



Scientometric Analysis of Phytochemistry Literature

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ABSTRACT:

This article aims to present the results of the Scientometric analysis in the Phytochemistry literature. A total of 40699 records from 1995 to 2019 were taken for the analysis. The Data were downloaded from SCOPUS online database. This study mainly concentrates the Year wise Distribution of articles, Annual Growth rate, Exponential Growth rate, Times series analysis, applicability of Lotka's law, Prolific Authors, Prolific Journals, Bradford distribution, Zip's Law analysis. A total of 40669 records were found during the study period. Fluctuations were found in Annual growth rate. Even though there are some fluctuations in the EGR the overall trend is an increasing one. Time series analysis shows that the Future Growth of Phytochemistry literature output is increased from 2349 in the year 2019 to 4751.66 in 2040. In the Journal productivity, the journal titled "Phytochemistry" got the first position with 1890 (4.65%) publication. It produced 1890 publications which received 70171 citations. The calculated Chi Square value (10.66) was less than the Chi-Square table value i.e. 73.31 at a degree of freedom of 55, level of significance at 0.05. Among the prolific authors, Van Staden, J. from South Africa got the first position with 79 publications (0.043%). In the Bradford application in this study shows that small number of 23 journals was identified with the core zone representing 0.85% of the journals covered 13607 (33.46%) articles. In the zipfs law analysis shows that the C value is almost same for each keyword.

1. INTRODUCTION

Bibliometrics is defined as the quantitative analysis of written publications, such as articles or books. Bibliometrics/Scientometrics are used to find the growth of academic literature. It comes under the major discipline Statistics. Because it uses statistical tools for the analysis. Since it is used to quantify the academic literature only, it is considered as a different discipline. But the Several research fields use bibliometrics and scientometrics to discover the impact of their field and the impact of a particular paper. It is also used for the development of thesauri, assessment of reader usage and descriptive linguistics.

2. REVIEW OF LITERATURE

Ahmed, S.M. Zabed & Rahman, Md. Anisur. (2009)¹ examined the applicability of Lotka's law to authorship productivity in the nutrition research literature in Bangladesh. A list of articles published in nutrition research literature in Bangladesh during the period 1972-2006 was taken for analysis. In authorship productivity, a total of 998 author names were identified. The results suggest that Lotka's law is found to be fit to nutrition research of Bangladesh. **M, Muthukrishnan. (2017)⁶** carried out research in oncology research output in India during the period of 2005-2015. A total of 10298 research articles were analysed for this study. The study concentrated the author productivity, authorship pattern, applicability of Lotka's law. Data were collected from Web of Science online database. The analysis was carried out using Histcite software. The total numbers of authors were 21443 and oncology research output conformed particularly fit to Lotka's law with table value $C = 0.618$. **Nisonger, Thomas. (2008)⁷** examined the Pareto distribution 80/20 rule and explained the historical origins of the term. The relationship between Pareto 80/20 rule and Bradford's Law is also explored. Some of the research related to the 80/20 rule is also reviewed. The utility of the 80/20 rule for defining the core collection in serials collection management is discussed in this study. It is found that the 80/20 rule is a valid method for determining the core concept in journal collection management. **Sen, B. & Taib, Che Azlan & Hassan, M.F.b. (1996)⁹** presented the findings of the study to test the applicability of Lotka's Law in the library and information science discipline (LIS). The Data of personal authors from the annual Name Index of Library and Information Science Abstracts (LISA) for 1992 and the annual Author Index of LISA for 1993 were taken for the analysis. The chi square value for the Lotka's law was found to be 3.23 for 1992 data and 3.1 for 1993 data. The study reveals that the Lotka's Law is found to be fit in this study. **Baskaran (2013)** analyzed that informatics focuses on understanding issues from a stakeholder perspective and applying information and other technologies as needed. That is, it deals with system problems first, not individual technologies in the system. In this regard, informatics considers the technology to be the answer to technical decisions, as it believes that technology is "developed according to its own laws, has its own potential, and is limited only by available material resources." **Baskaran (2013)** used a total of 6610 records from the Web of Science to contribute to the academic productivity and

research of the encryption fields in four major countries: China, the United States, Taiwan, and Japan. It was analyzed that the distribution of diversity was evaluated and related research areas. Baskaran (2013) argued that doubling time (Dt) tends to increase and decrease in this study. The degree of cooperation and its average value is determined to be 0.963. The three institutions of are productivity leaders. That is, Aragappa University, National Chenking University, Anna University, where CECRI is located. Baskaran and Binu (2019) analyzed that most of the 416 respondents (98.8%) were looking for educational and research information. Research results can determine various parameters of scientific access to electronic resources. Research facilitates the acquisition of electronic information and helps stimulate user research and academic thinking. Baskaran (2018) investigated the role of computers in the provision of education. Baskaran (2016) discussed the best papers published in the *Bioinformatics Journal*, and Harvard scientists contributed most of the papers to this study. Both RGR and DT showed this trend throughout the study. Baskaran (2015) investigated the three most important paradigm shifts in 21 library environments. Baskaran (2015) analyzed that US scholars contributed a total of 15832 (30.815%) of articles, 87.947% of which were published as journals. article. Harvard scientists have received a lot of attention in various research papers and occupy a leading position in research collaboration in the field of enzyme research. Baskaran (2012) argued that doubling time (Dt) tended to fluctuate during the study period. The results use the least squares method to exclude productive authors and the maximum likelihood method to examine the exponential growth of authors. In the process, it was decided that Lotka's law was applicable to graph theory research. Baskaran and Ramesh (2019) analyzed that the study analyzed that electronic information access patterns between faculty and staff play an important role in performing a variety of tasks for engineering respondents. According to this survey, the survey aims to analyze that 76% of respondents are male, of which 26% are female.

Baskaran and Ramesh Babu (2019) investigated the publishing productivity of forensic outcomes from 1989 to 2016. Growth of publications in research, RGR and Dt of research results, cooperation between authors. Baskaran (2018) analyzed that the highest SD is 21.71405 and 21.71405 Issues found Missing smartphone and lacking security of personal data. The best resume was 864.5, which was found in the absence of personal data security. Baskaran and Karuilancheran (2015) has a significance level of 29 degrees of freedom at C.V. 0.05, which gives a chi-square (X²) calculation of 5309,368. After that, the performance of researchers began to decline. It was supported by SPI, which is only between 9 and 10.

Baskaran (2014) discussed the quantitative analysis of the productivity and characteristics of citations from Library and Information Science (LIS) publications from 2003 to 2012. A total of 1,942 articles and 12,502 citations have been published in the SSCI-indexed LIS journal. 21.36% of the citations were received in 2012. Baskaran, C. (2013) analyzed that 70 (59.1%) of faculty members who participated in the survey learned through 28 (56%) guidance from teachers / managers. There is evidence that the majority of faculty and staff, 21 (42%), use their department to access information, and 28 (40%) of researchers access their department's e-journals. Baskaran (2019) analyzed 4,444,210 (55.26) respondents who were very happy with OPAC / Web-OPAC. 205 (53.90) respondents are very happy with EDatabases and 192 (50.52) respondents are very happy with the automated lending service.

Baskaran (2018) uses the software HistCite to publish on the number of publications, growth rate and doubling time, distribution of publications across journals, publication output, author patterns, and bioremediation research in India. We investigated a map of the impact of this on global quotes. , VOS viewer. Indian Institute of Technology, Baba Atomic Research Center, and CSIR are leading producers of research in the field of bioremediation. Sivakami and Baskaran (2016) analyzed a total of 64,030 datasets from the MEDLINE database in this study. Resources of all types showed the largest decline in 2010 and 2011, with an average of 2,784 publications per year. We conducted a time series analysis of the most productive countries (US) and India and compared the results over the next few years. Baskaran (2014) describes the quality of the collection in terms of books, magazines and resources. Yahoo is the most popular search engine for internet surfing. Book rental is a favorite of the staff. Saravanan and Baskaran (2019) investigated bibliographic binding, linguistic distribution, keyword distribution, geographical distribution of documents, and a history of local and global citations by established institutions. Analyzed by Bascalan (2019). Most of the 90 (33%), 76 (27.8), and 51 (18.7%) respondents said they "fully agree," "agree," "no comment," "easily accessible," and "prefer." I answered. Analyze large amounts of data. " Baskaran (2018) surveyed most publications in 44.15% of the two authors in the analysis of BM. Guptha has published 18 articles on DJ LIT and is the lead author. .

Baskaran, (2013) explored Degree of collaboration and its' mean value is found to be 0.963. The top three institutions with Alagappa University are Central Electro Chemical Research Institute, National Cheng King University, and Anna University. Baskaran and Sivakami, (2014) discussed Quantitative analysis is carried out to identify the literature growth, authorship pattern, collaboration and journal distribution on Swine influenza disease research based on data obtained from Pubmed databases for a period from 2006-2010. A total of 2360 articles were downloaded from Pubmed database using the search term "Swine*" subjected to bibliometric data analysis techniques. Baskaran (2013) analysed that Information science focuses on understanding problems from the perspective of stakeholders and then applying information and other technologies as needed. In other words, it tackles systemic problems first rather than individual pieces of technology within that system. In this respect, information science can be seen as a response to technological determination, the belief that technology "develops by its own laws, that it realizes its own potential, limited only by the material resources available, Baskaran (2013) analysed that a total number of 6610 records which were retrieved from the Web of Science was used to assess the academic productivity and distribution of research diversity of cryptography field from four major countries -China, USA, Taiwan and Japan which contributed more papers in cryptography and allied field of researches.

Baskaran (2013) discussed that Doubling time (Dt) was found to be increased and decreased trend in this study. Degree of collaboration and its means value is found to be 0.963. The top three institutions with Alagappa University are Central Electro Chemical Research Institute, National Cheng King University and Anna University. Baskaran and Binu (2019) analysed that Majority of respondents 416 (98.8%) are searching for educational and research Information. The findings of the study could identify the various parameters while access Electronic resources by the academic community. The study would helpful to bring to access Electronic Information for momentum of gain research and academic ideas among the users. Baskaran (2018) examined that computers became involved in the delivery of education, a proposed definition identifies the delivery of instructional materials, using both print and electronic media. Baskaran (2016) discussed the highest publication published in *Bioinformatics journal* and Harvard University scientists contributed highest number of publication in the study. RGR and DT is exhibits that fluctuating trend happening whole period of study. Baskaran (2015) studied the three Major Paradigm Shifts 21st Century Library Setting, Revolutionary Changes, Library Roles, Millennial Generation, Cyber Infrastructure Characteristics, Major Challenges of 21st Century Librarian, Tasks, Library Should Be, the

researchers expectations and so on. Baskaran (2015) analyzed the USA scientists have contributed totally 15832 (30.815%) items and include 87.947% percent are appeared as journal articles. Harvard University scientists are much attention in produced large number of research papers and they hold top level among research collaboration in enzyme research.

Baskaran (2012) discussed that Doubling Time (D_t) has shown as fluctuating trend during the period of study. The result examined the author exponential growth using least squares excluding high productive authors and maximum likelihood method. Lotka's law is found to be applicable to graph theory research during the study period. Baskaran and Ramesh (2019) analyzed that The study analyses Electronic information access pattern among the faculty members is the significant role in the Engineering institutions towards various tasks to fulfil by the respondents. The study aim to analyze that 76 percent of the respondents are male and 26 percent of them are female observed from the study.

Baskaran and Ramesh Babu(2019) examined the publication productivity of Forensic Medicine output during 1989-2016. The growth of the publications, RGR and D_t of the research output, Collaboration of authors, Collaborative co-efficient etc. in the study. Baskaran (2018) analyzed the highest SD was 21.71405 and 21.71405 the problems were found Do not have smart Phone and Lack of security on personal information. The highest CV was 864.5 found on Lack of security on personal information. Baskaran and Karuilancheran (2015) analyzed the C.V. at 0.05 significant level for 29 degrees of freedom is 42.56 and the calculated value of Chi-Square (X^2) obtained in this case is 5309.368. Afterwards, the performance of researchers started diminishing. It was supported by SPI that ranges between 9 and 10 only. Baskaran (2014) discussed the quantitative analysis of the productivity and characteristics of citations of Library and Information Science (LIS) publications during 2003-2012. A Total of 1942 contributions published and 12102 citations received in the LIS journals indexed in SSCI. 21.36% of citations were received in 2012. Baskaran, C. (2013) analyzed that faculty members who respondents to the study, 70 (59.1%) learned through guidance from their teachers/guide 28 (56%). It is proved that the highest proportion of faculty member, 21 (42%), use their department for accessing the information, while 28 (40%) of the research scholars were accessing their e-journals in their department itself. Baskaran (2019) analyzed the 210 (55.26) respondents are extremely satisfied on OPAC/Web OPAC. 205(53.90) respondents are extremely satisfied on E-Databases, 192(50.52) respondents are extremely satisfied on Automated circulation services. Baskaran (2018) explored the map the number of publications, growth rate and doubling time, scattering of publication over journals, and its impact on publication output, authorship patterns and Global citation score of bioremediation research publication in India using the HistCite, VOSviewer software. Indian Institute of technology, Baba atomic research centre and CSIR are the major producers of research output in the area of bioremediation. Sivakami and Baskaran (2016) analysed that total of 64030 records were obtained from MEDLINE databases have been taken for this study. All kinds of resources are fallen in highest in the year 2010 & 2011 with average publications of 2,784 per year. The Time series analysis were carried out for the top most productive country (USA) and India to compare the research output in forth coming years. Baskaran (2014) discussed quality of collection with respect to books, Journals and e-resources. Yahoo is most popular search engine among the user for browsing the net. Book lending service is the most prefer by the staff.

Saravanan, and Baskaran (2019) examined the identifies bibliographic coupling of the institution, language distribution, keyword distribution, geographical distribution of the literature and Historiography on Local and Global Citation is also analyzed. Baskaran (2019) analyzed the majority 90 (33%), 76 (27.8) and 51 (18.7%) of the respondents of them recorded that "Strongly Agree", "Agree", and "No Comment" respectively to prefer "Easy to access massive amount of data to analyse". Baskaran (2018) examined the majority of publications 44.15% representing by the two authors in the analysis BM. Gupta was published 18 papers in DJLIT, who is a ranked 1 author. It followed by Chenupathi K. Ramiah shored second his publications 11. University of Delhi, which is the top ranked institution. Binu and Baskaran (2017) analyzed the assess the user satisfaction with respect to the e-resources and services. It reveals that majority of respondents are using e-resources at large extent or very large extent for different purposes. Users' satisfaction level is very high with respect to various electronic resources and services available in the library. Ramesh Babu and Baskaran (2017) analyzed the analyses that research growth trend of Forensic Medicine during 1989-2015. It is observed highest out of Forensic Medicine research Forensic Medicine research in 2013 was 447 (11.05 %) of the publications, followed by 420 (10.38%) of the publication brought out in 2015. the doubling time of the publications also a fluctuate trend appears whole study period. Baskaran (2020) analyzed the lowest relative growth rate (RGR; 0.04) was found in 2008. 2010, 2012, and 2014 RGR rose up to 0.75 in 1990, and the average mean value of relative growth rate (RGR) is 0.15. The highest number of publications (293; 63.55%) accumulated from information science library science. This area has been ranked first among 21 research fields listed in the study. Baskaran (2020) describes Altmetrics use in public APIs across platforms to gather data with open scripts and algorithms. Altmetrics did not originally cover citation counts. It calculated scholar impact based on diverse online research output, such as social media, online news media, and online reference managers. Baskaran, C. (2020) analyzed the 11,941 total records on social networks and media retrieved from Web of Science database during the period of study. The predominantly records 2,576 (21.57%) of the publications brought out in 2018, followed by 2,281 (19.10%) records published in 2017. Palanivel and Baskaran (2018) studied the 2313 scholarly communications published in the Economic Affairs Journal. The analysis cover mainly the number of articles, form of document, the study is obtained from the SCOPUS database in 2313 results for thirty seven years in this results retrieved are analyzed using excel worksheets. Pramanathan and Baskaran (2015) discussed the 199 (49.13%) and 131 (43.52%) of the respondents were female respondents from Bharathidasan University and Periyar University. Majority of the 310 (76.54%) and 198 (65.78%) of the respondents who have got research experience below 3 years from Bharathidasan and Periyar university. Murugaiah and Baskaran (2013) analyzed the high number of papers was collaborated with United States researchers in the field of Human DNA. The study measures the performance based on several parameters, country year-wise growth rate, authorship pattern, collaborative index, collaborative coefficient, leading collaborative countries and authors have contributed publications in Human DNA research. Baskaran (2020) discussed the maximum 290 (12.20%) of the publications contributed by the researchers from Central Electro chemical Research Institute was highly collaborated with Alagappa Universities, which has top Citations and h-Index 3852 and 32 respectively. The propounded according to Google Scholar Metrics (GSM) SK Pandian was to be a top ranked researcher, despite his year wise citations shows 4491 and h-Index credited 36 during 2008-2018. Ramesh and Baskaran (2019) analyzed the respondents "Satisfied" with e-resources offering lecturing materials. This data presents that a large number of respondents 265 (51.0%) prefer gateway portal to a "Large Extent" and 139 (26.7%) of the respondents prefer to a "Very Large Extent". On the other hand, it has also been noticed that 105 (20.2%) of the respondents are "Less satisfied" whereas 11 (2.1%) of the respondents opted "No Comment". Baskaran (2018) discussed the majority of 63 (27.6%) specified "Aware" and Usage of Whatsapp, 53 (23.2%) You Tube, 47 (20.6%) Google+, 46

(20.2%) Face Book, 23 (10.1%) Tumbler/Messenger, 21 (9.2%) Twitter, 18 (7.9%) Others and 17 (7.5%) Instagram. Functions appropriate to their parent institutions.

Baskaran (2021) analyzed the majority 134 (1.96%) of the publications contributed by the researchers from the University of California systems. Zhang Y was the top author has contributed 16(0.23%) of the publications in the field of Web 2.0, subsequently, Kolt GS, Li Q, Vandelante C, Zhang J, the publications equally appears 13(0.19%) of the publications. Baskaran and Pitchaipandi (2021) analyzed the respondents highly prefer group sites (Yahoo, Google, and Whatsapp). The research analyses that social media tools for research the majority of the respondents highly preferred Facebook wall for shared the research information by the respondents in the eight Universities in Tamil Nadu. Pitchaipandi and Baskaran (2021) examined the 51.3% of the respondents visit 1/hr day in using WhatsApp. 78.9% of the respondents added the Whatsapp Groups from Friends of the respondents respectively. Among the WhatsApp as instructive help devices and administrations in a Thiruvalluvar University. Baskaran (2020) analyzed that there are twenty five institutions are listed, among them University of Washington has contributed highest 48 (0.98%) of the publications witnessed be a first position out of twenty five. Radhakrishnan and Baskaran, C. (2020) discussed there is a moderate correlation between Citation and Altmetric Score. Only one paper obtains citation and Altmetric score equally. Another paper gets citation and Altmetric score in near equal. Out of the 10 papers, four papers received more citations. Of the 4 highly cited articles, three papers receive very low Altmetric score and only one paper receives high Altmetric score.

3. OBJECTIVES

The Main purpose of the study is to present the results of the scientometrics analysis of Phytochemistry literature. This study mainly concentrates the Year wise Distribution of articles, Annual Growth rate, Exponential Growth rate, Times series analysis, applicability of Lotka's law, Prolific Authors, Prolific Journals, Bradford distribution, Zipf's Law analysis

4. METHODOLOGY

The data on Phytochemistry literature were taken from SCOPUS online database for the year 1995 -2019. The collected data were analysed with MS office Excel Spreadsheet and presented the findings in the form of Tables and Graphs.

5. ANALYSIS AND INTERPRETATIONS

5.1 Publishing Trend in Phytochemistry Literature

The table 5.1 shows the publishing trend, annual Growth rate and Exponential Growth rate in Phytochemistry Literature. A total of 40669 publications were found in Phytochemistry literature during the study period. The average paper per year is found to be 1626.76. Maximum number publications were produced during the last 13 years 72.07% (2007 to 2019). Only 27.93% publications were produced during the first 12 years (1995 to 2006). But the overall growth is found to be increasing trend in Phytochemistry literature.

Annual Growth rates refer to the percentage change of a specific variable within a specific time period, given a certain context. The range of AGR is found to be -27.58 to 42.72. Fluctuations were found in Annual growth rate. The highest annual growth rate 42.72 is found in the year 2007. The Lowest Annual growth rate -27.58 is found in the year 2001.

Exponential growth rate can be used to predict future population of any species of animals. It is used globally to predict human population. With the knowledge of the periodic rate i.e., the number of years through which the growth rate is to be calculated for the original population, calculation of the exponential growth rate can be done with ease. The EGR has got the highest value of 1.43 and at the same time the lowest EGR value 0.72 has got by the year 2001. Even though there are some fluctuations in the EGR the overall trend is an increasing one.

The **formula** for calculating the **exponential growth** is given below:

$$N_{(t)} = N_{(0)}(1 + r)^t$$

Where,

$N_{(t)}$ = the population when the time elapsed is "t" years

$N_{(0)}$ = the initial publications

r = the growth rate

t = the number of years

e = the natural base of logarithms whose value is 2.711828

The **annual growth rate of publications** was calculated from the following **formula**

$$AGR = \frac{\text{End value} - \text{First value}}{\text{First value}} \times 100$$

Table 5.1: Publishing Trend in Phytochemistry Literature

S.No	Year	Publications	Percentage	Annual Growth Rate	Exponential Growth Rate
1	1995	886	2.18		
2	1996	929	2.28	4.85	1.05
3	1997	896	2.2	-3.55	0.96
4	1998	966	2.38	7.81	1.08
5	1999	1335	3.28	38.2	1.38
6	2000	1349	3.32	1.05	1.01
7	2001	977	2.4	-27.58	0.72
8	2002	976	2.4	-0.1	1
9	2003	924	2.27	-5.33	0.95
10	2004	806	1.98	-12.77	0.87
11	2005	705	1.73	-12.53	0.87
12	2006	611	1.5	-13.33	0.87
13	2007	872	2.14	42.72	1.43
14	2008	1046	2.57	19.95	1.2
15	2009	1352	3.32	29.25	1.29
16	2010	1913	4.7	41.49	1.41
17	2011	2676	6.58	39.88	1.4
18	2012	2907	7.15	8.63	1.09
19	2013	2720	6.69	-6.43	0.94
20	2014	2573	6.33	-5.4	0.95
21	2015	2692	6.62	4.62	1.05
22	2016	2965	7.29	10.14	1.1
23	2017	2545	6.26	-14.17	0.86
24	2018	2699	6.64	6.05	1.06
25	2019	2349	5.78	-12.97	0.87
Total		40669	100		
Average paper per year			1626.76		

5.2: Time Series analysis in Phytochemistry Literature

Time series is an ordered sequence of values of a variable at equally spaced time intervals. In other words, we can say that a time series is a sequence of data points, measured typically at successive times, spaced at (often uniform) time intervals. According to Mooris Hamburg (1970), "A time series is a set of statistical observations arranged in chronological order".

Time series analysis is used to predict the expected future publication in Phytochemistry Literature. The Time series analysis in Phytochemistry Literature output is clearly shown in the Table 5.2 and Figure 5.1. The analysis shows that the Future Growth of Phytochemistry literature output is increased from 2349 in the year 2019 into 3331.25 in 2025, 3804.72 in 2030, 4278.19 in 2035 and 4751.66 in 2040. Therefore the future growth of publications in Phytochemistry literature output may take an increasing trend during the future years. The Figure 5.1 clearly shows the overall future growth of publications in Phytochemistry literature is a linear growth.

$$\text{Equation of Straight Line } Y_c = a + bx$$

Where,

Y = Trend value to be computed

X = Unit of time (Independent variable)

a = Constant to be calculated

b = Constant to be calculated

Table 5.2: Time Series analysis in Phytochemistry Literature

S.No	Year	Publications Y	X	X ²	XY
1	1995	886	-12	144	-10632
2	1996	929	-11	121	-10219
3	1997	896	-10	100	-8960
4	1998	966	-9	81	-8694
5	1999	1335	-8	64	-10680
6	2000	1349	-7	49	-9443
7	2001	977	-6	36	-5862
8	2002	976	-5	25	-4880
9	2003	924	-4	16	-3696
10	2004	806	-3	9	-2418
11	2005	705	-2	4	-1410
12	2006	611	-1	1	-611
13	2007	872	0	0	0
14	2008	1046	1	1	1046
15	2009	1352	2	4	2704
16	2010	1913	3	9	5739
17	2011	2676	4	16	10704
18	2012	2907	5	25	14535
19	2013	2720	6	36	16320
20	2014	2573	7	49	18011
21	2015	2692	8	64	21536
22	2016	2965	9	81	26685
23	2017	2545	10	100	25450
24	2018	2699	11	121	29689
25	2019	2349	12	144	28188
Total		40669	0	1300	123102

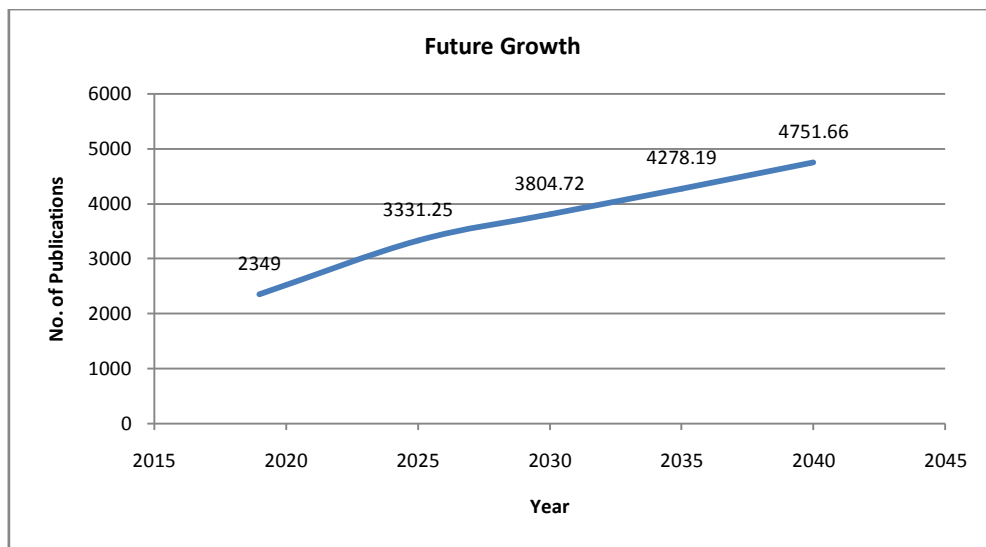


Figure 5.2: Time Series analysis in Phytochemistry Literature

5.3: Lotka's law of Productivity in Phytochemistry Literature

The Lotka's law was tested using chi-square method in relation to a number of authors who contributed 'n' number of publications. Lotka's Law is used to analyse the frequency of publication by authors in a given field. It states that "the number of authors making n contributions is about $1/n^2$ of those making one contribution. Lotka's law is also tested with Chi-Square model in relation to the number of authors who contributed n number of publications. From the table 5.3 it is clear that the observed authors (184687) is greater than the expected authors (145871) as predicted by Lotka's equation. To test more exactly the Chi-Square test was applied to compare the observed values with the expected value of the author's productivity. The calculated Chi Square value (10.66) was less than the Chi-Square table value i.e. 73.31 at a degree of freedom of 55, level of significance at 0.05. Here the Chi-Square value was highly significant and Lotka's law was applicable to this data.

It can be denoted by the following equation.

$$an = a1/n^2$$

Whereas, n = 1, 2, 3

In other words, for every 100 authors making one contribution each, there would be 25 authors contributing two articles each ($100/2^2 = 25$) about 11 contributing three articles each $100/3^2 = 11.1$ and so on. Where 'an' is the number of authors contributing 'n' papers each and a1 is the number of authors contributing one paper each. The chi-square can be calculated as $(O-E)^2/E$

O = observed number of authors with n publication

E = expected number of authors

Table 5.3: Lotka's law of Productivity in Phytochemistry Literature

No. of Paper	Observed Authors	Log O	Observed Author Percentage	Expected Authors	Log of E	Expected Authors Percentage	(O-E) ² /E
1	89680	11.40	100	89680	11.40	100	0
2	29196	10.28	32.56	22420	10.02	25	0.01
3	15282	9.63	17.04	9964.44	9.21	11.11	0.02
4	9688	9.18	10.80	5605.00	8.63	6.25	0.03
5	6720	8.81	7.49	3587.20	8.19	4.00	0.05
6	5286	8.57	5.89	2491.11	7.82	2.78	0.07
7	4214	8.35	4.70	1830.20	7.51	2.04	0.09
8	3112	8.04	3.47	1401.25	7.25	1.56	0.09
9	2610	7.87	2.91	1107.16	7.01	1.23	0.10
10	2310	7.75	2.58	896.80	6.80	1.00	0.13
11	1859	7.53	2.07	741.16	6.61	0.83	0.13
12	1632	7.40	1.82	622.78	6.43	0.69	0.14
13	1391	7.24	1.55	530.65	6.27	0.59	0.15
14	1148	7.05	1.28	457.55	6.13	0.51	0.14
15	1035	6.94	1.15	398.58	5.99	0.44	0.15
16	880	6.78	0.98	350.31	5.86	0.39	0.14
17	799	6.68	0.89	310.31	5.74	0.35	0.16
18	594	6.39	0.66	276.79	5.62	0.31	0.10
19	684	6.53	0.76	248.42	5.52	0.28	0.19
20	580	6.36	0.65	224.20	5.41	0.25	0.17
21	483	6.18	0.54	203.36	5.31	0.23	0.14
22	616	6.42	0.69	185.29	5.22	0.21	0.28
23	299	5.70	0.33	169.53	5.13	0.19	0.06
24	288	5.66	0.32	155.69	5.05	0.17	0.07
25	375	5.93	0.42	143.49	4.97	0.16	0.19
26	260	5.56	0.29	132.66	4.89	0.15	0.09
27	324	5.78	0.36	123.02	4.81	0.14	0.19
28	168	5.12	0.19	114.39	4.74	0.13	0.03
29	261	5.56	0.29	106.63	4.67	0.12	0.17
30	90	4.50	0.10	99.64	4.60	0.11	0.00
31	155	5.04	0.17	93.32	4.54	0.10	0.06
32	128	4.85	0.14	87.58	4.47	0.10	0.03
33	66	4.19	0.07	82.35	4.41	0.09	0.01
34	204	5.32	0.23	77.58	4.35	0.09	0.21
35	175	5.16	0.20	73.21	4.29	0.08	0.18
36	144	4.97	0.16	69.20	4.24	0.08	0.13
37	74	4.30	0.08	65.51	4.18	0.07	0.00
38	266	5.58	0.30	62.11	4.13	0.07	0.51
39	39	3.66	0.04	58.96	4.08	0.07	0.04
40	80	4.38	0.09	56.05	4.03	0.06	0.03
41	82	4.41	0.09	53.35	3.98	0.06	0.05
42	84	4.43	0.09	50.84	3.93	0.06	0.06
43	43	3.76	0.05	48.50	3.88	0.05	0.00
44	44	3.78	0.05	46.32	3.84	0.05	0.00
45	45	3.81	0.05	44.29	3.79	0.05	0.00
46	92	4.52	0.10	42.38	3.75	0.05	0.16
47	141	4.95	0.16	40.60	3.70	0.05	0.42
49	49	3.89	0.05	37.35	3.62	0.04	0.02
50	300	5.70	0.33	35.87	3.58	0.04	1.26
52	104	4.64	0.12	33.17	3.50	0.04	0.37
54	108	4.68	0.12	30.75	3.43	0.03	0.46
55	55	4.01	0.06	29.65	3.39	0.03	0.11
65	130	4.87	0.14	21.23	3.06	0.02	1.08

66	66	4.19	0.07	20.59	3.02	0.02	0.45
70	70	4.25	0.08	18.30	2.91	0.02	0.62
79	79	4.37	0.09	14.37	2.67	0.02	1.09
Total	184687	332.94		145871	291.55		10.66

5.4 Prolific Authors (author at any position) in Phytochemistry Literature

Table 5.4 listed the top 25 Prolific Authors (author at any position) in Phytochemistry Literature. There were 116492 unique authors who contributed 184687 times in the total publications during the study period 1995-2019. It is found that Van Staden, J. from South Africa affiliated to Research Centre for Plant Growth and Development, School of Life Sciences, University of KwaZulu-Natal Pietermaritzburg got the first position with 79 publications (0.043%) which was the highest contribution. Lindroth, R.L. from United States affiliated to Department of Entomology, University of Wisconsin-Madison got the second rank with 66 publications (0.036%) and Hostettmann, K from Switzerland affiliated to Laboratory of Pharmacognosy and Phytochemistry, School of Pharmaceutical Sciences, University of Geneva got the third rank with 65 publications (0.035%).

Table 5.4: Prolific Authors (author at any position) in Phytochemistry Literature

S. No	Author	Publications	% of 184687	Rank	Country	Affiliations
1	Van Staden, J	79	0.043	1	South Africa	Research Centre for Plant Growth and Development, School of Life Sciences, University of KwaZulu-Natal Pietermaritzburg
2	Lindroth, R.L	66	0.036	2	United States	Department of Entomology, University of Wisconsin-Madison
3	Hostettmann, K	65	0.035	3	Switzerland	Laboratory of Pharmacognosy and Phytochemistry, School of Pharmaceutical Sciences, University of Geneva
4	Khan, I.A	65	0.035	3	United States	Department of BioMolecular Sciences, Research Institute of Pharmaceutical Sciences, School of Pharmacy, University of Mississippi University
5	Zengin, G	55	0.030	4	Turkey	Department of Biology, Science Faculty, Selcuk University
6	Vilegas, W	54	0.029	5	Brazil	UNESP - Universidade Estadual Paulista, Instituto de Biociências, Laboratório de Bioprospecção de Produtos Naturais
7	Sarker, S.D	54	0.029	5	United Kingdom	Centre for Natural Products Discovery, School of Pharmacy and Biomolecular Sciences, Faculty of Science, Liverpool John Moores University
8	Viljoen, A	52	0.028	6	South Africa	Department of Pharmaceutical Sciences, Tshwane University of Technology
9	Choudhary, M.I	52	0.028	6	Pakistan	International Center for Chemical and Biological Sciences, H.E.J Research Institute of Chemistry, University of Karachi
10	Setzer, W.N	50	0.027	7	United States	Department of Chemistry, University of Alabama in Huntsville

5.5 Prolific author VanStaden, J. Publications Vs Citations in Phytochemistry Literature

Table 5.5 shows the publications, citations and Citation per paper of Prolific Author Van Staden, J. It is found that Van Staden, J. produced 79 papers which covered 20 years. Maximum papers 14 were published in the year 2013. He got total citations of 1683 against 79 papers. A maximum citation of 259 is received in the year 2013. Maximum Citation per paper 46.25 is received against 4 paper in the year 2010. The overall Citation per paper value is found to be 21.30.

Table 5.5 Prolific author VanStaden, J. Publications Vs Citations in Phytochemistry Literature

S. No	Year	Publications	Citations	CPP
1	1995	1	20	20
2	1999	1	31	31
3	2000	1	84	84
4	2001	2	90	45
5	2002	5	90	18
6	2003	2	18	9
7	2005	1	36	36
8	2007	2	24	12
9	2008	1	14	14
10	2009	1	41	41
11	2010	4	185	46.25
12	2011	6	236	39.33
13	2012	9	222	24.67
14	2013	14	259	18.50
15	2014	6	112	18.67
16	2015	4	44	11
17	2016	7	119	17
18	2017	3	17	5.67
19	2018	4	23	5.75
20	2019	5	18	3.6
	Total	79	1683	21.30

5.6 Journal Productivity in Phytochemistry Literature

Table 5.6 listed out the top 10 journals ranked up to 10. The ranking of journals based on their productivity are made to help in the selection of core journals and evaluating the importance of these journals in a particular subject field. It is found that there were 2708 journals which produced 40669 publications. It is found from the table 5.6 the journal titled "Phytochemistry" obtained the first position with 1890 (4.65%) publication. It produced 1890 publications which received 70171 citations. In this journal Citation per paper value is found to be 37.13. "Biochemical Systematics and Ecology" obtained the second rank with 937 publications which received 13411 citations. Citation per paper value for this journal is found to be 14.31. The third most productive journal was "Industrial Crops and Products" with 836 (2.03%) publications. It received 18392 citations against 836 publications and got 22 citations per Paper.

Table 5.6 Journal Productivity in Phytochemistry Literature

S. No	Journal Title	Publications	% of 40669	Citations	CPP	Rank
1	Phytochemistry	1890	4.65	70171	37.13	1
2	Biochemical Systematics and Ecology	937	2.30	13411	14.31	2
3	Industrial Crops and Products	836	2.06	18392	22.00	3
4	Journal of Ethnopharmacology	826	2.03	38687	46.84	4
5	International Journal of Pharmacy and Pharmaceutical Sciences	760	1.87	4787	6.30	5
6	Natural Product Communications	648	1.59	3632	5.60	6
7	Asian Journal of Pharmaceutical and Clinical Research	643	1.58	2692	4.19	7
8	PlantaMedica	586	1.44	15805	26.97	8
9	International Journal of Pharma and Bio Sciences	557	1.37	2618	4.70	9
10	Fitoterapia	553	1.36	11405	20.62	10

Conclusions

The analysis reveals that a total of 40669 publications were found in Phytochemistry literature during the study period. The average paper per year is found to be 1626.76. But the overall growth is found to be increasing trend in Phytochemistry literature. The range of AGR is found to be -27.58 to 42.72. Fluctuations were found in Annual growth rate. The highest annual growth rate 42.72 is found in the year 2007. The Lowest Annual growth rate -27.58 is found in the year 2001. The EGR has got the highest value of 1.43 and at the same time the lowest EGR value 0.72 has got by the year 2001. Even though there are some fluctuations in the EGR the overall trend is an increasing one. Time series analysis shows that the Future Growth of Phytochemistry literature output is increased from 2349 in the year 2019 to 3331.25 in 2025, 3804.72 in 2030, 4278.19 in 2035 and 4751.66 in 2040. Therefore the future growth of publications in Phytochemistry literature output may take an increasing trend during the future years. The Lotka's law reveals that the calculated Chi Square value (10.66) was less than the Chi-Square table value i.e. 73.31 at a degree of freedom of 55, level of significance at 0.05. Here the Chi-Square value was highly significant and Lotka's law was applicable to this data. There were 116492 unique authors who contributed 184687 times in the total publications during the study period 1995-2019. It is found that Van Staden, J. from South Africa got the first position with 79 publications (0.043%) which was the highest contribution. In the journal productivity, "Phytochemistry" obtained the first position with 1890 (4.65%) publication. It produced 1890 publications which received 70171 citations. Bradford analysis shows that small number of 23 journals was identified with the core zone representing 0.85% of the journals covered 13607 (33.46%) articles. Zipf's law analysis shows that the C value is almost same for each keyword. Hence the Zipf's law is fit to the keyword occurrences.

Bibliography

Ahmed, S.M. Zabeed & Rahman, Md. Anisur. (2009). Lotka's law and authorship in nutrition research in Bangladesh. *Annals of Library and Information Studies*, 56. 95-102.

M, Muthukrishnan. (2017). Author Productivity of Oncology Research Output in India: Testing Lotka's Law. *International Journal of Information Dissemination and Technology*, 7. 187-189.

Nisonger, Thomas. (2008). The "80/20 Rule" and Core Journals. *Serials Librarian - SERIALS LIBR*, 55. 62-84.

Sen, B. & Taib, CheAzlan & Hassan, M.F.b. (1996). Library and information science literature and Lotka's Law. *Malaysian Journal of Library and Information Science*.

Baskaran, C and Sivakami, N (2014) Swine Influenza Research Output: A Bibliometric Analysis, *SRELS Journal of Information Management*, Vol.51 Issue 1, p13-20, <http://www.srels.org/index.php/sjim/article/view/47191>

- Baskaran, C. (2013) Scientometric Analysis of Cryptography Research Output, SRELS Journal of Information Management, Vol.50 Issue 4, p413-421. <http://www.srels.in/index.php/sjim/article/view/37422>
- Baskaran C. (2013) Research Growth Trend and Author Collaboration of Alagappa University in India during 1999-2011, International Journal of Library and Information Studies, Vol.3, Issue 1, p57-64, <https://www.ijlis.org/articles/research-growth-trend-and-author-collaboration-of-alagappa-university-in-india-during-19992011.pdf>
- Baskaran C. (2016) A Scientometric study on Bioinformatics Literature during 1999-2013, International Journal of Library Science and Information Management (IJLSIM), Vol.2, Issue 4, p 62-71,
- Baskaran, C. (2015). Research productivity of enzymes literature: A Scientometric study. *International Journal of Library Science and Information Management (IJLSIM)*, 1(2), 17-21.
- Baskaran, C. (2012) Research Productivity of Graph Theory during 2004-2011: a Bibliometric Study, SRELS journal of Information Management, Vol.49, Issue 6, p 683-691. <http://www.srels.in/index.php/sjim/article/view/43933>
- Baskaran C. and Ramesh Babu P. (2019). The substantial research on Quantitative analysis and Publications measure in Forensic Medicine. *Library Philosophy and Practice*, 1-17. <https://digitalcommons.unl.edu/libphilprac/2145/>
- Baskaran, C. (2018). Use of Social Networks (SNs) and Medias on Dissemination of Scholarly information among the Research Scholars in Alagappa University, Karaikudi, Tamil Nadu. *Journal of Advances in Library and Information Science*, 7(3), 217-261. <http://jalis.in/pdf/7-3/Baskaran.pdf>
- Baskaran, C., & Karuilancheran, C. (2015). Activity Index and Lotka's Law Application with Diabetes and Allied Diseases in India during 1995-2013. *SRELS Journal of Information Management*, 52(6), 423-431. <http://52.172.152.24/index.php/sjim/article/view/83972>
- Baskaran, C. (2014). Citations analysis on library and information science research: The quantitative approach from Web of Science. *SRELS Journal of Information Management*, 51(3), 165-169. <http://www.srels.in/index.php/sjim/article/view/50743>
- Baskaran, C. (2013). Accessing pattern of Electronic Journals through UGC-INFONET by the faculty members and research scholars in Alagappa University: A Study. *Pearl: A Journal of Library and Information Science*, 7(1), 31-37. <https://www.indianjournals.com/ijor.aspx?target=ijor:pjolis&volume=7&issue=1&article=006>
- Baskaran, C. (2018). Mapping of Bioremediation Research Output in India: A Scientometric Study. *Library Philosophy and Practice*, 2038. <https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=5402&context=libphilprac>
- Sivakami, N and Baskaran, C. (2016). Time series analysis of swine flu literature during 1991-2013. *International Journal of Library Science and Information Management*, 2(1), 38-46. <https://www.researchgate.net/publication/324537439>
- Saravanan, S and Baskaran, C. (2019). Thirty Years of Global Literature on Bioleaching: A Scientometric Analysis. *Library Philosophy and Practice*, 1-17. <https://digitalcommons.unl.edu/libphilprac/2230/>
- Baskaran, C. (2018). Publication meant for highly quality research through LIS in India: The Special Reference to DESIDOC Journal of Library and Information Technology (DJLIT). *Library Philosophy and Practice*, 1-20. <https://digitalcommons.unl.edu/libphilprac/2031/>
- Ramesh Babu, P and Baskaran, C. (2017). Research Pattern on Forensic Medicine in Global Output: A Scientometric Analysis. *International Journal of Library Science and Information Management*, 3(1), 53-64. <https://www.researchgate.net/publication/324537543>
- Baskaran, C. (2020). Altmetrics research on the global output: A scientometric analysis. In *Measuring and Implementing Altmetrics in Library and Information Science Research* (pp. 62-73). IGI Global. <https://www.igi-global.com/chapter/altmetrics-research-on-the-global-output/247745>
- Baskaran, C. (2020). Altmetrics Research: An Impact and Tools. In *Measuring and Implementing Altmetrics in Library and Information Science Research* (pp. 1-10). IGI Global. <https://www.igi-global.com/chapter/altmetrics-research/247735>
- Baskaran, C. (2020). Research Patterns on the Social Networks and Media: A Scientometric Portrait. In *Handbook of research on emerging trends and technologies in library and information science* (pp. 189-207). IGI Global. <https://www.igi-global.com/chapter/research-patterns-on-the-social-networks-and-media/241564>
- Palanivel, K and Baskaran, C. (2018). Bibliometric Analysis of the Journal-Economic Affairs. *International Journal of Research in Library Science*, 4(1), 7-15. <https://www.researchgate.net/profile/Chinnasamy-Baskaran-2/publication/328215016>

- Murugiah, P and Baskaran, C. (2013). Assessment of Research Collaboration on Human DNA In Japan During 1990-2011. *International Journal of Library and Information Studies*, 3, 2.p 9-16. <https://www.researchgate.net/publication/324536941>
- Baskaran, C. (2020). Scientometric analysis of Publication trend on Information Management (IM). *Library Philosophy and Practice*, 1-15. <https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=7794>
- Radhakrishnan, S and Baskaran, C. (2020). Phytochemistry Literature: An Altmetrics Analysis. *Library Philosophy and Practice (e-journal)*, p-112. <https://digitalcommons.unl.edu/libphilprac/4048/>
- Baskaran, C and Binu, P. C. (2020). The Faculty Members and Research Scholars Attain Academic and Research Thoughts by Accessing Electronic Information in the Universities of Kerala, India. *Library Philosophy and Practice*, 1-26. <https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=7038>
- Baskaran, C. (2020). Initiatives of an Institutional Repository (IR) of the Academic Institutions in the Indian Scenario: Prospects and Challenges. In *Handbook of Research on Emerging Trends and Technologies in Library and Information Science* (pp. 208-214). IGI Global. <https://www.igi-global.com/chapter/initiatives-of-an-institutional-repository-ir-of-the-academic-institutions-in-the-indian-scenario/241565>
- Radhakrishnan, S., &Baskaran, C. (2019). Authorship Productivity and Applicability of Lotka's Law in Phytochemistry Literature, *Library Philosophy and Practice (e-journal)*, 3618, <https://digitalcommons.unl.edu/libphilprac/3618/>
- Baskaran, C., &Babu, P. R. (2019). Activity Index and Author Exponential Growth on Forensic Medicine. *Journal of Social Sciences*, p19-28. <https://thescpub.com/abstract/10.3844/jssp.2019.17.28>
- Baskaran, C. (2018). Citations impact of the faculties in Alagappa University, Karaikudi, Tamil Nadu. *Pearl: A Journal of Library and Information Science*, 12(3), 300-309. <https://www.indianjournals.com/ijor.aspx?target=ijor:piolis&volume=12&issue=3&article=013>
- Baskaran, C and Rameshbabu, P. (2018). Publication Pattern and Research Colloboration of Forensic Medicine During 1989-2016.8(1), *IJLIS*,105-115. <https://www.ijlis.org/articles/publication-pattern-and-research-collaboration-of-forensic-medicine-during-19892016.pdf>
- Radhakrishnan.Sand Baskaran C. (2018) *Journal of Solar Energy Engineering, Transactions of the ASME : A Scientometric Analysis*, *Journal of Advances in Library and Information* Vol. 7. No.1. Pp.103-108. <file:///C:/Users/student/Downloads/64.pdf>
- Murugiah, P and Baskaran, C. (2014) Status of Human DNA Research in the United States of America: A Scientometric Analysis, *Journal of Advances in Library and Information Science*, Vol. 3. No.4. Pp328-334. <http://jalis.in/pdf/pdf3-4/Murugiah.pdf>
- Sivakami, N and Baskaran, C. (2014). A Scientometric Analysis Of Research Productivity In Wine Flu Disease. *International Journal of Library and Information Studies*,4(4). <https://www.ijlis.org/articles/a-scientometric-analysis-of-research-productivity-in-wine-flu-disease.pdf>
- Baskaran, C. (2013). Research growth trend and author collaboration of Alagappa University in India during 1999-2011. *International Journal of Library and Information Studies*, 3(1), 57-64. <https://www.researchgate.net/publication/324537117>
- Veeramuthu, P and Baskaran, C. (2018). Scientometric Analysis Of The Journal "Nature Biotechnology". "Knowledge Librarian" An International Peer Reviewed Bilingual E-Journal of Library and Information Science Volume: 05, Issue: 02, 217-228 <https://www.researchgate.net/publication/328215023>
- Senthil Kumar P.A and Baskaran, C. (2018) Scientometric Analysis of Synthetic Fiber Literature. *Library Philosophy and Practice (e-journal)*.pp1-11, <https://core.ac.uk/download/pdf/220153043.pdf>
- Krishnan, P and Baskaran, C. (2018) Scientometric Analysis of the Journal "Green Chemistry". *International Journal of Research in Library Science*, 4(1), 16-24.
- Baskaran C. (2013) Research Growth Trend and Author Collaboration of Alagappa University in India during 1999-2011, *International Journal of Library and Information Studies*, 3 (1), 57-64, <https://www.ijlis.org/articles/research-growth-trend-and-author-collaboration-of-alagappa-university-in-india-during-19992011>.
- Baskaran C. (2013). Research growth trend and author collaboration of Alagappa University in India during 1999-2011. *International Journal of Library and Information Studies*, 3(1),57-64. <https://www.ijlis.org/articles/research-growth-trend-and-author-collaboration-of-alagappa-university-in-india-during-19992011.pdf>

Baskaran C. (2016). A Scientometric study on Bioinformatics literature during 1999-2013. *International Journal of Library Science and Information Management(IJLSIM)*, 2(4),62-71.

Baskaran C. (2015). Research productivity of enzymes literature: A Scientometric study, *International Journal of Library Science and Information Management(IJLSIM)*,1(2),17-21.

Baskaran C. (2012). Research productivity of Graph theory during 2004-2011: A Bibliometric study, *SRELS journal of Information Management*,49(6),683-691.<http://www.srels.in/index.php/sjim/article/view/43933>

Baskaran C and Karuilancheran C. (2015). Activity Index and Lotka's Law Application with Diabetes and Allied Diseases in India During 1995–2013, *SRELS Journal of Information Management*, 52(6).<http://www.informaticsjournals.com/index.php/srels/article/view/3298>

Baskaran and Ramesh Babu (2019).The substantial research on Quantitative analysis and Publications measure in Forensic Medicine,Library Philosophy and Practice.