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Quantitative Analysis of Scientific Publications Output 2001-2011 on Nanotechnology - A Multidisciplinary Research

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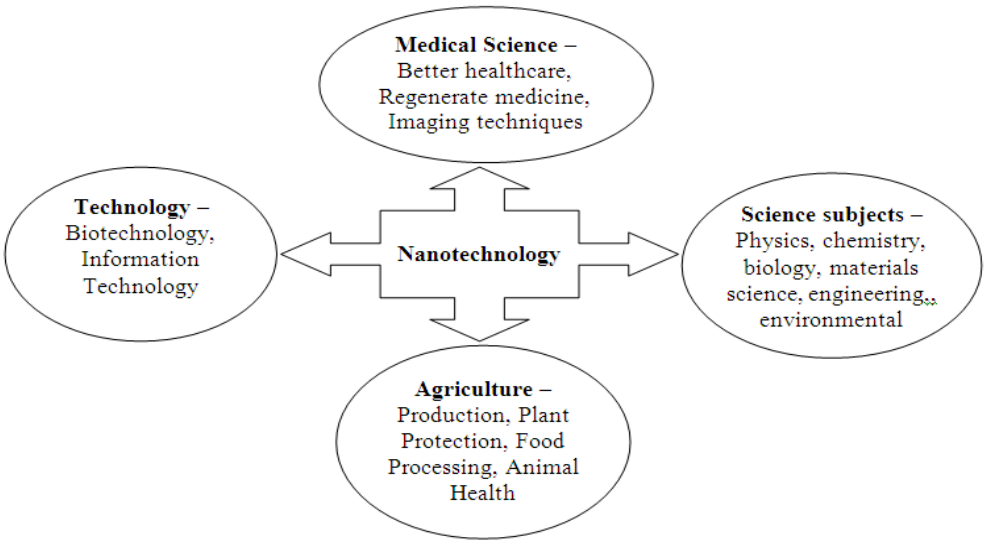
1. Introduction

Nano is a Greek word which means dwarf or very small. The dictionary meaning of nanotechnology is the techniques, machines, tools and processes needed to manipulate matter size of atoms and molecules. Nanoscience and nanotechnology is about the precise and purposeful manipulation of matter at atomic level. Nanoscience is the study of atomic and molecular assemblies with dimension ranging from 1nm to about 100nm and nanotechnology is concerned with incorporation of such assemblies and devices.

Nanotechnology is the study and application of extremely small materials and can be used across all the other science fields, such as chemistry, biology, physics, materials science, engineering and applied sciences[1].



Medical nanotechnology is a branch of nanotechnology which applies principles in this field to health care issues. There are a number of potential applications for medical nanotechnology, which is in its early phases. It has also been mentioned in his paper that nanotechnology medicine is an area of medicine in which nanotechnology is applied. This technology has a number of potential applications which make it a field of immense interest among some medical researchers who believe that it could revolutionize medicine and medical treatment[2].

Within the last decade, nanotechnology has changed and influenced considerably every field of science. At present, the nanotechnology has become a powerful technique in medicine and it is very practical in improving nanoparticles for diagnostic and screening points, artificial receptors and in DNA sequencing, development of unique drug delivery systems, gene therapy applications and the enablement of tissue engineering[3].

2. Objectives

The objectives of current study is to analyze and visualize the trend of scientific research output in the field of nanotechnology based on PubMed database between 2001 and 2011, a period of 11 years by Indian authors at Indian institutions. Analysis of data showed that the research papers have been increased steadily through the period of study. The number of publication in 2011 was ~ 31.5 times greater than those in 2001 as per data collected whereas the publication from all over the world in 2011 was ~ 26.6 times greater than those in 2001. The total number of papers appear as 1042 as per data collected and 36081 papers from all over the world for the period beginning from 2001 to 2011[4].

3. Methodology

The study is based on Indian authors papers published in the Indian was well as foreign journals indexed in PubMed database. PubMed is a free database accessing primarily the MEDLINE database of references and abstracts on life sciences and biomedical topics. The United States National Library of Medicine (NLM) at the National Institutes of Health maintains the database as part of the Entrez information retrieval system. PubMed was first released in January 1996[5]. The basic data relating to total output of research papers of Indian authors in nanotechnology during 2001 to 2011 were collected using Boolean method (System) specifying the keywords nanotechnology, India and year combined with the operator AND in free open access database of PubMed. The data in respect of total output of research papers of authors from all over the world between 2001 and 2011 were collected in similar way leaving the keyword India.

4. Scientific Publication Output in Nanotechnology

As indicated in table 1 Indian authors from various institutions of India have contributed as many as 1042 papers as per data collected and at the same time table 2 indicates 36081 number of papers by the authors from all over the world.

Table 1: Number of Papers published by Indian authors 2001-2011

Publication Year	Record Count	Growth rate %
2001	8	
2002	16	100
2003	18	12.5
2004	27	50
2005	49	81.48
2006	69	40.81
2007	133	92.75
2008	143	7.51
2009	149	4.19
2010	178	19.46
2011	252	41.57
Total	**1042**	

Table 2: Number of Papers published by authors form all over the world 2001-2011

Publication Year	Record Count	Growth rate %
2001	244	
2002	829	239.75
2003	1195	44.14
2004	1710	43.09
2005	2379	39.12
2006	2952	24.08
2007	3752	27.10
2008	4931	31.42
2009	5404	9.59
2010	6197	14.67
2011	6488	4.69
Total	**36081**	

The data was accessed in two phases for the same period using the free open access database of PubMed that is publications of Indian authors and the output of authors from all over the world in nanotechnology. The indexed number of publication rose up in respect of Indian authors as well as authors from all over the world. The number appears as shown below:

1. As per table 1, open access search of PubMed, the total number of papers were published 8 in 2001 (the starting year of the study). This number rose to 16 in 2002, 18 in 2003, 27 in 2004, 49 in 2005, 69 in 2006, 133 in 2007, 143 in 2008, 149 in 2009, 178 in 2010 and 252 in 2011.

Figure 1 depicts the annual growth whereas figure 2 indicates the annual growth rate in percentage of papers published in nanotechnology by authors in India.

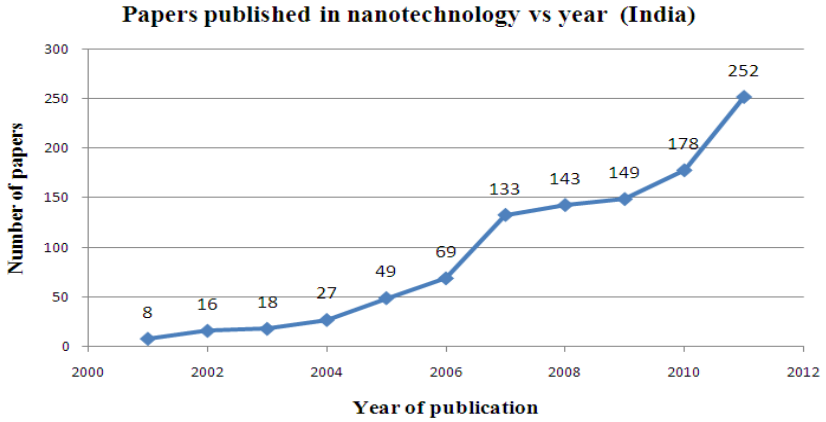


Figure 1: Annual growth of papers published in nanotechnology (India).

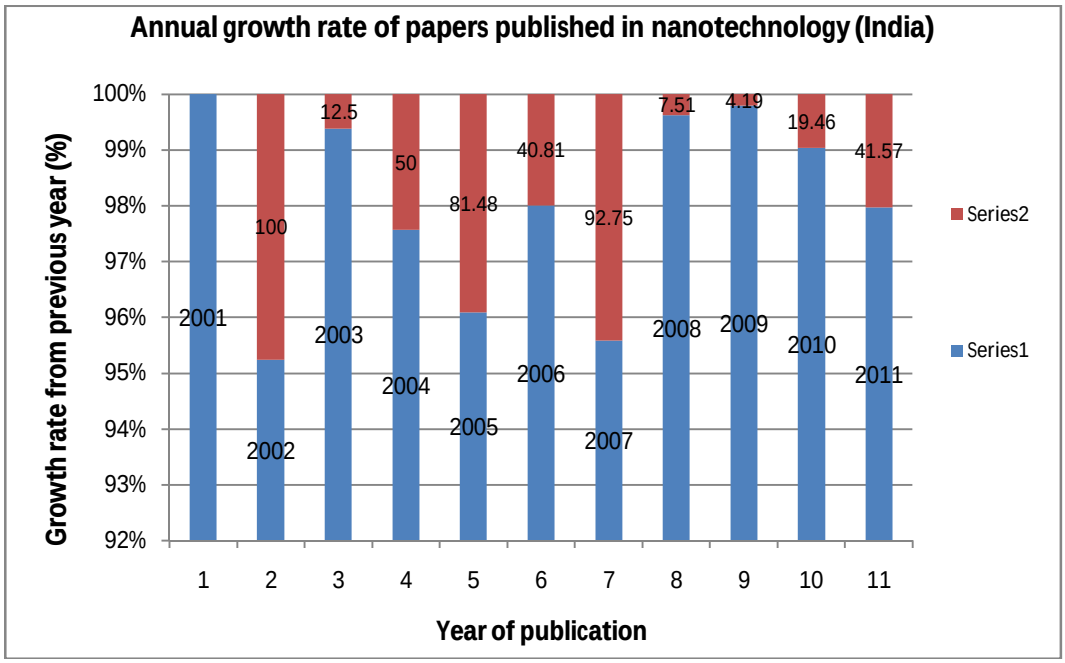


Figure 2: Annual growth rate of papers published in nanotechnology (India).

1. Table 2 indicates the growth in publications output of nanotechnology by authors from all over the world since the year 2001. It was 244 papers in 2001, 829 in 2002, 1195 in 2003, 1710 in 2004, 2379 in 2005, 2952 in 2006, 3752 in 2007, 4931 in 2008, 5404 in 2009, 6197 in 2010 and 6488 in 2011.
   Figure 3 depicts the annual growth whereas figure 4 indicates the annual growth rate in percentage of papers published in nanotechnology by authors from all over the world.

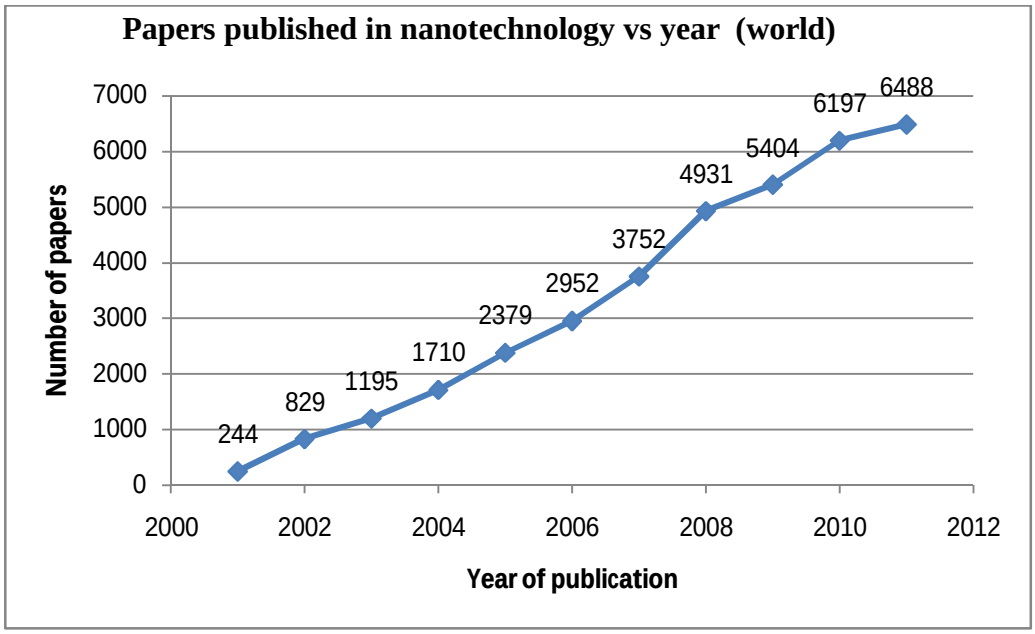


Figure 3: Annual growth of papers published in nanotechnology (world).

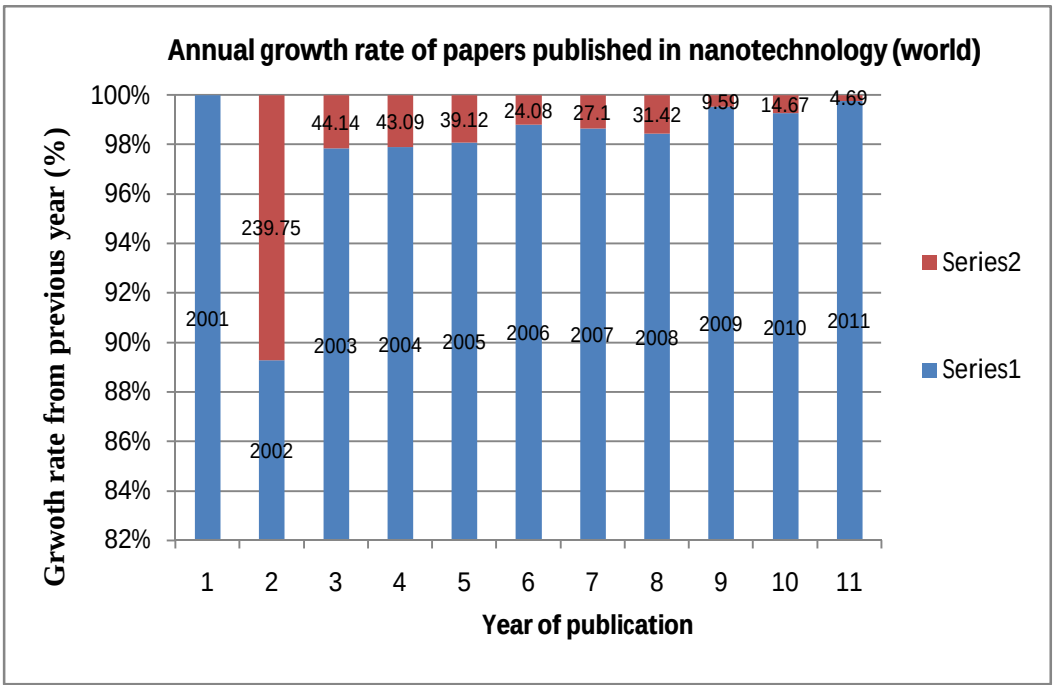


Figure 4: Annual growth rate of papers published in nanotechnology (world).

In table 3, it is observed that there is a constant growth of publications output in nanotechnology in the world beginning from the year 2001 to 2011. At the same time, it is noticed from table 3 that there is regular yearly growth of publications by Indian authors in nanotechnology for the same period indexed in PubMed. The share of publications output by Indian authors is 1042 papers that is 2.88% of 36081 papers published by authors from all over the world in different journals for 11 years.

Table 3: Publication output in nanotechnology from all over the world 2001-2011 and share of Indian authors.

Publication Year	Record Count World	Record Count India	India's share %
2001	244	8	3.27
2002	829	16	1.93
2003	1195	18	1.50
2004	1710	27	1.57
2005	2379	49	2.05
2006	2952	69	2.33
2007	3752	133	3.54
2008	4931	143	2.90
2009	5404	149	2.75
2010	6197	178	2.87
2011	6488	252	3.88
Total	**36081**	**1042**	**2.88**

5. Quantitative Analysis of papers published in nanotechnology in 2011

An analysis was done in the study of 252 papers of Indian authors in nanotechnology published in the national and international journals of which maximum have impact factors indexed by PubMed for the year 2011. The salient feature of the analysis is as follows:

1. National and international journals which have published 8 and more papers in 2011 of Indian authors in nanotechnology with their impact factor are depicted in the table 4.

Table 4: Journals published 8 and more papers in nanotechnology by Indian authors in 2011.

Name of the Journal	No. of papers published	Impact factor
1. Nanotechnology (IOP Publishing Ltd.)	37	3.979
2. Journal of Biomedical Nanotechnology (American Scientific Publishers)	22	4.216
3. Parasitology Research (Springer)	23	2.149
4. Colloids and Surfaces B: Biointerfaces (Elsevier)	17	3.456
5. Biosensors and Bioelectronics (Elsevier)	8	5.602
6. Journal of Nanoscience and Nanotechnology (American Scientific Publishers)	8	1.563

2. Total of 252 papers by Indian authors in nanotechnology have been published in 83 journals of which 74 journals have impact factor and balance 9 journals do not have impact factor in the year 2011 indexed in PubMed. 12 journals which have impact factor of 6.827 and more are depicted in table 5 in descending order with number of papers published.

Table 5: Papers published by Indian authors in journals having high impact factor in descending order in nanotechnology in 2011.

Name of the Journal	Impact factor	No. of papers
Chem Soc Rev	28.76	1
Adv Mater	13.877	2
Angew Chem Int Ed Engl	13.455	2
Adv Drug Deliv Rev	11.502	2
ACS Nano	10.774	2
Proc Natl Acad Sci U S A	9.681	2
Biotechnol Adv	9.646	1
Small	8.349	3
Curr Opin Biotechnol	7.711	1
Biomaterials	7.404	3
Nat Commun	7.396	2
ChemSusChem	6.827	1

1. Chem Soc Rev (Chemical Society Reviews - **Royal Society of Chemistry, London**) with impact factor of 28.76 has published a paper of Indian authors from Raman Research Institute, Bangalore, India.
2. The 252 research papers in nanotechnology which have been published in national and international journals and indexed in PubMed in the year 2011 by Indian authors from Indian research institutions and universities from different states are shown in descending order as under:

Table 6: Publications output in nanotechnology from States in India in 2011.

Name of the State	No. of papers published	Name of the State	No. of papers published
Tamil Nadu	55	Haryana	4
Delhi	31	Himachal Pradesh	4
Uttar Pradesh	29	Oddisha	3
Maharashtra	25	Chandigarh	2
West Bengal	24	Uttarakhand	2
Karnataka	22	Gujarat	1
Punjab	12	Jammu & Kashmir	1
Andhra Pradesh	11	Meghalaya	1
Kerala	11	Rajasthan	1
Assam	6	Tripura	1
Madhya Pradesh	6		

It is observed from the table 6 that 55 research papers have been published from Tamil Nadu, Delhi with 31, Uttar Pradesh with 29, Maharashtra with 25, West Bengal with 24, Karnataka with 22, Punjab 12, Andhra Pradesh and Kerala with 11 each and the rest of the states shown in the table are in single digits.

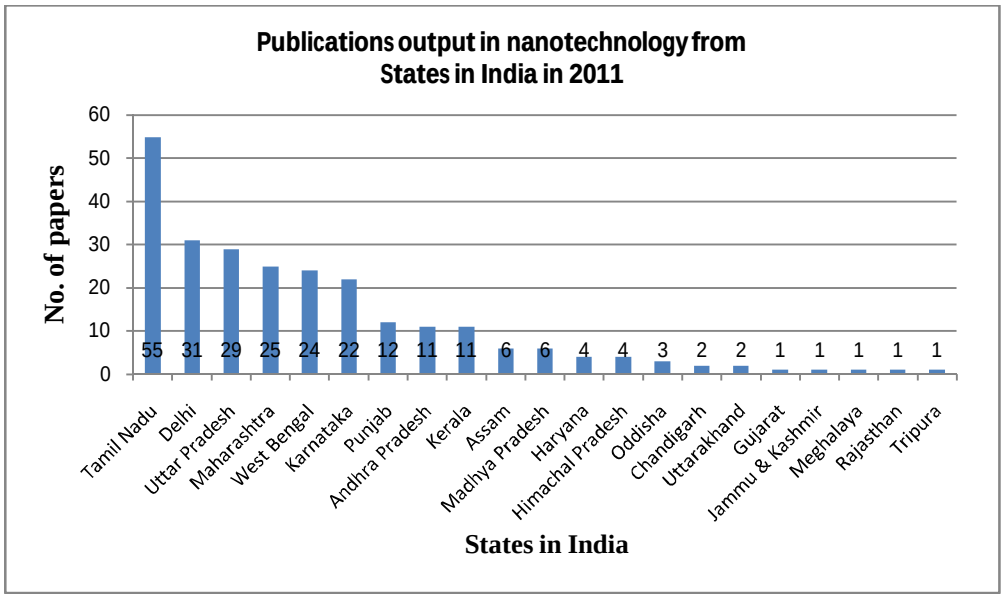


Figure 5: Publications output in nanotechnology from States in India in 2011.

6. Findings

The total number of 36081 papers in nanotechnology between 2001 and 2011 by the authors from all over the world and the share of 1042 research papers by Indian authors were accessed by using electronic database of PubMed. This indicates that the Indian authors have been engaging themselves in various meaningful scientific research activities in nanotechnology relating to physics, chemistry, biology, materials science, engineering and environmental science and they are able to disseminate their findings through scholarly and impact factored national as well as international journals.

Analysis of data indicates higher and undeviating number of research findings, which are published in journals and it has been noticed from various research institutes, universities with the support of Government of India are involved in research activities in different locations in India. It is expected with the steady and perennial researches in various research institutes and universities' science departments, the output of research in the form of publications will be in manifold in the coming years.

Conclusion

The analysis of study gives the quantitative status of publications output of scientific researches in nanotechnology in the journals indexed in PubMed and most of accessed journals possess impact factor, may it be an Indian or international. It has also been noticed that PubMed indexes a few papers of Indian journals whereas there are numerous Indian journals, which are either new or not covered by PubMed. Hence, the actual growth of publications in nanotechnology by Indian authors is much more than the papers indexed in PubMed.

References

[1] Iyengar N, Iyengar SA. Applications of nanoscience and nanotechnology: a revolution in agriculture. In: Prasad D, Sharma R. Potential plant protection strategies. New Delhi, India: I.K. International; 2011. pp 559-79.

[2] Smith SE. 2011. What is medical nanotechnology? [Accessed on Jan. 24, 2013], available at: www.wisegeek.com/what-is-medical-Nanotechnology. html

[3] Emerich DF, Thanos CG. Nanotechnology and medicine. Expert Opin Biol Ther. 2003; 3(4): 655-63.

[4] http://www.ncbi.nlm.nih.gov/pubmed

[5] http://en.wikipedia.org/wiki/PubMed