

Scientometric Analysis of Library and Information Science Research Output in Asian Countries

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Abstract - This study explores that the publication trends of scholarly database of web of science in Library and information science (LIS) during 1973 to 2012. This study also reveals the trend in authorship pattern and collaborative research in network security with a sample of 388 articles downloaded from the database of web of knowledge during 1973 to 2012 (four decades) with 108 LCS and 1404 TGCS and 9958-time cited reference also measured. The growth trend is booming taken the sample duration in this field LIS research output. The study also indicates that multi-authors productivity is dominant, single research also exists. The proportion of single authored papers has shown a declining trend during the period 2002 - 2007. The degree of collaboration in research is 0.95 in network security research productivity.

Keywords - Library Science; Information science, Authorship Pattern, Collaborative Research, Solo Contribution, Collaborative Index

I. INTRODUCTION

Collaborative research is a well-recognized feature of modern science, and there has been a consistent trend towards increased collaboration in all branches of science during the present century. Price (1963), on the basis of a survey of Chemical Abstracts observed a steady increase in the trend towards multiple authorship and held that "... if it continues at the present rate, by 1980 the single authored papers will be extinct". Though the above postulation may not hold true in zoology, a decline in the number of scientific papers published by single authors is evident. Fox and Faver (1984) are 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 main reason for collaborative research can be attributed to the interdisciplinary nature of investigations, escalating cost of instrumentation, laboratory facilities and common interest of scientists in the same field. A large number of studies have been conducted to analyses and interpret the trends in collaborative authorship in different disciplines. Maheswarappa and Mathias (1987) studied the research collaboration in different disciplines of applied sciences in India and observed an increasing trend towards collaborative research but the actual rates of increase varied from one discipline to another. Karisiddappa *et al.* (1990) analyzed the authorship pattern in psychology and found that the proportion of single authored papers has fallen to 39.43% in 1988 when compared to 84% in the 1920's indicating the trend towards multiple authorship. Usha *et al.*

(1993) has analyzed and interpreted the trends in multiple authorship of agricultural sciences and noticed the predominance of multiple authors over single authors.

II. OBJECTIVES OF THE STUDY

The major objectives are framed with the unique principle of the present study as mentioned below

1. To find the year wise and source wise distribution of network security output of the study from 2002 to 2011
2. To examine the growth rate, doubling time and exponential growth rate of network security output during period of 2002 to 2011
3. To find out the historiography of LCS and GCS links for selective journals.
4. To apprehend the applicability of Bradford's law of scattering in the field of network security
5. To identify the nature of collaboration and co-authorship pattern and determine the degree of collaboration in network security research.
6. To test the applicability of Lotka's law of author productivity (find n – value) in the field of network security.

III. DATA AND METHODOLOGY

There are various sources contributing to the research output in the field of LIS research by the scientists all over. In this study secondary sources are also taken for analysis. The necessary data were collected from the Science Citation Index (SCI) and Social Science Citation Index (SSCI) and Arts & Humanities Citation Index (ACHI) which are available on the Web of Science (WoS). The WoS is the search platform provided by Thomson Reuters (the former Thomson Scientific emerged from the Institute for Scientific Information (ISI) in Philadelphia). SCI and SSCI database is one of the very comprehensive databases covering all aspects of science. The study period 1973 to 2012 is selected as the database is available. A total of 388 records were downloaded and analyzed by using the Histcite software application as per the objectives of the study.

The findings of this study apply only to LIS research other related fields are used for the data from the databases of SCI, SSCI and ACHI. This study is limited to web of science database. This study reimburses special attention

only to the research outputs of LIS. In addition, this study takes into account the publication only from 1973 to 2012.

IV. RESULTS AND DISCUSSION

The growth in the number of total publications and collaborative publications are considered in during periods have shown a consistent increasing trend with time since 1973 to 2012. However, table-1 reveals that the proportion of collaborative publications in total during years. The

proportion of year wise publications is 2.06 percent during 1973 to 1975 and its risen the value of 30.67 percent during 2010 to 2012. It reveals that the growth rate is increase manifolds (fifteen times). The proportion of collaborative contributions in 0.77 during 1976 to 1987; 3.35 during 1991 to 1994; 3.09 percent at during 1995 to 1997; 5.93 percent of output at during 1998 to 2000; 12.37 percent of publications at during 2001 to 2003; 16.49 percent of output during 2004 to 2006; 25.26 percent of output during 2007 to 2009 and 30.67 percent of output during 2010 to 2012.

TABLE I TOTAL PUBLICATIONS AND COLLABORATIVE PUBLICATIONS BETWEEN 1973 TO 2012

S.No.	Year group	No. of recs.	%	TLCS	TGCS	CR
1	1973 - 1975	8	2.06	0	7	
2	1976 - 1987	3	0.77	0	20	
3	1991- 1994	13	3.35	2	125	
4	1995 -1997	12	3.09	1	81	
5	1998 - 2000	23	5.93	15	158	
6	2001 – 2003	48	12.37	15	377	
7	2004 -2006	64	16.49	34	312	
8	2007 - 2009	98	25.26	29	235	
9	2010 - 2012	119	30.67	12	89	
	Total	388	100	108	1404	

As indicated in the table I, authors from SAARC have contributed as many as 388 publications during 1973 to 2012 in different scholarly journals. The highest number of research output 119 (30.67%) was produced in the years 2010-2012 and the least research output was in the years 1976-1987 with 3 (0.77%). However, there was a gradual growth of publications during 2001- 2012. The annual average research output of SAARC is 12.93 records. The impact of research was ascertained in terms of citations received by SAARC papers of their publication from the date of the publication. A year wise growth of research output and citations received by the authors of SAARC is presented in the Table 1. On considering the citation profile

of papers of SAARC 1973-2012, it was observed that 48 papers scored highest citation 393 in the year 2001-3003.

Table II presents the distribution of published literature according to type. Out of the 388 published papers, 333 (85.82 %) were journal articles with 1285 Global Citation Scores followed by 20 (5.15%) Conference proceedings, 13 (3.35%) of Book Reviews, 8 (2.06%) of Letter format, Editorial material and Review are published each five articles, and other format publications of Note, Correction and Item about an individual are just two and one articles respectively.

TABLE II TYPES OF PUBLICATION

S.No.	Document Type	Recs	TLCS	TGCS
1	Article	333	102	1285
2	Article; Proceedings Paper	20	3	16
3	Book Review	13	0	0
4	Letter	8	0	2
5	Editorial Material	5	1	8
6	Review	5	2	69
7	Note	2	0	19
8	Correction	1	0	5
9	Item About an Individual	1	0	0
	Total	388	108	1404

The highest number of publications was of journal articles indicate that the authors from SAARC countries were involved enough in LIS research activities to disseminate their research findings through scholarly journals.

From the sample, 114 (29.38 %) of articles appeared as single-authored publications, 140 (36.08 %) as two-authored publications, 60 (15.46 %) as three authored publications, 33 (8.5 %) as four authored publications, 11 (2.84 %) as five-authored publications, 10 (2.58 %) as six authored publications; 3 (0.77 %) as seven authored publications; 7 (1.8 %) as eight authored publications; 2 (0.52 %) as nine authored publications and the rest 8 (2.06

%) as ten and more than ten -authored publications respectively. Out of 1023 authors, 11.14 percent of authors were produced single authored 114 articles, 280 (27.4%) of authors were contributed 140 articles, 180 (17.59 %) of authors were produced 60 articles, 132 (12.9 %) of authors were produced only 33 articles, 55 (5.37 %) of authors were produced only 11 articles, 60 (5.86 %) of authors were produced only ten articles, 21 (2.05 %) of authors were contributed only 3 articles, 56 (5.47 %) of authors were contributed in LIS research only 7 articles, 18 (1.76 %) of authors were produced only 2 articles and 107 (10.46 %) of authors were produced only eight articles in LIS research.

TABLE III SAARC LIS RESEARCH PUBLICATIONS CLASSIFIED BY NUMBER OF AUTHORS BETWEEN 1973 TO 2012 AND RELATIVE FREQUENCY INDEX

Years		Single	double	triple	four	five	six	seven	eight	Nine	10 & >	Total
1973 - 1975	Articles	6 (0.05)	2(0.001)	-	-	-	-	-	-	-	-	8
	Authors	6	4	-	-	-	-	-	-	-	-	10
1976 - 1987	Articles	-	3 (0.02)	-	-	-	-	-	-	-	-	3
	Authors	-	6	-	-	-	-	-	-	-	-	6
1991- 1994	Articles	3 (0.03)	5(0.04)	4 (0.07)	-	-	-	-	1 (0.14)	-	-	13
	Authors	3	10	12	-	-	-	-	8	-	-	33
1995 - 1997	Articles	5 (0.04)	4 (0.03)	2 (0.03)	-	1(0.09)	-	-	-	-	-	12
	Authors	5	8	6	-	5	-	-	-	-	-	24
1998 - 2000	Articles	10(0.09)	8 (0.06)	3(0.05)	2(0.06)	-	-	-	-	-	-	23
	Authors	10	16	9	8	-	-	-	-	-	-	43
2001 - 2003	Articles	24(0.21)	12(0.09)	7(0.12)	3(0.09)	-	1(0.10)	-	-	-	1 (0.13)	48
	Authors	24	24	21	12	-	6	-	-	-	12	99
2004 - 2006	Articles	25 (0.22)	17 (0.12)	8 (0.13)	10 (0.30)	2 (0.18)	2 (0.2)	-	-	-	-	64
	Authors	25	34	24	40	10	12	-	-	-	-	145
2007 - 09	Articles	24(0.21)	43 (0.31)	13 (0.22)	6 (0.18)	3 (0.27)	3 (0.30)	-	2 (0.29)	1 (0.5)	3 (0.38)	98
	Authors	24	86	39	24	15	18	-	16	9	44	275
2010 - 2012	Articles	17 (0.15)	46 (0.33)	23 (0.38)	12 (0.36)	5 (0.45)	4(0.40)	3 (1.0)	4 (0.57)	1 (0.5)	4(0.5)	119
	Authors	17	92	69	48	25	24	21	32	9	51	388
Total	Articles	114 (29.4)	140 (36.1)	60 (15.5)	33 (8.5)	11 (2.8)	10 (2.6)	3 (0.8)	7(1.8)	2 (0.5)	8(2.1)	388
	Authors	114 (11.14)	280 (27.4)	180 (17.59)	132 (12.9)	55 (5.37)	60 (5.86)	21 (2.05)	56 (5.47)	18 (1.76)	107 (10.46)	1023

Analysing the percentage contribution of individual types of coauthored publications, a systematic increase is observed in all the categories of co-authored publications, although with different growth rates as described below: The proportion of two-authored publications has increased from 2 articles during 1973 to 1975 and it increase 92 article during 2010 to 2012. The proportion of three authored publications has increased 4 articles during from 1991 to 1994 and it was risen 69 articles during 2010 to 2012. The

quantity of four-authored publications has increased 2 articles during 1998 to 2000 and it increase 48 articles during 2010 to 2012. Remaining authorship productivity has highest output during 2010 to 2012. Overall collaborative is 274 (70.61 %) and the quantity of non-collaborative (solo contributions) contributions is 29.38.

In single-authored publications the relative frequency has increased from 0.05 during 1973 - 1975 to 0.15 during 2010

- 2012, while in different types of multi-authored publications, it has increased from: 0.001 during 1973 - 1975 to 0.33 during 2010 - 2012 in two-authored publications; 0.07 during 1991 - 1994 to 0.38 during 2010 - 2012 in three-authored publications; 0.06 during 1998 - 2000 to 0.36 during 2010 - 2012 in four-authored publications; 0.09 during 1995 - 1997 to 0.45 during 2010 - 2012 in five-authored publications; 0.10 during 2001 - 2003

to 0.40 during 2010 - 2012 in six authored publications; 1.0 during 2010 - 2012 in seven authored publications; 0.14 during 1991 - 1994 to 0.57 during 2010 - 2012 in eight authored publications; 0.5 during 2007 - 2009 and the same value during 2010 - 2012 in nine authored publication; and 0.13 during 2001 -2003 to 0.5 during 2010 - 2012 in ten and above authored publications.

TABLE IV COLLABORATIVE INDEX AND DEGREES OF FREEDOM OF SAARC LIS RESEARCH

Year	No. of Authr	No. of Article	CI	No. of non - collaborative author	No. of collaboration	Degree of freedom
				NA	NA	
1973 -1975	10 (0.98)	8 (2.06)	1.25	6 (5.26)	2 (0.22)	0.20
1976 - 1987	6 (0.59)	3 (0.77)	2.0	-	6 (0.66)	1.00
1991- 1994	33 (3.23)	13 (3.35)	2.54	3 (2.63)	30 (3.30)	0.91
1995 -1997	24 (2.35)	12 (3.09)	2.0	5 (4.39)	19 (2.09)	0.79
1998 - 2000	43 (4.2)	23 (5.93)	1.87	10 (8.77)	33 (3.63)	0.77
2001 - 2003	99 (9.68)	48 (12.37)	2.06	24 (21.05)	75 (8.25)	0.76
2004 -2006	145 (14.17)	64 (16.49)	2.27	25 (21.93)	120 (13.2)	0.82
2007 - 09	275 (26.88)	98 (25.26)	2.81	24 (21.05)	251 (27.61)	0.91
2010 - 2012	388 (37.9)	119 (30.67)	3.26	17 (14.91)	373 (41.03)	0.96
Total	1023	388		114 (11.14)	909 (88.85)	0.88

The applicability of selected statistical probability distributions is explored for their goodness-of-fit in publication data on distribution of authorship in different periods in LIS research from 1973 to 2012. Single authored publications mean value is 12.67, standard deviation value is 0.19 and its CV value is 66.68; two authored productivity mean value is 15.56, SD value is 17.09 and CV value is 0.91; three authored mean value is 8.57, SD value is 7.36 and its CV value is 1.16; four authored mean value is 6.60, SD value is 4.33 and its CV value is 1.52 five authored productivity mean 1.83, SD value is 1.94 and its CV value

is 0.94; six authored publications mean value is 2.50, SD value is 1.291 and its CV value is 1.94; seven authored publications there is no mean and SD values; eight authored publications mean value is 3.0, SD value is 2.33 and its CV value 1.29; nine authored publications there is no mean and SD values; and ten and above authored publications mean value is 2.0, SD value is 1.826 and its CV value is 1.10. The degree of freedom for taken duration is 0.88., i.e., 88 percent of collaborative productivity is dominate in the subject of Library and Information science from SAARC countries.

TABLE V BASIC STATISTICS DERIVED FROM DISTRIBUTION OF AUTHORSHIP DATA BETWEEN 1973 TO 2012

Status of authorship contribution	No. of recs.	Basic Statistics			
		Mean	SD	CV	T test
Single author	114	12.67	0.19	66.68	3.819
Two authors	140	15.56	17.096	0.91	2.730
Three authors	60	8.57	7.368	1.16	3.078
Four authors	33	6.60	4.336	1.52	3.404
Five authors	11	1.83	1.941	0.94	2.314
Six authors	10	2.50	1.291	1.94	3.873
Seven authors	3	-	-	0	-
Eight authors	7	3	2.33	1.29	2.646
Nine authors	2	-	-	0	-
Ten & more authors	8	2.0	1.826	1.10	2.191
Total	388				

The researcher has taken the categories of all authors (844), first authors (241), non-collaborative authors (114) and co-authors (668). Overall authors' contribution is following facts; 88.03 percent of single contributions, 6.87 percent of them are two times contribution and more than two time contributors are very less number of authors. First authors also 89.21 percent of them are single contribution, 8.30 percent of them are two time contribution, 2.07 percent of contributors three time contribution and only 0.41 percent of four time

contribution. Non collaborative authors 60.53 percent of authors were only one time contributing, 4.39 percent of them are two time contributing, 5.26 percent of three time contributing and 1.75 percent of them are four time contributing in LIS research from SAARC. 88.62 percent of co authors were contributes at single time, 9.28 percent of them are two times 2.54 percent of three time contribution and less number of percent values are highest number of contributions.

TABLE VI VARIATION BETWEEN THE SINGLE, FIRST AND CO AUTHORS CONTRIBUTION

No. of contribution (X)	All authors (y) N=844		First authors N = 241		Non – collaborative authors N = 114		Co authors N = 668	
	No. of authors	% of total	No. of authors	% of total	No. of authors	% of total	No. of authors	% of total
1	743	88.03	215	89.21	69	60.53	592	88.62
2	58	6.87	20	8.30	5	4.39	62	9.28
3	29	3.44	5	2.07	6	5.26	17	2.54
4	6	0.71	1	0.41	2	1.75	4	0.60
5	5	0.59			-		1	0.15
6	1	0.12			-			
7	0	0			-			
8	0	0			-			
9	1	0.12			1	0.88	1	0.15
10	0	0			-			
11	0	0						
12	-	0						
13	1	0.12						

It conclude from this analysis, all type of authors categories were contributed in highest number in single time, followed by two times and three times and very less number of contributions in highest number of times.

Observed the percentage share of single-authored publications, it is realistic that it has decreased from 5.26 percent during 1973 – 1975 to 14.91 percent during 2010 - 2012. The increasing trend is observed in all years. Such a decline in percentage share of single authored publications appears to have some resemblance with quasi-logistic model suggested by O'Connor (1969). In order to test whether this

decline in percentage contribution of single-authored publications follows a logistic or some other kinds of growth model, the applicability of Logarithmic, inverse, Power, exponential and logistic growth models was explored in the publication data. The power and logistic models were found to be the best amongst the five growth models studied, as seen from the parameter values obtained and fit statistics derived. Multi-authored publications, it is realistic that it has decreased from 0.22 percent during 1973 – 1975 to 41.03 percent during 2010 - 2012. The increasing trend is observed in all years (table VII).

TABLE VII FIT STATISTICS DERIVED FROM THE APPLICATION OF SELECTED GROWTH MODELS TO THE DECLINE IN PERCENTAGE CONTRIBUTION OF SINGLE VS MULTI AUTHORED CONTRIBUTIONS

Types of Growth models	Fit Statistics for single authors			Fit Statistics for multiple authors		
	R ²	F	T test	R ²	F	T test
Logarithmic model	0.566	9.131	3.022	0.518	7.533	2.745
Linear model	0.674	14.49	3.807	0.758	21.93	4.683
Inverse model	0.334	3.515	4.271	0.286	2.804	2.968
Quadratic model	0.679	6.354	1.084	0.970	95.409	2.163
Cubic Model	0.962	42.445	4.128	0.994	264.69	1.768

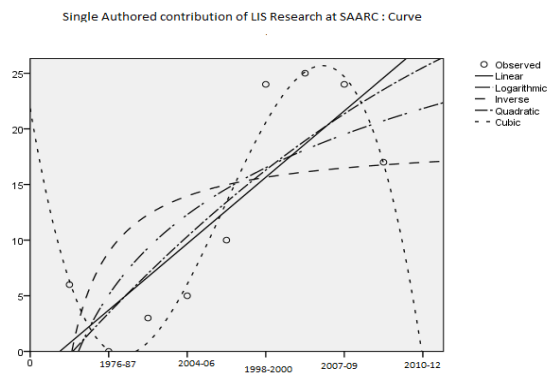


Fig. 1 Single Authorised contribution of LIS Research at SAARC: Curve

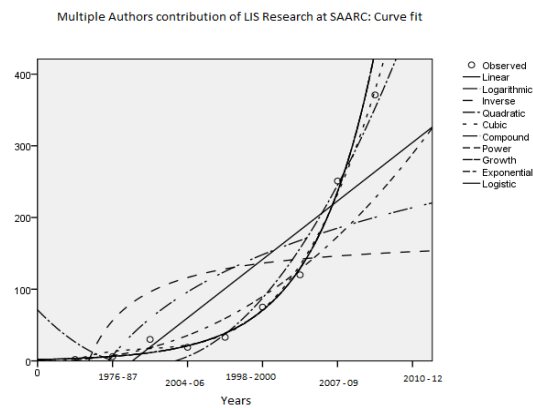


Fig. 2 Multiple Authors Contribution of LIS Research at SAARC: Curve fit

V. CONCLUSION

The highest number of publications of SAARC LIS research during 2007 -2009 and 2010 – 2012.it is found from the

journal type of articles were dominated in first position. The proportion and extent of collaborative publications have shown a systematic increase with time along with the growth of total number of publications in the discipline of Library and information science. The proportion of collaborative authored publications is high. Some resemblance quoracy-logistic model, in actual practice, Power and Logistic growth models showed positive fits in the data. Simple probabilistic distributions were explored for their goodness of- fit in the publication data on the number of authors per publication in LIS research from SAARC countries.

REFERENCES

- [1] Gunasekaran, M., and R. Balasubramani. Scientometric analysis of artificial intelligence research output: An Indian perspective. *European Journal of Scientific Research* 70.2 (2012): 317-322.
- [2] A.Manimekalai & N.Amsaveni (2012). Collaborative Research Publications of Genetics in India. *Journal of Advances in Library and Information Science*, 1(2),Apr-June, 2012, pp-88-93.
- [3] Gupta, B.M., S. Kumar, S. and R. Rousseau. 1998. Applicability of selected probability distributions to the number of authors per article in theoretical population genetics. *Scientometrics*, Vol. 42: 325-333.
- [4] Price, D. J. De. S and D. De B. Beaver (1966). Collaboration in an invisible college. *American Psychology*, 21, 1011-1018.
- [5] Subramanyam, K. 1983. Bibliometric studies of research collaboration: A review. *Journal of Information Science*: 33-38.
- [6] Smith, M.(1958). The trend toward multiple authorship in Psychology. *American Psychologist*, 13, 596-599.
- [7] Maheswaran, R. (2007). Bibliometric phenomenon of Tamil Publications in Sri Lanka in 2005. *Journal of the University Librarians Association of Sri Lanka*, 11,2-36.
- [8] Raja, S., & Balasubramani, R. (2011). Scientometric study of the research publication on malaria 2003-2007: a global perspective. *International Research Journal of Library, Information and Archival Studies*, 1(3), 114-125.