Bibliometric Study of Chemistry Literature in North Eastern Hill University During 2000 to 2010

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Abstract – The main purpose of the study is to find out the scattering of Chemistry periodical literature in 'North Eastern Hill University (NEHU)' using bibliometric studies and to identify the core journal in this field. For the purpose of this study faculty members from Chemistry department have been chosen which comprise of nineteen faculty members and articles published by them in research journals during the period 2000 to 2010. The articles included in the present study were collected from NEHU institutional repository, Developing Library Network (DELNET) via Document Delivery Service (DDS) and also from 'Web of Science (WoS)' database of the Institute for Scientific Information (ISI). A total of 377 journals containing 4134 references were collected, MS-Excel spreadsheet and MS-Word were used to analyse the final data collected in order to generate tables, charts, graphs, etc. From the growth of literature on the subject of Chemistry the analysis of data showed that the nature of growth literature is not consistent as the number of publication varies in nature. In identification of core journals Leimkuhler model was employed and the following relationship of each zone is 5: 41 : 331 377 which fit into Bradford's distribution.

Keywords: Bibliometric, Chemistry Department, Authorship pattern, Core journal, Bradford's law.

I. Introduction

The department of Chemistry at the North Eastern Hill University, Shillong was started in 1976. The department is under the School of Physical Sciences. During the last four decade, the department has been actively involved in teaching and research activities relating to the fields of Inorganic Chemistry, Organic Chemistry and Physical chemistry. The department has initiated the programme and is providing training and research environment which provides people with latest information in their respective fields and brings them closer to the rest of the world as far as scientific advancements are concerned. The faculty members of the department of Chemistry has participated and presented papers in regional, national and international seminars/conferences. The faculty members published a good number of papers and books emanating from their research work. However, no specific effort has been made to evaluate the research contributions of the department of Chemistry. In the present work an attempt will be made to study the contribution of the Chemistry department by analyzing the periodical literature published during the period of 2000 to 2010.

II. Objectives

This study explores the growth of literature in North Eastern Hill University (NEHU) of Chemistry department over time using bibliometric study and to identify the core journal in this field. The main objectives of the study are to address the following aspects:

[1] To find out the number of publications by Chemistry faculty members of NEHU.

[2] To examine the nature of authorship pattern amongst faculty members of NEHU.

[3] Identification of core journals in the field of Chemistry through the application of Bradford's law.

III. Methodology and Literature Review

For the purpose of this study faculty members from Chemistry department have been chosen which comprise of nineteen faculty members and articles published by them in research journals during the period 2000 to 2010. The

articles included in the present study were collected from DELNET via Document Delivery Service (DDS), NEHU institutional repository and also from Web of Science (WoS) database of the Institute for Scientific Information (ISI). Web of Science is a product of ISI that provides access to current and retrospective multidisciplinary information from approximately 8500 research journal all over the world. The search strategy used for collecting data for North Eastern Hill University (NEHU) was: "Author=Lal R A; Address=Ne hill Univ; Document type=article; Time Span= 2000 to 2010" The same strategy was used to collect data for all other faculty members. To substantiate the data collected, consulting the Annual Reports of NEHU of the last ten years (2000 to 2010) was done which also help in finding out about the publications by the faculty members of NEHU.

Various studies have been conducted in the past, analyzing the research output of faculty members to manage journal collection using bibliometric studies. Arunachalam [1, 2] clarifies that universities are still in the lead in contributing biotechnology publications. He also specified that the reason for greater volume of work at the higher educational institutes, compared to better endowed national laboratories, is the presence of a large number of doctoral students. Chikate and Patil [4] ranked the list of journals in the field of Library and Information Science (LIS) titles arranged in their decreasing order. They revealed that the most cited journal by LIS researchers is *College and Research Libraries*, which was cited 141 times, more than 5.3 per cent of the total percentage of citations, followed by *Scientometrics* at 129 (4.9 per cent), *Journal of American Society for Information Science*, 113(4.3 per cent), *Journal of Documentation* 99 (3.8 per cent), *Aslib Proceedings* 82 (3.1 per cent), *Library Quarterly*78 (3.0 per cent), and *Library Trends* with 62 (2.3 per cent). Goyal, Gupta and Kumar [5] studied authorship trends and collaborative research in the field of chemical sciences based on the data collected from Indian Journal of chemistry section-B (IJCB) published during the 2002-2011. Findings revealed that multi authored articles 97.24% prevail the single authored articles 2.75%. The degree of collaboration in the field of chemical sciences is 0.97 and average number of authors per paper varies from 3.21-3.78. Patra, Bhattacharya and Verma [6] in their bibliometric study of literature found that

about 280 journals publish 3781 articles. Scientometrics is on the top with 1571 articles, which is about 41.54 per cent of the total publications, followed by Journal of American Society of Information Science and Technology, which published 197 articles (5.21 per cent). Patra and Chand [7] summarised the growth of biotechnology literature from 1 article in 1982 to more than 300 articles in 2003. They have also stated that there is a growth in research and development output over the years, but for the period of 22 years, both the number of manpower devoted to it and the number of institutions, it look slow. Sevukan and Jaideep [9] have analyzed the research output of Biotechnology faculty members in some Indian Central Universities from 1997 to 2006. Their results indicate that the growth of literature increased from 15 articles in 1997 to 43 article in 2006; in most of their work co-authorship that is two- authored publication predominate amongst the pattern of authorship.

IV. ANALYSIS AND INTERPRETATION

A. Growth of Periodical Literature

As summarized in the Table 1, out of the total number i.e. 221 periodical literatures from 2000 to 2010. The period 2000 to 2001, 7 (3.17 percent) periodical article were published, 2001 to 2002 showed the least growth of periodical literature as only 6 (2.71 percent) in 2002 to 2003 the number of periodical literature increase to 10 (4.52 percent), 26 (11.76 percent) in 2003 to 2004, 22 (9.95 percent) in 2004 to 2005, 21 (9.50 percent) in 2005 to 2006, 28 (12.67 percent) in 2006 to 2007, 27 (12.22 percent) in 2007 to 2008, 30 (13.57 percent) in 2008 to 2009 and in 2009 to 2010 the growth of periodical literature is maximum which reported to 44 (19.91 percent).

TABLE 1 GROWTH OF LITERATURE

Year	No. of Periodical Literature	In percentage
2000-2001	7	3.17
2001-2002	6	2.71
2002-2003	10	4.52
2003-2004	26	11.76
2004-2005	22	9.95
2005-2006	21	9.50
2006-2007	28	12.67
2007-2008	27	12.22
2008-2009	30	13.57
2009-2010	44	19.91
Total	**221**	100.00

B. Authorship Pattern

Table 2. Shows details of authorship pattern out of 221 papers, 2 (0.90 percent) have been contributed by single author, 62 (28.05 percent) by two authors, 64 (28.96 percent) by three authors, 19.00 percent by four authors, 9.95 percent by five authors, 4.52 percent by six authors and 2.71 percent by seven authors and so on. Here, two and three authorship pattern is most preferred by Chemistry faculty members.

TABLE II AUTHORSHIP PATTERN

SI. No	Authorship Pattern	Number	percentage
1	Single Authorship	2	0.90
2	Two Authorship	62	28.05
3	Three Authorship	64	28.96
4	Four Authorship	42	19.00
5	Five Authorship	22	9.95
6	Six Authorship	10	4.52
7	Seven Authorship	6	2.71
8	Eight Authorship	7	3.17
9	Nine Authorship	5	2.26
10	Ten Authorship	1	0.45
	Total	**221**	**100.00**

C. Identification of Core Journals

The literature in Chemistry covered in the present study (2000 to 2010) comprises a total of 4134 articles contained in 377 journals. To observe the appropriateness of the distribution of journals using the verbal formulation of Bradford Law, the following explanations were made and the results were presented. The first part deals with the verbal formulation of the theory based on data consisting of whole journal references arranged by their decreasing frequency of citation, while the second part examines the graphical representations based on the same data.

1.Verbal Formulation

The number of cited journals has been arranged by decreasing number of citations. To test the verbal formulation of Bradford's law, the rank number of journals, numbers of citations, cumulative citations were given.

For testing the algebraic interpretation of the law, the 4134 journals articles were divided into three zones. The Bradford's multiplier factor was arrived at by dividing journals of a zone by its preceding zone. Bradford's multiplier was expressed as the ratio of the number of

journals in any group to the number of journals in any immediately preceding group. The basis for choosing the three zones was that the percentage error in the distribution of citations, among the three zones should be minimum.

The distribution of journals and corresponding number of citations in three zones along with the value of Bradford Multipliers (BM) are shown in table no. 3

TABLE III BRADFORD'S DISTRIBUTIONS OF ARTICLES OVER DIFFERENT JOURNALS

Zone	Number of Journals (observed)	Journal Percentage	Number of articles (observed)
First	6	1.59	1279
Second	22	5.84	1357
Third	349	92.57	1498
Total	**377**	**100.00**	**4134**

In the present data set it was observed that, 6 journals covered 1279 articles, next 22 journals covered 1357 articles and next 349 journals covered 1498 articles. In other words, one third of the total citations have been covered by each group of the journals.

According to Bradford [3] "If scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into 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 number of periodicals in the nucleus and succeeding zones will be as 1: n: n^2.". But it was found that the relationship of each zone in the present study is 6: 22: 349. This does not fit into Bradford's distribution. Therefore, the following method based on the Leimkuhler model was employed for the verification of Bradford's Law of Scattering.

2. Application of Leimkuhler Model

In the present study of Journal citation, for application of Bradford's law the citation distribution were divided in three zones (p=3 Where p denote the number of zones) then by using the mathematical formula,

$$k = (e^y \, y_m)^{\frac{1}{p}}$$

Where y is Euler's number

$$(e^y = 1.781)$$

$$k = (1.781)^{\frac{1}{P}}$$

The value of Bradford's multiplier k is calculated as follows:

In the present case y_m = number of items in the most productive source is 303 and hence

$$k = (1.781 \times 303)^{\frac{1}{3}}$$

$$k = 8.14$$

$$y_o = \frac{A}{P}$$

Where, A denotes the total number of articles = 4134 and P denotes the number of zones = 3

$$y_o = \frac{4134}{3} = 1378$$

and r_o = number of journals in the nucleus of Bradford is calculated as

$$r_o = \frac{T(k-1)}{k^P - 1}$$

Where T = Total number of Journals

$$r_o = \frac{377(8.14-1)}{(8.14^3 - 1)}$$

$$r_o = 5$$

$$a = \frac{y_o}{\log k}$$

log of 8.14 = 0.91

$$a = \frac{1378}{0.91}$$

$$a = 1514.28$$

$$b = \frac{k-1}{r_o}$$

$$b = \frac{8.14-1}{5}$$

$$b = 1.42$$

The number of journals in the nucleus is 5 and the mean value of the bradford multiplier is 8.14. Therefore, the Bradford's distribution is written as:

$$5 : 5 \times 8.14 : 5 \times (8.14)^2 \gg 1 : n : n^2$$

$$5 : 40.70 : 331.29 \gg 376.99$$

Percentage of error $= \frac{377 - 376.99}{376.99} \times 100 = 0.002\%$

Here the percentage error is negligible. It is also observed that, the number of periodicals contributing reference to each zone increases by a multiplier of 8.14. After rounding the data of the zonal analysis shows that the first zone containing 5 journals contributed 1138 references, the 40.70 journals of the second zone produced 1872 references and the 331 jounals produced 1124 references. Here the mean value of the Bradford Multiplier (BM) is large i.e. two digits. The larger the BM, presumably, the higher is the scatter. Although the value of BM also depends on the size of the data, smaller the data, smaller the value of Bradford's Multiplier.

TABLE IV SCATTERING OF JOURNALS AND CITATION OVER BRADFORD'S ZONES

Zone	Number of Journals	Journal Percentage	Number of articles
First	5	1.33	1138
Second	41	10.88	1872
Third	331	87.80	1124
Total	377	100	4134

3. Graphical Formulation

The graphical formulation is just the experimental verification of the verbal formulation which observes certain regularity in the distribution of scientific publications.

The graph is logarithmic plot of the cummulative number of journals titles on the horizontal axis and the cumulative number of citations on the vertical axis.

IV. CONCLUSION

During the period 2009 to 2010 the faculty members of Chemistry produced maximum research papers with 19.91 percent out of the total publication. The most common type of authorship pattern is three in which 28.96 percent collaboration is seen. In identification of core journals according to Bradford's law of distribution the relationship between the zone is 1: n: n^2 (i.e. 1: 5: 25). But it was found that the relationship of each zone in the present study is 6: 22: 349 this does not fit into Bradford's distribution. Therefore, the following method based on the Leimkuhler model was employed for the verification of Bradford's Law of Scattering. After following Leimkuhler model the

following relationship of each zone is 5 : 40.70 : 331.29 ≫≫ 376.99 which fit into Bradford's distribution. The top cited journals in Chemistry department are Journal of Organometallic Chemistry, Journal of the American Ceramic Society, Inorganic chemistry, Journal of Physical Chemistry A and Journal of Physical Chemistry.

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ANNEXURE I TOP RANK LIST OF JOURNAL IN CHEMISTRY DEPARTMENT

SI. No.	Cumulative Number of Journals	Log of Cumm. No. of Journals	Rank	Name of Journals	No. of Citations received from 2000 to 2010	Cumm. No. of Articles
1	1	0	1	Journal of Organometallic Chemistry	303	303
2	3	0	2	Journal of the American Ceramic Society	248	551
3	6	1	3	Inorganic chemistry	234	785
4	10	1	4	Journal of Physical Chemistry A	195	980
5	15	1	5	Journal of Physical Chemistry	158	1138