

Mapping of Research Productive in Periyar University: A Scientometric Study

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Abstract - *The study presents the growth and the contribution of research carried out by the scientists of Periyar University (PU). The pattern of communications of authors and scattering of their research out put in different journals, analysis the strong and weak areas of university research. The study shows that there was a gradual growth of publications during 2005 - 2014. Relative Growth Rate (RGR) was found to be fluctuating trend during the study period. The Doubling time (Dt) was found to be increased and decreased trend in this study. Degree of collaboration and its means value is found to be 0.963.*

Keywords: Scientometric Analysis, Research Productively, Periyar University.

Introduction:

The terms bibliometrics and scientometrics have been introduced simultaneously by Pritchard, Nalimov and Mulchenko in (1969). Pritchard defined the term 'Bibliometrics' as 'the application of mathematical and statistical methods to books and other communication medium. Nalimov and Mulchenko (1969) defined 'Scientometrics' as 'the application of those quantitative methods which are dealing with the analysis of science viewed as an information process'. So, scientometrics is the measurement of science communication, and bibliometrics deals with more general information processes.

Web of Science is a Bibliographic database covers prestigious and high impact research journals of sciences across the world. According to the Badenhorst of Worldwide Information Services it is an online academic citation database provided by Thomson Reuters. It is designed for providing access to multiple databases, cross-disciplinary research and in-depth exploration of specialized subfields within scientific discipline. As a citation index, any cited paper lead to any other literature (book, academic journal, proceedings, etc.) which currently, or in the past cites this work. In addition, literature which shows the greatest impact on a field covered by Web of Science, or more than one discipline, can be selectively obtained. For example, a paper's

influence can be determined by linking to all the papers that have cited it. In this way, current trends, patterns and emerging fields of research can be assessed. Web of Science has indexing coverage from the year 1900 to the present.

Periyar University:

The Government of Tamil Nadu established the Periyar University in Salem on 17th September 1997 as per the provisions of the Periyar University Act, 1997. The University covers the area comprising the districts of Salem, Namakkal, Dharmapuri and Krishnagiri. The University got the 12 (B) and 2f status from the University Grants Commission and has been accredited by NAAC with A grade in 2015. The University is named after the Great Social Reformer E. V. Ramasamy affectionately called "Thanthai Periyar".

The University aims at developing knowledge in various fields to realize the maxim inscribed in the logo "Arival Vilayum Ulagu" (Wisdom Maketh World). "Holistic development of the students" is the primary objective of the esteemed Periyar University. Thanthai Periyar had been advocating throughout his life the importance of being rational and created a stir by his self-respect movement. He incessantly toiled for social justice among people to liberating the downtrodden women and insisted on the priority of one's mother tongue. The Periyar Chair was created in 1998 to inculcate these ideas in the minds of students. The University tie-ups with various academic, research institutes and universities across the world to bring laurels to the academia. (www.periyaruniversity.ac.in)

Review of Literature:

Ranganathan, A. and Balasubramani, R. (2014) have investigated Green Energy Research in India as revealed by the scholarly publication indexed in web of science (WoS) for a period of fifteen years from 1999 to 2013. It was seen that the analyses included research growth, author productivity, authorship pattern, Geographical distribution of the literature, citation analysis rank, global publications' share, citation impact, share of international collaborative papers and major collaborative partner countries and patterns of research communication in most productive journals. It also analyses the characteristics of most productive institutions, authors and high-cited papers

Goyal et al. (2013) has been evaluated his research papers in authorship patterns and collaborative research trends in the field of chemical sciences the authorship trends and collaborative research are studied in the field of Chemical Sciences based on the data collected from Indian Journal of Chemistry Section-B (IJCB) published during the 2002-2011. Outcome of the study shows that multi authored articles 97.24% prevail the single authored articles 2.75%. The degree of collaboration in the field of chemical sciences is 0.97. Average number of authors per paper varies from 3.21-3.78. This study is in support for the fact that chemical sciences research is collaborative in all aspects.

Baskaran, C. (2013) reported a study analysed the author productivity, discipline-wise and institution-wise collaboration and ranking of authors in research contribution of Alagappa University during 1999-2011. Relative Growth Rate (RGR) was found to be fluctuating trend

during the study period. The Doubling time (Dt) was found to be increased and decreased trend in this study. Degree of collaboration and its mean value is found to be 0.963. The top three institutions with Alagappa University are Central Electro Chemical Research Institute, National Cheng King University and Anna University.

Srinivasa Ragavan, S., Surulinathi, M. and Neelakandan, B. (2012) has described the objective of this work was to analyse the scientometric parameters for Medicinal plant research publications. Investigators have compared the author productivity and citations by various institutions at national level. It could clearly see that during the period 1973-2009, a total of 1265 publications were published at national level and the data have reflected in Web of science database. This paper finds trend towards collaborative research is gaining momentum. As every work of researchers depends mainly on the library since it provides more scholarly information and hence this kind of studies are more relevant in identifying thrust areas of research.

Krishnamoorthy.G, Ramakrishnan.J, Devi.S, (2009) conducted a study on Bibliometric analysis of diabetes literature indexed the MEDLINE database for the period 1995-2004 which shows that maximum number of records (13244) was made during 2003, followed by 12690 in 2002 and 11061 in 2001. Relative Growth Rate (RGR) was found to be decreasing year wise. The Doubling Time (Dt) was found to increase every year. Ranking of the journals based on the quantum of research output on diabetes during 1995-2004 shows that USA is the largest contributor of literature on diabetes research. The research productivity of diabetes conforms to Bradford's Law of Scattering.

Scope of the Study:

The aim the study is to analysis the research output performance of Periyar University, The University are started by the Government of Tamil Nadu and it has more no. of faculty members and students when comparing other universities. It is discussed about the research articles produced by the authors and citations.

Objectives of the Study:

The major objectives are framed with the exclusive notion of the present study as mentioned below:

- To find out the year wise distribution of publications.
- To ascertain the authorship pattern.
- To identify the geographical distribution of publications.
- To examine the institution wise distribution of publications.
- To study journal wise distribution of publications.

Methodology:

The present study data were collected from Web of Science database for the period 2005-2014. It can be seen that nearly 680 bibliographic records of contribution in the field of Periyar University over the period of 10 years. The researcher applied the search strings of Periyar University that has used for the data extraction from the database of Web of Science to download

the records based on the above strings. A total of 680 records were downloaded and analysed by using the Histcite software applications as per the objectives of the study.

Table 1 - Shows Year wise Distribution of Periyar University

Sl. No	Year	Recs.	%	TLCS	TGCS
1	2005	18	2.65	15	339
2	2006	12	1.77	19	215
3	2007	33	4.85	39	184
4	2008	47	6.91	64	539
5	2009	67	9.85	115	701
6	2010	81	11.91	91	763
7	2011	70	10.30	90	476
8	2012	97	14.26	87	463
9	2013	107	15.74	53	272
10	2014	148	21.76	31	160
Total		680	100	604	4112

As indicated in the table 1, authors from PU have contributed as many as 680 publications during 2005 to 2014 in different scholarly journals. The highest number of research output 148(21.76%) was produced in the year 2014 and the least research output was in the year 2006 with 12(1.77%). However, there was a gradual growth of publications during 2012- 2014. The annual average research output of BHU is 68 records. A year wise growth of research output and citations received by the authors of PU is presented in the Table 1. On considering the citation profile of papers of PU from 2005-2014, it was observed that 81papers scored highest citation 763 in the year 2010.

Relative Growth Rate (RGR)

The relative growth rate is the increase in the number of publications/pages per unit of time. Here, one year is taken as the unit of time. The mean relative growth rate R (1-2) over a specified period of interval can be calculated from the following equation suggested by Mahapatra.

$$R(1-2) = \frac{W_2 - W_1}{T_2 - T_1}$$

where

- R = Mean relative growth rate over the specific period of interval
- W1 = log w1 (Natural log of initial number of publications/ pages)
- W2 = log w2 (Natural log of final number of publications/pages)
- T2-T1 = Unit difference between the initial time and final time. Therefore,
- R (a) = Relative growth rate per unit of publications per unit of time (year)
- R (p) = Relative growth rate per unit of pages per unit of time (year).

Doubling Time (DT)

A direct equivalence exists between the relative growth rate and doubling time. If the number of publications/pages on a subject doubles during a given period, then the difference between the logarithms of the numbers at the beginning and at the end of the period must be the logarithms of the number 2. This difference has a value of 0.693. Thus, the corresponding doubling time for publication and pages can be calculated by the following formula:

$$\text{Doubling time (Dt)} = \frac{0.693}{R}$$

Therefore,

$$\text{Doubling time for publications Dt (a)} = \frac{0.693}{R (a)}$$

Table 2 shows Relative Growth Rate and Doubling Time calculated for the publication brought out by the faculty members of Periyar University. The table indicates the increasing trend of publication output over the study period, but the output is at the beginning at the two digit-level. It increased to three digits only in the year 2013 also indicates that the Relative Growth Rates for all sources of Periyar University research output has the result of Relative Growth Rate decreased from 0.51 in 2006 to 0.24 in 2014. The overall study period has witnessed a mean Relative Growth Rate of 1.63. The mean Doubling Time for publications for the periods of 2005-09 and 2010-14 are 1.04 and 2.67 years respectively. The whole study period has witnessed a Doubling Time for publications in 1.86 years. In general of Periyar University research output has shown a declining trend as far as the Indian publications is concerned inversely Doubling Time for publications has increased progressively.

Table 2 - Year Wise Relative Growth Rate and Doubling Time of Periyar University

Year	Publication	Cumulative	W1	W2	R (a) (W2- W1)	Mean R(a)= W2- W1	Dt (0.693/R(a))	Mean Dt(a)
2005	18	18	0	2.89	2.89		0.24	
2006	12	30	2.89	3.40	0.51		1.36	
2007	33	63	3.40	4.14	0.74		0.94	
2008	47	110	4.14	4.70	0.56		1.24	
2009	67	177	4.70	5.18	0.48	2.59	1.44	1.04
2010	81	258	5.18	5.55	0.37		1.87	
2011	70	328	5.55	5.79	0.24		2.89	
2012	97	425	5.79	6.05	0.26		2.67	
2013	107	532	6.05	6.28	0.23		3.01	
2014	148	680	6.28	6.52	0.24	0.67	2.89	2.67
Total	680				6.52	1.63		1.86

Table 3 - Shows Productivity and Citation Profile of top 20 Authors of Periyar University

Sl. No	Author	Department	Recs	TCS	ACPP	h-index
1	Krishnakumar V	Physics	111	1224	10.44	19
2	Gopi D	Chemistry	75	804	8.54	17
3	Kavitha L	Physics	75	777	8.63	15
4	Viswanathamurthi P	Chemistry	43	255	5.26	8
5	Anbarasan PM	Physics	41	232	5.54	10
6	Kumaradhas P	Physics	41	169	3.32	6
7	Nagalakshmi R	Physics	36	229	5.97	9
8	Palvannan T	Biochemistry	33	263	7.48	9
9	Raj V	Chemistry	21	75	3.19	4
10	Sathishkumar P	Biochemistry	21	250	11.05	9
11	Sekar C	Physics	21	143	7.10	8
12	Velraj G	Physics	20	93	4.50	6
13	Mathammal R	Physics	18	126	6.56	5
14	Prabavathi N	Physics	18	233	12.39	9
15	Ramasamy AK	Chemistry	18	95	5.11	5
16	Rajesh KB	Physics	16	90	5.25	6
s17	Muthukumar M	Chemistry	15	93	4.80	6
18	Lalitha A	Chemistry	14	113	8.14	6
19	Kannan S	Zoology	13	70	4.62	5
20	Perumal P	Biotechnology	13	41	3.77	4
Total			663	5375	6.45	8.30
Total of the University			890			
Share of Top 20 Authors in University Output			74.49			

ACPP - Average Citations Per Paper

Results found : **680**
 Sum of the Times Cited : **4491**
 Average Citations per Item : **6.59**
 h-index : **27**

The profile of that top 20 most productive authors of the Periyar University is given in table 3 the table also explains individual author's productivity, affiliated department, citations received average citations per paper and h-index. The 20 top ranked authors together have contributed 663 papers (varying from 13 to 111), constituting 74.49% of the total university output and with the average productivity per author of 44.50 during the study period 2005-14. Only three authors have scored high productivity compared for the average productivity of all 20 authors. They are V. Krishnakumar with 111 papers, D. Gopi and L. Kavitha with 75 papers each. The average h-index registered by these 20 authors was 8.30 (varying from 4 to 19). Four authors have registered high h-index compared to the average h-index of all authors.

Table 4 - Shows Year wise Authorship Pattern of Periyar University

Authorship Pattern	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total (% age)
Single	-	-	1	1	-	1	-	-	-	1	4 (0.59)
Two	7	6	9	9	20	15	15	28	18	25	152 (22.35)
Three	6	2	11	19	27	36	20	24	32	33	210 (30.88)
Four	4	3	3	8	10	10	14	18	32	28	130 (19.12)
Five	1	1	8	7	5	9	8	12	14	28	93 (13.68)
Six	-	-	1	1	3	5	8	9	8	14	49 (7.20)
Seven	-	-	-	2	2	-	2	4	1	7	18 (2.65)
Eight	-	-	-	-	-	1	3	1	2	6	13(1.91)
Nine	-	-	-	-	-	4	-	1	-	2	7 (1.03)
Ten & above	-	-	-	-	-	-	-	-	-	4	4 (0.59)
Total	18	12	33	47	67	81	70	97	107	148	680 (100)
CI	3.50	3.17	2.47	3.52	3.25	3.71	3.89	3.41	3.75	4.25	3.49
CC	0.63	0.59	0.65	0.67	0.65	0.69	0.70	0.68	0.70	0.79	0.68
MCC	0.67	0.64	0.67	0.68	0.66	0.70	0.71	0.69	0.71	0.80	0.69

Table 4 presents a detailed overview of year wise authorship pattern of papers published between 2005 and 2014. In this table, all the publications were divided into ten categories. It is observed that out of 680 contributions, a total of 210 (30.88%) publications have been contributed by three authors, followed by two authors 152 (22.35%), four authors 130 (19.12%). It is observed that 93 (13.68%) publications are five authored. During the period of the study, only 4 (0.59%) publications were authored by single authors and ten and above authors. Collaboration Index that is a measure of mean number of authors per paper varies between 3.50 for the block year 2005 and 4.25 for the block year 2014 with a mean value of 3.49. To differentiate between the levels of multiple authors, two parameters CC and MCC were calculated and presented in Table 4 CC is between 0.63 for the block year 2005 and 0.79 for the block year 2014. MCC varies between 0.67 for the block year 2005 and 0.80 for the block year 2014.

Table 5 - Show Lotka's Law of Author Productivity of Periyar University

No. of Contributions	No. of Contributors	No. of Authors	$\Sigma X = \log X$	$\Sigma X = \log Y$	$\Sigma X*Y$	$\Sigma X*X$
1	521	111	0	6.26	0	0
2	135	150	0.69	4.91	3.39	0.48
3	69	43	1.10	4.23	4.65	1.21
4	41	82	1.39	3.71	5.16	1.93
5	35	36	1.61	3.56	5.73	2.59
6	23	33	1.79	3.14	5.62	3.20
7	10	63	1.95	2.30	4.49	3.80
8	9	20	2.08	2.20	4.58	4.33
9	10	54	2.20	2.30	5.06	4.84
10	1	16	2.30	0	0	5.29
11	9	15	2.40	2.20	5.28	5.76
12	7	14	2.48	1.95	4.84	6.15
13	2	26	2.56	0.69	1.77	6.55
14	1	84	2.64	0	0	6.97
15	1	99	2.71	0	0	7.34
16	1	10	2.77	0	0	7.67
18	3	90	2.89	1.10	3.18	8.35
20	1	72	3.00	0	0	9.00
21	3	70	3.04	1.10	3.34	9.24
33	1	138	3.50	0	0	12.25
36	1	175	3.58	0	0	12.82
41	2	164	3.71	0.69	2.56	13.76
43	1	207	3.76	0	0	14.14
75	2	270	4.32	0.69	2.98	18.66
111	1	521	4.71	0	0	22.18
534	890	2563	63.18	41.03	62.63	188.51

The general formula is $XY = C$, where X is the number of publications, Y is the relative frequency of authors with X publications, and n and C are constants, depending on the specific field. In brief, the author who publishes two articles accounts, on average, for 1/4 of the total number of publications. The authors who publish three articles account for about 1/9 of the total number of publications, and soon. Therefore, authors who publish one article account for 60% of all the publications. That is to say, authors who publish n publications will be $1 / n^2$ of the proportion of total publications.

P = Number of x items in table = 25

N = Sum of contributors = 2563

N: Observed value

$$n = \frac{N \sum XY - \sum X \sum Y}{N \sum X^2 - (\sum X)^2} = \frac{25(62.63) - (63.18)(41.03)}{25(188.51) - (63.18)(63.18)} = -1.42$$

$$C = \frac{1}{\sum_1^{p-1} 1/x^2 + 1/(n-1)(P^{n-1}) + 1/2 P^n + n/24 (p-1)^{n+1}}$$

$$C = \frac{1}{\sum_1^{24} 1/x^{1.42} + 1/(0.42)(25^{0.42}) + 1/2 (25)^{1.42} + 1.42/24 (24)^{2.42}} = 0.2323$$

Totally 2563 authors have contributed of Periyar University. It emphasizes the fact that the number of publications by a researcher in any field requires the high degree of inquisitiveness, competency, efficiency, insistence, and exposure to literature. That is why the majority of authors have contributed number of papers. Further, the nature of the institutions in which the researchers are working, the research area of specialization, and availability of infrastructure facilities influence the author's productivity.

In other words, for every 100 authors making one contribution each, there would be 25 others contributing 25 articles each (100/22 =25) and about 11 contributing three articles each (100/33 = 11.1) about 6 contributing four articles each (100/44 = 6.25), and so on.

Lotka's law can be expressed by the equation: $a_n = a_1/n^2$, $n = 1,2,3,.....$

Where, a_n is the number of authors contributing n papers each and a_1 is the number of authors contributing one paper each.

Table 5 indicates that the application of Lotka's law with respect to author productivity of Periyar University research output. It could be seen clearly from the table that proportion of all contribution that makes a single contribution is 0.59 percentage. It means that the collaborative authors' contribution is very high.

Further, Lotka's Chi-square model confirms the source trend. It explains the fact that the tabulated value shows that observed authors value is more than expected value. Thus, the present analysis clearly invalidates the Lotka's findings. In the present analysis, productivity is attributed to several factors. If a complete publication detail of an author is taken, the Lotka's law testing may present a different picture. Hence, the fourth hypothesis is proved (The scientific productivity of authors in the discipline of Periyar University research conforms to Lotka's (n – value) inverse square law of scientific productivity).

Table 6 - Shows Geographical Distribution of Periyar University

Rank	Country	Recs	TLCS	TGCS
1	India	680	604	4112

2	South Korea	48	55	431
3	Italy	36	51	181
4	Poland	15	12	99
5	Germany	13	8	52
6	Saudi Arabia	11	2	22
7	USA	10	3	70
8	Portugal	9	23	53
9	Japan	8	15	65
10	Malaysia	7	0	4
11	Egypt	6	1	9
12	Finland	5	10	49
12	Spain	5	2	16
13	Hungary	4	4	28
13	Peoples R China	4	0	11
13	Serbia	4	4	14
13	UK	4	3	24
14	Chile	3	1	1
14	France	3	1	28
14	Iran	3	4	9

Table 6 presents the value for the Periyar University majority of India 680 with 604 TLCS and 4112 TGCS with first rank position in producing articles, second rank South Korea 48 with 55 TLCS and 431 TGCS third rank is Italy 36 with 51 TLCS and 187 TGCS, fourth rank is Poland 15 with 12 TLCS and 99 TGCS and fifth rank is Germany 13 with 8 TLCS and 52 TGCS of Periyar University for the duration 2005-2014. Nearly ten countries they have published more the 5 articles among the 20 countries.

Table 7 - Shows Institution Wise Distribution top 20 of Periyar University

Sl. No	Institution	Recs	TLCS	TGCS	TLCS	TGCS
1	Periyar University	673	599	4078	1919	13520
2	Sri Sarada College Women	30	26	302	75	739
3	Abdus Salam International Centre for Theoretical Physics	29	43	161	89	261
4	National Institute of Technology	29	14	114	77	274
5	Bharathiar University	27	18	128	6	86
6	Anna University	26	19	234	11	209
7	Chonbuk National University	22	22	177	45	249
8	Alagappa University	21	6	281	23	436

9	Govt Arts College Autonomous	19	15	197	27	128
10	Bharathidasan University	18	4	45	29	686
11	Annamalai University	14	10	51	16	298
12	Sungkyunkwan University	13	21	215	71	249
13	University Madras	13	33	95	36	221
14	ChikkannaGovt Arts College	11	0	3	40	250
15	Cental University Tamilnadu	10	6	19	20	24
16	C Abdul Hakeem College	9	6	28	15	268
17	Sona College Technology	8	5	33	18	239
18	Sri Paramakalyani College	8	2	34	21	23
19	Womens Christian College	8	0	1	92	370
20	Adhiparasakthi Engineering College	7	0	32	30	371

Table 7 shows that the affiliation is Majority of Periyar University occupied the first position with 673 articles, Sri Sarada College Women in the second position with 30 articles, Abdus Salam International Centre for Theoretical Physics and National Institute of Technology in the third position with 29 articles and Bharathiar University in the four position with 27 articles.

Conclusion:

The research activity of Periyar University, this analysis is based on the publications data consisting of 680 research papers published by the university researchers during 2005-2014. It was observed that 641 papers scored the highest citation Periyar University 763 in the year 2010. The average citation per paper of total publications of Periyar University 26.87 on the basis of the open citation window. The university has indeed progressed in terms of quality of research. The authorship pattern of Periyar University research identified that the majority of papers are multi-authored, based on the data presented in the table indicates that the research output of the authors of Periyar University is fairly collaborative. The trends towards collaborative research are gaining currency day-by-day. Every work of researchers depends purely on the library because it contains more source information. The researchers have become an important entity wherein more and more researchers help to make it innovative.

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