Assessment of Bradford Law's of Scattering to Neural Network Literature Through Bibliometric Study

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Abstract

The main purpose of this paper is to analyze the application of Bradford's Law of Scattering to the neural network literature published in India during 2001-2015. The paper presents an overview on scholarly contribution presented on Bradford law applied in different studies both theoretical as well as practical aspects of the law and it is being tested here over neural network literature. The data for this study has been taken from Web of Science for the period of 15 years (2001 - 2015) and it yielded 5209 articles and 58249 citations. A ranked list of journals has been prepared and it is found that *Applied Soft Computing* is most productive journal which has published 3.4 percent of articles on neural network. As far as the implication of Bradford law is concern, in theoretical aspect this law does not fit, but the alternatives such as Leimkuhler model holds good for neural network literature.

Keywords: Neural network, Bradford law, scattering of journals, citation analysis

1. INTRODUCTION

Any areas Publication productivity is the top most measure in fixing the researcher's performance capability by various national and regional governments. This has necessitated the Librarians and Library and Information Science researchers and Information Scientists to deploy a range of tools and techniques to have detailed and depth analysis of publications by the faculty and researchers, which also enable to reveal the strength and weakness, the trends that are taking place in the subject, the core journals and publications, the premier organizations and the geographical area where the particular subject research is gaining the attention, as this would greatly help the national governments in funding and providing the opportunities in the required area of research to have a balanced growth in all fields of life. Scientometrics techniques are engaged to analyze the publications on neural network studies to identify the trends in the publication, the thematic pattern and so on.

2. OBJECTIVE

The major objective of this study is to analyse the scattering pattern of journals publishing in neural network literature. Based on this dispersion study, to organize a ranked list of journals and test the Bradford's law of scattering.

- To find out most productive and core journals

- To test the applicability of Bradford's Law of scattering

3. METHODOLOGY AND DATA COLLECTION

The data for this study was collected from Web of Knowledge database and it's includes SCI, SSCI and ACHI. A ranked list of journals prepared based on the most productive journals publishing neural network literature. The search string is "neural network', limitation is during 2001 to 2015. A total of 5209 records have been retrieved from the database and taken into consideration for the study. It is found that the 1346 different sources have produced 5209 documents during the period of 2001-2015. These 1346 journals have been analyzed to test the Bradford laws to see the patterns of publications in these journals. It shows from figure 1, 58249 citations and 82 h-index values were found from 5209 records of neural network research output in India.

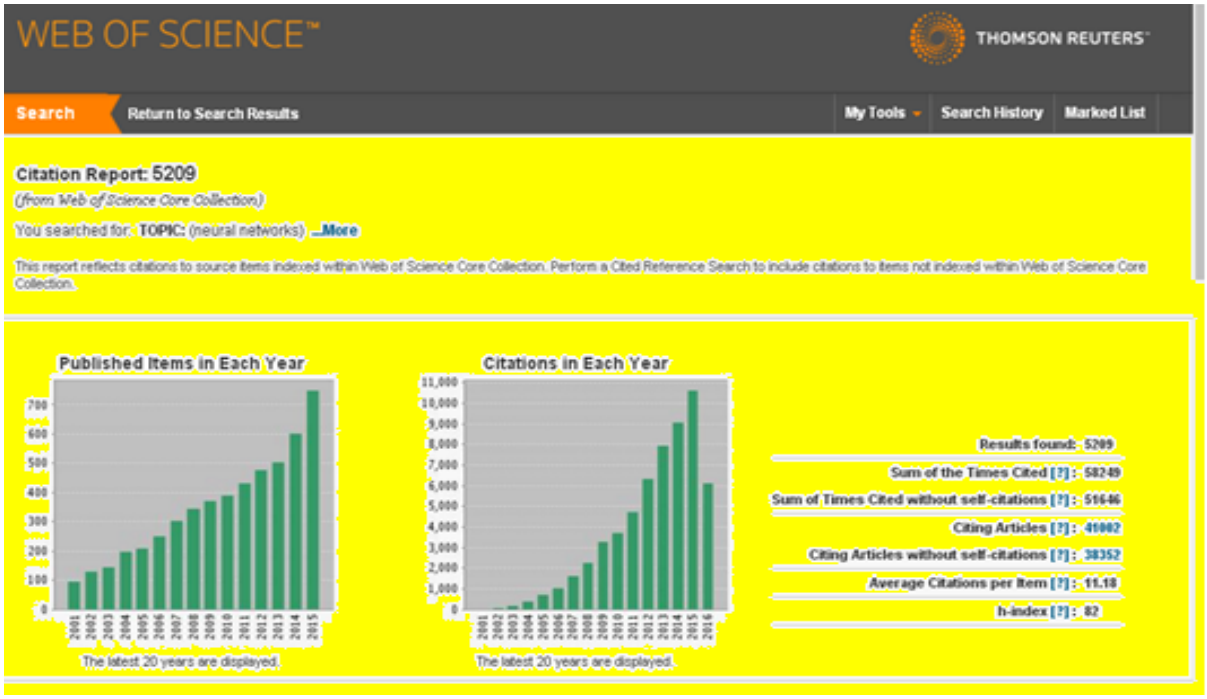

Figure 1: citation scores of neural network research output in India

4. BRADFORD'S LAW

To test the Bradford (1948) observation over the literature in the field of neural network, the whole literature has been divided into three zones or groups. The conclusion derived by the Bradford states that the ratio of the titles of journal in successive zones followed a common pattern and it states as if scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to the subject and there are several groups or zones containing same number of periodicals in the nucleus and succeeding

zones will be in 1: n: n^2, where n is a multiplier 18 and the observation of Bradford later described as linear relation by Brookes (1969) which is expressed as: F(x)= a+b logx; where, F(x) is the cumulative number of references contained in the first x most productive journals, and a and b are constant.

Brookes linear expression of Bradford law is most widely used formulation. Again, Vikery (1948) extended the verbal formulation of the Bradford law t o show that its application in any number of zones of equal values. Later on Leimkuhler (1967) has given a simple expression of Bradford law which is later known by his name and its is expressed as: R(r) = a log(1+br), where, R(r) is the cumulative number of articles contributed by journals ranked 1 through r, and a and b are parameters.

Similarly, Brooks derivation of journals productivity takes the form R(r) = a log(b/r). Further, Wilkinson noticed that the formulae provided by Leimkuhler and Brookes did not describe the same phenomenon. Several other mathematicians provided different models but the Brookes and Bradford laws, however, gained more acceptance than others.

5. GROWTH RATE AND TIME SERIES ANALYSIS

5.1 Growth of Literature

During 2001- 2015, 5209 articles indexed in Web of Knowledge database on neural network in India and it is found that there is increase in the number of research output. Neural network publications during the study period appeared only in English languages and the most common medium of communication was English language. 0.14 is relative growth rate and 6.2 years for doubling time for growth in neural network research output in India.

Table 1: Growth of literature and Time Series analysis of neural network research ouput

Year	Recs.	$\log_e \frac{1}{p}$	$\log_e 2^p$	Rt(P)	Dt(P)	X	X^2	XY
2001	95	-	4.554	-	-	-7	49	-665
2002	130	4.554	4.868	0.31	2.21	-6	36	-780
2003	147	4.868	4.990	0.12	5.64	-5	25	-735
2004	199	4.990	5.293	0.30	2.29	-4	16	-796
2005	211	5.293	5.352	0.06	11.84	-3	9	-633

2006	252	5.352	5.529	0.18	3.90	-2	4	-504
2007	304	5.529	5.717	0.19	3.69	-1	1	-304
2008	346	5.717	5.846	0.13	5.36	0	0	0
2009	372	5.846	5.919	0.07	9.56	1	1	372
2010	390	5.919	5.966	0.05	14.67	2	4	780
2011	432	5.966	6.068	0.10	6.78	3	9	1296
2012	477	6.068	6.168	0.10	6.99	4	16	1908
2013	503	6.168	6.221	0.05	13.06	5	25	2515
2014	602	6.221	6.400	0.18	3.86	6	36	3612
2015	**749**	6.400	6.619	0.22	3.17	7	49	5243
Total	**5209**			**2.06(0.14)**	**93.01 (6.2)**		**280**	**11309**

Straight line equation is applied to arrive at estimates for future growth under the Time Series analysis. Straight Line equation $Yc = a + bX$, Since $\sum x = 0$

$a = \sum Y/N = 11309 / 15 = 753.93$; $b = \sum XY/\sum x2 = 11309 / 280 = 40.39$

Estimated literature in 2025 is, when $X = 2025 - 2008 = 17$

$= 753.93 + 40.39 * 17 = 1440.56$

On the application of the formula of Time Series Analysis and subsequently, from the results obtained separately for the year 2025, it is found that the future trend of growth in Research Literature output may take an increasing trend during the years to come. The inference is that there is a positive growth level in research literature output in neural network research literatures.

5.2 Most Productive Journals

The 5209 articles were published by 1346 journals. Out of 1346 journals, only 21 most productive journals were taken here for analysis. 667 journals (49.55 %) published each one article, and the Applied Soft Computing (ISSN 1568-4946; IF (2015): 3.288) has published 178 articles (13.22 %) with 277 TLCS and 2687 TGCS, 27 h index values. The second rank hold by Journal of Expert systems with Application published 110 (8.17 %) of articles with 168 TLCS, 1756 TGCS, 23 h-index, 2.879 impact factor values. Rest of sources was produced below 100 articles.

Table 2: Most productive journals of Neural network research output in India

Rank	Journal	Recs.	TLCS	TGCS	h-index
1	Applied Soft Computing	**178**	**277**	**2687**	**27**
2	Expert Systems With Applications	110	168	1756	23
3	Neurocomputing	97	126	1076	18
4	International Journal of Advanced Manufacturing Technology	89	156	1021	16
4	Neural Computing & Applications	89	56	439	11
5	International Journal of Electrical Power & Energy Systems	70	63	854	17
6	Materials And Manufacturing Processes	52	73	595	15
7	Water Resources Management	46	130	807	19
8	Journal of Hydrologic Engineering	45	156	637	13
9	IETE Journal of Research	44	3	30	3
10	Electric Power Components And Systems	42	34	204	8
11	Journal of Materials Processing Technology	37	141	1103	22
12	International Journal of Remote Sensing	36	37	404	11
13	Journal of Hydrology	35	140	1116	16
14	Engineering Applications of Artificial Intelligence	33	32	390	13
14	Journal of Medical Systems	33	35	302	9
15	Journal of Scientific & Industrial Research	30	30	100	5
15	Proceedings of The Institution of Mechanical Engineers Part B-Journal of Engineering Manufacture	30	28	189	8
16	Measurement	29	13	235	10
17	Applied Mathematics and Computation	28	73	470	14
18	Soft Computing	26	23	123	7

There are 4 journals which have published papers ranging 50-100, 14 journals publishes papers ranging 25-49, 92 journals published papers ranging 10-24, 19 journals published 9 articles each, 13 journals published 8 articles each, 27 journals published 7 articles each, 39 journals published 6 articles each, 57 journals published 5 articles each, 74 journals published 4 articles each, 106 journals published 3 articles each, 230 journals published 2 articles each, while 667 journals published one article. The core journals in any field of study are chosen based on the subject coverage, and play a crucial role in selection of journals for publication or research articles. The

selection criterion of ranking of the core journals usually made based on the number of citation received by the articles published in that journal during a period. So, the ranking of the journals publishing neural network literature is made on the basis of number of papers published by each journal in the field (Table 3).

5.3 Theoretical Interpretation of Bradford Law

The quantitative relationship between journals and paper published by the journal is the key observation which can be drawn from the Bradford law, where small number of core journals occupy the nucleus of papers in a given subject. This occupancy is related in a linear expression where a substantial percentage (about one third) of the articles accounts for it, followed by a second larger group of journals accounts for another one third and whereas much larger group of journals have last third. This law is popularly known as Bradford Law of Scattering. The theoretical interpretation of the Bradford law was tested from time to time for various subject literatures and the given hypothesis was proved or disproved, and also alternatives, analogy and models have been suggested from time to time.

In this study the explains the Leimkuhler model expressed in the form of verbal formulation of Bradford law as: $R(r)= a \log(1+br)$, $r = 1, 2, 3$ ----------(1)

Egghe explained Leimkuhler model as $a = Y_0/\log k$----------(2) $b = k\text{-}1/r_0$ ----------(3)
where, r_0 is the number of sources in the first Bradford zone, Y_0 is the number of items in each Bradford zone and k is Bradford multiplier. $R(r)$ is cumulative number of items produced by the sources of ranks 1,2,3…r and a and b are the constant appearing in Leimkuhler model.
For calculation of the Bradford Multiplier, Egghe has given a mathematical expression as:

$k=(e^{r}y_{m})1/p$ ---------- *(4)*

Table 3: Bradford's law of scattering of sources in neural network research output in India

Rank	No. of Jrls	Cumulative no.of journals	No. of pubs.	Journals. %	Cum. no.of pubs.	Cum.total pubs.	Pubs. %	Citation scores	Cum. citations
1	1	1	178	0.07	178	178	3.42	2687	2687
2	1	2	110	0.15	110	288	5.53	1756	4443
3	1	3	97	0.22	97	385	7.39	1076	5519

4	2	5	89	0.37	178	563	10.81	1460	6979
5	1	6	70	0.45	70	633	12.15	854	7833
6	1	7	52	0.52	52	685	13.15	595	8428
7	1	8	46	0.59	46	731	14.03	807	9235
8	1	9	45	0.67	45	776	14.90	637	9872
9	1	10	44	0.74	44	820	15.74	30	9902
10	1	11	42	0.82	42	862	16.55	204	10106
11	1	12	37	0.89	37	899	17.26	1103	11209
12	1	13	36	0.97	36	935	17.95	404	11613
13	1	14	35	1.04	35	970	18.62	1116	12729
14	2	16	33	1.19	66	1036	19.89	692	13421
15	2	18	30	1.34	60	1096	21.04	289	13710
16	1	19	29	1.41	29	1125	21.60	235	13945
17	1	20	28	1.49	28	1153	22.13	470	14415
18	1	21	26	1.56	26	1179	22.63	123	14538
19	1	22	24	1.63	24	1203	23.09	532	15070
20	2	24	23	1.78	46	1249	23.98	735	15805
21	2	26	22	1.93	44	1293	24.82	468	16273
22	3	29	21	2.15	63	1356	26.03	1112	17385
23	4	33	20	2.45	80	1436	27.57	1484	18869
24	2	35	19	2.60	38	1474	28.30	587	19456
25	5	40	18	2.97	90	1564	30.02	1288	20744
26	4	44	17	3.27	68	1632	31.33	416	21160
27	**5**	**49**	**16**	**3.64**	**80**	**1712**	**32.87**	**617**	21777
28	5	54	15	4.01	75	1787	34.31	1264	23041
29	8	62	14	4.61	112	1899	36.46	1579	24620
30	10	72	13	5.35	130	2029	38.95	1246	25866

31	11	83	12	6.17	132	2161	41.49	1976	27842
32	14	97	11	7.21	154	2315	44.44	1308	29150
33	17	114	10	8.47	170	2485	47.71	2294	31444
34	19	133	9	9.88	171	2656	50.99	2629	34073
35	13	146	8	10.85	104	2760	52.99	908	34981
36	27	173	7	12.85	189	2949	56.61	1864	36845
37	39	211	6	15.75	234	3183	61.11	2746	39591
38	**57**	**268 (219)**	**5**	**19.99**	**285**	**3468**	**66.58**	3276	42867
39	74	342	4	25.48	296	3764	72.26	3145	46012
40	106	448	3	33.36	318	4082	78.36	3297	49309
41	230	677	2	50.45	460	4542	87.20	3861	53170
42	**667**	**1346 (1078)**	**1**	**100**	**667**	**5209**	**100**	**5079**	**58249**
Total		**1346**				**5209**		**58249**	

The value of $e^{x} = 1.781$. His expression is based on, if the sources are ranked in decreasing order of productivity, then expression y_m is the number of items in the most productive source. Then, Y_0 and r_0 are expressed as $Y_0 = y_m 2 \log k$ -----(5); $r_0 = (k\text{-}1)y_m$ ----(6)

Once one gets the value of p in Eqn. (4), the value of k can be calculated by using the following Eqn. $k= (1.781y_m)1/p$ ----------(7) and $Y_0 = A/p$, where A is the total number of articles.

Again, let T represents the total number of journals in Bradford zone, then there are $r0k$i-1 sources would constitute the group ($i = 1, 2, 3, \ldots p$)

$T = r_0 + r_0k^2 + \ldots\ldots\ldots\ldots + r_0k^{p-2}$ ----------(8)

So, $r_0 = T/1+k+k^2+\ldots+k^{p-1} = T(k\text{-}1)/(k^{p-1})$ ---------- (9)

From this, one is able to derive the value of A and T, r_0 and y_0 can be calculated by expression using Eqn. (7) which gives the value of p. This whole expression is tried here to justify the application of Bradford law and Leimkuhler model to test their fitness of good for the literature in neural network.

Table 3 presents the overall coverage of the journals and the number of articles published by them. The table also presents the data for cumulative number of journals, cumulative percentage of journals, cumulative citations to assess the distribution of Bradford plot.

Table 4: Scattering of journals in Bradford zone of neural network research output in India

Zone	No.of journals	No. of publications	No. of citations	Multiplier
1	49 (3.64)	1712 (32.87)	21777	-
2	219 (16.27)	1756 (33.71)	21090	4.47
3	1078 (80.09)	1741 (33.42)	15382	7.80
	1346	**5209**	**58249**	**6.14**

On the basis of the distribution of journals and corresponding number of articles published by each journal, a three zone has been framed as per the Bradford conception. The distribution of these three zones is given in Table 4. In context of present literature on neural network, it is found that 49 journals constitute first zone have 1712 (32.87 %) articles, next zone with 219 journals have 1756 (33.71 %) articles and much larger group of 1078 journals have 1741 (33.42 %) articles. Bradford postulated the division into three equal zones of one third article is each zone. Based on the Bradford law, each zone should follow a linear geometric expression in the form of 1: n : n^2. On analysis of the data, it is found that the literature on neural network does not follow this rule and each zone represents the Bradford expression as 49: 219:1078 which does not fit into the expression.

The first zone, which is represented as nucleus zone have 49 journals and the multiplier value n = 6.14 (the mean value) is expressed as: 49 : 49 x 6.14 : 49 x (6.14)2 :: 1 : n : n^2. i.e., 49 : 300.86 : 1847.2804 >> 2197.1404

Percentage error =2197.1404 – 1346 /1346 *100 = 63.23 %.

On the basis of this calculation, it is found that the percentage error is very high, and the data of neural network literature does not fit the Bradford expression.

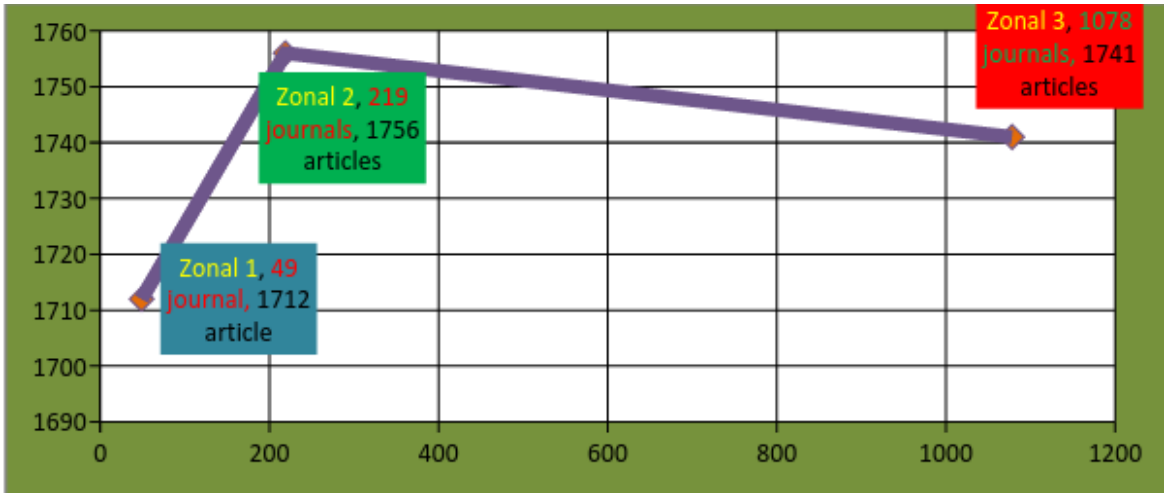

Figure 2: Scattering of journals in Bradford's law of neural network research output

5.4 Verification of Bradford Law through Leimkuhler Model

Bradford law's of scattering has been widely used to study the distribution of literature throughout the globe. According to this law, there are small numbers of a journal which produce maximum number of literature, constitutes a nucleus of core journals. There is various variant interpretation of Bradford law. These variant forms were discussed by Leimkuhler. For this study both the model of Bradford as well as Leimkuhler were tested to justify the scattering of the literature in neural networks. A = 5209 (Total number of articles)

y_m = 178 (Number of items in most productive source); T = 1346 (Total number of journals)

p = 3 (Number of zones in which the data has to be divided)

y_0 = A/p = 5209/3 = 1736.33 = 1736 (approx.)

$k = (1.781 \times 178)^{1/3} = (317.018)^{1/3} = 10.567 = 11$ (approx.)

$r_0 = T(k-1)/(k^p-1) = 1346\ (11-1)/(11^3-1) = 10.12$ (approx.)

$a = y_0/\log k = 1736/\log 35 = 1736/1.544 = 1124$ (approx.)

$b = k\text{-}1/r_0 = 11\text{-}1/35 = 0.29$

Thus, one can notice that the percentage error in this case is negligible, and the number of journals publishing neural networks literature is increased by 5.74, the new Bradford multiplier. The Bradford constant was calculated from the distribution of journals in 3 zones according to Bradford model (Table 5). In the graphic formulation of Bradford-Zipf plot (Fig. 3) the behavior can be seen of scientific publications going as an ascending line. It is necessary to calculate Bradford's constant 'k'

which will be the multiplied to calculate the increasing number of journals for each zone. Using the formula of Egghe (1991), $k= (e^{r}y_m)1/p$ *where* $r = 0.5772$; rm is the number of articles by the journal of rank one and p is the number of zones or Bradford's groups. Using the formula of Egghe, $k = (e^{r}y_m)1/p$ $p = 3$, $e = 2.718$, $y = 0.5772$,

$k = (2.7180.5772 * 178)^{1/3} = 10.56$

For calculating the number o journal in each Bradford froup or zone by find the number of journals in the first Bradford group or zone or the nucleus zone, $r_0= T(K-1) / (kp – 1) = 10.12$ (approx.) with the values of k and r_o it is possible to calculated the number of journals in other Bradford groups and they will be $r_0 = r_0 \times 1 = 10.12 *1 = 10.12$; $r_1 = r_0 *k = 10.12 * 10.56 = 106.87$; $r_2 = r_0*k^2 = 10.12 * (10.56)^2 = 1128.52$.

Here it is found that the nucleus zone is having 10.12, the next zone is having 106.87 and next higher zone is having 1128.52. i.e., from the table we can find it is 49, 219 and 1078 respectively. Bradford's law is not suitable for the present set of data.

5.5 Institution wise distribution of neural network research output

Totally 2837 institutions were contributed in neural network research in India during 2001 to 2015. The research has taken most productive institutions (10) based on their productivity. Among those, Indian institute of Technology produced 110 articles, 2121 TLCs, 17142 TGCS and 57 h- index with stood in first rank position. Followed by institutions of National Institute of Technology and Jadavpur University was contributed more than 200 articles. Indian institute of Science has highest h – index in second rank place. It could be identified the '**Indian institute of Technology'** has contributed more number of articles are earned highest number of citations scores and h – index values.

Table 5: Institution wise contribution of Neural network research output in India

S.No	Institution	Recs.	TLCS	TGCS	h-index
1	Indian Institute of Technology	1100	2121	17142	57
2	National Institute of Technology	360	347	3290	28
3	Jadavpur University	215	242	2814	27
4	Anna University	186	91	1560	18
5	Indian Institute of Science	168	250	2903	29
6	Indian Statistical Institute	159	169	1976	23
7	Annamalai University	68	44	558	12

8	Bharathiar University	68	75	640	14
9	PSG College of Technology	68	33	432	10
10	University of Calcutta	63	90	432	12

5.6 Highly cited articles

Totally 117784 cited references by 5209 articles in neural network research output in India, among those, most cited articles were displayed in below table 6. The author of 'Haykin S' has earned highest citation by 353 articles from different sources. Followed by the author of 'Rumelhart D.E' has earned highest citation by 245 articles from different sources. The author of 'Vapnik VN' has earned highest citation by 211 articles from different sources. Rest of the authors and sources were cited by others in below 200 times. It could be noted that the '**Haykin S'** is active author for most cited references by others.

Table 6: Highly cited articles in Neural network research output in India

Authors	Year	Source	Cited times
Haykin S	1999	Neural Networks Computer	200
Goldberg DE	1989	Genetic Algorithms Science	162
Hornik K	1989	Neural Networks	158
Haykin S	1994	Neural Networks Computer	153
Rumelhart DE	1986	Nature	140
Hagan MT	1994	IEEE T Neural Networks	123
Bishop C-M	1995	Neural Networks Patt.	122
Maier HR	2000	Environ Modell Software	114
Vapnik VN	1995	Nature Stat Learning	109
Jang JSR	1993	IEEE T Syst. Man Cyb.	105
Rumelhart D.E	1993	Parallel Distributed	105
Takagi T	1985	IEEE T Syst Man Cyb.	103
Vapnik VN	1998	Stat Learning Theory	103
Zadeh LA	1965	Inform Control	102
ASCE	2000	J Hydrol Eng.	93

5.7 HISTORIOGRAPHIC (authors) ANALYSIS OF LCS and GCS

The congregation records were exported into the HistCite software for data extracting to acquire list of 5209 articles were published by 1346 different journals during 2001 to 2015, and their local and global citation scores (LCS and GCS). HistCite enables one to draw a citation network among highly cited research articles (authors and journals) from which one gets a feel for the fruition of the subject (or research obverse) over the years.

For the LCS map, due to the top publication (top 30) number (18) of links, and to have a clear graph a minimum of 14 Total Local Citation Scores to maximum 49 Total Global Citation Scores and 106 cited references was derived.It could be identified the 141st article has published in the journal of "hydrological Processes" at 2002, it earned the 15 cited references, 49 local citations (highest), 166 global citations measured; followed by the 476th article has published in the journal of "Journal of Hydrology", it earned the 43 cited references, 25 local citations, 244 global citations (highest) measured written by the authors of "Nayak PC, Sudheer KP, Rangan DM, Ramasastri KS" at 2004; and the 1013th article has written by the authors of "Tripathi S, Srinivas VV, Nanjundiah RS" at 2006 and published in the journal of "Journal of Hydrology", it earned the 106 cited references (highest), 17 local citations, 147 global citations measured. It concludes from this analysis among the selected 25 nodes, the journal of "Hydrological Process" and 'Journal of Hydorology' was identifying the active journals.

For the LCS map, due to the top publication (top 30) number (3) of links, and to have a clear graph a minimum of 124 Total Local Citation Scores to maximum 300 Total Global Citation Scores and 250 cited references was derived. It could be identified the 141st article has published in the journal of "hydrological Processes" at 2002, it earned the 15 cited references, 49 local citations (highest), 166 global citations measured; Followed by the 3292th article has published in the journal of "Journal of Neuroscience", it earned the 88 cited references, 300 global citations (highest) measured at 2012; and the 946th article at 2006 and published in the journal of "Renewable and Sustanable energy Reviews", it earned the 250 cited references (highest), 2 local citations, 172 global citations measured. It concludes from this analysis among the selected 30 nodes, the journal of "Hydrological Process" and 'Journal of Neuroscience' was identifying the active journals. Figure 3 reveals the same result for journals based on their highest citation scores.

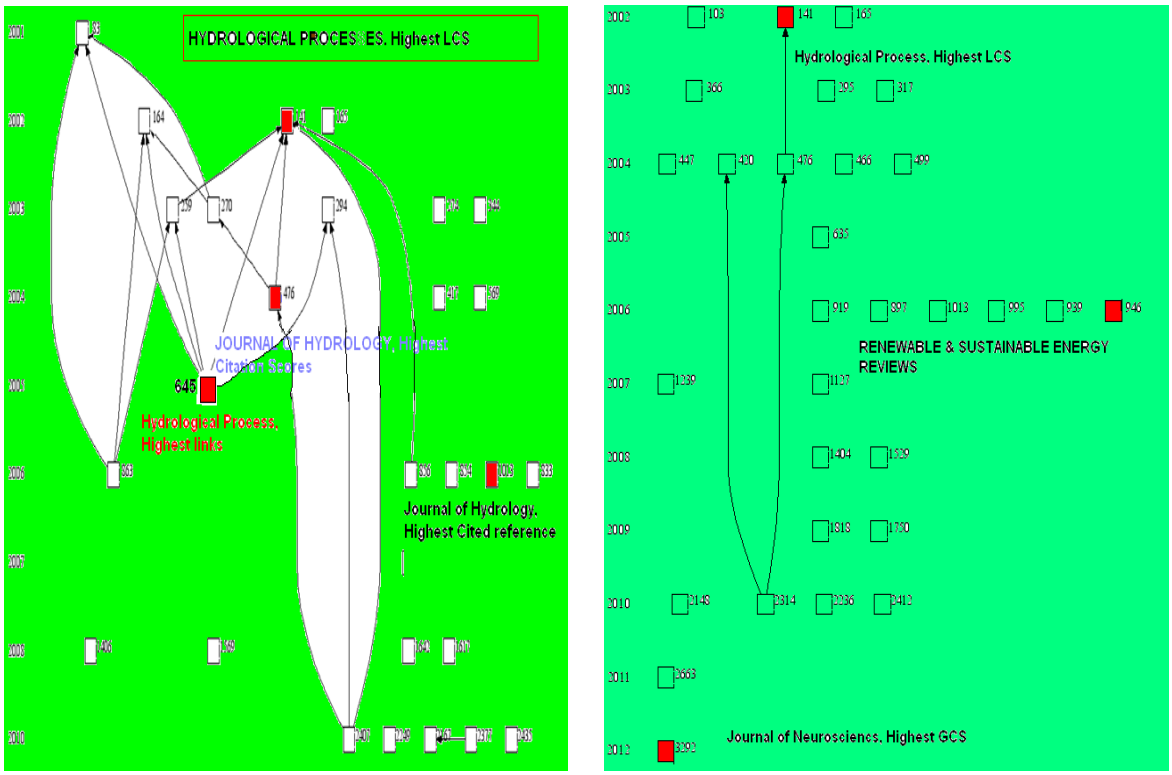

Figure 3: Historiographic (LCS and GCS) analysis for journals in neural network

6. CONCLUSIONS

Based on this research analysis, the format of journals article types were contributed highest publications in neural network research output in India, 5209 articles were available in the web of science database during 2001 to 2015. The journal distribution pattern Library and Information Science theses does not fit the Bradford's distribution pattern $1:n:n^2$. In the present data set 49 journals covered 1712 articles, next 219 journals covered 1756 articles and next 1078 journals covered 1741 articles. In other words, one third of the total citations were covered by each group of the journals. According to Bradford's, the zones, thus identifies will form an approximately geometric series in the form 1: n: n was found that the relationship of each zone in the present study was 49:219:1078. This does not fit into the Bradford's distribution. Therefore, the method based on the Leimkuhler model is employed for the verification of Bradford's Law When the Leimkuhler model is employed for the verification of Bradford's Law, it was found that the law find valid for the data set. The percentage of error is found to be the most negligible. Bradford's Law of Scattering was an area work has been done. It is identified the most productive journal of "Applied Soft Computing" have highest contributions and contributors with highest citation and h-index values. From the LCS Historiographic map analysis "Journal of Hydrology" and "Hydrological Process" has highest links

and highest LCS and GCS values measured. From the GCS Historiographic map analysis, "Journals of Neuroscience" has highest earned maximum GCS scores measured. 'Indian Institute of Technology" has produced more number of articles in this field and author of '**Haykin S'** is identified the active author for most cited references by others.

This study is an attempt to analyze the patterns of publication in the field of neural network. This study shall be helpful to the library and information science community to choose right journal in case of computer science dealing. This study shall also be helpful to the scientists who are working in the area of computer science who wish to publish their research in this area.

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