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RESEARCH OUTPUTS OF STATE GOVERNMENT UNIVERSITIES OF ODISHA: A BIBLIOMETRIC STUDY

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Abstract

This study highlights the bibliometric analysis of research productivity of Odisha's state universities during 2010 to 2014 indexed in SCOPUS Database which is 490. The study analyzes different aspects of bibliometric study and found that Utkal University is the most productive institutions with 37.76% of total publications and growth rate of publication of the study is -105.63%. Physics and Astronomy is most preferred subject area having 20% of total publications. The most preferred journal for publications is Optics Communications and Indian Journal of Physics with 1.63% of contributions each and P.K. Mishra. Is the most productive author having 3.06% of total publications. Article is the most preferred type of document with 87.35% of total publications. The numbers of publications by multiple authors is 96.73% which is much higher than publications by single author. The paper published by Hoffmann M., et al. (2010) titled "The impact of conservation on the status of the world's vertebrates" published in *Science*. is the highest cited paper; Degree of collaboration of the study is 0.97.

Keywords: Bibliometric, Odisha, Scopus, research productivity, research outputs

Introduction

Bibliometric study is one of the most promising areas of research activities in the field of Library and Information Science and has become very popular with the development of various citation databases. Universities being the premier institutions in the field of higher education apart from normal teaching must contribute their research outputs for the benefits of society since large amount of public money are utilized to carry out various research works. Bibliometric study facilitates the analysis of research outputs of researchers from various aspects. There are many government and private universities, autonomous institutions including technical institutions in Odisha. Among these, the present study covers only six state government universities such as Utkal University, Bhubaneswar; Sambalpur University, Burla; Berhampur University, Berhampur; North Orissa University, Baripada; Ravenshaw University, Cuttack and Fakir Mohan University, Balasore.

Literature Review

Koganuramah, M. M , Angadi, M. & Kademani,B. S (2002) had carried out a research on Bibliometric dimension of innovation communication productivity of Tata Institute of Social Sciences, which reveals the domination of single author contributing 613 publications out of 663 publications . Maharana, R. K & Das, P. (2013) Analyzed 447 number of publications contributed by the researcher of Utkal University during 2008-2012. It revealed that Annual average growth of Utkal University during the study was 8.77% as well as they noticed that three authored publications (29.75%) dominated during the period of study followed by two authored publications with 20.36%. Maharana, R. K & Sethi, B. B. (2013) in their study on A bibliometric analysis of the research output of Sambalpur University's publication in ISI Web of Science during 2007-11 found that annual average growth rate of publications of Sambalpur University during the study was 30.53%. Out of 170 publications 47 (27.65%) numbers of publications published under Chemistry as a subject of research area. Swain, D. K , Rautaray, B. & Swain, C (2013) In the study Scientimetric dimension of research productivity KIIT University, Bhubaneswar and found that most of the publications were contributed by three authors followed by two authors and four authors respectively where as quite less number of publications contributed by single authors .Also the degree of collaboration was 0.93.

Chaurasia, N. K. & Chavan, S. B (2014) in their study on Research output of Indian Institute of Delhi(IIT Delhi) during 2001-2010: a bibliometric analysis found that out of total 6109 number of publications journal articles were observed as the most favored document type having 5731 publications followed by proceeding paper with 461 publications and Review with 192 publications . Maharana,R.K & Pati, S (2014) in their study on Bibliometric analysis of Fakir Mohan Universities research output indexed in Scopus during 2008 to 2012 found that maximum number of four authored paper published during the period with 29.79% of total publications as well as degree of collaboration is 0.96 during the period of study. Kumar, H. A. , Dora, M. & Desai, A.(2015) analyzed 760 number of publication contributed by the researcher of Gujarat University during 2004 -2013.The study completely revealed that Journals are the most favored form of publication by the researcher of Gujarat University. Sa, M. K (2015) made a study on Research output of institute of minerals and materials technology India indexed in scopus during 2004-2013: a bibliometric analysis. He found that average growth rate of publications is 7.43%. In the field of subject area he found chemistry is the most productive subject area contributing 144 publications out of 419 publications which is 34.37% of total publications. Similarly keyword "Article" used maximum number of time in 82(19.57%) publications where as degree of collaboration is 0.98 and Journal is the source type of publications. Siwach,A.K. & Kumar, S (2015) in their study on Bibliometric analysis of research publications of Maharshi Dayanand University (Rohtak) during 2000-2013 analyzed 1247 number of publications of which highest 455 number of publications contributed by the researcher of Maharshi Dayanand University under Chemistry as the major subject area of publications.

Objectives of the study

The various objectives of the present study are summarized below.

- a) To analyze yearly contribution of publications
- b) To recognize most productive authors
- c) To find out most preferred subject area of research
- d) To highlight contribution of publications by type of document
- e) To identify the most productive journals

- f) To investigate the most frequently used keywords by the researchers
- g) To know the most productive institutions
- h) To study source wise distribution of publications
- i) To study authorship pattern
- j) To recognize most cited papers
- k) To study the Degree of collaboration

Methodology followed for the study

In order to get require data for the study "Scopus" used as the main source of data provider from where data were retrieved on dated 5/4/2015 by making advanced search choosing affiliated city option putting Orissa as affiliated city then limited to the following six state university namely Utkal University,Sambalpur University, Berhampur University, North Orissa University, Ravenshaw University and Fakir Mohan University from the year 2010-2014.The retrieved data i.e. 490 number of publications were exported into MS Excel and then data were arranged in a organize way based on the objectives of the study to make analysis of the data .

Scope and limitations of the study

The scope of the present study covers the research productivity of six state Universities of Odisha namely Utkal University, Sambalpur Unibersity, Berhampur University, North Orissa University,Ravenshaw University and Fakir Mohan University which has been indexed in SCOPUS during 2010 to 2014.The other publications of these universities of Odisha state which are not included in the SCOPUS has been excluded from the study

Data Analysis

Yearly Distribution of Publications

Table 1 divulges the yearly distribution of publications by six state university of Odisha during 2010 to 2014. it is observed that out of total 490 publications published during the period of study, maximum 170 (34.69%) numbers of publications published in 2011 followed by 128 (26.12%), 117 (23.88%), 50 (10.20%) numbers of publications in the year 2010, 2012 and 2013 respectively where as only 25 (5.10%) publications published in 2014 which is lowest during the period of study. Further the average growth rate of the publications is -103 (-105.63%) because except the year 2011, the trend of publications is in decreasing order.

Table-1: Yearly Distribution of Publications

Year	Publication(N=490)	Percentage (%)	Growth Rate	Growth %
2010	128	26.12	0	0.00
2011	170	34.69	42	32.81
2012	117	23.88	-53	-31.18
2013	50	10.20	-67	-57.26
2014	25	5.10	-25	-50.00
Total	490	100.00	-103	-105.63

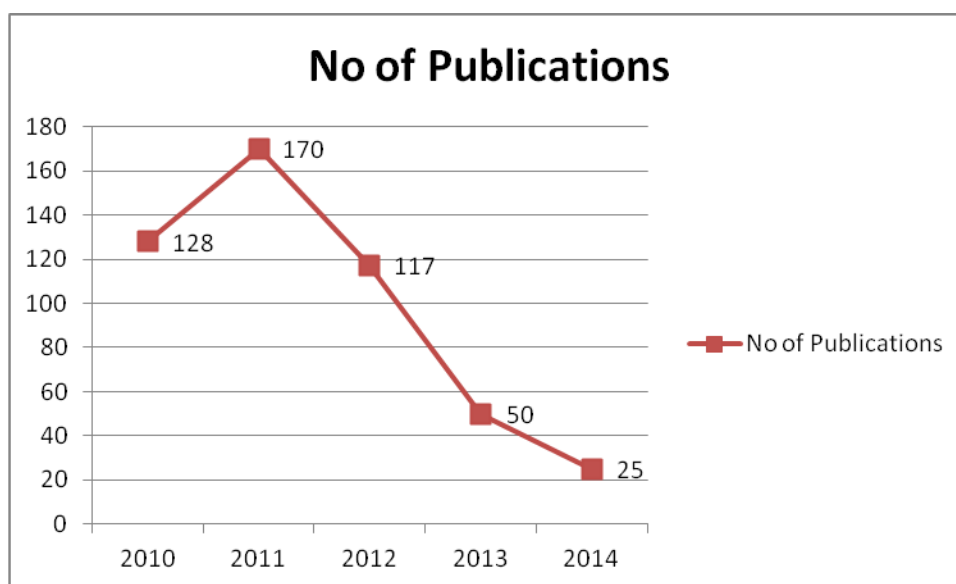


Fig-1: No. of Publications

Most Productive Authors

To find out top productive authors, total count method was used and equal weightage was given to each author. The analysis of Table 2 reveals that out of 490 numbers of publications R.K.Mishra is the most productive author with highest numbers of publications i.e.15 (3.06%) securing 1st rank. It is followed by three authors such as S.K.Sahoo,S.K. Dutta and B.K.Mishra with 14 (2.86%) publications each securing 2nd rank. Similarly S.Sahoo, N.N.Das, P.K.Behera, C.K.Chakraborty, S.P.Pati, and R.C. Mohanty contributed 13 (2.65%) publications each securing 3rd rank in the hierarchy.S.Panigrahi is the author with 7th rank who contributed 9 publications (1.84%).

Table-2: Most Productive Authors

Rank	Author Name	No. of Publications(N=490)	Percentage (%)
1	Mishra, R.K.	15	3.06
2	Sahoo, S.K.	14	2.86
2	Dutta, S.K.	14	2.86
2	Mishra, B.K.	14	2.86
3	Sahoo, S.	13	2.65
3	Das, N.N.	13	2.65
3	Behera, P.K.	13	2.65
3	Chakraborti, C.K.	13	2.65
3	Pati, S.P.	13	2.65
3	Mohanty, R.C.	13	2.65

4	Khandpekar, M.M.	12	2.45
5	Mohanty, P.	11	2.24
5	Ray, R.C.	11	2.24
5	Chand, P.K.	11	2.24
5	Poddar, D.R.	11	2.24
6	Behera, S.	10	2.04
6	Jena, S.N.	10	2.04
6	Pal, A.	10	2.04
6	Nath, R.K.	10	2.04
7	Panigrahi, S.	9	1.84

Most Preferred Subject Area

The purpose of subject wise scientific research outputs is to observe the research trends in specialized subject areas in terms of research outputs. Table 3 depicts subject wise publications by the researchers of six universities of Odisha. "Physics and Astronomy" is the top subject with 98 (20%) numbers of publications; followed by "Pharmacology, Toxicology and Pharmaceutics" with 96 (19.59%); Chemistry with 82 (16.73%); Engineering with 80 (16.33%); Materials Science with 68 (13.88%) numbers of publications respectively. Whereas Neuroscience; Nursing and Psychology are the lowest subject areas with only 1 (0.20%) number of publication each.

Table-3: Most Preferred Subject Area

Rank	Subject Area	Number of Publications(N=490)	Percentage (%)
1	Physics and Astronomy	98	20.00
2	Pharmacology, Toxicology and Pharmaceutics	96	19.59
3	Chemistry	82	16.73
4	Engineering	80	16.33
5	Materials Science	68	13.88
6	Environmental Science	67	13.67
7	Biochemistry, Genetics and Molecular Biology	65	13.27
8	Agricultural and Biological Sciences	60	12.24
9	Medicine	45	9.18
10	Mathematics	40	8.16
11	Chemical Engineering	39	7.96
12	Computer Science	38	7.76
13	Earth and Planetary Sciences	25	5.10
14	Social Sciences	22	4.49
15	Energy	16	3.27
15	Immunology and Microbiology	16	3.27

16	Business, Management and Accounting	7	1.43
17	Arts and Humanities	6	1.22
17	Economics, Econometrics and Finance	6	1.22
18	Multidisciplinary	5	1.02
19	Health Professions	4	0.82
20	Veterinary	3	0.61
21	Decision Sciences	2	0.41
22	Neuroscience	1	0.20
22	Nursing	1	0.20
22	Psychology	1	0.20

Preferred Types of publications

Table 4 shows the preferred type of publications by research communities of six state university of Odisha during the study. It is found that out of total 490 number of publications, article is the most preferred type with 428(87.35%) number of publications, followed by Conference Paper with 30 (6.12%); Review with 16 (3.27%) and Book Chapter with 13 (2.65%) publications respectively. The last preferred type of publication in this study is Editorial, Letter and Note with 1(0.20) publication each.

Table-4: Preferred Document

Rank	Type of Document	Number of Publications(N=490)	Percentage (%)
1	Article	428	87.35
2	Conference Paper	30	6.12
3	Review	16	3.27
4	Book Chapter	13	2.65
5	Editorial	1	0.20
5	Letter	1	0.20
5	Note	1	0.20
Total		490	100.00

Most Productive Journals

Table 5 lists the most productive journals with their rank where the researchers of six state universities published their research outputs. The analysis of data reveals that both “Optics Communication” and “Indian Journal of Physics” are in 1st rank with 8(1.63%) numbers of publications each; followed by Journal of the Indian Chemical Society, Tropical Journal of Pharmaceutical Research and AIP Conference Proceedings are in 2nd rank with 7(1.43%)numbers of publications each. Similarly Theoretical Physics and Nonlinear Optics Theories and Models, Asian Journal of Pharmaceutical and Clinical Research, Environmental Monitoring and Assessment, Indian Drugs, International Journal of Pharmtech Research, Journal of the Korean Chemical Society are in 3rd rank with 5 (1.02%) numbers of publications each. The other journals where researchers have published their research output are listed in Table-5.

Table-5: Most Productive Journals

Rank	Name of The Journals	No. of Publications (N=490)	Percentage (%)
1	Optics Communications	8	1.63
1	Indian Journal of Physics	8	1.63
2	Journal of the Indian Chemical Society	7	1.43
2	Tropical Journal of Pharmaceutical Research	7	1.43
2	AIP Conference Proceedings	7	1.43
3	Theoretical Physics and Nonlinear Optics Theories and Models	5	1.02
3	Asian Journal of Pharmaceutical and Clinical Research	5	1.02
3	Environmental Monitoring and Assessment	5	1.02
3	Indian Drugs	5	1.02
3	International Journal of Pharmtech Research	5	1.02
3	Journal of the Korean Chemical Society	5	1.02
4	Journal of Hazardous Materials	4	0.82
4	Colourage	4	0.82
4	Research Journal of Pharmaceutical Biological and Chemical Sciences	4	0.82
4	International Journal of Pharmaceutical Sciences Review and Research	4	0.82
4	International Journal of Earth Sciences and Engineering	4	0.82
5	13 publications has three each	3	0.61
6	61 Publications have 2 each	2	0.41
7	70 Publications have 1 each	1	0.20

Most Frequently Used Keywords

Table 6 depicts the most frequently used keywords by the researchers of state universities of Odisha under the study. It is found that “Article” is the most frequently used keywords having 144 (29.39%) publications followed by “Controlled Study” having 76 (15.51%), Nonhuman having 63 (2.86%), and publications respectively. Similarly India as a name of a country used in 49(10%) publications where as “Orissa” which is a state of India used in 28 (71%) publications. In addition to that “PH” and “Water” are two different keywords used in only 17 (3.46%) publications which have been used rarely by the researchers.

Table-6: Most Frequently Used Keywords

Rank	Keywords	Number of Publications(N=490)	Percentage (%)
1	Article	144	29.39

2	Controlled study	76	15.51
3	Nonhuman	63	12.86
4	India	49	10.00
5	Unclassified drug	41	8.37
6	Infrared spectroscopy	29	5.92
6	Scanning electron microscopy	29	5.92
7	Orissa	28	5.71
8	Priority journal	27	5.51
9	Male	23	4.69
10	In vitro study	22	4.49
11	Animal experiment	21	4.29
12	Rat	20	4.08
13	Animal model	19	3.88
13	Animals	19	3.88
13	FTIR	19	3.88
14	Plant extract	18	3.67
14	Drug formulation	18	3.67
15	PH	17	3.47
15	Water	17	3.47

Most Productive Institutions

Table 7 shows the collaborative research productivity of the six state universities of the Odisha under the study. The total numbers of publications of these universities in this table exceeds 490 because many publications which are published jointly by authors of two or more universities, the same publications have been listed more than once in all universities by SCOPUS. It is found that Utkal University is in top position contributing highest 185 (37.76%) numbers of publications out of total 490 publications. It is followed by Sambalpur University with 120 (24.49%), Berhampur University with 92 (18.78%), North Orissa University with 58 (11.84%) and Ravenshaw University with 41 (8.37%) numbers of publications .Fakir Mohan University contributed lowest numbers of publications i.e. 22 which is only 4.49 % of the total publications.

Table-7: Ranking of Universities

Rank	Most Productive Institutions	Number of Publications(N=490)	Percentage (%)
1	Utkal University	185	37.76
2	Sambalpur University	120	24.49
3	Berhampur University India	92	18.78
4	North Orissa University	58	11.84
5	Ravenshaw University	41	8.37

6	Fakir Mohan University	22	4.49
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Source Wise Distribution of Publications

Table 8 depicts the distribution of research publications by different type of sources. It reveals that out of total 490 number of publications ,as high as 441 numbers of publications(90%) contributed in Journals followed by Conference Proceedings with 24 , Books with 13 and Trade publications with 7 numbers of publications contributing 4.90%,2.65% and 1.43% of total publications respectively. Further only 5 (1.02%) publications contributed in book series which is lowest of its type.

Table-8: Source wise Distribution of Publications

Rank	Source Type	Number of Publications(N=490)	Percentage%
1	Journals	441	90.00
2	Conference Proceedings	24	4.90
3	Books	13	2.65
4	Trade Publications	7	1.43
5	Book Series	5	1.02
Total		490	100.00

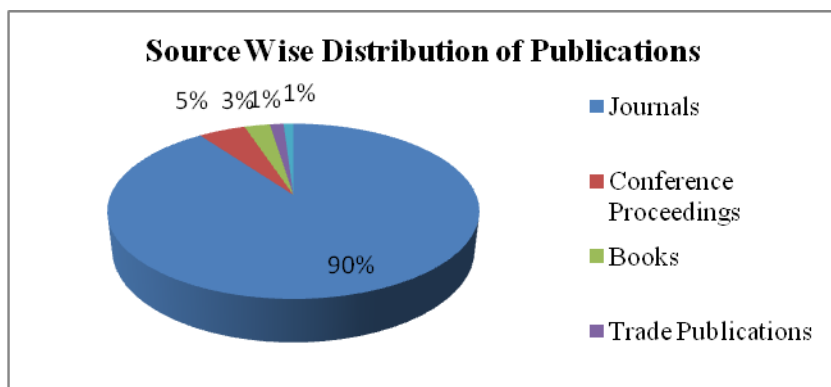


Fig. 2:- Source wise distribution of publications

Authorship Pattern

Table 9 analyzes collaborative publications by six different authorship patterns. The analysis of data indicates the domination of 3 authored publications contributing highest publications i.e. 137 (27.96%), followed by 4 authored with 112 publications (22.86%), 2 authored and ≥ 5 authored with 107 (21.84%) publication each. Further only 16 (3.27%) publications contributed by single authored and lowest 11 (2.24%) publications contributed by ≥ 10 authored.

Table-9: Authorship Pattern

Year	Authorship	Total
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	1	2	3	4	≥5	≥10	
2010	3	30	37	30	26	2	128
2011	3	38	44	43	38	4	170
2012	8	24	30	25	28	2	117
2013	1	9	21	7	10	2	50
2014	1	6	5	7	5	1	25
Total	16	107	137	112	107	11	490
%	3.27	21.84	27.96	22.86	21.84	2.24	100.00

Most Cited Publications

Citation is tool to measure the impact of research. Table 10 listed top 10 cited papers. The paper titled "The impact of conservation on the status of the world's vertebrates" published in *Science* is the highest cited paper which has been cited 283 times followed by "2-Iodoxybenzoic acid (IBX): An efficient hypervalent iodine reagent" by Satam,V. published in *Tetrahedron* cited 98 times and "Geochemical speciation and risk assessment of heavy metals in the river estuarine sediments-A case study: Mahanadi basin, India" by Sundaray S.K. published in *Journal of Hazardous Materials* cited 78 times.

Table-10: Most Cited Publications

Rank	Title	Authors	Year	Source title	Cited Times
1	The impact of conservation on the status of the world's vertebrates	Hoffmann M.,et al.	2010	Science	283
2	2-Iodoxybenzoic acid (IBX): An efficient hypervalent iodine reagent	Satam V., Harad A., Rajule R., Pati H.	2010	Tetrahedron	98
3	Geochemical speciation and risk assessment of heavy metals in the river estuarine sediments-A case study: Mahanadi basin, India	Sundaray S.K., Nayak B.B., Lin S., Bhatta D.	2011	Journal of Hazardous Materials	78
4	Comparative study of bio-ethanol production from mahula (<i>Madhuca latifolia</i> L.) flowers by <i>Saccharomyces cerevisiae</i> cells immobilized in agar agar and Ca-alginate matrices	Behera S., Kar S., Mohanty R.C., Ray R.C.	2010	Applied Energy	42
5	Certain subclasses of analytic and bi-univalent functions	Srivastava H.M., Mishra A.K., Gochhayat P.	2010	Applied Mathematics Letters	37

6	A compact UWB bandpass filter with embedded SIR as band notch structure	Ghatak R., Sarkar P., Mishra R.K., Poddar D.R.	2011	IEEE Microwave and Wireless Components Letters	36
7	Studies of dielectric and electrical properties of a new type of complex tungsten bronze electroceramics	Pradhan D.K., Behera B., Das P.R.	2012	Journal of Materials Science: Materials in Electronics	34
8	Chemical and microbial remediation of hexavalent chromium from contaminated soil and mining/metallurgical solid waste: A review	Dhal B., Thatoi H.N., Das N.N., Pandey B.D.	2013	Journal of Hazardous Materials	33
9	Reduction of hexavalent chromium by Bacillus sp. isolated from chromite mine soils and characterization of reduced product	Dhal B., Thatoi H., Das N., Pandey B.D.	2010	Journal of Chemical Technology and Biotechnology	33
10	Organogels: Properties and applications in drug delivery	Sahoo S., Kumar N., Bhattacharya C., Sagiri S.S., Jain K., Pal K., Ray S.S., Nayak B.	2011	Designed Monomers and Polymers	31

Degree of Collaboration

Degree of collaboration examines the trend in authorship pattern of publication. Table 11 used K. Subramanian's formula for Degree of collaboration. It is observed from the table that degree of author collaboration is 0.97.

$$DC = \frac{M_n}{S_n + M_n} \text{ where}$$

DC= Degree of Collaboration

S_n =Single Author

M_n =Multiple Authors

$$DC = \frac{474}{16+474}$$

Table-11: Degree of Collaboration

Year	Single(N_s)	Multiple(N_m)	$N_s + N_m$	Degree of Collaboration©
2010	3	125	128	0.98
2011	3	167	170	0.98

2012	8	109	117	0.93
2013	1	49	50	0.98
2014	1	24	25	0.96
Total	16	474	490	0.97

Findings of the study

The findings of the present study are summarized below.

- a) It is quite surprising that in spite of continuous growth of faculty members , full time and part time research scholars of these universities ,the growth rate of research publications during the study is -105.63%,which shows a negative trend.
- b) Utkal University found the most productive university among the six state universities of the study with 37.76% numbers of publications.
- c) R.K.Mishra is the most productive author contributing 3.06 % of the total 490 numbers of publications.
- d) Physics and Astronomy is the most preferred subject area with 20% of total publications followed by Pharmacology, Toxicology and Pharmaceutics and Chemistry in 2nd and 3rd rank respectively. Further Social science subjects remains in the 14th rank .It indicates that social science researches in these universities is lagging far behind basic and pure science subjects.
- e) Article is the most preferred document type with 87.35% of total publications which seems to be quite natural.
- f) The journals “Optics communication” and “Indian Journal of physics” are jointly recognized as most productive journals with 1.63% of publications which also seems to be justified since Physics and Astronomy is the most preferred subjects by the researchers of these universities.
- g) The keyword “Article” is found to be the most frequently used keywords by the researchers with 29.39% of total publications.
- h) Journal found most productive source for publication of research outputs with 90% of total publications which is quite natural. Also the reason behind this is that research outputs published in journals have more Academic Performance Indicator (API) Score than other sources.
- i) The paper titled”The impact of conservation on the status of the world's vertebrates” by Hoffmann M.,et al published in *Science*. is the highest cited paper which has been cited 283 times.
- j) Domination of multiple authors on single author is quite high with 96.73% of total numbers of publications. It indicates towards present trends of collaborative research and inters disciplinary research by the researchers of these universities.
- k) Degree of collaborations by the authors of this study is 0.97

Conclusion

Universities being the premier institutions of higher education should give proper emphasis on research and more and more researches need to be carried out by the faculty members and research scholars .But the present study highlights a gloomy picture of the research outputs of the six old government universities of Odisha with quite less numbers of research publications which are indexed in SCOPUS.

Further the growth of research publications shows negative trends which are a matter of concern for all. Hence the state government and universities authorities need to take necessary steps for creating conducive research environment in these universities, so that more and more people will take interest in research and there by numbers of research publications will increase .Also strict guideline need to be framed for faculty members and research scholars for quality research publications, not merely to full fill the promotion criteria but also to serve the society and nation.

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