
RESEARCH PRODUCTIVITY OF SCIENTISTS OF ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES), NAINITAL : A STUDY

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ABSTRACT

Describes the results of research productivity of Scientists of Aryabhata Research Institute of Observational Sciences (ARIES), Nainital. The purpose of the study was to evaluate the research performance of ARIES's Scientists. For the present study the data has been collected from the annual publication of ARIES scientists, Nainital over a period of 09 years from 2004-2012. Based on the 449 numbers of research publications published in last 09 years in which 319 numbers of research publications are in referred journals and 130 numbers of research publications are in conferences, symposiums and bulletins. Identified the scientists that are active, the areas in which they are active and the journals in which they publish their work. Findings indicate the publication productivity and the nature of the research activities.

KEYWORDS: Astronomy, Astrophysics, Atmosphere, Solar Physics, Research Productivity, Scientometric, ARIES.

Introduction

The contribution of research productivity of scientists towards the socio-economic development of a country is well accepted. Scientific publications seems to have provided the best available basis for measuring the outputs of individual scientist as there is good correlation between the eminence of scientists and their sustained research publications (Price, 1986). However, the research productivity

of scientists is characterized by an extremely unequal distribution. This property adds a special interest to the analysis since it leads to a better understanding of its determinants. In evaluating research productivity of a scientific community, publication of research findings is the most common measure which is being considered at present, even though it is not the most accurate indicator. It is now argued that gaps and shortcomings could exist in evaluating research productivity of scientists only through their publications. This may be due to the complex nature of the changing world in the present time where factors other than scientific productivity also exert a major influence on scientific career development. Although publication of research findings is very important to gain scientific recognition and identity towards professionalization of the scientific community in a particular country, it should not be the main and the only criteria for evaluation of research productivity of the scientific community. However, one must accept the fact that publication of research avoids duplication or repetitions of similar kinds of research which otherwise leads to the wastage of money and other resources.

According to Allison (1980), the most fundamental social processes of science are the communication and exchange of research findings and results. The principal means of scientific communication is the publication process, which allows scientists to verify the reliability of information, to acquire a sense of relative importance of a contribution, and to obtain critical response to work. It is an accepted fact that scientists receive professional recognition and esteem, as well as promotion, advancement, and funding for future research through their publications. Publication is so central to the productivity in research that the work becomes 'a work' only when it takes a conventional and physical (that is, published) form which can be received, assessed, and acknowledged by the scientific community. More recognition a scientist receives by rewards for his or her publications, more productive he or she will become subsequently. Measuring research productivity through output indicators has been useful not only to evaluate the contribution of the scientific community, but also to get an insight as to how far a country has progressed in R&D for the betterment of socio-economic aspects of the nation.

Objective of the Study

In every scientific research, there must be some specific aims and objectives for which the study is to be conducted. Without definite aims, research has no meaning. In the present study “Research Productivity of Scientists of Aryabhata Research Institute of Observational Sciences (ARIES), Nainital” has following aims and objectives as enumerated below.

- Evaluation of the research productivity of scientists in ARIES, Nainital through their publications and other research outputs.
- Analysis of authorship pattern in research publications.
- Examine average number of authors per paper.
- Highlight most popular journals in term of publications.
- Ascertain year wise publications and productivity.
- To analyze the contribution of the scientists of ARIES in national and international journals.
- Examine most popular journal in terms of Journal Impact Factor.
- To discover the most frequently cited journals in the field.

Statement of the Problem

Statement of problem is the key sentence of the project on the basis of which a research is carried out, supportive arguments are developed. So statement is a fact or assertion offered as evidence that something is true. The statement of the problem, therefore, describes the background of the study, its theoretical basis and underlying assumptions and the problem in concrete, specific and workable questions.

The problems involved in the present research can be represented through the following questions:

- What is the productivity level of the ARIES scientists with regard to research publications?
- What is the trend in research publications with regard to the sources, authorship pattern and frequency of publication etc.?

Scope and Limitation

Nainital from 2004 to 2012. This investigation aims to explore the research output of the scientists of ARIES, Nainital. Thus, the scope of the research is limited to the Astronomy, Astrophysics, Solar Physics and Atmospheric science scientists of ARIES and the subject is limited to productometric study as a part of bibliometric/scientometric measure.

Methodology and Data Source

The methodology includes a scientometric analysis of the annual Research publication of ARIES scientists at Nainital. There are 449 research papers published by the 90 ARIES scientists on Astronomy, Astrophysics, Solar Physics and Atmospheric sciences in particular during the period

from 2004 to 2012. In this research, two types of publication sources have been included for the analysis, such as journals, proceedings & bulletin. All the collected data are imported in MS-Excel for data manipulation and statistical calculations for the present research.

Review of Literature

A literature review is a survey and discussion of the literature in a given area of study. It is a concise overview of what has been studied, argued and established about a topic and it is usually organized chronologically or thematically. A literature review surveys scholarly articles, books and other sources relevant to a particular issue, area of research, or theory, providing a description, summary and critical evaluation of each work.

Har Kaur & B. M. Gupta (2010), in his study “Mapping of dental science research in India: a scientometric analysis of India's research output, 1999–2008” examines that India's performance based on its publication output in dental sciences during 1999–2008, based on several parameters, including the country annual average growth rate, global publication share and rank among 25 most productive countries of the world, national publication output and impact in terms of average citations per paper, international collaboration output and share and contribution of major collaborative partners, contribution and impact of select top 25 Indian institutions and select top 15 most productive authors, patterns of communication in national and international journals and characteristics of its 45 high cited papers.

S.J.D. Varaprasad, Sidhartha Sahoo, & S. Madhusudhan (2010), in their study “*Research contributions of J.S. Yadav to Chemical Sciences: a scientometric study*” mentioned *The quantitatively the growth and development of chemical science research by J.S. Yadav during the period from 1986-2009*. J.S. Yadav has published 722 papers during 1986 to May 2009 and published his first paper in 1986. The percentage of solo research papers has been found to be very low. The percentage of collaborative work was very high. He had of 408 scientist collaborators whom he guided as a mentor. His highest degree of collaboration was found during 2002-2003. His papers have been scattered in 56 high impact factor scientific journals. *The h index of 41 after 24 years of scientific activity is a clear indication of his consistent publication productivity behaviour.*

Jayant M. Modak & Giridhar Madras (2008), “Scientometric analysis of chemical engineering publications” have conducted the study *to analyse the scientometric parameters for chemical engineering publications. They have compared number of journal publications and citations by various countries and institutions. The publication record in terms of quantitative aspects of the number of publications from China has increased and overtaken USA. The analysis of the output of*

selected Indian universities/organizations against the top universities in the world, indicated that the records of top institutions from India are not comparable to the best universities in USA but are comparable to the best in Asia and are significantly better than the best universities in China.

A.I. Bonilla-Calero (2008), in his study “Scientometric analysis of a sample of physics-related research output held in the institutional repository Strathprints (2000-2005)” found that the number of documents in this open access repository has increased during the period under consideration, although it has the number of authors, centres and countries per document. In terms of institutional origin, Scottish institutions occupy first or final position in 94 per cent of the total documents. Documents published in 2000 (the earliest documents in the repository) are the mostly cited. The most cited and downloaded types of documents are articles; post-prints are the most downloaded type of publication. There is no relationship between the journals with the highest average of citations per document in web of science (WoS) and those with the highest number of citations in Strathprints.

Chu Keong Lee (2003), in his study “A scientometric study of the research performance of the Institute of Molecular and Cell Biology in Singapore” has described the results of a scientometric study of the Institute of Molecular and Cell Biology (IMCB). He has evaluated the research performance of IMCB in the first ten years since its establishment. He examined research inputs and three research outputs such as publications, graduate students and patents filed. He found that in the ten years, IMCB produced 395 research papers, 33 book chapters, 24 conference papers and 4 monographs, graduated 46 PhDs and 14 MScs and filed 10 patents. IMCB researchers have been very selective in where they publish the articles were published in ISI journals. The articles received an average of 25 to 35 citations per article and the percentage of uncited articles is 11.6%. Four articles received more than 200 citations and 18 received between 100 to 200 citations

Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital: A Profile

The mark of a progressive institution is judged by the strength of its library. Ever since the inception of the Observatory in 1954, its Knowledge Resource Centre (KRC)/Library has been steadily building up through the years. The KRC continued with its basic activities of information resources development by collecting, processing, organizing, storage and retrieval of information; maintaining liaison with other related institute libraries for resource sharing and for exchange of information; providing need based current awareness, reference and bibliographic services; and facilitating on-line access to wide range of information resources in print and electronic versions. The number of Institutions, both from the country and abroad, on exchange list is about 100. The KRC acquires

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books and journals mainly related to Astronomy, Astrophysics, Atmospheric Sciences and Solar Sciences. The KRC also acquires reference books from time to time.

KRC Resource Development and Collections

Books	:	10,506
Bound volumes of Journal	:	Over 11,250
Subscription to Journals (Print + Online)	:	76+ through NKRC
ARIES Publications	:	1241
ARIES Theses	:	64

Apart from books and journals, non-book materials such as slides, charts, maps, diskettes, CD-ROMs, etc. are also available in the KRC. LIBSYS-7 software is being used for the house-keeping activities of the KRC. The new features of Online Catalogue are available at Web-OPAC on ARIES home page as well as ARIES Intranet. DSpace open source software (1.5.2. Version) has been installed successfully for digital repository of ARIES and available at ARIES KRC home page. The subscribed e-journals and online journals/databases through National Knowledge Resource consortium, ARIES academic reports and updated list of publications are also available at ARIES KRC home page. The ARIES KRC is a member of FORSA (Forum for Resource Sharing in Astronomy and Astrophysics), which has been established by Indian Astronomy Librarians in 1979. IOP Journals (print & online) are subscribed under FORSA consortium. The ARIES KRC is also a member of CSIR–DST E-Journals Consortium.

Data Analysis

Data analysis is the major part of every research work. For the present study the data is collected from the annual publications of ARIES scientists, Nainital over a period of 09 years from 2004-2012. A total of 449 research publications were collected published in last 09 years. The data was analysed using MS-Excel sheet for statistical calculation.

Growth of Research Publications

Table 1 above presents the data relating to growth of research publications of ARIES scientists over a period of 09 years i.e. during 2004 to 2012. The year 2011 was the highest productive year in which 70 (15.6%) research papers were published. The lowest number of papers published was in the year 2004 in which only 26(5.8%) papers were published.

Table 1: Year-wise Growth of Research Publications at ARIES Nainital

Year	Number of Research Papers Published (N=449)	Percentage (%)
2004	26	5.8
2005	60	13.4
2006	35	7.8
2007	37	8.2
2008	64	14.3
2009	36	8
2010	58	12.9
2011	70	15.6
2012	63	14
Total	449	100

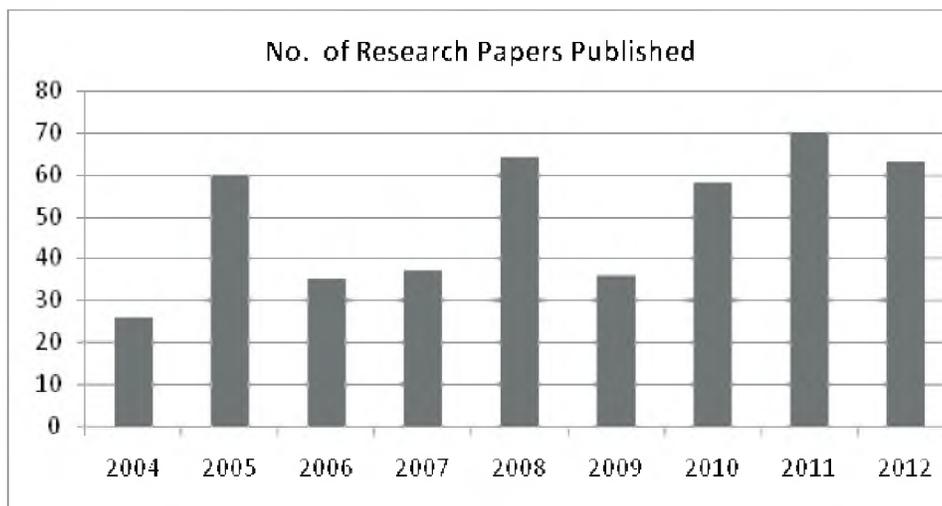


Figure 1: Number of Research Paper Published

Type of Publications

The publication from ARIES is grouped into two categories- journal articles, and conference proceedings & Bulletin. The distributions of the papers are as follows:

Table 2: Distribution of Articles According to Type of Publications

Type of Publications	Number of Articles (N=449)	Percentage
Journals	319	71.05%
Conference Proceedings & Bulletin	130	28.95%

The present Table 2 shows the number of articles according to the type of publications. The whole publications by the ARIES scientists have been divided into two categories such as Journal & Conference Proceedings and Bulletins. The table discloses that a major share of publications i.e. 319 (71.05%) is in Journals followed by 130 (28.95%) in conference proceedings & Bulletins.

Authorship Pattern

Authorship pattern discloses how the papers are distributed among the authors, author collaborations, etc. Authorship Pattern is one of the very important bibliometric indicators in order to assess the degree of collaboration of the authors in a particular discipline or in an institution.

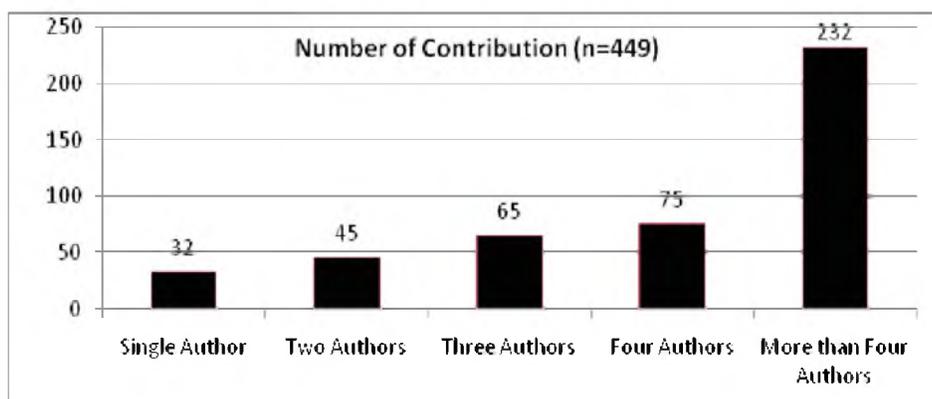


Figure 2: Number of Contributions

Figure 2 above indicates that the highest 232 (51.67%) number of articles have more than four authors followed by 75 (16.7%) with four authors, 65 (14.48%) and 45 (10.02%) have three authors and two authors respectively, while 32 (7.13%) number of articles are authored by single author. Data relating to authorship pattern as above is evident that more than four authors of ARIES have produced very high number of articles.

Table 3: Alphabetical List of Journals in which ARIES Papers are Published

1	Acta Astronomica
2	Advanced Geophysics
3	Advances in Geosciences
4	Advances in Space Research
5	Aerosol Science & Technology
6	Annales Geophysicae
7	Annual Review of Astronomy & Astrophysics
8	Applied Optics
9	Astronomical Journal
10	Astronomy
11	Astronomy & Astrophysics
12	Astronomy & Astrophysics Review
13	Astronomy & Geophysics
14	Astronomy Now
15	Astronomy Reports
16	Astrophysical Bulletin
17	Astrophysical Journal
18	Astrophysical Journal Letter
19	Astrophysical Journal Supplement Series
20	Astrophysics & Space Science

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21	Atmospheric Environment
22	Atmospheric Research
23	Atmospheric Science Letter
24	Baltic Astronomy
25	Bulg. Astronomical Journal
26	Bull. of the Astronomical Society of India
27	Chinese Jr. Astronomy & Astrophysics
28	Comm. In Asteroseismology
29	Current Science
30	Earth Planet Space
31	Geoemipution
32	Geophysical Research Letters
33	Indian Jr. of Radio & Space Physics
34	International Journal of Adv. Technology
35	International Journal of Molecular Physics
36	International Journal of Remote Sensing
37	Journal of Applied Remote Sensing
38	Journal of Engineering Technology Research
39	Jr. of Aerosol Science
40	Jr. of Applied Meteorology and Climatology
41	Jr. of Astrophysics & Astronomy
42	Jr. of Atmospheric & Solar-Terrestrial Physics
43	Jr. of B. A. A.
44	Jr. of Cosmology & Astroparticle Physics

45	Jr. of Earth System Science
46	Jr. of Geophysical Research-A-Space Physics
47	Jr. of Geophysical Research-D-Atmosphere
48	Jr. of Korean Astronomical Society
49	Jr. of Optics
50	Jr. of R. A. S. of Canada
51	Memorie Della Societa Astronomica Italiana
52	Monthly Notices of the R. A. S.
53	Nature
54	New Astronomy
55	New Astronomy Reviews
56	New Scientist
57	Observatory
58	Plasma Physics Report
59	Publications of the Astron. Society of the Pacific
60	Publications of the Astronomical Society of Australia
61	Publications of the Astronomical Society of Japan
62	Revista Mexicana de Astronomia Y Astrophysica
63	Romanian Astronomical Journal
64	Science
65	Science China
66	Scientific American
67	Scientific Research & Essay
68	SIBCOLTEJO
69	Solar Physics

Ranking of Authors by Number of Contributions (Top 11 Authors)

Table 4 describes about the top eleven authors according to their number of publications. K. Mishra is the most productive author with a total of 34 (7.57%) research publication. The second most productive author is A. K. Srivastava who has 29 (6.46%) publications. R. Sagar with 27 (6.02%) research papers is the third most productive author, whereas A. C. Gupta and S. B. Pandey both having 24 (5.35%) articles is in fourth position. The fifth most productive author is W. Uddin who has 19 (4.23%) articles. A. Pandey who has 14 (3.12%) research publications is in sixth rank. Out of 449 articles 12 (2.67%) articles have been published by P. Pant and S. Joshi who are in seventh position whereas J. C. Pandey is having 11 (2.45%) with eight rank and S. Lata, U. C. Dumka and B. Joshi has 10 (2.23%) publications each and are in the ninth position. Both A. Omar, M. Singh and M. Gopinathan are having 9 (2.00%) articles and are in tenth rank; whereas B. Kumar, R. K. S. Yadav, S. Sharma and A. Goyal are in 11th position with 8 (1.78%) publications each.

Table 4: Ranking of Authors by Number of Contributions

Rank	Name of the Authors	Number of Contributions n=449	Contribution %
1	K Mishra	34	7.57
2	A K Srivastava	29	6.46
3	R. Sagar	27	6.02
4	A C Gupta	24	5.35
	S B Pandey	24	5.35
5	W Uddin	19	4.23
6	A K Pandey	14	3.12
7	P Pant	12	2.67
	S Joshi	12	2.67
8	J C Pandey	11	2.45
9	Sneh Lata	10	2.23
	U C Dumka	10	2.23
	B Joshi	10	2.23
10	A Omar	9	2
	M Singh	9	2
	M Gopinathan	9	2
11	B. Kumar	8	1.78
	R K S Yadav	8	1.78
	S Sharma	8	1.78
	A Goyal	8	1.78
Others		154	34.3
Total		449	100

Publication in Indian and Foreign Journal (Referred Journals)

The figure presents the publishing preferences of scientists in Indian origin and foreign journals. The data clearly stated that out of 319 papers scientists preferred to publish their papers in foreign journals with the majority of 281 (88%), where as 38 (12%) scientists preferred to publish their papers in Indian Journals.

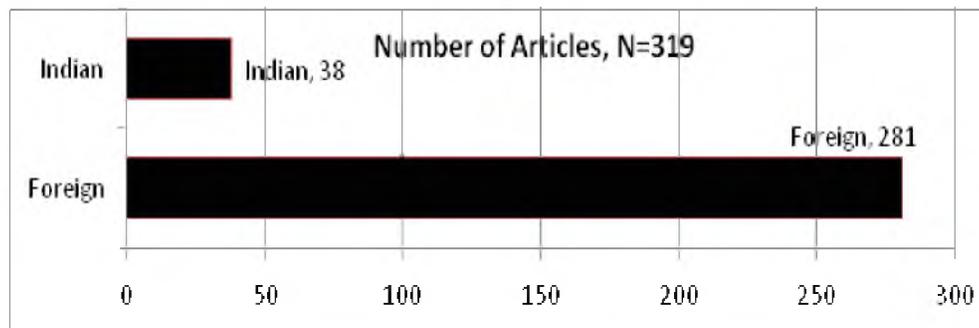


Figure 3: Publication in Indian and Foreign Journal

Impact Factor of Published Articles in Referred Journals (Year Wise)

The present figure shows the impact factor of published articles in referred journals in yearly. The above data shows that most highly impact factor i.e. 5.5 in year 2008.

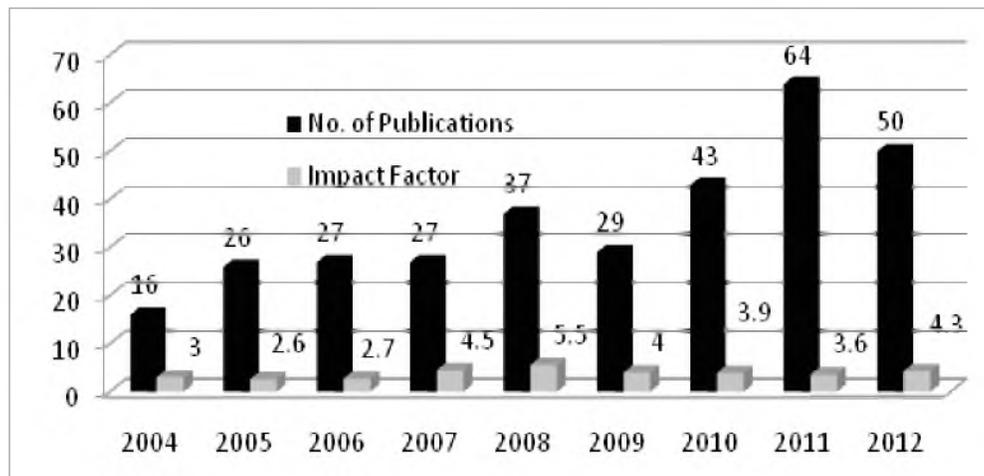


Figure 4: Impact Factor of Publications (Year Wise)

Findings of the Study

As a result of systematic analysis of data for the present study, the investigator observes the following facts about the study of research productivity of Astronomical, Astrophysical & Atmospheric scientists of ARIES, Nainital.

- From the analysis, it was found that research publications of ARIES scientists over a period of 09 years i.e. during 2004 to 2012 have published 449 numbers of articles. The year 2011 is the most productive year for ARIES, Nainital having published 70 (15.6%) research papers.
- According to the type of publications by the ARIES scientists, the more numbers of articles are published in journals having 319 (71.05%) numbers of publications. The contribution of more than four authored have the highest number of articles 232 (51.67%) which is in the top publication, whereas one authored contributions formed 32 (7.13%) which is very low. Hence it is found that research in collaboration of more than four authors is dominants on individual and other collaborative research.
- K. Misra, Scientist of ARIES, Nainital who is the most productive researcher has 34 (7.57%) numbers of highest contributions, whereas B. Kumar, R.K.S. Yadav, S. Sharma and A. Goyal has 8 (1.78 %) numbers of contributions each who are the least productive author.
- Most numbers of authors have published 281 (88%) articles in preferred foreign journals than Indian journals.
- The journal MNRAS is the most preferred journal by the ARIES, Nainital scientists having maximum number of contributions i.e. 99(31%).

Conclusion

ARIES (Nainital) is a developing research institute. This paper has highlighted quantitatively contributions made by the ARIES, Nainital scientists during 2004-2012. The results of the present study show the research productivity of researchers/scientists which is evaluated through their publications output. This paper has identified the scientist those are active, the areas in which they are active and the journals in which they publish their work. Findings indicate the publication productivity and the nature of the research activities. This study can be done in other institutions as well as subject fields. This study will be helpful to researchers who want to identify primary sources of information and also will be helpful for library and information science professionals who want to provide suitable services for users and the researchers.

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