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Research Productivity of Alagappa University during 1999-2011: A Bibliometric Study

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ABSTRACT

The 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.

Keywords: *Web of Science*, degree of collaboration, authors productivity, relative growth rate

1. INTRODUCTION

The terms bibliometrics and scientometrics have been introduced simultaneously by Pritchard, Nalimov & Mulchenko in 1969. Pritchard[1] defined the term 'Bibliometrics' as 'the application of mathematical and statistical methods to books and other communication medium'. Nalimov & Mulchenko[2] 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. Bandyopadhyay[3] has studied the authorship collaboration in physics, philosophy and political science. The author analysed the authorship pattern of different disciplines such as mathematics, physics, mechanical engineering, philosophy and political science[4]. Price[5] on the basis of survey of *Chemical Abstracts*, observed a steady trend towards multiple authorship and thereby holding that if it continues at the present rate, by 1980 the single author papers will be extinct. Though the above postulation may not hold true, a decline in the number of scientific papers published by single authors is evident. Fox & Fever[6] were of the view that the increase in the number of multi-authored papers may be due to the collaboration of specialists leading to enhanced quality of research. The reasons for collaborative can be attributed to the interdisciplinary nature of investigations, escalating cost of instrumentation and laboratory facilities and interest of scientists in the same subjects fields. Degree of collaboration in respect of a discipline in an organisation is the ratio of multi-authored papers published during a year and total number of papers published during the year. Science is an inherently collaborative enterprise. Collaboration being a significant indicator of the nature of scientific activity is geographically dispersed organisation that brings together scientists, instrumentation and data to facilitate scientific research. It supports rich and recurring human interaction oriented to a common research area and provides access to the data sources artifacts and tools required to accomplish research[5].Collaborators have been made possible by new communication and computational tools that enable more flexible and ambitious collaborations. Such collaborations are increasingly necessary. As science progresses, the unsolved problems become more complex, the need for expensive instrumentation increases larger data sets are required and a wider range of expertise is needed.

In scientific collaborations, researchers work together on a specific research project with a common goal. It can take many forms depending on the willingness of practitioners to collaborate which is influenced by the goals of those providing the funding (e.g., Government agency or philanthropic foundation) the needs of researchers for access to knowledge and research tools the availability of these researchers for access to knowledge and research tools, the availability of these resources

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and the opportunities of practitioners to link together (e.g., Conferences, internet connection)[7]. Within a sub-field of science, practitioners interact or co-operate with other scientists in a variety of ways including face to face meetings sharing papers and data attending seminars and workshops sharing equipment the most intense being collaboration in research experimentation.

International collaboration is an important ingredient of present day scientific research. Such collaboration with fruitful exchange of ideas, research techniques, methods and knowledge can be beneficial to both partners. Collaboration between single researchers can help them to obtain results faster and go ahead of the field in such 'Big Science' environment. At the same time co-authorship is easily detected in bibliographical databases and widely used as a reliable indicator of collaboration. It is also a method of measuring the integration into international scientific community or mainstream connectivity.

2. ABOUT THE UNIVERSITY

Alagappa University accredited with 'A' Grade by National Assessment and Accreditation Council (NAAC) is located at Karaikudi in TamilNadu. The 440 acre green and lush campus houses all the academic activities. This University has emerged from the galaxy of institutions initially founded by the great philanthropist and educationist Dr. R.M. Alagappa Chettiar.

Alagappa University was brought into existence by a Special Act of the Government of TamilNadu in May 1985 with the objective of fostering research, development and dissemination of knowledge in various branches of learning. Alagappa University is recognised by the University Grants Commission (UGC) of India. The University has 18 departments, 5 centres and 2 constituent colleges on its campus. twenty eight affiliated colleges located in the districts of Sivaganga and Ramanathapuram are part of the University. As a member of the Association of Indian Universities (AIU), as well as the member of the Association of Common Wealth Universities (ACU), it has rewarding relations with other academic institutions, research laboratories and industrial establishments that promise a spectacular feature. The University have international collaborations with universities/institutions of higher learning in countries like China, Malaysia, West Indies, USA, and South Korea. New innovative programmes suitable are designed and offered at the University (for the foreign students). Many exchange programmes attract the attention of the teachers and students from abroad.

3. OBJECTIVES

The objectives of the present study to observe the trend of research collaboration among teaching community of Alagappa University, the publications have been brought out from science and its allied area. The main objectives of the study are:

(i) To examine the year-wise distribution of the publications in Alagappa University,

(ii) To analyse the relative growth rate (RGR) and doubling time (DT) of the research productivity, and

(iii) To find out the single author vs. multi authored papers with degree of collaboration of research productivity.

4. METHODOLOGY

The study aims to evaluate the research publication of Alagappa university in the field of science and technology. The degrees of collaboration of authors are examined to identify the pattern of research contribution in the field of science. The study is based on the data retrieved from *Web of Science* (*WOS*) database, an online database provided by Thompson Scientific Inc., Philadelphia, USA. Alagappa University publications identified on *WOS* by searching for the string Alagappa University ('Alagappa Univ') in the author affiliation field. Alagappa University publications from 1999-2011 are considered. WOS renders unique affiliation of all the authors; this feature of *WOS* makes it ideal for collaborative study. The research papers published by the researchers of Alagappa University in the field of science and technology covered by the *WOS* database over 12 years (1999-2011) were taken as the prime source for the present study, as *WOS* is multidisciplinary and provides affiliations of all the authors of a publication. The publications, which affiliate at least one address from Alagappa University, are taken for the analysis. The total publications produced during the study period accounted for 776. Bibexcel is the main tool used for the analysis of the data set. The idea is to generate data files that can be imported to excel that takes tabbed data records for further analyse.

5. ANALYSIS

The analysis includes:

(i) Year-wise distribution,

(ii) Author-wise collaboration,

(iii) Institutional collaboration, and

(iv) Subject-wise collaboration.

5.1 Growth of Research Productivity

The research output of the Alagappa University is given in Table 1. From the Table, it is observed that there is an increase in the number of publications were published in 1999 (3.99 %) and in 2011 (12.5 %). However in 2004 and 2005 it is equally contributed (7.47 %). It is observed that there is less than 5 % of publications brought from 1999 to 2001, and less than 10 % of publications were published between 2002 and 2008. It is also observed that more that 10 % of publications occured during 2009 to 2011 (Fig.1).

Table 1. Growth of research productivity

S. No.	Year	No. of output	Percent	Cumulative percent
1.	1999	31	3.99	3.99
2.	2000	34	4.38	8.37
3.	2001	37	4.76	13.14
4.	2002	39	5.02	18.17
5.	2003	48	6.18	24.35
6.	2004	58	7.47	31.83
7.	2005	58	7.47	39.30
8.	2006	61	7.86	47.16
9.	2007	62	7.98	55.15
10.	2008	71	9.14	64.30
11.	2009	87	11.21	75.51
12.	2010	93	11.98	87.5
13.	2011	97	12.5	100
Total		**776**	**100**	

There exists a direct equivalence between the relative growth rate and the doubling time. If the number of articles/pages of subject double during a given period then the difference the logarithms of numbers at the beginning and end of this period must be logarithms of number 2. If natural logarithm is used this difference has a value of 0.693. Thus the corresponding doubling time for each specific period of interval and for both articles and pages can be calculated by the formula,

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

Table 2. Relative growth rate (RGR) and doubling time (DT) of publications

S. No.	Year	No. of output	W_1	W_2	RGR	DT
1.	1999	31		1.491	0	0
2.	2000	34	1.491	1.531	0.04	0.057
3.	2001	37	1.531	1.568	0.037	0.533
4.	2002	39	1.568	1.591	0.023	0.033
5.	2003	48	1.591	1.681	0.09	0.129
6.	2004	58	1.681	1.763	0.082	0.118
7.	2005	58	1.763	1.763	0	0
8.	2006	61	1.763	1.785	0.022	0.031
9.	2007	62	1.785	1.792	0.007	0.010
10.	2008	71	1.792	1.851	0.059	0.085
11.	2009	87	1.851	1.939	0.088	0.126
12.	2010	93	1.939	1.968	0.029	0.418
13.	2011	97	1.968	1.986	0.018	0.025

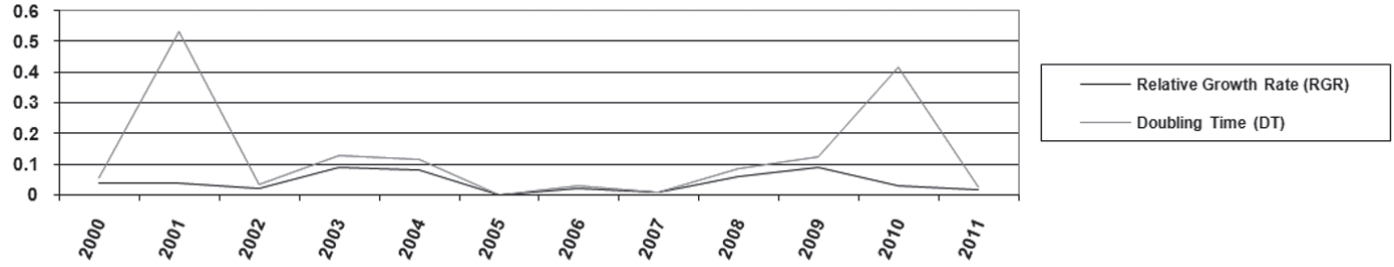

Fig. 1. Relative growth rate (RGR) and doubling time (DT)

5.2 Relative Growth Rate (RGR) and Doubling Time (DT)

The relative growth rate (RGR) is the increase in number of articles/ pages per unit of time. The Mean relative growth rate (R) over the specific period of interval can be calculated from the following equation.

Relative Growth Rate (*RGR*)

$$1-2^{R} = \frac{^{-}Log_{e}\ {}_{2}W - log_{e}\ {}_{1}W}{2^{T} - 1^{T}}$$

It has been observed from Table 2 and Fig.1 that RGR is down ward and upward trend from 2000 (0.04) to 2011(0.01). The doubling time (DT) initially increases and suddenly decreases in the period of study. The data in Table 2 reveals that DT has increased and the decreases from 0.010 to 0.533 during 2000 to 2011.

5.3 Degree of Author Collaboration

Subramanyam[8] proposed a mathematical formula for calculating author's degree of collaboration in a discipline. The degree of collaboration among authors is the ratio of the number of papers published in a discipline during certain period of time.

The degree of collaboration (collaboration coefficient) among authors is measured mathematically as;

$$C = \frac{N_m}{N_m + N_s}$$

Where, C is the degree of collaboration, N_m is number of multi-authored papers, and N_s is number of single-authored papers

The degree of collaboration in different years calculated as per the equation proposed by Subramanyam is presented in Table 3. The degree of collaboration over the years from 1999-2011 is calculated and it varies from 0.923 to 0.983. The mean value is found to be 0.963.

Table 3. Degree of collaboration of research productivity

S. No.	Year	Single-authored	Multi-authored	Total	Degree of collaboration
1.	1999	1	30	31	0.96
2.	2000	1	33	34	0.97
3.	2001	1	36	37	0.97
4.	2002	3	36	39	0.92
5.	2003	2	46	48	0.95
6.	2004	2	56	58	0.96
7.	2005	3	55	58	0.94
8.	2006	1	60	61	0.98
9.	2007	3	59	62	0.95
10.	2008	2	69	71	0.97
11.	2009	3	84	87	0.96
12.	2010	2	91	93	0.97
13.	2011	2	95	97	0.97
	Total	**26**	**750**	**776**	**0.96 (Mean)**

5.4 Institution-wise Publications

The institutional affiliation of contributors was determined from their address. Among the 91 contributors, 73.69 % were from Alagappa University, and the remaining 26.30 % were from other institutions. Table 4 shows the collaboration of Alagappa University with different institutions over the period of time. It can be observed that the top five institutions are with which Alagappa University having collaborative links. The percentage of collaboration with these institutions is, Central Electrochemical Research Institute (12.25 %), National Cheng Kung University (4.84 %), Anna University (4.55 %), and Kyungpook National University (4.27 %).

5.5 Country-wise Publications

Scientific literature is being published in almost all countries of the world due to the newer technology development and scientific research and inventions

Table 4. Institutions-wise publication

S. No.	Name of the institution	No. of papers	Percent
1.	Central Electrochemical Research Instt.	129	16.62
2.	National Cheng Kung University	51	6.57
3.	Anna University	48	6.18
4.	Kyungpook National University	45	5.78
5.	Madurai Kamaraj University	23	2.96
6.	Ajou University	21	2.70
7.	National Taiwan Ocean University	20	2.57
8.	Sree Sevugan Annamalai College	14	1.80
9.	Indira Gandhi Centre Atomic Research Institute	13	1.67
10.	Periyar University	13	1.67
11.	Nano Practice Application Centre	12	1.54
12.	Scott Christian College Autonomous	12	1.54
13.	Thiagarajar College of Engineering	12	1.54
14.	University of NACL Autonoma Mexico	12	1.54
15.	AVVM Sri Pushpam College	11	1.41
16.	Saraswathi Narayanan College	11	1.47
17.	Central Leather Research Institute	9	1.15
18.	Dongguk University	9	1.15
19.	University of Madras	9	1.15
20.	Indian Institute of Science	8	1.03
21.	Institute of Physics	8	1.03
22.	Kalasalingam University	8	1.03
23.	National Institute of Technology	8	1.03
24.	National Taiwan University	8	1.03
25.	Priyadarshini Engineering College	8	1.03
26	SASTRA University	8	1.03
27.	HH Rajahs College	7	0.90
28.	National Taipei University of Tech.	7	0.90
29.	TDMNS College	6	0.77
30.	VO Chidambaram College	6	0.77
31.	Women's Christian College	6	0.77
32.	Bishop Heber College Autonomous	5	0.64
33.	Case Western Reserve University	5	0.64
34.	Centre for Advanced Technology	5	0.64
35.	Hannam University	5	0.64
36.	Indian Institute Of Technology	5	0.64
37.	MIET Arts Science College	5	0.64
38	Nanyang Technology University	5	0.64
39.	Thanthai Hans Roever College	5	0.64
40.	AKGS Arts College	4	0.51
41.	Ananda College	4	0.51
42.	Bharathidasan University	4	0.51
43.	Bishop Heber College	4	0.51
44.	Gandhigram Rural University	4	0.51
45.	Dept.of Bio-Technology, Govt. of India	4	0.51
46.	High Energy Material Research Laboratory	4	0.51

Table 4. Institutions-wise publication

S. No.	Name of the institution	No. of papers	Percent
47.	Institute of Mexicano Petr	4	0.51
48.	Korea Atom Energy Res. Institute	4	0.51
49.	Nano Practical Application Centre	4	0.51
50.	National Institute of Material Science	4	0.51
51.	National Physical Laboratory	4	0.51
52.	National United University	4	0.51
53.	AC Ramasamy Raja Polytechnic College	4	0.51
54.	PSG College of Technology	4	0.51
55.	Scott Christian College	4	0.51
56.	SSSA College	4	0.51
57.	SN College of Engineering	4	0.51
58.	Tech University of Munich	4	0.51
59.	VHNSN College	4	0.51
60.	Ayya Nadar Janaki Ammal College	3	0.38
61.	Chonbuk National University	3	0.38
62.	Coimbatore Instt. of Engg. Info. Tech.	3	0.38
63.	Deptt. of Fisheries, Govt. of Tamilnadu	3	0.38
64.	Jamal Mohamed College	3	0.38
65.	Kyung Hee University	3	0.38
66.	Manonmaniam Sundaranar University	3	0.38
67.	Mepco Schlenk Engineering College	3	0.38
68.	National Taiwan University Sci. & Tech.	3	0.38
69.	Periyar Maniammai College Technology for Women	3	0.38
70.	Popes College	3	0.38
71.	TamilNadu Pollution Control Board	3	0.38
72.	Thiruvalluvar University	3	0.38
73.	Tohoku University	3	0.38
74.	University of Arizona	3	0.38
75.	University of Osnabruck	3	0.38
76.	Aditanar College Arts Science	2	0.25
77.	AVC College	2	0.25
78.	Gandhigram Rural Institute	2	0.25
79.	Gashub Technological Pvt. Ltd	2	0.25
80.	Govt. Arts Science College	2	0.25
81.	Korea Institute of Sci. & Tech.	2	0.25
82.	Korea University	2	0.25
83.	Loyola College	2	0.25
84.	Malankara Catholic College	2	0.25
85.	National Institute of Ocean Technology	2	0.25
86.	Presidency College	2	0.25
87.	Sathyabama University	2	0.25
88.	Shanmugha College of Engineering	2	0.25
89.	Sri Venkateswara College of Engineering	2	0.25
90.	UGC DAE Consortium Sci. Research	2	0.25
91.	YONSEI University	2	0.25

in research. In this context all peer-reviewed journals are categorised according to their country of origin to find out the most productive publications in India on par with developed countries. Table 5 presents the country-wise distribution of paper cited in *WOS*. As analysed, the Indian productivity is found to be 73.69 %. The collaboration rate of South Korea (8.83 %) is next to India but is less than 10 %. The remaining 17 % of publications are from the other 18 countries as shown in Fig. 2.

Table 5. Country-wise publications

S. No.	Country	No. of papers	Percent (%)
1.	India	776	73.69
2.	South Korea	97	8.83
3.	Taiwan	84	7.99
4.	Mexico	24	2.27
5.	Japan	15	1.42
6.	USA	13	1.23
7.	Singapore	10	0.94
8.	Germany	9	0.75
9.	China	4	0.37
10.	UAE	4	0.37
11.	Israel	3	0.28
12.	Poland	3	0.28
13.	Spain	2	0.18
14.	Bangladesh	2	0.18
15.	Canada	1	0.09
16.	England	1	0.09
17.	Eritrea	1	0.09
18.	North Ireland	1	0.09
19.	Oman	1	0.09
20.	Scotland	1	0.09
21.	South Africa	1	0.09

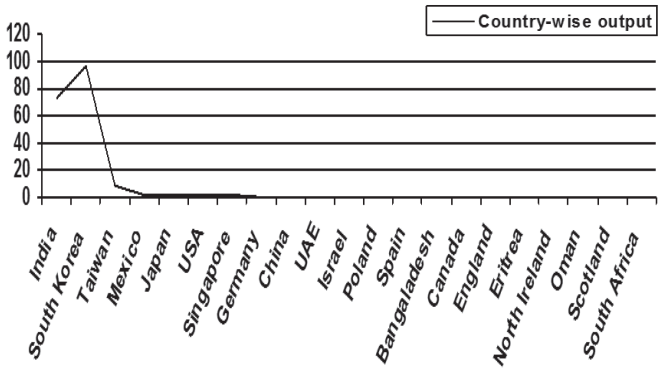

Fig. 2. Country-wise distribution of publications.

5.6 Subject-wise Publications

The purpose of analysis of the subject-wise scientific research output is to observe the research trends in terms of research output in specialised

disciplines of the subject interest. The subject-wise break up (Table 6) of 1273 articles were observed from the classification scheme devised by the author revealed that 20.18 % of articles were on Material science The next top five disciplines in which publications are maximum were: Physics (16.33 %), Chemistry (12.80) %, Electrochemistry (12.33 %), and Polymer Science (7.6 %).

Table 6. Subject-wise publications

S. No.	Name of subject	No. of paper	Percent
1.	Material Science	257	20.18
2.	Physics	208	16.33
3.	Chemistry	163	12.80
4.	Electrochemistry	154	12.33
5.	Polymer Science	90	7.06
6.	Engineering	58	4.55
7.	Crystallography	48	3.77
8.	Energy Fuels	32	2.51
9.	Science and Technology other topics	24	1.88
10.	Environmental Science Ecology	22	1.72
11.	Metallurgy & Metallurgical Engg.	21	1.64
12.	Biotechnology applied Microbiology	19	1.49
13.	Microbiology	15	1.17
14.	Mineralogy	15	1.17
15.	Mathematics	14	1.09
16.	Biochemistry Molecular Biology	12	0.94
17.	Optics	11	0.86
18.	Pharmacology	10	0.78
19.	Instruments & Instrumentation	9	0.71
20.	Spectroscopy	9	0.71
21.	Toxicology	7	0.54
22.	Biophysics	6	0.47
23.	Life Science Biomedicine	6	0.47
24.	Nuclear Science& Technology	6	0.47
25.	Parasitology	5	0.39
26.	Plant Science	5	0.39
27.	Thermodynamics	5	0.39
28.	Marine Freshwater Biology	5	0.39
29.	Automation Control Systems	4	0.31
30.	Water Resource	4	0.31
31.	Microscopy	4	0.31
32.	Zoology	3	0.23
33.	Integrative Complementary Medicine	3	0.23
34.	Agriculture	3	0.23
35.	Anatomy Morphology	2	0.15
36.	Computer Science	2	0.15
37.	Telecommunication	2	0.15
38.	Fisheries	2	0.15
39.	Food Science Technology	2	0.15
40.	Genetic Heredity	2	0.15
41.	Infectious Diseases	2	0.15
42.	Mining Mineral Processing	2	0.15

6. FINDINGS

(a) Data suggests that there was significant research productivity among the researcher in Alagappa University during the period of study.

(b) Contributors of publications and collaboration of research has healthy pattern of progress during the study.

(c) Year-wise research output of Alagappa University found to be publications growth gradually increased and sudden change is observed in growth rate shows higher after 2002.

(d) RGR was found to be fluctuating during the period. DT was found to be increasing and decreasing trend during the period.

(e) Multi-authored papers are more in number 750 (96.64 %) and single-authored papers 26 (3.35 %) of the research publications of Alagappa University.

(f) DC is fluctuating from 0.92 to 0.98 during the period also DC means observed as a whole 0.96 from 1999-2011.

(g) South Korea rank first by producing 7.61 % of collaborative papers out of total research output.

(h) Institutions-wise contribution of research output by Central Electrochemical Research Institute publications reveal first rank with 129 (16.62 %) of papers.

(i) The subject-wise contribution of research publications by the researchers from Material Science shows more number of papers with 172 (22.26 %) from the research output.

7. CONCLUSIONS

This study analysed the scientific collaboration is being most frequently among the academic community and professionals members. In this case of this study to examine trend and pattern of collaborations in Alagappa University an indexed in *WOS* from 1999-2011. Among the Institutions, which are collaborating with Alagappa University, it has been observed that South Korea is high collaborative link with Alagappa University. The degree of collaboration of Alagappa University and degree of collaboration is found to be 0.963. The single author contributions of publications are 3.35 %, while multi-authored papers contribute 96.64 % of the total productivity. It could be observed that the number

of collaborative nature of research is upward also the result of this type of study would be appeared to be great ambience in pursuing the research in the field of science. The result of collaborative research can be emerged to the interdisciplinary nature of investigations, need of increasing cost and laboratory facilities and keen for carry out their research in the field of science.

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