	23	87	3.78
2013	43	328	7.63
2014	48	314	6.54
2015	44	358	8.14
2016	58	620	10.69
2017	84	455	5.42
2018	62	135	2.18
2019	84	66	0.79
Total	503	2857	Average: 5.67

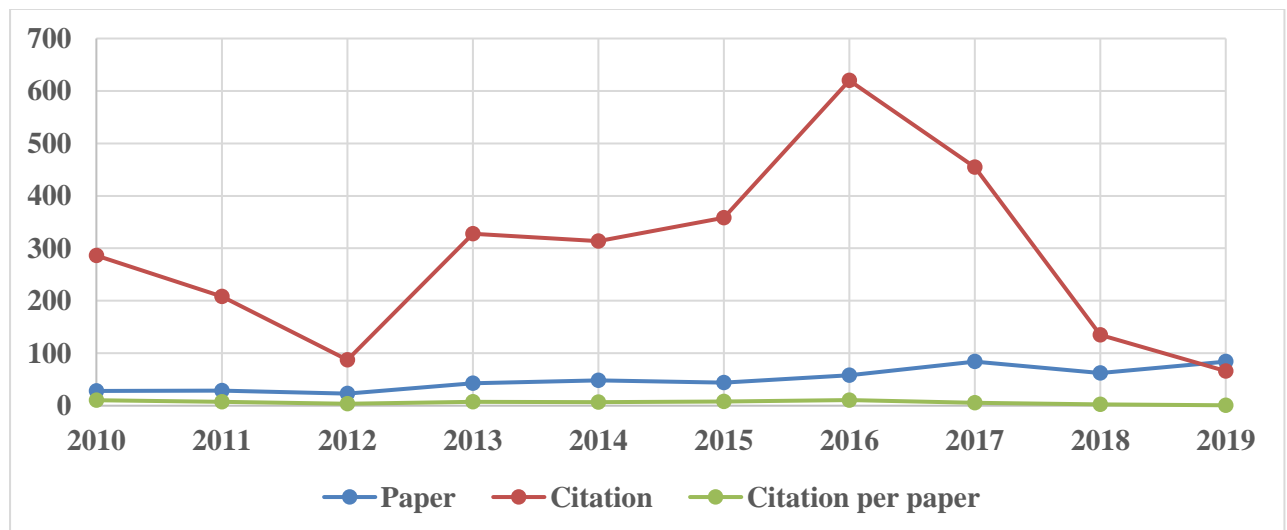


Figure-1: Citation wise distribution

It was found that in the year 2016 highest 620 citation used in 58 publications having citation per paper is 10.69, followed by year 2017 where citation is 455 in 84 publications, in the year 2015 citation used 358 in 44 publications, in the year 2013 citation used 328 in 43 publications, in the year 2014 citation used 314 in 48 publications, in the year 2010 citation

used 286 in 28 publications, in the year 2011 citation used 208 in 29 publications, in the year 2012 citation used 87 in 23 publications and the lowest citation found in the year 2019 having 66 citation in 84 publications.

7.8 Most prolific authors (Top 10)

Table-6 show the top 10 prolific author's contribution during the period of study. From the observation of the table it was found that Bhattacharjee, D secure first rank with 68(13.51%) publications, followed by Hussain, S. A. with 62(12.32%) publications, DE, B.K with 40(7.95%) publications, Dinda, B and Guha, A with 36(7.15%) publications, Nath, R.K with 30(5.96%) publications, Bhattacharjee, S with 27(5.36%) publications, Das, A and Majumdar, S with 24(4.77%) publications, Chattopadhyaya, S with 23(4.57%) publications, Chakraborty, A with 22(4.37%) publications and Pal, A with 1 (4.17%) publications securing ranks second to tenth respectively.

Table-6: Top 10 most prolific authors in Tripura University

Sl. No	Author	Publication	Percentage	Rank
1	Bhattacharjee, D	68	13.51	1
2	Hussain, S. A	62	12.32	2
3	DE, B.K	40	7.95	3
4	Dinda, B	36	7.15	4
5	Guha, A	36	7.15	4
6	Nath, R.K	30	5.96	5
7	Bhattacharjee, S	27	5.36	6
8	Das, A	24	4.77	7
9	Majumdar, S	24	4.77	7
10	Chattopadhyaya, S	23	4.57	8
11	Chakraborty, A	22	4.37	9
12	Pal, A	21	4.17	10

7.9 Distribution of papers by types of document

Table-7 and figure-2 displays the type of document which authors preferred in there research. Out of total 503 documents maximum 445(88.46%) are the journal articles and which is the most preferred document type, followed by Review with 27(5.36%), Meeting Abstract with 8(1.59%), Letter and Early access with 6(1.19%) each, Correction, Editorial material and Proceedings papers with 3(0.59%) each, Book review with 2(0.39%), This shows that 88.46% of researchers frequently like article type document and only 11.54% of researchers like other types of documents.

7.10 Top 10 Collaborative institutions with Tripura University

Table-8 states the top 10 collaborative institutions with Tripura University during the study. Out of 503 publications Jadavpur university with 48(9.54%) publications was the highest collaborative institutions during the period of study, trailed by University of Calcutta having 41(8.15%) publications, Womens college, Agartala with 26(5.16%) publications, NIT Agartala with 24(4.77%) publications, MBB University Agartala with 20(3.97%)

publications Sambalpur University with 13(2.58%) publications, Government degree college, Agartala with 12(2.38%) publications, NEHU Shillong with 9(1.78%) publications, Bose Institute and Council of Scientific Industrial Research CSIR India with 8 (1.59%) publications each. This shows that Tripura University has a good number of collaborative works with other Indian Institutions.

Table-7: Document type wise distribution

Document Type	Record count	Percentage
Article	445	88.46
Review	27	5.36
Meeting Abstract	8	1.59
Letter	6	1.19
Early Access	6	1.19
Correction	3	0.59
Editorial Material	3	0.59
Proceedings Paper	3	0.59
Book Review	2	0.39
Total	503	

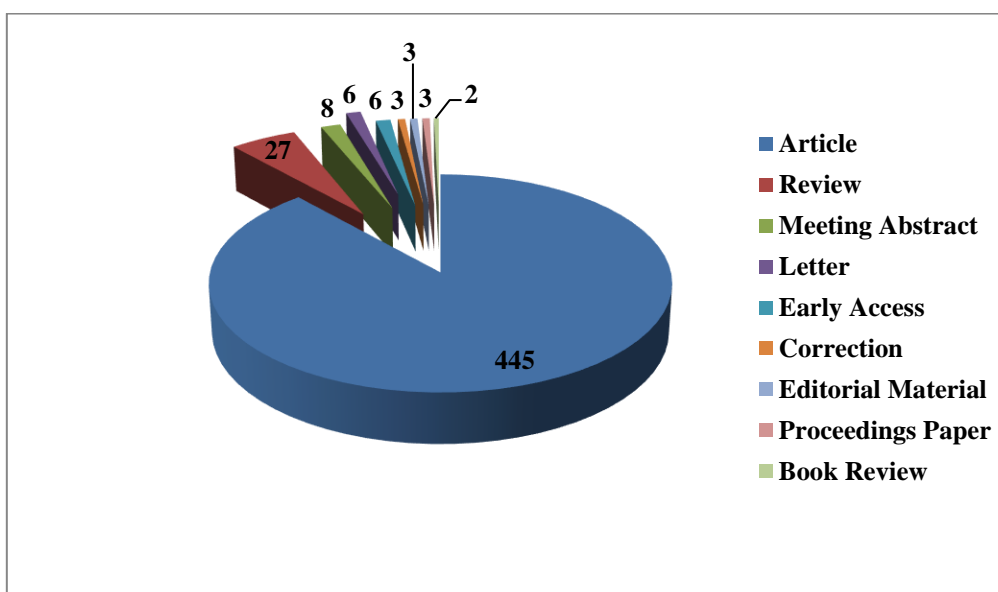


Figure-2: Document type wise distribution

Table-8: Top 10 Collaborative institutions with Tripura University during 2010- 2019

Sl. No	Organization	Publication	Percentage
1	Jadavpur University	48	9.54
2	University of Calcutta	41	8.15
3	Womens College, Agartala	26	5.16
4	NIT Agartala	24	4.77
5	MBB University, Agartala	20	3.97
6	Sambalpur University, Orissa	13	2.58
7	Government Degree College, Agartala	12	2.38
8	NEHU, Shillong	9	1.78
9	Bose Institute	8	1.59
10	Council of Scientific Industrial Research CSIR India	8	1.59

8. CONCLUSION AND SUGGESSTIONS

The present study has highlighted that published articles are limited to only Tripura University. From the study we can observe that many authors from various institutions have jointly published their articles with Tripura University during the period of study. More than five authorship pattern is the most favored authorship pattern among researchers and the single-author paper was very less. In the year 2016, the highest number of publication recorded 108(18.43%), the second highest number of publication recorded in the year 2017 which is 84(14.33%). The Highest Co-authorship Index which has been observed among the single authors (414.5) in the year 2010 which is more than average. It was found that maximum documents published are in the form of article which was 445(88.46%) followed by review paper 27(5.36%) out of total number of publication 503. Highest number of citation 286 was found in the year 2010 having 10.21 citation per paper. Bhattacharjee, D and Hussain S,A was the top most polific authors having 68 and 62 publications respectively. Jadavpur University has highest collaboration with Tripura University having 48 publication which is 9.54% of total publications.

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