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Aquaculture Research Outputs from Scopus Database: A Bibliometric Analysis

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Abstract **- This study aims to research output of aquaculture research indexed to the Scopus database during 1999-2013. About 1,06,227 bibliographical records were downloaded from Scopus database during 1999-2013. The present study demonstrates the various aspects such as year wise distribution of article, source wise distribution of article, Bradford's law of scattering, Lotka's law of author productivity, Zipf's law analysis of word frequency have been analysed.**
Keywords: **Aquaculture, Bibliometric, Bradford's Law , Lotka's Law, Zip's Law, Vos Viewer**

I. INTRODUCTION

Bibliometrics has emerged as thrust area of research incorporating different branches of human knowledge. Bibliometrics is a fast developing area in Library and Information Science, which is defined as a discipline that investigates the properties and behavior of Information. The term "bibliometrics" was coined by Pritchard in 1969. A pioneering example of a bibliometric study was statistical analysis of the literature of comparative anatomy from 1543 to 1860, done by counting books and Journal titles, and grouping them by countries of origin and periods. In 1923, a study was conducted by Hulme, entitle "Statistical Analysis of the History of Science". His analysis was based on the entries in the English International Catalogue of Scientific Literature. A third study was the work of Gross and Gross reported in 1927. They counted and analysed the citations in articles from the Journal of the American Chemical Society, and produced a list of journals deemed important to chemical education. Another prominent work was Bradord's 1934 article on the distribution of literature in lubrication research. In 1948, the great library scientist, S. R. Ranganathan, coined the term "librametry" which historically appeared first and was intended to streamline the services of librarianship. Bibliometrics is analogous to Ranganathan's librametrics, the Russian concept scientometrics, biometrics, technometrics, chemometrics and climemetrics, where mathematics and statistics are applied to study and solve problems in their respective fields. Scienctometrics is now used for the application of quantitative methods to the history of science and overlaps with bibliometrics to a considerable extent.

II. SCOPE AND PURPOSE

The Scope of bibliometric analysis includes the study or relationship within a literature and describing a literature. Bibliometrics studies are generally base on quantitative measurement without any qualitative evaluation. The scope of bibliometrics includes studying the relationship with a literature or describing a literature typically, these description focus on consist pattern, involving authors, journals or subject, and language. It is quantitative science and it is divided into two basic categories viz. description and evaluative bibliometrics. The descriptive bibliometrics further included the study of the number of publications in a given field or productivity of literature in the field for the purpose of comparing amount of production during different period or the amount product in different subdivisions of the field. Evaluative bibliometrics includes the study of literature used by research workers in a given field. Such a analysis is often made counting the references cited by a large number f research workers in the research papers.

III. DATA AND METHODOLOGY

In order to get an idea about similar studies done in bibliometrics, an exhaustive literature search was carried out. For this the necessary data were collected from the Scopus database using term of "aquaculture", collecting, organizing and analyzing of data were done on the basis of established bibliometrics / Scientometric methods. The downloaded data was sorted to prepare table and figures using MS-Excel software. This data has downloaded limits the duration of 1999 to 2013 and the major topic of aquaculture.

IV.LITERATURE REVIEW

Literature plays a very important role in research activities, as it forms the very first step of a research pursuit. The researcher reviewed only those studies which are related to the present study concerned. Swain and Panda (2012) conducted a bibliometric study on Journal of Intellectual Property Rights, 2002 to 2010 and found that due to absolute domination of solo contributions, the visibility of collaborative contribution was found remarkably less. The study further revealed that about one third of the total publications received citations, more than half of the cited articles carried just one citation, one fourth got 2 citations, and the rest received citations between 3 to 9 times**.** Surulinathi et al. (2011) analysed the Indian literature output scanned in Web of Science during 1999-2011 on solar

energy research indicates that the growth of the literature. The area of solar fuels and Material sciences multidisciplinary has received maximum attention. Publication output of literature by different countries collaboration follows the trend in basic sciences with USA and South Korea being the major producers with India. The contribution of Indian Institutions and Global Citation Scores, h-index, g-index and h-index has been analysed. Si, Linbo (2010) has carried on the statistical analysis to the published papers, column set, author and citation of Tsinghua Journal of Education (2007-2008) through applying the method of scientometrics, and makes the appraisal of its publication characteristic and academic influence accordingly. McKieran (2005) has described the bibliometrics as traditionally associated with the quantitative measure of documentary materials and embraces all studies which seek to quantify the process of written communication. These include 48 science studies, research evaluation, knowledge management, environmental scanning, trend analysis, and the optimization of library and information resources. Significant Web resources relating to bibliometrics and related approaches are now available.

V. OBJECTIVES OF THE STUDY

1. To find out year wise and source wise distribution of Aquaculture research productivity from 1999-2013;
2. To find out Bradford's law of scattering (3519 Journal Articles) during 1999 to 2013;
3. To study Lotka's law of author productivity distribution of aquaculture during 1999-2013
4. To study Zipf's law analysis of word frequency distribution of aquaculture during 1999-2013.

VI. DATA ANALYSIS OF THE STUDY

The selected period taken for this analysis of aquaculture research productivity is from 1999-2013 (fifteen years). Totally, 106227 numbers of records were downloaded from the database of Scopus during the sample period in the subject of aquaculture.

TABLE I YEAR WISE DISTRIBUTION OF AQUACULTURE RESEARCH PRODUCTIVITY

S.No.	Year	No. of records	Percentage	Growth trend	Cumulative records	Cumulative percentage
1	1999	3314	3.12	-	3314	3.12
2	2000	3426	3.23	0.11	6740	6.35
3	2001	3802	3.58	0.35	10542	9.92
4	2002	4105	3.86	0.28	14647	13.79
5	2003	4774	4.49	0.63	19421	18.28
6	2004	5011	4.72	0.23	24432	23.0
7	2005	5489	5.17	0.45	29921	28.17
8	2006	6760	6.36	1.19	36681	34.53
9	2007	7256	6.83	0.47	43937	41.36
10	2008	7834	7.37	0.54	51771	48.74
11	2009	8052	7.58	0.21	59823	56.32
12	2010	9705	9.14	1.56	69528	65.45
13	2011	11403	10.73	1.59	80931	76.19
14	2012	11822	11.13	0.4	92753	87.32
15	2013	13474	12.68	1.55	106227	100
	Total	106227	100			

The year wise assessment reveals that in the year 1999 has 3314 (3.12%) records shared; followed by the year of 2000 when 3426 (3.23%) articles were published in the subject of aquaculture; 2001 when 3802 (3.58%) articles were found; the year of 2002 when 4105 (3.86%) articles in aquaculture; the year of 2003 when 4774 (4.49%) articles were found in aquaculture; the year 2004 when 5011 (4.72%) articles were found the year 2005 when 5489 (5.17%) articles were found the year 2006 when 6760 (6.36%) articles were found the year 2007 when 7256 (6.83%) articles were found; the year 2008 when 7834 (7.37%) articles were found; the year 2009 when 8052 (7.58%) articles were found; the year of 2010 when 9705 (9.14%) articles were found; the year 2011 when 11403 (10.73%) articles were found; the year 2012 when 11822 (11.13%) articles were found and the year 2013 when 13474 (12.68%) articles were found. Among those 106227 publications; the year of 2013 has the highest number of publications of 13474 (12.68%); in 2012 11822 (11.13%) records were published and in the year 2010 11403 (10.73%) records were found from the Scopus database and the years of 2013, 2012 and 2011 have highest number of publications and it occupied the first, second and third positions among the sample fifteen years.

The eight (8) document types have brought out this aquaculture research output at the global level such as articles; conference proceeding papers; Letters; Reviews; Notes, Short Surveys; Errata and Editorials.

TABLE II ANALYSIS OF SOURCE WISE OF AQUACULTURE RESEARCH OUTPUT

S.No.	Source Types	1999 - 2003	2004 - 2008	2009 - 2013	Total
1	Article	17264 (18.15)	28324 (29.78)	49531 (52.07)	95118 (89.54)
2	Conference papers	1283 (23.19)	2078 (37.56)	2171 (39.24)	5532 (5.21)
3	Letter	15 (0.38)	1674 (42.43)	2256 (57.19)	3945 (3.71)
4	Review	732 (80.62)	71 (7.82)	105 (11.56)	908 (0.85)
5	Note	34 (14.98)	31 (13.66)	162 (71.37)	227 (0.21)
6	Short Survey	51 (23.83)	76 (35.51)	87 (40.65)	214 (0.20)
7	Erratum	16 (9.64)	59 (35.54)	91 (54.82)	166 (0.16)
8	Editorial	26 (22.41)	37 (31.9)	53 (45.69)	116 (0.11)
	Total	19421(18.28)	32350 (30.45)	54456 (51.26)	106227

The above table shows that the researcher has divided the study period into the three year groups: 1999 to 2003; 2004 to 2008 and 2009 to 2013. The article sources have 18.15% of publications in 1999 to 2003 year group; 29.78 percent of publications were in the year group of 2004 to 2008 and 52.07% of publications were in the year group of 2009 to 2013. The source of conference proceeding papers has 23.19% of publications in the year group of 1999 to 2003; 37.56% of publications were in the year group of 2004 to 2008 and 39.24% of publications in the year group of 2009 to 2013. The form of Letter source publications is highest in the year group of 2009 to 2013; followed by the form of Review source publications in the year group of 1999 to 2003; the form of Note sources produced highest publication in the year group of 2009 to 2013; the form of Short survey sources, the form of Erratum and Editorial sources produced highest publications in the year group of 2009 to 2013 respectively. It could be presumed from the above discussion that journal articles predominate over other sources of publications in aquaculture productivity during the sample period. More than fifty per cent of publications were produced by the year group of 2009 to 2013. It occupies the pivotal place in journals as a medium of scientific communication more than any other form of publication.

The aim of *Bradford's* law is to explain that a group of journals could be arranged in an order of decreasing productivity and reveal that journals which yield most productive articles come first while the most unproductive tail last. According to this law journals are to be grouped into a number of zones each producing a similar number of articles. However, the number of journals in each zone will increase rapidly. Then the relationship between the zones is 1: a: n2. The total number of articles 106227 and the total number of journals are 3519.

An extensive review of literature of Bradford Law of Scattering (BLS) is provided by Lockett (1989) and Wilson (1995). BLS is a well-known bibliometric law which has received a lot of attention in information and library science re-search (e.g. Vickery, 1948; Brookes, 1968, 1969; Garfield, 1971; Buckland, 1972; Bonitz, 1980). BLS describes how articles in a subject (topic) are scattered across journals. “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 several groups or zones containing the same number of articles as the nucleus, when the numbers of periodicals in the nucleus and succeeding zones will be as a : n : n^2 : n^3 …“ (Brad-ford 1948). There are numerous examples of applications of Bradford law in various disciplines like natural sciences and social sciences (e.g. Wagner-Döbler, 1997; Peritz, 1990). This law seems to be a very robust and commonly appearing phenomenon in most of the current literature databases and bibliographies. BLS is still under discussion as shown by recent papers (Nicolaisen and Hjørland, 2007, Mayar and Umstätter, 2007, Umstätter, 2005, Bates, 2002, Hood and Wilson, 2001). (Bates, 2002) Bates applies conceptually different search techniques (directed searching, browsing and linking) to the classical three Bradford zones (Z1, Z2 and Z3).

The above table identifies the highest number of journals which contributed articles in aquaculture research publications during 1999 to 2013. This study reports 3519 sources to have published 106227 articles. 24 different single journals produced more than 509 to 8128 articles. 1029 (29.24%) journals contributed. The bold letters mention the values of three zones based on Bradford’s law of scattering. It is concluded from the analysis that first zone (ninety nine) journals were found on nuclear or core journals.

TABLE III BRADFORD'S LAW OF SCATTERING (3519 JOURNAL ARTICLES) DURING 1999 TO 2013

S.No.	No. of journals	R. O/P	Total no. of R. O/P	Cum. No. of R. O/P
1	1	8128	8128	8128
2	1	3567	3567	11695
3	1	2620	2620	14315
4	1	2257	2257	16572
5	1	1871	1871	18443
6	1	1734	1734	20177
7	1	1575	1575	21752
8	1	1480	1480	23232
9	1	1362	1362	24594
10	1	1329	1329	25923
11	1	1124	1124	27047
12	1	985	985	28032
13	1	864	864	28896
14	1	726	726	29622
15	1	714	714	30336
16	1	684	684	31020
17	1	657	657	31677
18	1	637	637	32314
19	1	624	624	32938
20	1	620	620	33558
21	1	595	595	34153
22	1	578	578	34731
23	1	529	529	35260
24	1 (24) (0.68)	509	509	35769 (35409) (33.67)
25	5	503	2515	38284
26	8	501	4008	42292
27	12	492	5904	48196
28	11	457	5027	53223
29	17	389	6613	59836
30	11	371	4081	63917
31	14	338	4732	68649
32	10 (88) (2.50)	316	3160	71809 (70818) (33.93)
33	12	293	3516	75325
34	14	252	3528	78853
35	18	226	4068	82921
36	21	207	4347	87268
37	20	177	3540	90808
38	19	106	2014	92822
39	23	99	2277	95099
40	22	57	1254	96353
41	23	26	598	96951

42	24	12	288	97239
43	37	11	407	97646
44	42	10	420	98066
45	55	9	495	98561
46	61	8	488	99049
47	73	7	511	99560
48	82	6	492	100052
49	131	5	655	100707
50	275	4	1100	101807
51	539	3	1617	103424
52	887	2	1774	105198
53	1029 (3407) (96.81)	1	1029	106227 (34418) (32.40)
	3519	40657	106227	

TABLE IV SHOWING BRADFORD'S DISTRIBUTION OF JOURNALS

Zone	No. of journals	No. of records	Multiplier factor
Z1	24 (0.68)	35769 (33.67)	-
Z2	88 (2.5)	36040 (33.93)	3.67
Z3	3407 (96.81)	34418 (32.40)	38.72
	3519	106227	14.13

The above table 4 shows the observation of small groups of twenty four journals identified to be the nuclear or core zone representing 0.68% of total journals covered. A maximum segment of articles is 35769 (33.67). The second larger group of 88 (2.5%) journals provides 36040 (33.93%) articles and the third largest zone of 3407 (96.81%) periodicals yield the next 34418 (32.40%) articles. The Bradford multiplier between the number of references in zone 1 and zone 2 is 3.67, while it is 38.72 between zone 2 and zone 3. The average multiplier value is 14.13.

According to *Bradford's* distribution, the relationship between the zone is 1: a: n^2. In contrast is the relationship in each of the present study i.e. 24:88:3407 which does not fit into *Braflord's* distribution. This shows that core contributions are given by 24 journals, i.e. less than Bradford formulated and the final zones (Z_3) contain a very large number of journals, i.e. much more than the Bradford's formula. This is a clear indication that core zone is more concentrated and the other zone is much extended showing the scattering of journals / sources on aquaculture research literature. When this analysis is done for a wider range of periods, the extent of scattering can increase. Hence the analysis of data clearly discounts Bradford's Law of scattering. Sixth (The distribution of Aquaculture research output journals and articles confirms the implications of Bradford's law) hypothesis is proved from the above analysis.

Lotka's Law of Author Productivity

Lotka's law is one of the three major laws of bibliometrics that mainly explains the distribution of literature of various authors' productivity in a given field (Lotka 1926). It finds that most articles are being contributed by a few researchers, with a large proportion of researchers contributing to just one publication. Therefore, Lotka summarizes the logarithmic relation between researchers and publication quantities. It states that "the number of authors making n contribution is about $1/n^2$ of those making one publication and the proportion of all contributors that make a single contribution is about 60 percent" (Lotka 1926), as cited by Potter (1988). The general formula is $XY = C$, where X is the number of publications, Y is the relative frequency of authors with X publications, and n and C are constants, depending on the specific field. In brief, the author who publishes two articles accounts on average for 1/4 of the total number of publications. The authors who publish three articles account for about $1/9^{th}$ of the total number of publications and so on. Therefore, authors who publish one article account for 60% of all the publications. That is to say, authors who publish n publications will be $1 / n^2$ of the proportion of total publications. This formula is also called the Inverse Square Law (Tsay 2003).

TABLE V LOTKA'S LAW OF AUTHOR PRODUCTIVITY

No. of contributor's	No. of contribution	Y	∑X = log x	∑Y = log y	∑X*Y	∑X*X
1	621	621	0	6.431	0.000	0.000
1	594	594	0	6.387	0.000	0.000
1	528	528	0	6.269	0.000	0.000
1	496	496	0	6.207	0.000	0.000
1	437	437	0	6.080	0.000	0.000
2	362	724	0.693	6.585	4.564	0.480
1	316	316	0	5.756	0.000	0.000
1	292	292	0	5.677	0.000	0.000
1	276	276	0	5.620	0.000	0.000
2	254	508	0.693	6.230	4.319	0.480
1	233	233	0	5.451	0.000	0.000
3	218	654	1.099	6.483	7.122	1.207
1	189	189	0	5.242	0.000	0.000
2	179	358	0.693	5.881	4.076	0.480
1	161	161	0	5.081	0.000	0.000
2	153	306	0.693	5.724	3.967	0.480
3	148	444	1.099	6.096	6.697	1.207
2	137	274	0.693	5.613	3.891	0.480
5	131	655	1.609	6.485	10.437	2.590
1	297	297	0	5.694	0.000	0.000
2	277	554	0.693	6.317	4.379	0.480
4	261	1044	1.386	6.951	9.636	1.922
3	237	711	1.099	6.567	7.214	1.207
1	217	217	0	5.380	0.000	0.000
3	204	612	1.099	6.417	7.050	1.207
3	91	273	1.099	5.609	6.163	1.207
2	85	170	0.693	5.136	3.560	0.480
8	83	664	2.08	6.498	13.513	4.324
2	78	156	0.693	5.050	3.500	0.480
5	77	385	1.609	5.953	9.581	2.590
7	75	525	1.946	6.263	12.188	3.787
6	71	426	1.792	6.054	10.848	3.210
8	66	528	2.08	6.269	13.036	4.324
9	62	558	2.20	6.324	13.896	4.828
5	61	305	1.609	5.720	9.206	2.590
8	60	480	2.08	6.174	12.838	4.324
7	59	413	1.946	6.023	11.721	3.787
11	58	638	2.398	6.458	15.486	5.750
12	56	672	2.485	6.510	16.177	6.175
15	55	825	2.708	6.715	18.186	7.334
18	51	918	2.890	6.822	19.719	8.354
20	50	1000	2.996	6.908	20.694	8.974
19	48	912	2.944	6.816	20.068	8.670

21	47	987	3.045	6.895	20.991	9.269
23	44	1012	3.135	6.920	21.697	9.831
32	42	1344	3.466	7.203	24.965	12.011
45	41	1845	3.807	7.520	28.627	14.491
58	40	2320	4.060	7.749	31.466	16.487
63	38	2394	4.143	7.781	32.237	17.166
77	37	2849	3.611	7.955	28.724	13.039
81	35	2835	4.394	7.950	34.935	19.311
93	32	2976	4.533	7.998	36.253	20.544
98	31	3038	4.585	8.019	36.767	21.022
118	30	3540	4.77	8.172	38.985	22.759
130	28	3640	4.87	8.200	39.913	23.693
161	27	4347	5.08	8.377	42.568	25.821
182	26	4732	5.20	8.462	44.037	27.082
212	25	5300	5.36	8.575	45.935	28.693
276	24	6624	5.62	8.798	49.451	31.589
281	23	6463	5.64	8.774	49.470	31.791
318	22	6996	5.76	8.853	51.012	33.201
337	20	6740	5.82	8.816	51.309	33.873
413	19	7847	6.02	8.968	54.018	36.282
454	17	7718	6.12	8.951	54.765	37.431
598	16	9568	6.39	9.166	58.605	40.878
616	15	9240	6.42	9.131	58.653	41.258
728	14	10192	6.59	9.229	60.824	43.432
823	13	10699	6.71	9.278	62.282	45.064
936	12	11232	6.84	9.327	63.808	46.808
1089	10	10890	6.99	9.296	65.004	48.902
1315	9	11835	7.18	9.379	67.355	51.575
1594	8	12752	7.37	9.453	69.710	54.376
3295	7	23065	8.10	10.046	81.375	65.613
5708	6	34248	8.65	10.441	90.314	74.816
9661	5	48305	9.18	10.785	98.964	84.196
10064	4	40256	9.22	10.603	97.725	84.948
11186	3	33558	9.32	10.421	97.149	86.907
18536	2	37072	9.83	10.521	103.391	96.579
23592	1	23592	10.07	10.069	101.378	101.378
94420	9372	444969	275.0858	600.826	2357.231	1596.756

P = number of x items in table 4.66 = 82
N = maximum number of contributors = 444969
N: Observed value

Pao (1989) proposed the way to calculate n-value and c - value of Lotka's law as in (1) and (2)

$$n = \frac{N\Sigma XY - \Sigma X\Sigma Y}{N\Sigma X^2 - (\Sigma X)^2} \quad (1)$$

n = 82 (2357.231) – (275.0858) (600.826) / 82(1596.756) – (275.086) (275.086)
n = 0.5069

N is the maximum contribution of an author. X is log (x) and Y is log (y) where y denotes the authors who have x number of contribution.

$$c = \frac{1}{\sum_{1}^{p-1}\frac{1}{x^n} + \frac{1}{(n-1)(p^{n-1})} + \frac{1}{2p^n} + \frac{1}{24(p-1)^{n+1}}} \quad (2)$$

Where p is the number of publication groups which authors contribute same number of publications. Besides, Pao also used Kolmogorov – Smirnov (K–S) test to verify if Lotka's law is matched or not under the condition that p-value is greater than thirty five.
Square root of 444969 is 667.061

Verify K-S statistic value sees if Lotka's law is capable of holding for aquaculture related Publications. For N value is greater than 35, therefore, K-S statistics method can be used to verify if Lotka's law could hold for the sample area publications.

$$\text{K-S} = \frac{1.63}{\sqrt{N}}$$

K-S = 0.00244 for N = 444969

Totally 444,969 authors contributed in the area of aquaculture research. 29664.6 authors were calculating the mean value of every year author's contribution and 4.19 number of authors were calculated at individual articles. It emphasizes the fact that the more number of publications by a researcher in any field requires a high degree of inquisitiveness, competency, efficiency, insistence, and exposure to literature. So majority of authors have contributed more number of papers. Further, the nature of the institutions in which the researchers work, the research area of specialization and the availability of infrastructure facilities influence the author's productivity.

The above table indicates the application of *Lotka*'s Law with respect to author productivity of aquaculture research output. It is seen clearly from the table the proportion of all contributions made single contribution 23592. 48305 five authors contribution is higher than other types of joined authors. Further, Lotka's Chi square model confirms the source trend. It explains the fact that the tabulated value shows that observed authors' value is higher than the expected value. Thus, the present analysis clearly invalidates Lotka's findings.

In the present analysis, productivity is attributed to several factors. If a complete publication detail of an author is taken, Lotka's Law testing may present a different picture. This analysis proves the eighth (The scientific productivity of authors in the discipline of Aquaculture research conforms to Lotka's (n - value) inverse square law of scientific productivity) hypothesis.

Zipf's Law Analysis of Word Frequency

The frequency of words and letters in bodies of text has been studied for several purposes, one being Cryptography. This demonstration performs an analysis of several texts, including fragments of popular works in several languages. It shows the distribution of frequencies sorted from the most common to the least common. Word Frequency Analysis is 'Counting the number of times each word in a document is used and correcting any excess, as an author, seem to have a disconcerting habit of reusing the same word or phrase over and over again. Used once, a word can be concise and incisive. But repeated use first devalues and then ultimately annoys'.

Plotting word frequencies illustrates Zipf's law. This is a phenomenological law related to rank data frequencies, primarily of the linguistic corpora. It says that the most frequent word will occur approximately twice as often as the second most frequent word, which will occur approximately twice as often as the fourth most frequent word.

Using the Vos viewer software for counting the frequently occurrence terms in the sample data, the minimum number of occurrence of term is 10., of the 22173 terms were 385 terms relevance score will be calculated by the software itself. Based on this relevance score, the most relevance terms will be selected. 231 number of terms are to be selected. Those mentioned and calculated relevance scored will be showed in the figure below.

The below table shows the relevance score values of frequently occurrence terms; the term of "type strain" has occurred 14 times and having 4.63 relevance scores value; followed by the term of "Nov" which has occurred 14 times and 4.27 relevance score value; the term "royal society" has occurred 10 times and 4.11 relevance score value; the term "Mol" has occurred 13 times and 3.55 relevance score value; the term "specific growth rate" has occurred 15 times and 3.41 relevance score value; the term "book" has occurred 10 times and 3.04 relevance score value; the term "water sample" has occurred 10 times and 2.74 relevance score value; the term "ovary" has occurred 14 times and 2.68 relevance score value; the term "Catalase" has occurred 12 times and 2.47 relevance score value; the term "Chemistry" has occurred 19 times and 2.41 relevance score value; the term "trial" has occurred 18 times and 2.18 relevance score value; the term "estradiol" has occurred 13 times and 2.10 relevance score value; and the term "berlin" has occurred 14 times and 2.00 relevance score value respectively. It could be identified that the terms of "Chemistry", "Trial" and "specific growth rate" occurred many times. The term "type strain" has scored highest relevance score value.

TABLE VI RELEVANCE SCORE VALUES OF FREQUENTLY OCCURRENCE TERMS

Selected	Term	Occurrences	Relevance
☑	type strain	14	4.63
☑	nov	14	4.27
☑	royal society	10	4.11
☑	mol	13	3.55
☑	specific growth rate	15	3.41
☑	book	10	3.04
☑	water sample	10	2.74
☑	ovary	14	2.68
☑	catalase	12	2.47
☑	chemistry	19	2.41
☑	g l	10	2.33
☑	trial	18	2.18
☑	estradiol	13	2.10
☑	berlin	14	2.00

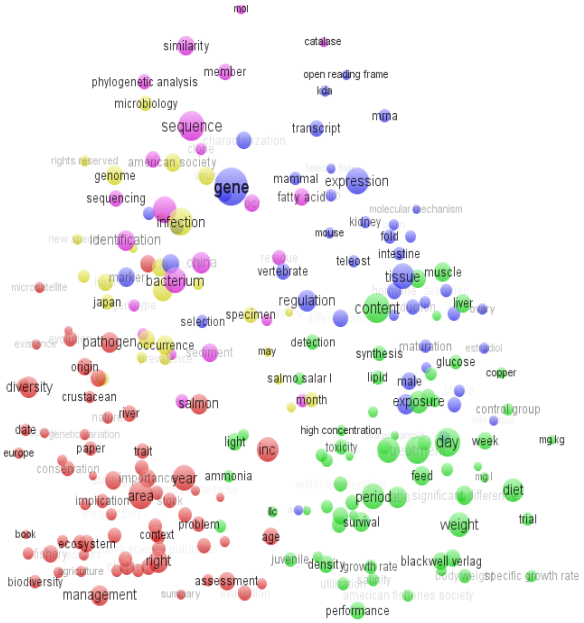

Fig.1 Label View of Frequently Occurring Terms

The above figure shows the frequently occurring term in total sample data label view using the Vos viewer software mapping in aquaculture research output during 1999 to 2013.

VII. FINDINGS AND CONCLUSION

The study sought to indicates that the bibliometric analysis of aquaculture research publication during from 1999-2013 through the Sopus Database has been conceded. It is found that the research on productivity in aquaculture highest publication show that out of 15 years (1999 to 2013), 13474 articles were published in 2013 followed by 2012 and 2011 having highest publications; source wise publications of research output on Aquaculture research ascertains the fact that journal articles predominate over other (eight) sources of publications; the result shows nearly closed the bradford's law of scattering of sources. The Bradford multiplier between the number of references in zone 1 and zone 2 is 3.67, while it is 38.72 between zone 2 and zone 3. The average multiplier value is 14.13. Further, Lotka's Chi square model confirms the source trend. Thus, the present analysis clearly invalidates Lotka's (n-value) findings. The key term of "type strain" has occurred 14 times and having

4.63 relevance scores value. However, journal refers to a record of events, experiences, thoughts, and observations kept on a regular basis by an individual for personal use. Writers often keep a daily journal to record ideas and material that may subsequently be incorporated into their works.

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