



Scientometric analysis of Research productivity: a case study of National Environmental Engineering Research Institute, Nagpur

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Abstract

The paper presents a Scientometric analysis of publications of National Environmental Engineering Research Institute, Nagpur, during 2012 to 2016 as reflected in Web of Science database. It attempts to analyze the growth and development of research activity of National Environmental Engineering Research Institute, Nagpur as reflected in publications output. Data for a total of 399 have been downloaded and analysed according to objectives. The study reveals the research productivity in terms of the year wise growth of literature with respect to total papers, Articles are the most published form of literature (90.98%), Council of Scientific Industrial Research India ranked first with 377 documents (94.49%) while 2nd rank was that of Rashtrasant Tukadoji Maharaj Nagpur University with 28 Publications (7.02%). The details of top ten collaborating institution/university with NEERI are also provided. The highly productive subject areas are Environmental Sciences and Ecology is the most favoured area of research among the contributors with 34.34%, followed by Engineering with 19.30%, Chemistry with 16.79% . USA, and Japan are the most favoured countries for collaborations, Top.prolific authors are Purohit H J;



Krishnamurthi K; Wate SR, Authorship pattern analysis shows that most preferred authorship pattern is of four authors (19.05%).

Keywords: Research Productivity, Research Output; Scientometric analysis, National Environmental Engineering Research Institute

1. Introduction

National Environmental Engineering Research Institute (NEERI), is located at Nagpur, Maharashtra state and it is a constituent of Council of Scientific & Industrial Research (CSIR), New Delhi and has a nation-wide presence with its five zonal laboratories at Chennai, Delhi, Hyderabad, Kolkata and Mumbai. The mandate of NEERI is: To conduct research and developmental studies in environmental science and engineering, , to participate in CSIR thrust area and National mission projects, to collaborate with academic and research institutions on environmental science and engineering for mutual benefit, to give assistance to the industries of the region, local bodies, etc. in solving the problems of environmental pollution through S &T intervention.

2. Review of literature

Few quantitative studies have been carried to analyzing institutions research outputs of the country by using scientometric analysis. The following studies have been reviewed in view of better understanding of research productivity using scientometric analysis:-

Singh (2015) analyzed the Research output of Indian Institute of Technology Mandi (IIT Mandi) and focused on the collaboration at different levels such as author, institution and status of collaboration at National/international level. Banshal et al. (2017) analyzed the research performance of 16 older Indian Institutes of Technology of India, shows that there is a substantial difference in research performance levels of old IITs vis-à-vis the new IITs. Nabi Hasan (2015) reported that “The paper attempts to evaluate the trend of research output of five top ranked Indian Institutes of Technology (IITs) on the basis of research papers/articles indexed in Web of Science online database for the five years’ period of 2009-13. A total of 215,019 records were retrieved for India which are 2.72% of the global records for the period 2009-13”. Bid (2016) “analysed publications of Indian Institute of Technology Kharagpur for the period 2000 to 2015 and emphasized the growth and

development of research activity of this institution". Jeevan⁵ et..al. (2002) analyzed the performance and impact of research produced in each department, and the comparison of the impact of research in various departments. Tasleem (2015) studied the Research Productivity of Indian Institutes of Technology, and faculty members of computer science Engineering departments of four IITs and found that there are much differences in research productivity in terms number of publications, growth of literature, per capita productivity, etc. Reported that IIT Madras has outperformed amongst them.

3. Objectives

1. To analyze year wise research output in terms of total papers.
2. To find out the top ten most productive authors and authorship pattern.
3. To know degree of collaborations amongst authors.
4. To know research area -wise distribution of publications
5. To find out the top participant institutions at national and international levels.
6. To identify the collaboration trend with other countries
7. To know the types of documents preferred, in which maximum research findings have been published.

4. Data collection

For collection of the publication data, the source Web of Science (WoS) a bibliographic and citation database was used which covers a selected group of journals and conferences. The data was collected for the period 2012-2016. The 5 years period is a good period to know research productivity. The search has been made for the collection of data using: [OG = " National Environmental Engineering Research Institute India" Timespan=2012 2016]. The data was obtained in May 2017. The full records were downloaded in the excel format. All types of documents such as articles, proceedings papers, editorial material, titles, author records, with affiliation and citation references etc. were covered.

5. Methodology

For Scientometric analysis of publication data of National Environmental Engineering Research Institute (NEERI), the standard form of methodologies were used to analyse various parameters like year wise growth rate of papers, Highly Prolific Authors, Internationally Collaborated Papers (ICP), authorship pattern, collaborative authors. Degree of

collaborations, the top productive authors were found out based on their publications productivity. The most collaborating institutions and countries have been recognized using extraction of information from affiliation text. Finally the major research areas were examined.

6. Data analysis and interpretation

6.1 Growth of Literature:

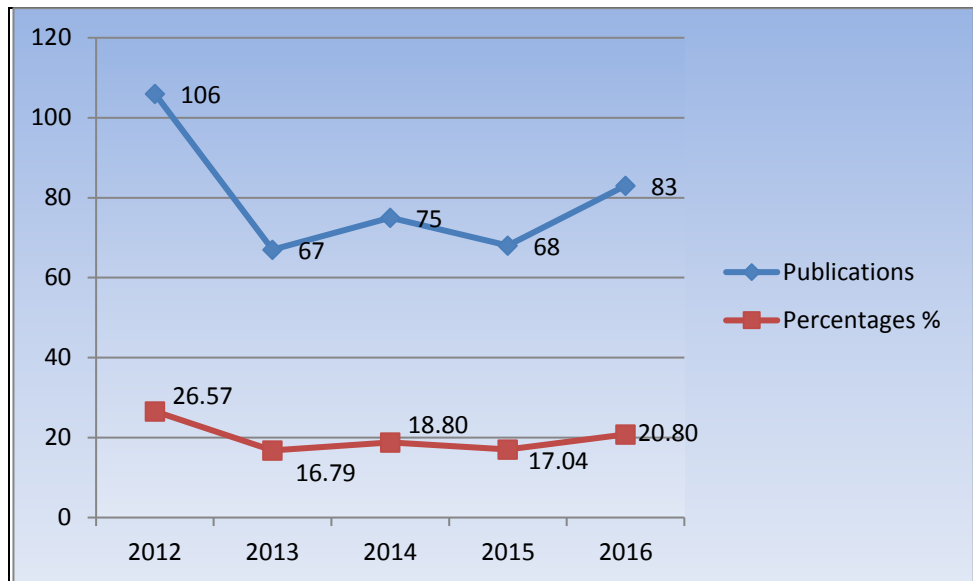


Figure 1: Year-wise research growth in terms of total papers

The year wise research growth in terms of TP (total papers) are given in figure 1, it shows that number of research papers decreased year wise form 2012 to 2016. It reveals that highest no. papers were published in 2012, Number. of papers: 106 (26.57%) and lowest in 2013 with total No. of papers as 67(16.79%).

6.2 Authors Pattern of Papers Published

Table 1
 Authorship Pattern of Papers Published

| Year | One Author | Two Author | Three Author | Four Author | Five Author | Six Author | Seven Author | Eight Author | Nine ++ Author | Total |
|---------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|----------------|---------------|
| 2012 | 8 | 4 | 28 | 21 | 16 | 11 | 9 | 4 | 5 | 106 |
| 2013 | 5 | 9 | 12 | 14 | 11 | 6 | 4 | 3 | 3 | 67 |
| 2014 | 1 | 5 | 10 | 12 | 14 | 13 | 11 | 4 | 5 | 75 |
| 2015 | 3 | 1 | 11 | 9 | 18 | 12 | 6 | 2 | 6 | 68 |
| 2016 | 5 | 8 | 13 | 20 | 12 | 12 | 7 | 2 | 4 | 83 |
| 5 year | 22 | 27 | 74 | 76 | 71 | 54 | 37 | 15 | 23 | 399 |
| %> | 5.51 | 6.77 | 18.55 | 19.05 | 17.79 | 13.53 | 9.27 | 3.76 | 5.76 | 100.00 |

Table 1 shows the authorship pattern of papers. Out of 399 papers, the maximum number of papers were 76 (19.05 %) from four authors followed by three authors 74 (18.55 %), five authors 71 (17.79), and so on. Data reveals that most of the authors like to publish papers with collaborations and most preferred authorship pattern is of four authors.

a. Degree of Collaboration (DC)
Table 2
Degree of Collaboration Measures (DC)

| | No. of publications | Percentage (%) of total publications | Nm+Ns | DC |
|--|---------------------|--------------------------------------|-------|------|
| Total number of Single/Multi-Authored Publications | 399 | 100 | | |
| No. of Co-Authored Publication (NM) | 377 | 94.48 | 399 | 0.94 |
| No. of Single-Authored Publication (NS) | 22 | 5.51 | | |
| No. of two-Authored Publication(NM) | 27 | 6.77 | 49 | 0.55 |
| No. of three-Authored Publication(NM) | 74 | 18.55 | 96 | 0.77 |
| No. of four-Authored Publication(NM) | 76 | 19.05 | 98 | 0.78 |
| No. of five-Authored Publication(NM) | 71 | 17.79 | 93 | 0.76 |
| No. of six-Authored Publication(NM) | 54 | 13.53 | 76 | 0.71 |
| No. of seven-Authored Publication(NM) | 37 | 9.27 | 59 | 0.63 |
| No. of eight-Authored Publication(NM) | 15 | 3.76 | 37 | 0.41 |
| No. of nine & above Authored Publication(NM) | 23 | 5.76 | 45 | 0.51 |

In order to better understand degree of collaboration, the formula suggested by Subramanyam (1982) and used by Bid (2016), has been applied for this study. The Degree of Collaboration calculates the proportion of co-author publications among total publications as indicator, and results are formulated in Table 2. The formula is $DC = Nm / (Nm + Ns)$ in which C is degree of collaboration in a discipline, “Nm” is number of multi-authored publications during specific period in some discipline, “Ns” is number of single authored publications in a discipline during the same period of time. The data given in the column of the Table 2 shows 0.94 as the highest degree of collaboration (2012-16) and second highest of 0.78 four-authored publications followed by 0.77 three-author publications. The value of Degree of Collaboration is lowest among eight authored publications, that is 0.41. Calculation: $DC = Nm / (Nm + Ns)$ As data given in Table 2, Degree of Collaboration(DC) for three authors publications; $Nm = 74$ & $Ns = 22$ $DC = 74 / (74 + 22) = 0.77$.

6.3 Most Productive/Highly Prolific Authors and their Publications

Table 3

Top Ten Highly Prolific Authors and their Publications

| S.No. | Author | Publications | Percentage (%) |
|-------|-----------------|--------------|----------------|
| 1 | Purohit HI | 44 | 11.028 |
| 2 | Krishnamurthi K | 22 | 5.514 |
| 3 | Wate SR | 20 | 5.013 |
| 4 | Kashyap RS | 20 | 5.013 |
| 5 | Taori Gm | 19 | 4.762 |
| 6 | Daginawala HF | 19 | 4.762 |
| 7 | Kapley A | 18 | 4.511 |
| 8 | Chakrabarti T | 18 | 4.511 |
| 9 | Pandey RA | 17 | 4.261 |
| 10 | Kumar R | 17 | 4.261 |

Table 2 shows a list of most productive/ prolific authors of NEERI, Nagpur. it is been revealed that Purohit H J, of NEERI, Nagpur, published highest numbers of papers, with 44, followed by Krishnamurthi K who published 22 papers with second position, Wate S R and Kashyap R S published 20 papers with third position.

6.4 Type of Publications:

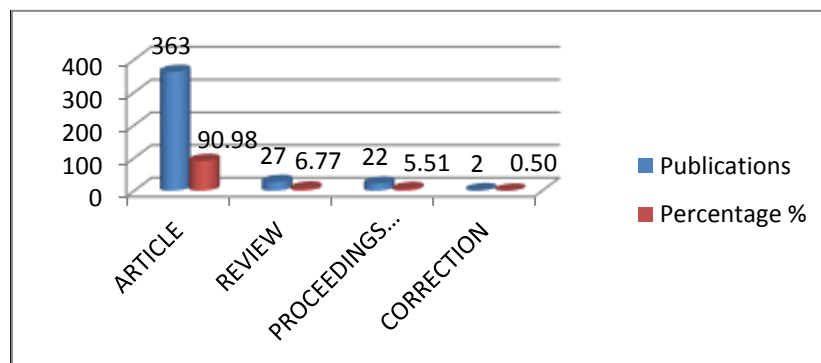


Figure 2: Distribution of publications according to type

Figure 2 shows that Distribution of publications according to type it shows that research productivity in the form of number of articles was 363 (90.98%) followed by no. of reviews

27 (6.77%), etc. it reveals that research productivity in term of articles is highest in NEERI, Nagpur.

6.5 Research area -wise Distribution of Publications

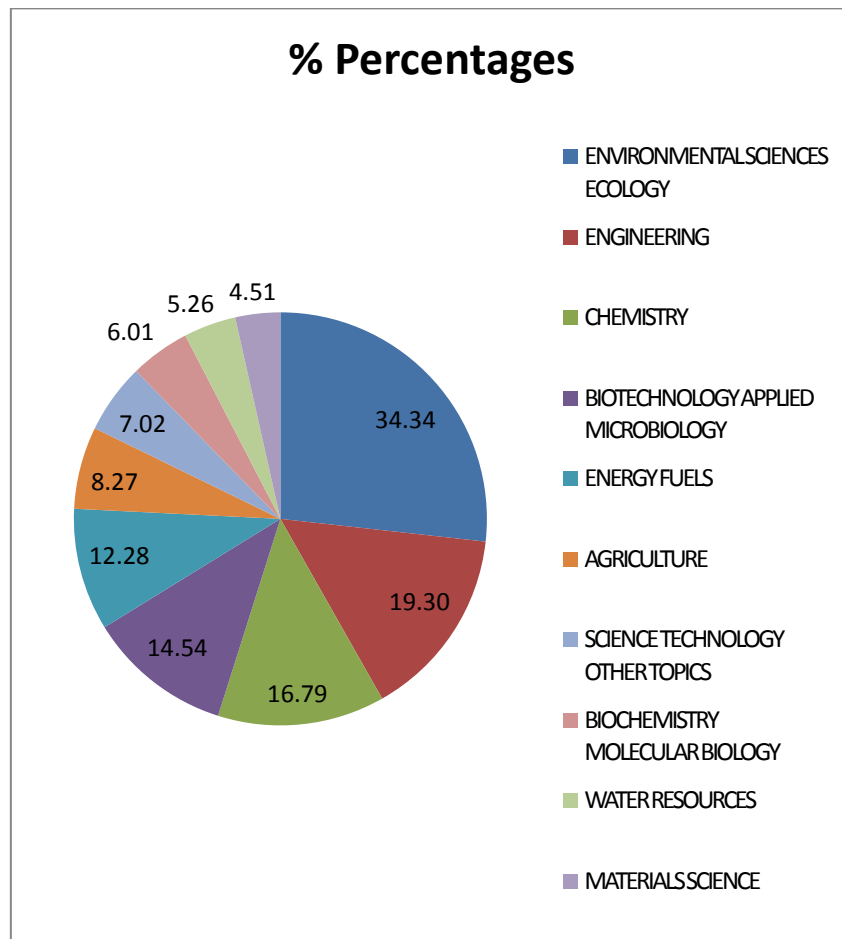


Figure 3: Research area -wise Distribution of Publications

Figure 3 shows the research output covered in this study during 2012-2016 with respect to various subjects as defined by WoS. Among the list of top subjects for which the authors of NEERI, Nagpur contributed, mostly contributed papers were in the field of Environmental Sciences where Ecology is the most favoured area of research among the contributors with 34.34%, followed by Engineering with 19.30%, Chemistry with 16.79%, Biotechnology Applied Microbiology 14.54%, Energy fuel with 12.28 % Agriculture 8.27%,

6.6 Collaboration with other Countries

Table 4

Collaboration of papers with other countries

| S.No. | Countries/Territories | Publications | Percentages% |
|-------|-----------------------|--------------|--------------|
| 1 | USA | 13 | 3.25 |
| 2 | Japan | 13 | 3.25 |
| 3 | Nigeria | 9 | 2.25 |
| 4 | South Korea | 8 | 2.00 |
| 5 | Peoples R China | 7 | 1.75 |
| 6 | Morocco | 6 | 1.50 |
| 7 | Italy | 6 | 1.50 |
| 8 | France | 5 | 1.25 |
| 9 | Canada | 5 | 1.25 |
| 10 | Portugal | 4 | 1.00 |

Table 3 shows collaboration of papers with other countries with authors of NEERI, Nagpur. It reveals that USA & Japan are in the top position with no. of publications as 13 (3.25%), followed by Nigeria 9 (2.25) at a second position and South Korea with no. of publication is 8 (2.00%) in third position.

6.7 Top participating institutions in collaboration with NEERI, Nagpur

Table 5

Top participating institutions in collaboration with NIT Kurukshetra

| S.No. | Top participating institutions in collaboration with NEERI, Nagpur | Records count | Percentage (%) |
|-------|--|---------------|----------------|
| 1 | National Environmental Engineering Research Institute India | 399 | 100 |
| 2 | Council of Scientific Industrial Research India | 377 | 94.49 |
| 3 | Rashtrasant Tukadoji Maharaj Nagpur University | 28 | 7.02 |
| 4 | Cent India Inst Med Sci | 20 | 5.01 |
| 5 | Visvesvaraya National Institute Of Technology Nagpur | 13 | 3.26 |



| | | | |
|----|---|----|------|
| 6 | Indian Institute Of Technology Bombay | 11 | 2.76 |
| 7 | University of Delhi | 7 | 1.75 |
| 8 | Kyushu University | 5 | 1.25 |
| 9 | Central Food Technological Research Institute India | 5 | 1.25 |
| 10 | University of Ibadan | 4 | 1.00 |

Table 5 shows the top participating institutions in collaboration with NEERI, Nagpur. It is found that authors/contributors of NEERI, Nagpur were collaborating with many institutions to publish their papers. Within top 10 collaboration institutions are: Council of Scientific Industrial Research India with 377 Publications (94.49%), Rashtrasant Tukadoji Maharaj Nagpur University with 28 Publications (7.02%) & Cent India Inst Med Sci with 20 Publications (5.01%), Visvesvaraya National Institute Of Technology Nagpur with 13 (3.26%); Indian Institute Of Technology Bombay with 7 publications(1.75%).

7. Findings and Conclusion

The study finds that National Environmental Engineering Research Institute (NEERI) has contributed 399 papers during 5 ears period. The contributors of NEERI have tendency to publish their work with four or more authors which indicates the multi author pattern and shows that the contributors of this institution is collaborative in nature. The most productive author based on their publication is Purohit H J ranked first with 44 papers (11.02%). Contributors from NEERI have a tendency to publish their papers in articles followed by reviews. Environmental Sciences Ecology is the most favoured area of research among the contributors with 34.34%, followed by Engineering with 19..30%, Chemistry with 16.79%, is the top priority subject followed by Biotechnology Applied Microbiology, Energy Fuels and others in which the contributors publish their papers. USA & Japan was at the top position with 13 publications in the list of collaborating countries with NEERI., followed by Nigeria with 9 publications and south Korea with 8 publications. In terms of top participating institutions in collaboration with NEERI, the Council of Scientific Industrial Research India ranked first with 377 documents (94.49%) followed by Rashtrasant Tukadoji Maharaj Nagpur University with 28 Publications (7.02%) & Cent India Inst Med Sci with 20 Publications (5.01%) and others . It is suggested that such types of studies should be carried out



periodically that will be helpful to review the progress in terms of research productivity of particular institution/University.

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