

# RESEARCH PRODUCTIVITY OF PHYSICAL SCIENCE DISCIPLINES IN SAMBALPUR UNIVERSITY (ORISSA): A SCIENTOMETRIC STUDY

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## ABSTRACT

This paper attempts to analyse quantitatively the growth and development of Physical Science Research in Sambalpur University in terms of publication output as reflected in Scopus Database. From its inception (1971) to till date (2010) a total of 417 papers were published by the Physical Science researchers of Sambalpur University in various subject domains: Physics, Chemistry, Mathematics, Statistics, Environmental Science, and Earth Science. The present study analyzed year-wise growth of publications, most preferred journals of the publications, Impact Factor (IF) of the publishing journals, authorship pattern of the papers, Subject wise distribution of papers, etc. Besides, the study explored intra-department, inter-department, intra-state, inter-state, and international research collaboration of the authors in Sambalpur University. The whole study will assess the intellectual output of the physical science researchers of the Sambalpur University and it may act as a catalyst for increasing their interest for further research. The findings of the research will be a matter of concern for various policy-making bodies and funding agencies of Sambalpur University, such as, UGC, NAAC, Ministry of HRD, etc.

**Keywords:** Physical Sciences, Scientometric analysis, Authorship pattern, Subject Domain, Impact Factor

## INTRODUCTION:

Research publications are the embodiments of intellectual discoveries primarily aiming to transmit new ideas or information for bringing advancement in knowledge. As reflected in the Scopus Online database, the quantity of Physical Science research is more than other subject areas like Life sciences, Health Sciences and Social Sciences. It also reflects that the publication output by the physical science researchers is much more than the researchers of other subject areas of Sambalpur University. Sambalpur University is one of the major universities of Odisha established in 1967. The University provides Post-Graduate, M.Phil and PhD programmes a wide range of subjects including modern subjects like, Master of Finance Control, Biotechnology, Bio-informatics, Food Science and technology, etc. The Department of Chemistry, Physics, Mathematical Science, Environmental Science, and Earth Science of Sambalpur University which fall under the category of Physical sciences are very prominent especially for their high quality research. Most of these Departments have been inducted under the special assistance research schemes such as DRS of UGC and FIST of DST. Many of the faculty members of these Departments have been acclaimed with several awards and recognition for their research. With this background, the study aims to make an assessment of the research work carried out in the above areas retrospectively only for those work which have been indexed in Scopus.

## REVIEW OF LITERATURE:

In the recent times bibliometric and scientometric techniques are increasingly used for the assessment of scientific research. The outcome of these studies helps in enhancing the visibility of institutions, trends of their research productivity, research collaboration, etc. and as a consequence the funding agencies come forward to support their research. The individuals and the team of researchers also get appreciation and inducement for their work. As such scientometric studies influence the research of the institution. In India, a good amount of literature on scientometric analysis of research is available. A few of such research have been reviewed as under:

Sharma (2009) evaluated research performance and collaborative writing pattern among scientists of Central Potato Research Institute (CPRI) and found that majority of scientists preferred to work in collaboration and publish research papers in joint authorship.

Jeevan and Gupta (2002) studied research productivity of nine departments of IIT, Kharagpur by analyzing proportion of papers covered in SCI, Impact rate, Proportion of high quality papers and Publication Effectiveness Index (PEI). In addition to this other factors such as degree of collaboration among departments as well as international collaborations are also measured. On ranking departments on the basis of publication effectiveness index (PEI), it was found that only four departments have received the PEI value above one. They are in order of ranking of PEI values as: chemistry (2.221), Rubber Technology (1.446), Physics and Meteorology (1.289) and Electronics and Electrical Communication Engineering (1.098). It is also observed that those departments, which qualitatively perform better also tends to collaborate more, both at the national, as well as the international level.

Lee (2002) made a scientometric study to find out research performance of the Institute of Molecular and Cell Biology (IMCB) of first ten years since its establishment. The findings shows that in the ten years, IMCB produced 395 research papers, 33 book chapters, 24 conference papers, and 4 monographs, graduated 46 PhDs, and filed 10 patents. In order to become world-class, IMCB researchers have been publishing in selected journals. It is found that 95.6% of the articles were published in ISI journals.

Sudhler and I S (2011) analyzed the research productivity of social scientists at the Centre for Development Studies (CDS), Thiruvananthapuram during 1998-2008. There were 599 research articles published by the CDS researchers, including 38.23% journal articles, 23.54% chapters in books and 15.03% working papers. The highest number of publications was in the year 2008. More than 66% of journal articles published are in Indian journals and 33.19% are published in foreign journals. *Economic and Political Weekly*, contributes the highest number of articles 79 (34.50%) followed by *Indian Journal of Labour Economics* with 7 (3.06%). Baby and Kumaravel (2012) studied research productivity of Periyar University faculties in India using the Scopus database for a period of thirteen years from 1998 to 2010. The results indicate that the growth of research has steadily increased from a single article in 1998 to 102 articles in 2010. The Relative growth rate and doubling time is 0.45 and 2.27 respectively. It was found that three-author publications predominate amongst the pattern of authorship. Journal articles occupy the entire place among sources of publication.

## OBJECTIVES:

The objectives of the present study are as follows:

- To trace the rate of growth in research publications in physical sciences of Sambalpur University
- To find out the high productive and low productive subject areas
- To examine the authorship pattern of in research publications
- To find out research collaboration of researchers at different levels
- To find out the most preferred journal where most of the papers of Sambalpur University appear.

## METHODOLOGY AND DATA SOURCE:

The publications by Sambalpur university in Physical Science (Physics, Chemistry, Mathematics, Statistics, Earth Science, Environmental Science) forms the basis of this study and it has been derived particularly from the Scopus database. It is the largest abstract and citation database of research literature and quality web sources, which covers nearly 18,000 titles from more than 5,000 publishers. In comparison to Web of Science, Scopus data is expected to generate a better picture of Indian science and technology in the global context and hence, it has been used for this study. Scopus indexes several different types of publications such as research papers, reviews, short notes, and editorial as appearing in journals. It also indexes articles appearing in conference/seminar proceedings. In this paper, all types of publications as indexed in Scopus have been included in the analysis. The records required for the study have been downloaded from the Scopus database using the “Sambalpur University” in the affiliation search. The size of data downloaded for the purpose is 417 and the records were imported into MS-excel for statistical analysis.

## SCOPE AND LIMITATION:

Scopus database categorises the whole publications in to four broad subject areas like: Life Sciences, Physical sciences, Health Sciences and social Sciences. The present study is limited to physical science publications only by the researchers of Sambalpur University indexed in the Scopus database retrospectively from 1971 to 2010. Scopus covers chemical engineering, chemistry, computer science, Earth & planetary science, energy, engineering, environmental science, mathematics, physics and astrology under the physical science category. However, the present study covers only six broad areas: Chemistry, Physics, Mathematics, Environmental science, Earth science and Statistics.

## DATA ANALYSIS AND DISCUSSION:

### AUTHORSHIP PATTERN OF WHOLE CONTRIBUTION:

**Table-1: Authorship Pattern**

Authorship Pattern	No. of Contribution (n=417)	Percentage
Single Author	32	7.65
Two Authors	117	27.99
Three Authors	123	29.42
Four Authors	96	22.96
Five Authors	37	8.85
More than five and less than ten Authors	11	2.63
Ten and more Authors	2	0.47

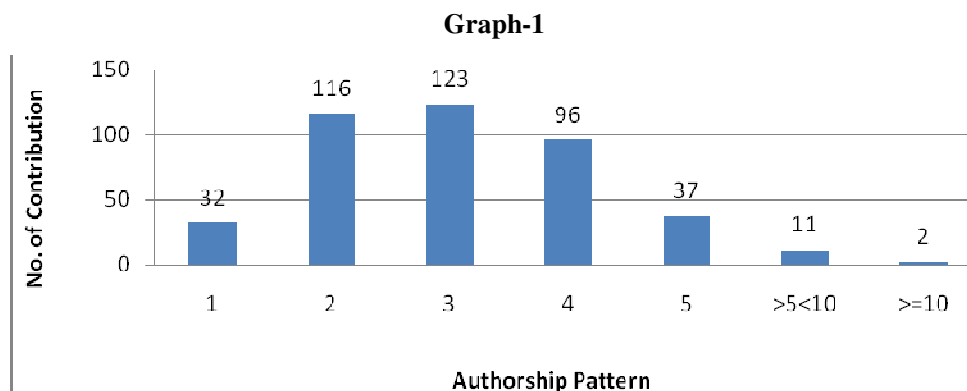


Table-1 and Graph-1 indicate that the highest 123 (29.42%) of articles have three authors followed by 117(27.99%) with two authors, 96 (22.96%) and 37(8.85%) have four and five authors respectively. While 32 (7.65%) articles are single authored, 11 (2.63%) articles are authored by more than five and less than ten authors. Only 2 (0.47%) articles are authored by ten and more authors. Data relating to authorship pattern as above is evident that the physical science researchers of Sambalpur University have a tendency to work in collaboration with other researchers usually in a team of 2 to 4 researchers. However, collaboration with more than five authors has produced very insignificant number of papers.

#### DISCIPLINE-WISE PRODUCTIVITY OF RESEARCH:

**Table-2: Discipline-wise productivity of research**

Broad Discipline under Physical Science as in SCOPUS	No. of Contributions	Percentage (%) (N=417)
Chemistry	198	47.48
Physics	131	31.41
Mathematics	46	11.03
Environmental Science	32	7.67
Earth Science	6	1.43
Statistics	4	0.95

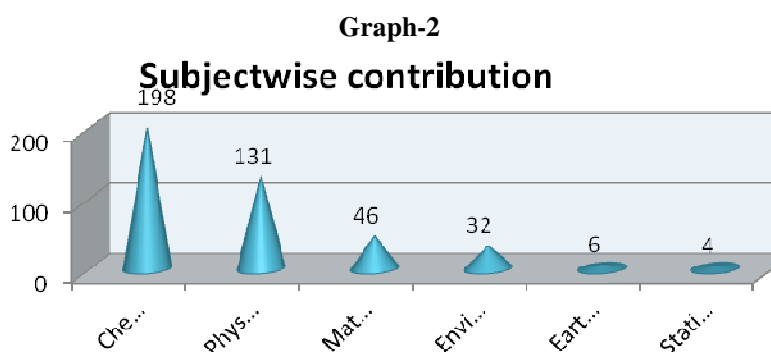


Table-2 and Graph-2 reveals the pattern of distribution of research papers among the broad disciplines. It is found at the outset that there is no uniformity in the research productivity of the various disciplines. It was further discovered that Chemistry and Physics are the two highly productive subjects with 198 (47.48%) and 131(31.41%) papers respectively during 1971-2010. While Mathematics and Environmental Science are the two mediocre research productive subjects having only 46 (11.03%) and 32 (7.67%) contributions respectively, Earth Science and Statistics are the two low productive subject areas of research having only 6 (1.43%) and 4 (0.95%) publications respectively during the same period in Sambalpur University.

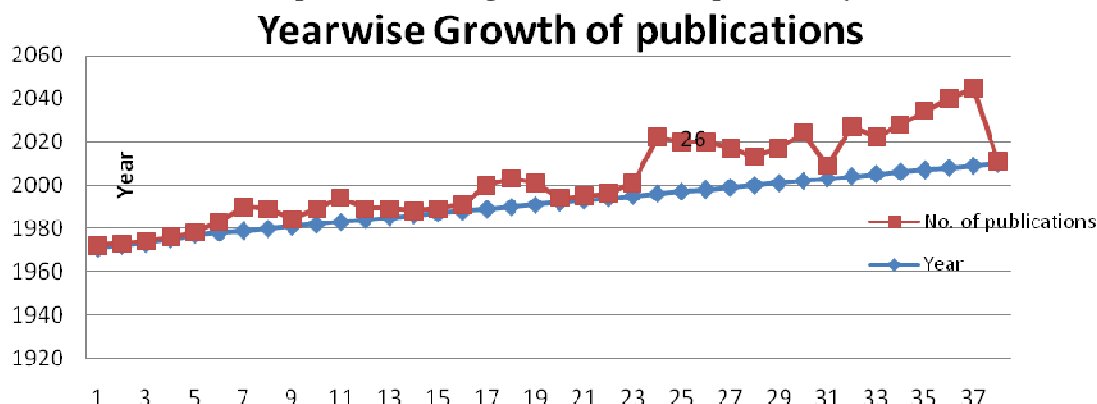
### YEAR-WISE GROWTH OF PUBLICATIONS:

Table-3 below presents the data relating to growth of physical Science research during 1971 to 2010. The years in which more than 10 papers published are 2009 (36 Papers), 2008 (32 Papers), 2007 (27 Papers), 1996 (26 Papers), 2004 (23 Papers), 1997 (23 Papers), 2006 (22 Papers), 2002 (22 Papers), 1998 (22 Papers), 1999 (18 Papers), 2005 (17 Papers) and 2001 (16 Papers) are relatively more productive in relation to total number of publications in Physical science research. The less productive years with less than 10 papers are 1971, 1972, 1973, 1975, and 1977 with one paper each; 1986, 1987, 1992, 1993, and 1994 with two papers each; 1981, 1988 with three papers each and 1985 with 4 Papers. The years 1974 and 1976 are zero-productive with out a single publication by any of the disciplines. The remaining years as shown in the table shows a moderate growth of research. As the publication data were downloaded on 7<sup>th</sup> April 2010 from the Scopus database the year 2010 is having only one publication. Hence, the investigators are unsure about the total productivity of the year 2010.

**Table-3: Year-wise growth of research productivity**

Year	Number of Research Papers published	Year	Number of Research Papers published
1971	1	1991	10
1972	1	1992	2
1973	1	1993	2
1974	0	1994	2
1975	1	1995	6
1976	0	1996	26
1977	1	1997	23
1978	5	1998	22
1979	11	1999	18
1980	9	2000	13
1981	3	2001	16
1982	7	2002	22
1983	11	2003	6
1984	5	2004	23
1985	4	2005	17
1986	2	2006	22
1987	2	2007	27
1988	3	2008	32
1989	11	2009	36
1990	13	2010(up to 7 <sup>th</sup> April)	1

**Graph-3: Year-wise growth of research productivity**



### RANKING OF AUTHORS BASED ON THEIR RESEARCH CONTRIBUTION:

The detail of the contribution of individual authors in various disciplines of Sambalpur University has been reflected in the Master Table in Appendix-1. For the convenience of analysis of the data and to find out the publication trend of individual authors the following table has been derived.

**Table-4: Distribution of authors by number of publications**

Nos. of Publications	Nos. of Authors	Percentage N=120
1-10	97	80.83
11-20	14	11.67
21-30	06	5
31-40	02	1.7
41-50	00	00
51-60	01	0.83

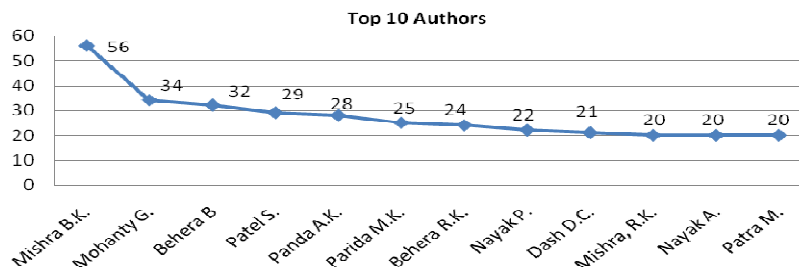
The above table is evident that more than 80% of the authors have  $\leq 10$  publications to their credit. Only a little less than 20% authors have more than 20 publications in a period of 40 years. Only one author has more than 50 publications. On the basis of number of publications, the top 10 authors in Physical Sciences in Samablpur University are as follows:

**Table-5: Ranking of authors by number of contributions**

Rank	Name of the Author	Department/ Discipline	No. of Contribution	No. of Single Authored Contribution	No. of Co- authored Contribution	No. of Contribution as First Author
1	Mishra B.K.	Chemistry	56	0	56	0
2	Mohanty G.	Mathematics	34	0	34	33
3	Behera B	Physics	32	0	32	25
4	Patel S.	Chemistry	29	1	28	8
5	Panda A.K.	Physics	28	0	28	14
6	Parida M.K.	Physics	25	9	16	12
7	Behera R.K.	Chemistry	24	0	24	5
8	Nayak P.	Physics	22	2	20	3
9	Dash D.C.	Chemistry	21	0	21	14
10	Mishra, R.K.	Chemistry	20	1	19	10
10	Nayak A.	Chemistry	20	0	20	0
10	Patra M.	Chemistry	20	10	10	10

Table-4.4.1 divulges that Dr. B. K. Mishra, a professor of the Department of Chemistry is the most productive author with a total of 56 research papers indexed in Scopus. The second most productive author is Prof. G. Mohanty, a professor (presently retired) of the School of Mathematical Sciences followed by Prof. B. Behera, a professor (presently retired) of the Department of Physics with 34 and 32 research papers respectively. Out of the 12 most productive authors in the list, 7 (58.3%) authors are from the subject Chemistry. This indicates that the Department of Chemistry has a strong research base. Physics is the second most productive subject as far as the research publications are concerned with 4 (33.3%) authors in the tops ten list of most productive authors. With regard to research collaboration, it was found that most of the researchers in physical sciences in Sambalpur University work in collaboration rather than carry out individual research. Out of 331 research papers, only 23 (6.95%) are individual research and rest are the result of collaborative research.

**Graph-4: Ranking of authors by number of contributions**



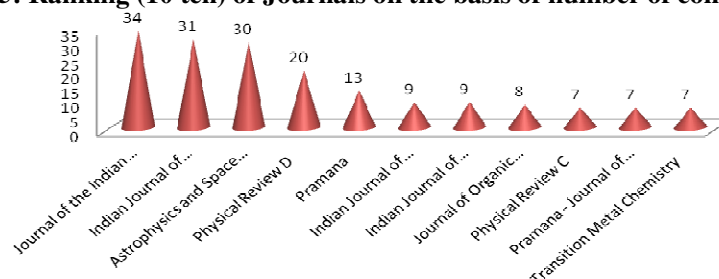
# **RANKING OF JOURNALS (TOP-10 JOURNALS) BASED ON NO. OF PUBLICATIONS:**

**Table-6: Research paper-wise Ranking of Journals of Journals**

Sl. No.	Name of the Journal	No.of Articles (N=417)	Percentage
1	Journal of the Indian Chemical Society	34	8.15
2	Indian Journal of Chemistry (Section A Inorganic, Physical, Theoretical and Analytical Chemistry)	31	7.43
3	Astrophysics and Space Science	30	7.19
4	Physical Review D	20	4.79
5	Pramana: the Journal of Physics	20	3.11
6	Indian Journal of Chemistry (Section B: Organic and Medicinal Chemistry)	9	2.15
7	Indian Journal of Environmental Protection	9	2.15
8	Journal of Organic Chemistry	8	1.91
9	Physical Review C	7	1.67
10	Transition Metal Chemistry	7	1.67

Table no. 4.5 displays the mapping of research papers published in various journals in physical sciences group. It is evident that, the researchers of Sambalpur University use to publish their work in a wide range of journals indexed in Scopus. The above table indicates that maximum number of papers, i.e, 34 (8.15%) are published in *Journal of Indian Chemical Society* followed by *Indian Journal of Chemistry*, *Journal of Astrophysics and Space Science*, *Physical Review*, and *Pramana* with 31, 30, 20 and 20 papers respectively. It is clear from the data that most of the journals with high frequency of publications of Sambalpur University are Indian journals.

**Graph-5: Ranking (10 ten) of Journals on the basis of number of contributions**



## **MAJOR FINDINGS AND OBSERVATIONS:**

- It was found in the analysis that, 120 authors of Sambalpur University have contributed 417 items during the period 1971 to 2010 with a per capita productivity of 3.475.



- ii. The contributions in physical science literature ranged from single authored publications to more than 10 authors. While three authored contributions ranked first forming 123 (29.42%) and single authored contributions formed 7.65% which is very low. Hence it is found that research in collaboration dominates individual research.
- iii. Chemistry and physics are the two highly productive subjects contributing large quantity of publications than other subject areas in physical science disciplines of Sambalpur University
- iv. Prof. B.K. Mishra from the Department of Chemistry has maximum number of contributions is the most productive researcher/author in Physical Sciences of Sambalpur University.
- v. *Journal of the Indian Chemical Society* is found to be the most favorite journal having maximum number of contributions (34 articles) from the physical science researchers of Sambalpur University.

## CONCLUSION:

It is observed that among the broad disciplines of physical Science the contribution to chemistry research is highest followed by physics and contribution to other discipline is very low. There is a team spirit and collaborative approach in physical science research as majority of research publications have been brought out in joint authorship. The year wise growth of research output shows that no uniform pattern of literature growth has been observed but the publication output is more in recent years than before. This looks obvious as research is an intellectual activity deeply influenced by state of mind of scientists and availability of sufficient information and other input of scientific productivity.

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