Performance of Research Productivity on Green Energy in India: A Scientometric Study

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Abstract - The study examines Green Energy Research in India as revealed by the scholarly publication indexed in web of science (WoS) for a period of fifteen years from 1999 to 2013. 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, share of international collaborative papers and major collaborative partner countries and patterns of research communication in most productive journals. It also analyses the characteristics of most productive institutions, authors and high-cited papers.

Keyword: Green Energy, Scientometric, Citation, India

I. Introduction

Green energies have a huge potential and can, theoretically, provide an unlimited supply of relatively clean and mostly local energy. In absolute terms, renewable energy supply has been growing strongly; albeit from a very low base. Green energy is closely associated with the concept of sustainable development introduced to the broad public in the report “Our Common Future” published in 1987 by the World Commission on Environment and Development chaired by Gro-Harlem Brundtland. The concept is defined in the report as: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Green is a term used for forms of energy which are not exhausted by use over time. It means that the renewable resources can be regenerated or renewed in a relatively short time. This Handbook focuses on the following leading renewable resources: biomass, wind, geothermal, solar and hydro. Industrial heat recovery power (IHRP) is a fairly novel approach to improving industrial energy efficiency by means of power generation, and in the US it is now included in the Renewable Energy Portfolio Standards. The sources of renewable energy can be divided, according to their origin, into natural renewable resources (wind, geothermal, solar, hydro, etc.) and renewable resources resulting from human activity (biomass, including landfill gas and industrial heat recovery power).
II. OBJECTIVES OF THE STUDY

The main objective of this study is to examine the current status of Indian Green Energy, as reflected in the country research output during 1999-2013. The researcher has framed the following objectives for the purpose of present research.

1. To identify and analyse the rate of growth of research productivity;
2. To examine the Year-wise distribution of publications;
3. To identify the Document-wise distribution of publications output;
4. To analyse the authorship pattern and examine the extent of research collaboration and ranking of authors based on publications output;
5. To identify journal-wise distribution of publications output;
6. To identify word-wise distribution of publications output;
7. To assess the Institution-wise research concentration;
8. To identify Country-wise Collaborative Distribution of Publications.

III. METHODOLOGY

The study entitled “Research Activities on Green Energy in India: A Scientometric Analysis” is a study encompassing records output on Science from Science Citation Index (SCI) available on online (Web of Science). The present study aims at analysing the research output of Researchers in the field of Green Energy. The growth rates of output in terms of research productivity is analysed from 1999 to 2013. The authorship pattern and author productivity are examined to identify the pattern of research contribution in the field of Green Energy. The data has classified into Histcite Software. The data so retrieved were downloaded and later imported into a database management system for data cleaning and coding. In data cleaning, all duplicate records as well records pertaining to publication years not under the purview of our study, were eliminated. It is also analytical in nature in strengthening the empirical validity due to application of suitable statistical tools.

A. Data Collection

The basic publication data used in this study is derived from the Expanded Version of Science Citation Index (SCI) database, available in Web of Science. The raw publications data along with their citations has been downloaded from the Web of Science in May 2013. Publications data for 15 years from 1999 to 2013 were used for analyzing the growth and impact of Green Energy research.

IV. DATA ANALYSIS

The table I depicts the Green Energy research output in the Indian level. From the below table, we could clearly see that during the period 1999 - 2013 a total of 1105 publications were published. In the present study the research output on Green Energy publication is taken as a tool to evaluate the performance at various levels.

**Table I shows Year Wise Distribution of Publication and Citation Scores**

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Table I shows that a chronological histogram of citations, demonstrating that citation frequency grew steadily from 1999; it reached a maximum GCS of 1439 in 2009 and LCS of 57 in 2009. The highest publication is 189 in 2012 with 170 Global Citation Scores followed by 166 papers in 2011 with 719 Global Citation Score and 123 papers in 2010 with 1241 Global Citation Scores. The lowest publication is 18 in 1999 with 83 Global Citation Scores. It shows that even minimum numbers of records were scored higher global citations. The study also reveals all these 1105 publications
have 34493 cited references it shows that there is a healthy trend in citing reference is found among the Indian Scientists belongs to Green Energy.

A study of data in table II indicates the Document-wise distribution of research output in Green Energy. This study has observed a total of 1105 publications in Green Energy during the period of fifteen years from 1999 to 2013. Out of various sources of publications in Green Chemistry, journal articles that appeared in the journals have shown a predominant contribution (91.9%) with Global citation score is 10076 and this source occupies the first position. The source of review comes second in order (4.5%) of sharing total research output in Green Energy during the period of analysis. The source of proceeding papers comes in the third position (3.2%) with respect to total output in Green Energy research during the study period.

The authorship pattern in green energy literature reveals the following facts. The present study brings papers under analysis contributed by one author to ten authors. Table III indicates that the three author’s papers rank first in order (27.76%), where as two authors papers obtain the second order of priority (25.70%) and four authors papers obtain the third order of priority (18.64%). The single author papers record the seventh order of priority (5.33%). The present study brings papers under analysis contributed by one author to ten authors. It is noticed that from four author papers to ten authors’ papers, the trend in number of publications has reduced. It is noticed that from five authors to ten authors papers, the trend in number of publication has reduce.

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Table IV indicates ranking of authors by number of publications. Authors “Rai SB” published highest number of articles for the study period with 29 records; next consecutive authors Kumar R is published next highest number of articles for the study period with 23 records. Das Dhaving highest Global Citation Scores of 736 with just 6 publications followed by Mittal.A having Global Citation Score of 389 with just 8 publications, while Kakani SL having lowest Global Citation Score of 7 with just 9 publications. Thus the most-cited authors are distinguished from the most-published ones. It is found from the analysis that Lotka’s law may not be applicable with regard to author productivity in proliferation of research in Green Energy as the research papers equally distributed by a large number of authors.

The study found that the total research output of the Green Energy for the study period (1999 – 2013) published in 86 journals. As the major portion of the research productivity (27.8%) covered by 25 journals that is coincide with the theory of Bradford’s Law of scattering of journals in research productivity. Top ten produced mostly 15% of the research output. The journal “JOURNAL OF LUMINESCENCE” topped with 23 publications with the Global Citation Score of 249, next “SPECTROCHIMICA ACTA PART A-MOLECULAR AND BIOMOLECULAR SPECTROSCOPY” has 22 publications with the Global Citation Score of 116 and “JOURNAL OF APPLIED PHYSICS” with 19 publications with the Global Citation Score of 175 respectively. “JOURNAL OF HAZARDOUS MATERIALS” has scored the highest Global Citation Score of 825 with 17 publications while “INDIAN JOURNAL OF PHYSICS AND PROCEEDINGS OF THE INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE” has scored a Global Citation Score of 2 with just 5 records.

Key Word is one of the best indicators to understand and grasp instantaneously the thought content of the papers,

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methodologies used and areas of research addressed to the high frequency keywords were “GREEN” is topped with 178 publications with the Global Citation Score of 2140, next “SYNTHESIS” with the Global Citation Score of 1040 respectively. “GREEN” has scored the highest Global Citation Score of 2140 with 178 publications. The high frequency keywords appeared more than five times.

In general, institutions which are specifically meant for research activities would contribute a greater level of research publications and it is not up to the mark of desired level of expectations in other institutions. The below given table VII analysis indicates Institution-wise research productivity. It is noted that 860 institutions were contributed 1105 of the total research productivity. It is noted that Central Green Energy Research Institute contributed the highest number of research publications (116) at the same time it ranks first in terms of Global Citation Score 2031.

### Table VII Institution-Wise Distribution of Publications

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The study of Country-wise distribution of a number of research output is an important factor in highlighting the research and development in any discipline of science. In this context, the analysis of performance of Indian Green Energy scientists is quite obvious with a view to reflect their achievements in attracting the attention of foreigners in terms of published research articles in the journals of various countries.

The below table VIII indicates that among the country-wise distribution of Green Energy covered by the study tops India with 1088(98.5%) publications followed by United States of America with 44(4.0%), South Korea with 24(2.2%), Japan with 22(2.0%) and Germany with 17(1.5%) research publications respectively. First place goes to India having total Global Citation Score of 11617 with 1088 publications. South Korea secured second rank in terms of GCS with 66 but with only 14 publications and also collaboration with more than 40 Countries.
V. Conclusion

It concluded quantitatively the contributions made by the Indian researchers during 1999-2013 as reflected in Web of Science database. During 15 years period (1999-2013) Indian contributions in terms of number of publications is significant. A comparison of Indian output in relation to the world output may help in understanding the contribution in a better angle. Though the records available in the Web of Science database reveal a small number, it is important that the Web of Science covers only the peer-reviewed journals. If a broader coverage database is available, it may provide a reasonable number of papers. Researcher suggest for tracking citation record of papers so that the impact of publications in Green Energy may be visible.

References


