

# Scientometric Profile Of Research Output Of The Women Scientists In Periyar University

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## Abstract

This study aims to identify the women scholars' contributions of periyar university researchers including Research scholars and faculties from its affiliated colleges. There were 1546 articles found and downloaded from the Web of Science database among those 2234 authors were 6661 times contributed in 31 various disciplines collaborated with 14 countries and 9 states in India 32 places from Tamilnadu state during 1998 to 2019. Of these, only 15 articles by women scientists alone, 618 articles by men scientists alone and remaining 913 articles were by both gender. Out of 2234 authors 1701(76.8) are male and 533 (24%) are female during 1998 to 2019. Women scientists alone contributions is very less at the same time collaborative with men scientists is highest. The highest contributions of the department of Physics and Chemistry by male authored. Majority of journals were having 0-1 impact factor.

**Keywords:** Women Studies, impact factor, citations, collaborative index, pattern of authorship, relative productivity, Female author ratio.

## 1.1 INTRODUCTION

49.9 percent of females were constitutes and 80.09 percent of literacy rate in Tamilnadu at 2011 population report. The Department of Science and Technology of the Government of India has started several programmes for the promotion of women in science. Overall India almost nearly 40 percent of women have secured PhD by various Indian Institutions. The Government of Tamil Nadu established the Periyar University at Salem on 17<sup>th</sup> September 1997 as per the provisions of the Periyar University Act, 1997. The University covers the area comprising four districts namely Salem, Namakkal, Dharmapuri and Krishnagiri. The University got the 12(B) and 2f status from the University Grants Commission, New Delhi and respectively reaccredited by the NAAC with "A" grade in 2015. The University bagged 83th rank among Indian Universities by MHRD NIRF 2020. The University is named after the Great Social Reformer E.V. Ramasamy, affectionally 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 the World).

“Holistic development of the students” is the primary objective of the esteemed Periyar University. The University has 28 departments and 109 affiliated colleges. Totally 152 faculties are there among those 47 (30.92%) of were women faculties.

## **1.2 METHODOLOGY**

The necessary data has collected from the database of Thomson Reuters WoS which indexes SCI, SSCI and A&HCI different journals published from the Periyar university researcher’s collaborated with from various places. This kind of gender contribution study is most difficult to identify the gender/sex from the indexed by productivity articles/collected bibliographical data from the WoS. The WoS has not provided the author’s gender but it shows the authors initial with names and surnames, later 2007 they started giving full names of the contributed authors. The necessary data has been downloaded on 3rd week of January 2020 from the Web of Science database during 1989 – 2019. After extracted (for extracting used software of Histcite and MS Excel) the downloaded data, the researcher culled out various discipline authors from 1546 articles. Individual contributed author’s affiliations and all bibliographical details were scanned for identity by gender from the extracted data. This data was also used for identified the authors institutions, identified the female scientists, male scientists and joint contribution of both gender, types of collaboration with other scientists and institution between states, national and international.

## **1.3 REVIEW OF LITERATURE**

Many researchers have studied the assessment of women researchers in relation to their male counterparts in different fields of science and technology since last two decades. Sotudeh & Khoshian (2013) studied the performance of gender scientists in terms of their output in Nano science and technology and found that women perform equally well as their men counter parts in terms of output and impact. Pudovkin et al. (2012) were measured the study on 313 papers published by DRFZ (Germany) also found that male scientists are more prolific and cited more often than women scientists. Lariviere et al. (2011) analyzed the relation between gender study of scientific impact at the University of Quebec (Canada) and found that women scientists are less productive than men and also get slightly less citations than men. Borrego et al. (2010) analyzed scientific output of 731 PhD holders awarded their doctorate by Spanish universities between 1990 and 2002 and found no significant differences in the scientific output between males and females.

## **1.4 OBJECTIVES**

The focus of the present study is on the following aspects:

- Relative productivity of female and male scientists, to identify the relative position of women scientists in the sequence of authors in papers written jointly by female and male scientists and also to determine how often female scientists sign first and act as corresponding author when they work in a team;
- To identify different fields in periyar university where female scientists concentrate;
- To study co-authorship and collaboration pattern in publications to understand how the team size varies for different genders;
- Impact of the scientific output as judged by publishing journals impact factor, and the pattern of citations obtained by the research output.

## 1.5 ANALYSIS AND INTERPRETATION

The downloaded sample is 1546 records duration 1989 to 2019 from the Web of Knowledge database; total number of contributing authors 6661; total number of journals 527; 736 collaborative institutions' from 58 different countries; 56 h index; 21654 times citations; the publication growth shows that increasing trend.

During the sample period WoS indexed 1546 articles published, of these 2234 authored contributed by 6661 times, of which 1161 (17.43 %) were female scientists and the rest 5500 (82.57 %) were male scientists. An analysis of data by type of documents indicates that out of 1546 articles, 1467 (94.6 %) were published as journal articles. Remaining articles were in the form of Review, Article in proceeding paper, Meeting abstracts, early access article, correction, letter, editorial material, articles in retracted publication and reprint.

### 1.5.1 Relative productivity and relative position of women scientists

Out of 1546 articles 927 (59.96%) articles were collaborated with female authors 619 (40.04%) of article were my male authors. Out of 2234 authors, 533 (24%) of female authors were found from the research output by Periyar university. The accurate calculation of female's contribution fractional contribution from the sample data. For this, the authors were multiplied each female fraction of articles in category of authorship pattern. For example, there are 121 articles in the category of 1/2 female fraction (Table 1), which means that there are two authors per article and only one of them is a female. Based on this, women's fractional contribution is 60.5 articles out of 121 ( $1/2 \times 121 = 60.5$ ). Based on this calculation, the sum of the fractional contributions for women is 927 articles, which is about 60% of total output in Periyar University including articles exclusively written by female scientists. Article per author share as a measure of productivity at the individual level for female scientists is 0.60 and male scientists is 0.40 (aprox.). This indicates that the productivity of female scientists at the individual level was nearly double level higher than that of their male counter parts.

The filtered data was analyzed to identify the position of Female researchers in published articles jointly authored by both gender. This implies that women occupied important position in a significant number of papers and least contribution. Out of 1546 articles, 572(37%) articles were only one female authors' contributed followed by 262 (17%) articles were two female authors contributed, 67 (4.3%) articles were three female authors contributed, 25 (1.62%) articles were four female authors contributed and only one (0.06%) article for five and six authored contributed by five and six authors. There is no collaboration female author with seven and above authored team.

The assessment of Co-authorship and collaboration pattern has been to recognize how the team size varies for different genders. Only 15 (0.97%) of article has published by women authored only followed by 928 (60.03%) of articles were by both genders and remaining 603(39%) by male authored publications. Only 17 % of women authors were contributed from whole authors from Periyar University.

**Table1: Ratio of Female authors to the total number of authors and pattern of authorship in total research output in Periyar University**

Female Ratio (A)	No. of papers (B)	A*B	Female Ratio (A)	No. of papers (B)	A*B	Female Ratio (A)	No. of papers (B)	A*B	Article per authored by female = 0.60; Degree of Collaboration is 0.99; Authors per article	
1/1	2	2	2/3	58	38.67	3/6	11	5.5		
1/2	121	60.5	2/4	67	33.5	3/7	3	1.29		
1/3	169	56.33	2/5	52	20.8	3/8	6	2.25		
1/4	92	23	2/6	33	11	3/9	3	1		
1/5	75	15	2/7	12	3.42	3/10	1	0.3		
1/6	52	8.68	2/8	12	3	3/11	3	0.82		
1/7	28	4	2/9	7	1.56	4/4	1	1		
1/8	17	2.13	2/10	4	0.67	4/5	10	8		
1/9	6	0.67	2/11	1	0.18	4/6	10	6.67		
1/10	4	0.44	2/12	1	0.17	4/7	2	1.14		
1/11	3	0.27	2/13	1	0.15	4/8	1	0.5		
1/13	1	0.08	2/15	1	0.13	4/11	1	0.36		
1/15	1	0.07	3/4	19	14.25	5/8	1	0.63		
1/17	1	0.06	3/5	21	12.6	6/11	1	0.55		
2/2	13	13	<b>Total female authored articles</b>				<b>928</b>			
Authorship pattern				Total output	both contributed output	Total authors	Male authors	Female authors		DC
Single authored articles				8 (0.52)	2	8 (0.12)	6	2	0.75	
Two authored articles				277 (17.9)	133	554(8)	420	134	0.52	
Three authored articles				372 (24.1)	227	1116(16.8)	886	230	0.39	
Four authored articles				284 (18.4)	176	1136 (17.1)	727	409	0.38	
Five authored articles				252 (16.3)	160	1260 (18.9)	1102	158	0.37	
Six authored articles				155 (10)	106	930 (13.96)	824	106	0.32	
Seven authored articles				77 (4.98)	45	539(8.09)	494	45	0.42	
Eight authored articles				53 (3.43)	37	424(6.37)	387	37	0.30	
Nine authored articles				35 (2.26)	16	315 (4.73)	299	16	0.54	
10 and > (till 18) authored articles				33 (2.13)	26	379 (5.69)	355	24	0.21	
<b>Total</b>				<b>1546</b>	<b>928 (60.03)</b>	<b>6661</b>	<b>5500 (82.57)</b>	<b>1161 (17.43)</b>	<b>0.40</b>	

The result indicates that women scientists work in very small teams which imply that women scientists have a lesser tendency towards co-authorship and independency in Periyar University. This table an analysis also shows that three authored articles and higher that other collaborated articles as well as in jointly both gender contribution and small number of papers by multi and mega authored paper exclusively written by women scientists. It could be noted that have interested to co-authorship with male collaborated work towards and less tendency to work independent the Periyar university researchers.

### 1.5.2 Activity profile by gender

Using activity index (AI) (Schubert and Braun 1986) authors identified the fields of relative research effort, a particular gender devotes to a given field. Here AI has been applied in a modified way and is explained below.  $AI = \{(N_{ij}/N_{i0}) / (N_{0j}/N_{00})\}$  Where,  $N_{ij}$  total number of publications of a particular gender  $i$  in discipline  $j$ ;  $N_{i0}$  total number of publications of gender  $i$  in all the disciplines;  $N_{0j}$  total number of publications of all genders in discipline  $j$ ;  $N_{00}$  total number of publications of all genders in all disciplines.

The data on absolute output and AI by gender is presented in Table 2. It indicates that different genders emphasized on different sub-fields. For instance, women scientists were most active in the field of Physics, Chemistry followed by Biotechnology. Female scientists had very low activity in the field Engineering, Humanities, Bioinformatics and Botany. It could be identified from this analysis highest contributions of authors were in the field of Physics, Chemistry and Biotechnology.

**Table 2: Publication Output (Activity Index) by Gender**

S. No	Department	Publication output (Activity Index)		
		M.authors	F.authors	Total authors
1	Physics	915 (84)	401(176)	1316
2	Chemistry	847 (90)	297 (147)	1144
3	Biotechnology	523(98)	121(107)	644
4	Environmental Biotechnology	472 (117)	18 (21)	490
5	Biochemistry	410(108)	50 (62)	460
6	Geology/Earth Science/Remote sensing	477(119)	9 (11)	486
7	Microbiology	241(106)	37(73)	278
8	Zoology	319(106)	44(73)	363
9	Mathematics	247(108)	35(61)	282
10	Medical Science	252(111)	20(46)	272

11	Botany	261(119)	4(9)	265
12	Marine Science & Technology	158(113)	10(39)	168
13	Computer Science/Information Tech	50(73)	33(128)	83
14	Food Science & Nutrition	46(87)	26(162)	72
15	Biology	74(98)	17(111)	91
16	Nanoscience & Technology	20(58)	22(101)	42
17	Mechanical Engineering	22(111)	2(48)	24
18	Bioinformatics	15(107)	2(67)	17
19	Humanities	12(112)	1(44)	13
20	Engineering community	139(111)	12(46)	151
	<b>Total</b>	<b>5500</b>	<b>1161</b>	<b>6661</b>

### 1.5.3 Pattern of domestic and international collaboration

Out of 1546 articles 2234 authors were repeat contributed 6661 times of different genders. Out of 2234 authors, 1216 (54.43%) of them were collaborated within university and its affiliated colleges, 753(33.71%) of them were collaborated with other districts from Tamilnadu, 148 (6.62%) of authors were collaborated with other States of India and followed by 117(5.24%) of authors were collaborated with other countries (57 countries). Among the most collaborated countries, South Korea has highest collaborated followed by USA, Italy and China remaining countries were collaborated below 50 articles respectively.

**Table 3: Pattern of Collaboration Publication Output by Gender**

Type of collaboration	Female authors	Male authors	Total authors
Within university	292	924	1216 (54.43)
With other districts	190	563	753 (33.71)
With other states	22	126	148 (6.62)
With other countries	19	98	117 (5.24)
<b>Total</b>	<b>523 (23.41)</b>	<b>1711 (76.59)</b>	<b>2234</b>
<b>Most Collaborated countries with Periyar University</b>			
<b>South Korea (109)</b>	USA (67)	Italy (66)	China (52)
Saudi Arabia (42)	Malaysia (38)	Poland (38)	Japan (30)
Portugal (19)	Egypt (17)	Germany (17)	France (16)
Spain (15)	Chile (12)	Australia (11)	Turkey (10)

### 1.5.4 Distribution of Research Output by range of impact factor

Based the impact of articles, three indicators were pointed that is, (a)publishing country of journals, (b) impact factor of journals and (c) the number of citations obtained by the published articles. Also the impact factor is main indicator of the reputation of particular journal.

**Table 4: Range of Impact Factor of journals**

Range of Impact factor	No. of Female contributed articles	No. of Male contributed articles	Both contributed articles	Total articles
0 - 1	11	354	487	852 (55.1)
$>1.1 \leq 2$	2	104	183	289 (18.69)
$>2.1 \leq 3$	0	65	121	187 (12.03)
$>3.1 \leq 4$	0	32	51	83 (5.37)
$>4.1 \leq 5$	0	17	27	44 (2.85)
$>5.1 \leq 6$	2	26	51	79 (5.1)
$\geq 10.1$	0	5	8	13 (0.84)
<b>Total</b>	<b>15 (0.97)</b>	<b>603(39)</b>	<b>928 (60.03)</b>	<b>1546</b>

The range of Impact factor 2020 identification of the below table analysis, the result shows that more than fifty percent of articles were published between 0 to 1 impact factor journals. Nearly 19% of articles were published between 1.1 to 2 impact factor journals. Very less number of articles was published the high impact factor journals. According to gender also mentioned the same result.

### 1.5.5 Most contributed journals

Table 5 shows that the highest (out of 527 journals, more than 10 articles published) contributing articles by Periyar University researchers. Among those, "Spectrochimica ACTA Part A-Molecular & Biomolecular Spectroscopy" has published 80 articles with 0.17 IF, followed by "RSC Advances" has published 23 articles with 1.32 IF, "Journal of Molecular structure" has published 21 articles with 1.4 IF and remaining journals were published below 20 articles respectively.

**Table 5: Journals most commonly used by Periyar University researchers**

Highest contributing journals	No of articles	IF of 2020
Spectrochimica ACTA Part A-Molecular & Biomolecular Spectroscopy	80	0.17
RSC Advances	23	1.32
Journal of Molecular Structure	21	1.4
Chemistry select	17	3.23
Journal of Materials Science-Materials In Electronics	14	2.93
Asian Journal of Chemistry	12	0.4
Journal of Raman Spectroscopy	12	13.5
Journal of The Indian Chemical Society	12	0.33

### 1.5.6 Distribution of Citations

Table 6 reveals that the distribution of citations received by the article under different gender category. Out of 1546 articles, 266 (17.21%) of articles were did not get any citations, 149 (9.64%) of articles were cited only one time followed by 122 (7.9%) of article were cited two times, 100(6.47%) of articles were cited three times, 99 (6.4%) of articles were cited four times and 74 (4.79%) of article were cited five times respectively. 223 (14.42%) of articles were cited between 6 to 10 times. Highest numbers of articles were earned between 11 to 100 citations. Less number (only 3) of articles was earned more than 101 citations. Less number of articles 513 (33.18%) earned high citations.

**Table 6: Citations of published articles**

No of citations	Female no of articles	Male no of articles	Male & Female no of articles	Total articles
0	4	108	154	266 (17.21)
1	4	56	89	149 (9.64)
2	1	47	74	122 (7.89)
3	0	42	58	100 (6.47)
4	0	45	54	99 (6.40)
5	1	27	46	74 (4.79)
6-10	3	88	132	223 (14.42)
11-50	2	178	289	469 (30.33)
51-100	0	12	29	41 (2.65)
≥101	0	0	3	3 (0.19)
<b>Total</b>	<b>15</b>	<b>603</b>	<b>928</b>	<b>1546</b>

### 1.5.7 Collaborative institutions

The total output came from 736 institutions' from domestic and international universities and its affiliated colleges. Of these most collaborated institutions are Anna University (various campuses), Bharathiyar University and Bharathidasan University respectively.

**Table 7: Most Collaborative institutions with Periyar University**

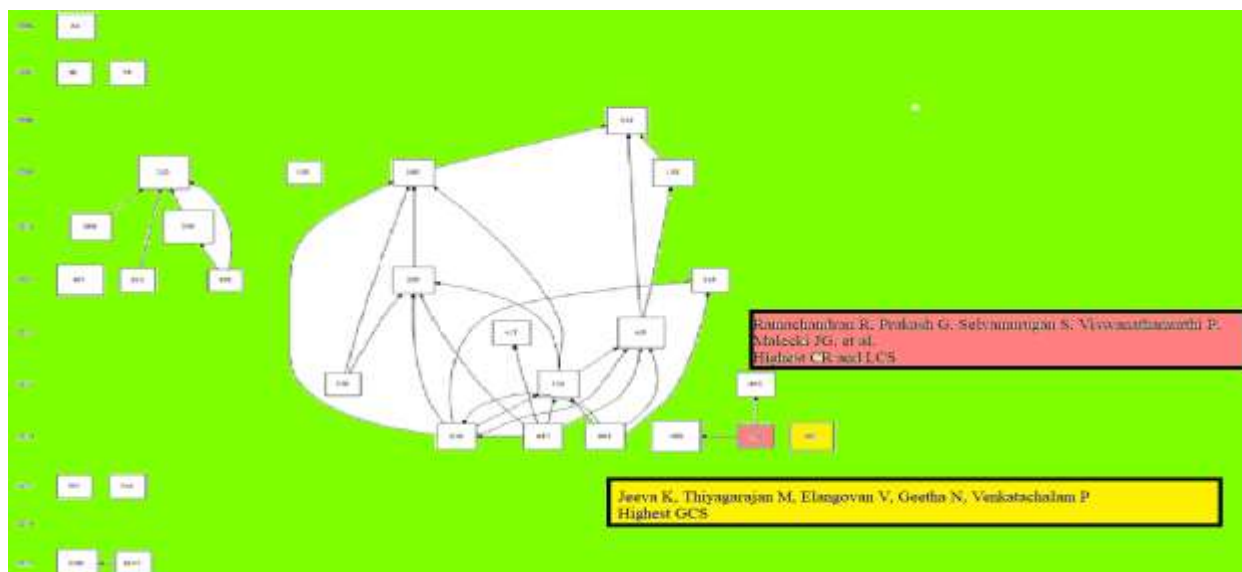
Institution	articles	Institution	articles
Anna University	179	Sri Sarada Coll Women	35
Bharathiyar University	109	DRDO	35
Bharathidasan University	48	IITs	34
Abdus Salam ICTP	45	Alagappa University	32
Central University of TN	41	Annamalai University	32
Jeonbuk National University	41	M Sundaranar University	32
Govt Arts Coll Autonomous	41	King Saud University	26
NIT Tiruchirappalli	40	Chikkanna Govt Arts Coll	22



University of Madras	39	SRM Institute of Sci. Tech	22
CSIR India	38	Western Kentucky University	21

### 1.5.8 Histriographic Analysis

The below histriographic map has reveals that highest cited and links authors among the selected nodes. Selected 30 nodes between the years 2006 to 2017 (duration is 1989 to 2019), more than 127 authors were contributed of this map. At 2014, the authors of “Jeeva K, Thiyagarajan M, Elangovan V, Geetha N, Venkatachalam P” were published in the journal of “Industrial Crops And Products” in 607<sup>th</sup> article has not having any kind of links between the selected nodes with 15 LCS, 106 (**highest GCS**) and 37 CR values measured. At 2014, the authors of “Ramachandran R, Prakash G, Selvamurugan S, Viswanathamurthi P, Malecki JG, et al.” were contributed in the journal of “Dalton Transactions” has two cited quotes also earned **highest LCS and CR**. It could be noted that the male and female collaborative article has highest citation score among the sample data.



### 1.5.9 VOSVIWER

Minimum five number of documents of citation of authors. Out of 34773 authors, 281 only meet the threshold. For each of the 281 authors, the number of co citation links will be calculated. The authors with the largest number of links will be selected. Some of the 281 items are not connected to each other. The largest set of connected items consists of 279 items. Derived the results from this figure were most reliable to the previous table analysis. Based on their citations and co citations values it has links between the selected authors with different groups indicated by the groups of colours. The highest cited authors are “Gopi, D”; “Kavitha L” and “Benelli,G”.

Selected	Author	Citations	Co-citations
<input checked="" type="checkbox"/>	gopi, d	305	820
<input checked="" type="checkbox"/>	kavitha, l	304	1822
<input checked="" type="checkbox"/>	benelli, g	230	2761
<input checked="" type="checkbox"/>	krishnakumar, v	208	2249
<input checked="" type="checkbox"/>	frisch, mj	200	2553
<input checked="" type="checkbox"/>	[anonymous]	161	1447
<input checked="" type="checkbox"/>	sundius, t	143	2249
<input checked="" type="checkbox"/>	ramkumar, m	130	511
<input checked="" type="checkbox"/>	becke, ad	124	1771
<input checked="" type="checkbox"/>	keresztury, g	123	1965
<input checked="" type="checkbox"/>	parr, rg	117	1747
<input checked="" type="checkbox"/>	ramesh, r	115	305
<input checked="" type="checkbox"/>	bader, rfw	112	1696



## 1.6 FINDINGS AND CONCLUSION

The following result has been derived from this study; majority of articles were published as journal articles and most collaborated institutions are Anna University from various campuses and Bharathiyar University. Among the various disciplines, Physics and Chemistry researchers were contributed highest particularly male authors. Women researchers are less productive compared to male scientists. 99.49 percent of co-authored articles among those more than 60 percent of authors were jointly contributed. This analysis result show that the female authors' contribution is very less activity from the university and its affiliated college. Reason might be very less number women faculties and scholars. Government or institutions may increase the facilities for women scientist to involve more research also support from family environment.

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