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Authorship Pattern Of Mycology Research Output At Global Perspective: A Scientometric Analysis

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Abstract

The study examines Mycology Research in Global level as revealed by the scholarly publication indexed in web of Science database for a period of thirty years from 1989 to 2018.It was seen that the analyses included research growth, author productivity, authorship pattern, Geographical distribution of the literature, citation analysis rank, global publications' share, citation impact, h-index , cited references research output, share of international collaborative papers and major collaborative partner countries and patterns of research communication. The authorship trend shows that, out of total 1765 research literatures published, 79.49% of them or published under the joint author of publications in Mycology research output. It is observed that author productivity is not in agreement with Lotka's law. This shows that team research is prevalent in the area of Mycology. It also analyses the characteristics of most productive authors and high-cited papers.

Key Word: Mycology, Scientometric, Authorship Pattern, Author Productivity, Lotka's Law, Collaboration.

1. Introduction

Mycology is the branch of biology concerned with the study of fungi, including their genetic and biochemical properties, their taxonomy and their use to humans as a source for tinder, medicine, food, and entheogens, as well as their dangers, such as toxicity or infection. The present study aims at analyzing the Scientometric Analysis of authorship trends in Mycology research based on Web of Science Database. The major focus of the study is to apply the Scientometric analysis with a view to analyzed the evaluation and performance of research output in Mycology. This

study related to authors, their productivity; collaborative patterns and other aspects is important and useful to understand the mechanism underlying the growth of knowledge of a discipline. This study also to analyses the performance and evaluation of Mycology research output in terms of its content and coverage growth and contribution of authors, h- index , cited references research output, authorship pattern , degree of collaboration, Lotka's Law of Author Productivity and Inverse square law of scientific author research productivity and citation analysis is also noted.

2. Objectives of the study

The main objective of this study was to use Scientometric analyze the key features of mycology research activities at global level:

1. To identify and analysis the pattern of distribution of Mycology research output in global level during the period from 1989 to 2018.
2. To identify the scientific productivity of authors and authorship Pattern of mycology research output in global level.
3. To study the leading prolific Ranking of Authors based on Publications and citations
4. To identify the proportion of single and multi–authored papers of mycology research output and degree of collaboration
5. To test the applicability of Lotka's law to the scientific productivity of authors in mycology research literature.
6. To test the applicability of scientific productivity of authors in the discipline of Mycology research conforms to Lotka's (n-value) inverse square law of scientific productivity.

3. Methodology

This study is conducted with a view to analyze the trend in the development of Mycology in Scientometric analysis. It is also focused to trace the past trends in the area of research output on Mycology in Scientometric analysis based on the sample data; the study evaluates the contribution of the Growth pattern and development of research productivity in Mycology in the last few decades. This study attempts to find research publication published Mycology research in Web of Science database.

3.1 Collection of Data

For this particular study, all the publications were retrieved from Web of Science database on Mycology, which covers a time span of 30 years starting from 1st January 1989 to 31st December 2018. The researcher has used the search string "Mycology" for getting data from the Web of Science database which includes Science Citation Index (SCI). The researcher has downloaded the bibliographical data in the form of notepad files. Overall data retrieved by the researcher are 1768 records and eliminated 03 duplicate records hence, the refined data consists only 1765 records taken for analyzing the present study. The data has analyzed and classified into Histcite

software. Then the bibliographical details are converted to the form of MS –EXCEL format using the PHP (hyper text pre processor) scripting language text extracting based a delimiters Programme. Finally, the unique data are rearranged in MS –EXCEL format to eliminate duplication from the downloaded data and to analyze the scattering of research in different dimensions.

3.2 Application of Metrics and Basic Laws of Bibliometrics

The following Metrics and Bibliometric law have been used in the analysis of data

3.2.1. Degree of Collaboration Co-Efficient

In order to identify the degree of collaboration, the research or has adopted K. Subramanyam's[1] formula. The formula is **C = Nm/ (Nm+Ns)**

Where, C = Degree of collaboration in a discipline
Nm = Number of multiple authored papers
Ns = Number of the single authored papers

3.2.2 Lotka's Law of Author's Productivity

Lotka's law[2] of author productivity explains number of authors contributed 'n' number of paper. Potter[3] identified the Lotka's fraction $1/n^a$ – 4.65 on the basis of Euler – Maclaurin formula of summation. This model is applied in the present study. The sum was used as deviser for 1/n 4.65 to determine the proportion of the total number of authors expected to produce 'n' paper (in the case of present study n=1, 2, 3, 4… 10), the following formula was used to find the proportions.

$$S = \sum_{n=1}^{10} 1/n\ 4.65$$

For present study S is the sum of Lotka's modified rations for the value a= 4.65.

The formula

$$An = 1/n\ 4.65\ T/S\ (n = 1, 2, 3 \ldots 10)$$

Where T is total number of authors in the sampling and 'An' is the total number of expected authors producing 'n' papers.

The Lotka's law also tested with the application of scientific productivity chi-square model in relation to a number of authors who contributed 'n' number of publication.

It can be expressed by the equation an = a1/n2, n =1,2,3…

In other words, for every 100 authors making one contribution each, there would be 25 others contributing two articles each ($100/2^2 = 25$) about 11 contributing three articles each $100/3^3 = 11.1$, and so on.

Where 'an' is the numbers of authors contributing 'n' papers each; and al is the number of authors contributing each one paper.

The chi-square can be computed as (F-p) 2/p.

F = observed number of authors with 'n' publications

P = expected number of authors.

3.2.3 Lotka's Law Inverse Square Law of Scientific Author Productivity

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 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/n2 of the proportion of total publications.

This formula is also called the Inverse Square Law (Tsay, 2003)[4]. P = Number of x items

N = Sum of contributors, N: Observed value

Pao (1986)[5] proposed the way to calculate n-value and c- value of Lotka's law as in (1) and (2)

The 'n' value is calculated by this method using the following formula

$$N = \frac{N\sum xy - \sum x \sum y}{N\sum x^2 - (\sum x)^2} \quad \ldots (1)$$

N is the maximum contribution of an author. Besides, Pao (1986)[5] 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 twenty.

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

4. Analysis and Discussion

4.1 Growth of Research Output and Citation

In the present study the research output on mycology publication is taken as a tool to evaluate the performance at various levels. Table-1 could clearly see that during the period 1989 - 2018 a total of 1765 publications were published at global level. The highest publication is 140 in 2018 with 229 Global Citation Scores followed by 114 papers in 2015 with 1084 Global Citation Score and 104 papers in 2017 and 2014 with 314 and 1714 Global Citation Scores. The lowest publication is 11 in 1990 with 66 Global Citation Scores. It shows that even minimum numbers of records were scored higher global citations.

It could be also noticed that from the table-1 below totally 1765 publications were

produced by 8218 authors for 30 years with 450 h-index values and its average value was 15 per year from 1989 to 2018 on mycology research. Totally **62036** times Cited references measured by other scientists and its mean value is **2067.87** for every year of sample periods and 32.50 times cited per article. The year of 2007 had the highest h index values and the years of 1989-1991,1993,1995,2018 were had very lowest h index values in single digit. **8218** authors contributed for mycology research output during sample periods and its mean value was **273.9** per year and **3.97** average authors for per article. The cited references it shows that there is a healthy trend in citing reference is found among the global Scientists belongs to Mycology

The year of 2018 had contributed the highest number of authors in mycology research publication. The years of 2012, 2014-2018 contributed more than 500 authors in the field of mycology. The years of 2002, 2009, 2011 and 2012-2018 had average author per article as more than 5 authors. The years of, 1999, 2006-2007 and 2010 had contributed the average author per article as more than 4 authors and other years of 1991-1992, 1998, 2000-2001, 2003-2005 and 2008 have more than three authors as average author per article. It is concluded from this analysis, that the highest h index value is 75 in the year 2007. Highest Cited References of 6733 times cited by authors in the year 2018. The year 2018 has contributed the highest number of authors in the field of Mycology.

Table 1: Shows Growth of Publication, Citation Score, H-Index and cited Reference

S. No	Year	Articles	%	TLCS	TGCS	h-Index	CR	ACRPA	NA	AAPA
1	1989	20	1.1	5	52	3	377	18.85	31	1.55
2	1990	11	0.6	4	66	4	340	30.91	15	1.36
3	1991	28	1.6	34	1045	9	481	17.18	87	3.11
4	1992	35	2.0	27	655	14	684	19.54	114	3.26
5	1993	18	1.0	13	299	7	427	23.72	37	2.05
6	1994	38	2.2	22	560	11	843	22.18	99	2.60
7	1995	31	1.8	24	801	8	594	19.16	77	2.48
8	1996	43	2.4	31	1646	15	1981	46.07	106	2.46
9	1997	31	1.8	17	607	12	1169	37.71	76	2.45
10	1998	42	2.4	31	840	14	1256	29.90	139	3.31
11	1999	44	2.5	35	1073	18	1691	38.43	177	4.02
12	2000	31	1.8	20	594	14	1095	35.32	110	3.55
13	2001	45	2.5	28	892	17	1273	28.29	143	3.18
14	2002	32	1.8	41	959	16	1428	44.63	164	5.12
15	2003	47	2.7	58	1091	18	1308	27.83	182	3.87
16	2004	44	2.5	69	2355	20	1548	35.18	155	3.52

17	2005	46	2.6	73	1096	16	1116	24.26	153	3.33
18	2006	64	3.6	55	1353	22	1691	26.42	289	4.51
19	2007	66	3.7	73	2032	24	2861	43.35	265	4.01
20	2008	53	3.0	32	574	16	1157	21.83	203	3.83
21	2009	74	4.2	99	1721	22	2566	34.68	432	5.84
22	2010	87	4.9	62	1878	21	3383	38.89	409	4.70
23	2011	80	4.5	75	1741	22	3188	39.85	449	5.61
24	2012	99	5.6	69	2395	22	3136	31.68	560	5.66
25	2013	95	5.4	85	1575	20	3574	37.62	475	5
26	2014	104	5.9	111	1742	18	4153	39.93	580	5.58
27	2015	114	6.5	60	1084	17	4238	37.18	660	5.79
28	2016	99	5.6	33	658	14	4159	42.01	507	5.12
29	2017	104	5.9	14	314	10	3586	34.48	606	5.83
30	2018	140	7.9	7	229	6	6733	48.09	918	6.56
Total		1765	100	1307	31927	**450**	**62036**	**975.17**	**8218**	**119.28**
Mean		**58.83**	**3.33**	**43.56**	**10642**	**15**	**2067.87**	**32.50**	**273.9**	**3.97**

4.2 Ranking of Authors Productivity Based on Publications

Table- 2 indicates ranking of authors by number of publications up to top twenty five authors are taken. Among the top twenty five authors, the Author "Negroni R" published highest number of articles for the study period with 26 publications, consecutive authors "Arechavala A" are published next highest number of articles for the study period with 23 publications. **"**Kibbler C C" having highest Global Citation Scores of 1165 with just 12 publications followed by "Tortorano AM" is having Global Citation Score of 1108 with just 11 publications, while Maiolo E having lowest Global Citation Score of 4 with just 12 publications. Thus the most-cited authors are distinguished from the most-published ones.

Table- 2 shows Ranking of Prolific Authors

S. No	Author	Publication	%	TLCS	TLCS /t	TGCS	TGCS /t	TLCR	TLCSb
1	Negroni R	26	1.5	8	0.74	18	3.36	9	1
2	Arechavala A	23	1.3	4	0.62	17	4.24	9	0
3	Dantigny P	20	1.1	99	10.68	410	47.27	58	17
4	Nenoff P	19	1.1	50	11.75	217	47.67	45	1

5	Cornely OA	17	1.0	27	9.71	600	182.42	43	3
6	Santiso G	16	0.9	3	0.51	7	2.72	6	0
7	de Hoog GS	15	0.8	14	2.00	462	63.33	27	4
8	Denning DW	15	0.8	52	10.15	1099	193.63	38	4
9	Hipler UC	14	0.8	5	1.67	11	3.67	14	0
10	Bensoussan M	13	0.7	83	7.65	291	29.13	28	14
11	Hawksworth DL	13	0.7	54	5.60	985	49.58	18	3
12	Meyer W	13	0.7	55	7.38	820	113.87	37	6
13	Ayadi A	12	0.7	7	1.02	87	14.24	4	1
14	Cuenca-Estrella M	12	0.7	46	9.53	764	163.53	26	8
15	Johnson EM	12	0.7	39	4.05	698	83.99	18	7
16	Kibbler CC	12	0.7	76	10.63	1165	153.60	30	13
17	Maiolo E	12	0.7	2	0.31	4	0.52	1	0
18	Meis JF	12	0.7	35	9.63	1085	252.77	36	4
19	Messina F	12	0.7	2	0.31	4	2.31	5	0
20	Arendrup MC	11	0.6	27	7.92	652	175.61	29	3
21	Gangneux JP	11	0.6	4	4.00	114	78.79	19	0
22	Gupta AK	11	0.6	13	1.81	262	35.87	16	6
23	Kruger C	11	0.6	45	10.28	182	42.52	30	1
24	Marin S	11	0.6	23	2.63	167	23.45	41	6
25	Tortorano AM	11	0.6	57	5.76	1108	115.28	23	22

4.3 Authorship Patterns

Table 3 indicates the authorship pattern of research publication on mycology research output. It could be noted that single author publications contribute 20.51 %, followed by four authors publications that contribute 13.37 %, double-author publications 12.75%, three-author research output with 12.58%, five-authors publications 9.86%, six-authors 8.95 % and above ten-author research output 5.21% respectively. From the result, we come to know that the multi-author publication is the highest compare to single-author publication. In thirty years analysis, year

2018 has recorded the highest publication distribution of 7.9% followed by the year 2015 recorded 6.5%, year 2014 and 2017 recorded 5.9% respectively. In view of this analysis, the following year distributions 1990 have contributed less than 1% on mycology.

Table 3: Showing year-wise authorship pattern

ar	Single Authors	Two Authors	Three Authors	Four Authors	Five Authors	Six Authors	Seven Authors	Eight Authors	Nine Authors	Ten Authors	Above Ten Authors	To
89	15	1	3	0	1	0	0	0	0	0	0	2 (1
90	8	2	1	0	0	0	0	0	0	0	0	1 (0
91	11	2	5	4	1	2	2	0	0	0	1	2 (1
92	15	3	3	5	3	2	1	1	0	1	1	3 (2
93	8	4	3	3	0	0	0	0	0	0	0	1 (1
94	13	10	5	5	3	0	1	0	1	0	0	3 (2
95	16	6	2	2	1	0	2	2	0	0	0	3 (1
96	17	12	4	3	3	3	0	1	0	0	0	4 (2
97	15	5	3	3	3	0	1	1	0	0	0	3 (1
98	15	5	5	4	5	2	3	2	1	0	0	4 (2
99	7	5	8	10	3	6	1	1	0	3	0	4 (2
00	11	6	5	1	2	2	2	0	0	0	2	3 (1
01	11	10	9	6	3	2	0	2	2	0	0	4 (2
02	6	5	4	6	6	1	1	0	0	0	3	3 (1
03	7	7	13	6	4	3	3	2	1	0	1	4 (2

04	15	4	8	2	7	3	1	0	2	0	2	4 (2
05	12	7	8	6	5	5	0	3	0	0	0	4 (2
06	14	11	7	7	5	6	4	2	4	1	3	6 (3
07	17	6	12	5	4	9	6	3	2	1	1	6 (3
08	14	7	5	5	10	4	2	4	1	0	1	5 (3
09	10	11	7	10	10	9	7	1	0	2	7	7 (4
10	15	9	6	14	14	12	7	1	3	2	4	8 (4
11	6	8	8	17	4	9	11	6	3	2	6	8 (4
12	16	3	15	12	12	12	8	4	5	1	11	9 (5
13	14	9	12	14	10	7	8	8	6	3	4	9 (5
14	11	10	8	16	15	13	7	7	7	3	7	1 (5
15	11	17	11	21	10	12	10	5	7	3	7	1 (6
16	12	12	14	17	7	10	10	5	3	0	9	9 (5
17	12	12	6	13	13	14	11	9	4	3	7	1 (5
18	8	16	22	19	10	10	14	9	9	8	15	1 (7
tal	**362 (20.51)**	**225 (12.75)**	**222 (12.58)**	**236 (13.37)**	**174 (9.86)**	**158 (8.95)**	**123 (6.97)**	**79 (4.47)**	**61 (3.46)**	**33 (1.87)**	**92 (5.21)**	**17 (1**

4.4 Single Vs Multiple-Authored Research Output and Degree of Collaboration

The single version multi-author research output during the period 1989–2018 is observed. At the overall level, the single-author contributed papers constitute 20.51% of the total publications where-as the remaining majority 79.49% of the papers are contributed by multi-authorship. In

order to determine the collaboration in quantitative terms, the formula suggested by K. Subramanyam was tested. It is inferred from Table 4 that at the aggregate level, the degree of collaboration is 0.74 during the study period 1989–2018, i.e., out of total 1765 literature published, 79.49 % of them were published under the joint authors of publications in mycology research output. The period wise analysis indicates that its level is somewhat less in the first period [1989-2003: 0.65] and it has shown. An increasing trend during the period [2004-2018: 0.82]. This brings out clearly the high level of prevalence of collaborative research in mycology. Based on this study, the result of the degree of collaboration **C=0.74** i.e., 74 percent of collaboration authors articles published during the study periods.

Table-4: Single Vs Multiple Authored Research output and Degree of Collaboration

Year	Single Author		Multiple Authors		Total	%	Degree of Collaboration	Mean in Degree of Collaboration
	No of Output	%	No of Output	%				
1989	15	75	5	25	20	1.13	0.60	0.65
1990	8	72.72	3	27.27	11	0.62	0.57	
1991	11	39.28	17	60.71	28	1.58	0.55	
1992	15	42.85	20	57.14	35	1.98	0.65	
1993	8	44.44	10	55.55	18	1.01	0.48	
1994	13	34.21	25	65.79	38	2.15	0.60	
1995	16	51.61	15	48.39	31	1.75	0.51	
1996	17	39.53	26	60.46	43	2.43	0.64	
1997	15	48.38	16	51.61	31	1.75	0.84	
1998	15	35.714	27	64.28	42	2.37	0.64	
1999	7	15.90	37	84.09	44	2.49	0.75	
2000	11	35.48	20	64.51	31	1.75	0.81	
2001	11	24.44	34	75.55	45	2.54	0.85	
2002	6	18.75	26	81.25	32	1.81	0.65	
2003	7	14.89	40	85.10	47	2.6	0.73	
2004	15	34.09	29	65.90	44	2.49	0.78	0.82
2005	12	26.08	34	73.91	46	2.60	0.74	
2006	14	21.87	50	78.125	64	3.62	0.73	
2007	17	25.75	49	74.24	66	3.73	0.86	
2008	14	26.41	39	73.58	53	3.00	0.82	
2009	10	13.51	64	86.48	74	4.19	0.925	
2010	15	17.24	72	82.75	87	4.92	0.83	

2011	6	7.5	74	92.5	80	4.53	0.85	
2012	16	16.16	83	83.83	99	5.60	0.89	
2013	14	14.73	81	85.26	95	5.38	0.90	
2014	11	10.57	93	89.42	104	5.89	0.87	
2015	11	9.64	103	90.35	114	6.45	0.88	
2016	12	12.12	87	87.87	99	5.60	0.94	
2017	12	11.53	92	88.46	104	5.89	0.79	
2018	8	5.71	132	94.28	140	7.93	0.60	
Total	**362**	**20.51**	**1403**	**79.49**	**1765**	**100**	**0.74**	**0.74**

4.5 .Lotka's Law of Author Productivity

Lotka's law of author productivity is tested with the applications of scientific productivity Chi–square model, and it is applied in relation to number of authors contributing to the number of publications (Table 5). Potter (1981) identified Lotka's fraction 1/na = 4.65 on the basic of the Euler–Maclaurin formula of summation. This model is applied in the present study. The Chi–square can be computed as $(f–p)^2/p$, where f = observed number of authors with "n" publications; p = expected number of authors. In this study, the productivity of mycology research scientists is examined. At the first observation, the analyzed data invalidate Lotka's findings that the proportion of all contributions that make a single contribution is less than 60%. Furthermore, Lotka's Chi-square model confirms the source trend. It explains the fact that the calculated χ^2 value is 72180.32 which is less than the tabulated value at 5% level of significance.

Table – 5: Lotka's Law of Author Productivity- Chi- Square Model

No. of authors	**Observed Number of authors with 'n' or (an) or (f)**	**Observed percentage of authors 100 x an/a1**	**Expected number of authors (an=an/n^2)or (p)**	**Expected percentage of authors**	**$(F-P)^2/P$**
1	362	100	362	100	0
2	225	62.154	56.25	25	506.25
3	222	61.326	24.66667	11.11	1578.667
4	236	65.193	14.75	6.25	3318.75
5	174	48.066	6.96	4	4008.96
6	158	43.646	4.388889	2.78	5376.389

7	123	33.978	2.510204	2.04	5783.51
8	79	21.823	1.234375	1.56	4899.234
9	61	16.851	0.753086	1.23	4819.753
10	34	9.392	0.34	1	3332.34
11	22	6.077	0.181818	0.83	2618.182
12	16	4.419	0.111111	0.69	2272.111
13	7	1.934	0.04142	0.59	1169.041
14	7	1.934	0.035714	0.51	1358.036
15	5	1.381	0.022222	0.44	1115.022
16	4	1.105	0.015625	0.39	1016.016
17	2	0.552	0.00692	0.35	574.0069
18	3	0.829	0.009259	0.31	966.0093
19	6	1.657	0.01662	0.28	2154.017
20	1	0.276	0.0025	0.25	398.0025
21	2	0.552	0.004535	0.23	878.0045
23	2	0.552	0.003781	0.19	1054.004
25	2	0.552	0.0032	0.16	1246.003
26	1	0.276	0.001479	0.15	674.0015
28	2	0.552	0.002551	0.13	1564.003
30	1	0.276	0.001111	0.11	898.0011
31	1	0.276	0.001041	0.10	959.001
34	1	0.276	0.000865	0.09	1154.001
46	1	0.276	0.000473	0.05	2114
53	1	0.276	0.000356	0.03	2807
57	1	0.276	0.000308	0.03	3247
63	1	0.276	0.000252	0.02	3967
66	1	0.276	0.00023	0.02	4354
				χ^2	**72180.32**

4.6 Lotka's Law Inverse Square Law of Scientific Author Productivity

Lotka's law is one of the three major laws of bibliometrics that mainly explain the literature distribution 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 just one publication. Therefore, Lotka summarizes the logarithmic relation between researchers and publication quantities. It states that "the number (of authors) making n contributions is about $1/n^2$ of those making one publication; and the proportion of all contributors, that makes a single contribution, is about 60 percent" (Lotka, 1926), as cited in Potter (1981).

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 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).
P = Number of x items in table = 6

N = Sum of contributors = 8218, N: Observed value

Pao (1986) proposed the way to calculate n-value and c- value of Lotka's law as in (1) and (2) . The 'n' value is calculated by this method using the following formula

$$N = \frac{N \sum xy - \sum x \sum y}{N \sum x^2 - (\sum x)^2} \quad \ldots (1)$$

$$N = \frac{21\,(177.45) - (45.83)\,(93.0014)}{21(114.257) - (45.83)^2}$$

$$N = \frac{3726.45 - 4262.2541}{2399.397 - 2100.3889}$$

$$N = \frac{-535.8041}{299.0081} = -1.7919$$

N is the maximum contribution of an author. Besides, Pao (1986) 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 twenty.

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

Square root of 8218 is 90.6531, and verifies K-S statistic value to see if Lotka's law be capable of hold for Mycology related Publications. For N value is greater than thirty five, therefore, K-S statistics method can be used to verify if Lotka's law could hold for the sample area publications.

K - S = 1.63 / 90.6531 K-S = 0.018 for N = 8218

Totally 8218 authors have contributed in the subject of Mycology. It emphasizes the fact that the more number of publications by a researcher in any field requires high degree of inquisitiveness, competency, efficiency, insistence, and exposure to literatures. That is why

majority of authors have contributed more number of papers. Further, the nature of the institutions in which the researchers are working, the research area of specialization, and availability of infrastructure facilities influence the author's productivity.

Table-6 indicates that the application of Lotka's law with respect to author productivity of Mycology research output. It could be seen clearly from the table that proportion of all contribution that makes a single contribution is 20.21 percentages. It means that the collaborative authors' contribution is very high. Further, Lotka's Chi square model confirms the source trend. It explains the fact that the tabulated value shows that observed author's value is more than expected value. Thus, the present analysis clearly invalidates the Lotka's findings. In the present analysis, productivity is attributed to several factors. If a complete publication detail of an author is taken, the Lotka's law testing may present a different picture. Hence, the sixth objective is proved (The scientific productivity of authors in the discipline of Mycology research conforms to Lotka's (n – value) inverse square law of scientific productivity).

Table – 6: Lotka's inverse square law of scientific Author Productivity

No. of Contribution X	No. of Contributors	Y	∑X= log x	∑Y= log y	∑X*∑Y	∑X*X
1	4931	4931	0	8.503297	0	0
2	623	1246	0.693147	7.127694	4.940541	0.480453
3	169	507	1.098612	6.228511	6.842719	1.206949
4	89	356	1.386294	5.874931	8.144383	1.921812
5	48	240	1.609438	5.480639	8.820748	2.59029
6	23	138	1.791759	4.927254	8.828453	3.210402
7	25	175	1.94591	5.164786	10.05021	3.786566
8	15	120	2.079442	4.787492	9.955309	4.324077
9	9	81	2.197225	4.394449	9.655592	4.827796
10	7	70	2.302585	4.248495	9.782522	5.301898
11	6	66	2.397895	4.189655	10.04635	5.749902
12	7	84	2.484907	4.430817	11.01017	6.174761

13	3	39	2.564949	3.663562	9.39685	6.578965
14	1	14	2.639057	2.639057	6.964624	6.964624
15	2	30	2.70805	3.401197	9.210613	7.333536
16	1	16	2.772589	2.772589	7.687248	7.687248
17	1	17	2.833213	2.833213	8.027098	8.027098
19	1	19	2.944439	2.944439	8.669721	8.669721
20	1	20	2.995732	2.995732	8.974412	8.974412
23	1	23	3.135494	3.135494	9.831324	9.831324
26	1	26	3.258097	3.258097	10.61519	10.61519
241	**5964**	**8218**	**45.83884**	**93.0014**	**177.4541**	**114.257**

5. Major Findings

1. The finding of growth of publication of mycology research output brings out the highest percentage of papers were published in the year 2018, 2015 and 2017 constituting 7.9% and 6.5% and 5.9%, respectively. It shows that even minimum numbers of records scored higher global citations. The study also reveals all these 1765 publications have 46751 cited references, and it shows that a healthy trend in citing reference is found among the scientists who belong to mycology.
2. The find out author "Negroni R" published highest number of articles for the study period with 26 records, consecutive authors "Arechavala A" are published next highest number of articles for the study period with 23 records. **"**Kibbler C C" having highest Global Citation Scores of 1165 with just 12 publications followed by "Tortorano AM" is having Global Citation Score of 1108 with just 11 publications, while Maiolo E having lowest Global Citation Score of 4 with just 12 publications.
3. The findings of degree of collaboration analysis reveal the following facts that the case of single author contributed papers is less. It brings out clearly the high level prevalence of collaborative research in Mycology. Based on this study, the result of the degree of collaboration **C=0.74** i.e., 74 percent of collaboration authors articles published during the study periods.
4. The findings of author productivity in terms of Lotka's law implications reveal the following facts that the analyzed data invalidate Lotka's findings. Lotka's Chi square

model confirms the source trend. It explains the fact that the calculated χ^2 value is **72180.32** which is greater than the tabulated value at 5 percent level of significance. Thus, the present analysis clearly invalidates the Lotka's findings.

5. The findings of author productivity in terms that proportion of all contribution that makes a single contribution is 20.51 percentages. It means that the collaborative authors' contribution is very high. The study identified that Lotka's generalized Inverse square law using "full productivity" of authorship is not applicable to research output of mycology. Using least- square method, this study found n= -1.7919, and K-S value is 0.018 for overall data. It explains the fact that the tabulated value shows that observed author's value is more than expected value. Thus, the present analysis clearly invalidates the Lotka's findings.

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