

Doctoral dissertations of CSIR-National Institute for Interdisciplinary Science & Technology (NIIST), Thiruvananthapuram: A study

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Analysis of 137 Ph. D theses submitted during 2001-2010 found that majority of the theses (107) were in chemistry. The study analysed the number of references included in the theses and found an average of 242.79 references to a thesis. Out of the 35 approved research guides, the maximum number of 21 theses were submitted under the guidance of Dr. G. Vijay Nair followed by 11 theses under the supervision of Dr. Suresh Das and 10 under Dr. A. Ajayaghosh. One thousand five hundred and twenty one papers of NIIST were included in the 124 theses out a total of 137 dissertations studied.

Introduction

Bibliometrics is one of the most common areas of study among the library and information scientists. The study is popular because it helps to improve scientific documentation, information and communication activities by quantitative analysis of library collections and services. Pritchard¹ coined the term bibliometrics and defined it as 'the application of mathematical and statistical methods to books and other media of communication'. Potter² defined it as 'the study and measurement of the publication pattern of all forms of written communication and their authorship'.

Research is considered to be the foundation for future investigation in any field. Universities and research laboratories contribute a major role in shaping the researchers in their key areas. Globally all governments are investing heavily in research and development facilities as the same provides access to wider range of resource and facilities. It is natural for the funding agencies to assess the performance of the faculties and facilities. Doctoral dissertations are the key towards such a study and are considered as the yardstick to assess the performance of the university or research laboratory in the field of research and development. The doctoral dissertations represent a very formal and focused form of research and the cited references in it reflects the author's familiarity

in the state of art knowledge of a topic with respect to related research and discipline.

The National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram, Kerala is a constituent laboratory of the Council of Scientific and Industrial Research (CSIR). Initially established in 1975 as a CSIR Complex, it was named as the Regional Research Laboratory (RRL) in 1978 and later renamed as NIIST in 2007. It has been recognized for its excellent contributions in areas such as spice & oilseeds processing, building materials, premium quality aluminium castings, processing and value addition of clays and minerals, organic photonic materials and environmental monitoring and remediation. The Institute has been consistently ranked as one of the top performing institutes in terms of quality and quantity of its research publications³.

The evolution of a small regional specific laboratory into a scientifically and technologically vibrant premier national institution with international visibility was achieved in phases by the untiring and dedicated efforts of its leadership and staff. During the three decades of its existence, the laboratory has witnessed phenomenal growth with addition of state-of-art infrastructure, technological upgradation of the R & D facilities coupled with quantum jump in the output. In a recent analysis by CSIR-NISCAIR, the Institute achieved the second position among the

CSIR labs in terms of number of high impact factor publications (890 numbers with average IF more than 2 per paper), 79 US patents filed and more than Rs. 48 crores received as ECF, during 2004-2008⁴. In addition, a major technology for the commercialization of a new process for the production of synthetic rutile from illuminite was handed over to Cochin Minerals and Rutile Limited (CMRL) in January 2008.

The Institute has established state-of-the-art facilities for conducting advanced research in the areas of interest. Pilot plant facilities for research training and process/product development in the areas of spices and oilseeds have been established. The institute has also been playing a significant role in Human Resource Development by training post graduate/graduate students, with over 252 Ph.D degrees awarded till date based on research conducted in the institute. The laboratory at present has a sanctioned strength of 62 scientists, 65 technical and 54 administrative staff. About 150 JRF/SRF are pursuing their doctoral work and an equal number of project assistants are involved in contract research activities. The Institute receives about Rs. 25 crores of budgetary support per annum.

The research output including doctoral dissertations reflect the identity of an institution. Here, an attempt has been made to analyse the research trend, particularly with regard to doctoral dissertations and also the publication output of NIIST scientists during the last 10 years (2001-2010).

Review of literature

Several bibliometric studies have been conducted by different authors for studying research output, publication trend, author collaboration, citation impact and other bibliometric indicators.

Kaushik⁵ identified various bibliometric aspects of the scientific contributions of the researchers and faculty of National Dairy Research Institute (NDRI), Karnal published during 2001-2011. It was found that most of the contributions were journal articles and average number of authors per contribution was 3.61. The degree of collaboration was 0.98 and the scientists had foreign research collaboration with 19 countries. Surulinathi and others⁶ studied quantitatively the contributions made by the Karunya University researchers in the field of science during 1993-2011 as reflected in Web of Science. A total of 145 publications were covered during the period and

h-index of the university is 9. The study revealed that there were 122 journal articles with 391 global citation scores.

Jeysankar, Ramesh Babu and Rajendran⁷ analysed bibliographical details of 1282 research articles published by the scientists of CECRI during the period 2001-2009. It was found that 2009 was the most productive year with 194 papers and collaborative research was prominent among the scientists. The study also investigated authorship pattern, highly prolific authors and preferred journals by the scientists of CECRI. Sahu, Goswami and Choudhary⁸ analysed R & D publication output of National Metallurgical Laboratory (CSIR), based on data obtained from the Science Citation Index. It was found that the highest number of 120 papers was published in the year 2010 and the average number of publications per year was 5.02.

Zafrunnisha and Reddy⁹ presented a study on the citations of Ph.D theses in psychology, submitted to Sri Venkateswara University, Tirupati, Andhra Pradesh, during the period 1963-2003. It was found that 9275 references were appended in the 56 theses and majority pertained to journals (63.7%). The share of multi-authored contributions accounts for 63.32% of the total references. Nandi and Bandyopadhyay¹⁰ examined research productivity in zoology, authorship pattern and nature of collaboration among the zoology scholars by analyzing 236 theses and 719 thesis articles submitted by the scholars of the zoology department at the University of Burdwan in eleven subdivisions of zoology during 1960-2000.

Sudhier and Kumar¹¹ carried an in-depth scientometric analysis on the doctoral dissertations in biochemistry in the University of Kerala. The study showed that during the period 168 doctoral degrees were awarded in biochemistry and maximum of 25.60% Ph.Ds were awarded in the area of clinical biochemistry (25.60%) followed by metabolism (17.26%).

Upadhye and others¹² conducted a study on the scientometric dimensions of the Nuclear Physics Division at Bhabha Atomic Research Centre. There were 257 research papers published during 2003-2008 in diverse domains of nuclear physics and the highest number of publications (51) was in the year 2006. The publications of the Division were spread over 42 journals and the collaboration trend was multi-authored publications. Shukla, Goswami and Sharma¹³ presented a bibliometric analysis of Ph.D

theses in Botany from Vikram University, Ujjain. Bibliometric study of 35 doctoral dissertations in the area of Botany awarded during 1966-2004 from Pt. Ravisankar Shukla University has been carried out by Verma and Thakur¹⁴.

Nandi and Bandyopadhyay¹⁵ studied the research contributions in chemistry at the University of Burdwan during 1960-2000 by analyzing 141 theses and 979 articles. Highest number of papers (283) was published during 1991-1995 and about 53% papers were published in Indian journals. Ardanuy, Urbano and Quintana¹⁶ studied the situation of research on Catalan literature 1976 to 2003 by carrying out a bibliometric and social network analysis of Ph.D dissertations defended in Spain. There are several other studies on institutions and doctoral dissertations carried out by various authors¹⁷⁻³¹, however, none on NIIST (CSIR), Thiruvananthapuram.

Objectives of the study

- To assess the distribution of references in theses and average number of references; and
- To find out the publication trend of research scholars.

Methodology

One hundred forty doctoral theses were submitted from NIIST during 2001 to 2010 out of which 137 were available at the Knowledge Resource Centre of NIIST. The details of the research scholar, guide, awarding university, publication details, and references were manually collected by physical verification of the theses. The collected data were entered into Microsoft Excel spreadsheet for further analysis.

Analysis

Year-wise distribution of theses

Figure 1 gives the year-wise distribution of Ph.D theses from NIIST during 2001-2010. Maximum number of theses, i.e., 21 (15.33%) was submitted during the year 2007 and minimum number of theses, 4 (2.92%) were submitted during the year 2003.

Areas of research

Table 1 shows that maximum number of 107 theses were in the subject of chemistry (75.10%). Other areas included material science and minerals.

Table 1—Broad subject areas of theses

Sl. No.	Subject	No. of theses	Percentage	Cumulative percentage
1	Bio Technology	3	2.19	
2	Chemical Engineering	2	1.46	3.65
3	Chemical Technology	2	1.46	5.11
4	Chemistry	107	78.10	83.21
5	Computer Science	1	0.73	83.94
6	Engineering and Technology	1	0.73	84.67
7	Environmental Chemistry	1	0.73	85.40
8	Environmental Science	1	0.73	86.13
9	Geology	2	1.46	87.59
10	Physics	15	10.95	98.54
11	Technology	2	1.46	100.00
Total		137	100.00	100.00

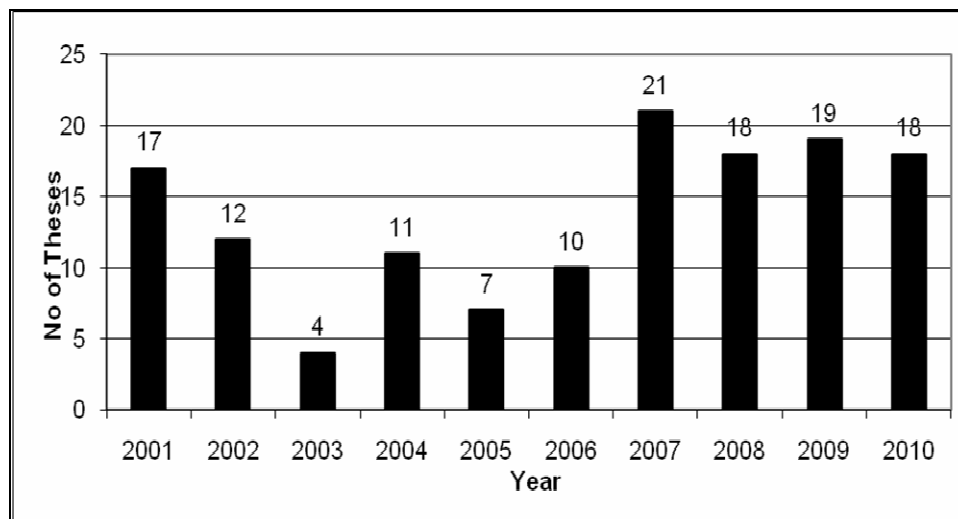


Fig. 1—Chronological distribution of theses

University - wise distribution of theses

The Ph.D theses from the institute were submitted to three different universities in Kerala. It was found that 65.69% of the theses were submitted to the University of Kerala, 32.12% theses to Cochin University of Science and Technology and 2.19% theses to Mahatma Gandhi University.

Research supervisors of NIIST

Table 2 shows the research supervisors who have guided 4 or more Ph.D theses in NIIST during the period of study.

The maximum number of theses (21) have been submitted under the guide ship of Dr. G. Vijay Nair (former Director, NIIST) in chemical sciences and technology. He is followed by Dr. Suresh Das (present Director, NIIST) with 11 theses and Dr. A. Ajayaghosh, with 10 theses. Twelve guides contributed only one thesis each so far.

Table 2—Research supervisors of NIIST

Sl. No.	Name	No. of theses	Rank	Percentage
1	G Vijay Nair	21	1	15.33
2	Suresh Das	11	2	8.03
3	A Ajayaghosh	10	3	7.30
4	K George Thomas	7	4	5.11
5	M T Sebastiaan	7	4	5.11
6	D Ramaiah	6	5	4.38
7	K R Gopidas	6	5	4.38
8	M L P Reddy	6	5	4.38
9	T Prasada Rao	6	5	4.38
10	U Syamaprasad	5	6	3.65
11	C Arumughan	4	7	2.92
12	C K S Pillai	4	7	2.92
13	K G k Warriar	4	7	2.92
14	M Jayakannan	4	7	2.92
15	Mangalam S Nair	4	7	2.92

Distribution of references in theses

Data on the number of reference in the theses are presented in the Table 3.

It was found that 40.88% theses have 151-250 citations. The maximum number of 672 references was in the thesis by P. S. Anjana. There were three theses with less than 100 references.

Year- wise distribution of references

The year- wise analysis of references in the theses is given in Table 4.

The number of references are increasing in the recent years, i.e., from 2007 onwards compared to the previous period. From Table 4 it is clear that the number of references is lesser, below 10%, up to the year 2006. The maximum value of the average number of references per thesis is in the year 2005 (285.29) and the minimum (198.50) in the year 2003. The average number of references per thesis is calculated to be 242.79 during the period of study.

Table 3—Distribution of citations in theses

Sl. No.	No. of references	No. of theses	Percentage	Cumulative percentage
1	Below 100	3	2.19	-
2	101 – 151	22	16.06	18.25
3	151 – 200	28	20.44	38.69
4	201 – 250	28	20.44	59.12
5	251 – 300	24	17.52	76.64
6	301 – 350	14	10.22	86.86
7	351 – 400	8	5.84	92.70
8	401 – 450	6	4.38	97.08
9	451 – 500	1	0.73	97.81
10	501 – 550	0	0.00	97.81
11	551 – 600	1	0.73	98.54
12	601 – 650	1	0.73	99.27
13	651 – 700	1	0.73	100.00
Total		137	100.00	100.00

Table 4—Year- wise distribution of references

Sl. No.	Cited year	No. of Theses	No. of references	Average No. of references	Percentage	Cumulative Percentage
1	2001	17	3829	225.24	11.51	--
2	2002	12	2795	232.92	8.40	19.91
3	2003	4	794	198.50	2.39	22.30
4	2004	11	2595	235.91	7.80	30.10
5	2005	7	1997	285.29	6.00	36.11
6	2006	10	2576	257.60	7.74	43.85
7	2007	21	4842	230.57	14.56	58.41
8	2008	18	4722	262.33	14.20	72.60
9	2009	19	4671	245.84	14.04	86.65
10	2010	18	4442	246.78	13.35	100.00
Total		137	33263	242.79	100.00	100.00

Publications included in the theses

The publications of the researcher included in the doctoral theses are analysed to study the publication pattern of researchers. These research articles are published during the period of their active research and are appended in the doctoral theses. An analysis of the list of publications included in the doctoral dissertations of NIIST researchers are shown in the Table 5.

It is observed that 13 (9.49%) researchers of NIIST do not include the list of publications in their theses. The highest number of 49 doctoral (35.77%) theses have 6-10 publications and 33 have 11-15 numbers of publications. The study revealed that majority of (90%) scholars include list of publications in their theses.

Bibliographic forms of publications

The bibliographic form-wise distribution of publications of researchers included in the theses are shown in the Table 6.

Table 5—Publications included in the theses

Sl. No.	No. of Publications	No. of Theses	Percentage	Cumulative Percentage
1	Below 5	17	12.41	—
2	6 – 10	49	35.77	48.18
3	11 – 15	33	24.09	72.26
4	16 – 20	10	7.30	79.56
5	21 – 25	5	3.65	83.21
6	26 – 30	2	1.46	84.67
7	31 – 35	6	4.38	89.05
8	Above 36	2	1.46	90.51
9	Not included	13	9.49	100.00
Total		137	100.00	100.00

Table 6—Bibliographic forms of publications

Sl. No.	Type of Publications	Count	Percentage	Cumulative Percentage
1	Journal articles	914	60.09	
2	Communicated journal articles	85	5.59	65.68
3	International conference/seminars/proceedings	106	6.97	72.65
4	National conference/seminars/proceedings	370	24.33	96.98
6	Reviews	4	0.26	97.24
7	Book/Book Chapters	12	0.79	98.03
8	Patents	29	1.91	99.93
9	Popular Article	1	0.07	100.00
Total		1521	100.00	100.00

The publication trend reveals that 137 research scholars have published a total of 1521 publications during the period of their research. The journals are the most preferred channel of publication of NIIST scholars and it amounts 60.09% (914) of all publications. 24.33% (370) articles are in the form of national conferences and seminars. The international seminars accounts 6.97% (106) and 85 (5.59%) are manuscripts. They are communicated for publishing in journals, and yet to be published. It is interesting to see that there are 29 patents (1.91%) are also in the list of publications.

From Table 7, it is evident that the number of publications has increased considerably during the year 2007-2010 with an average of 253.75 while, the general average publications is 152.1 per year and an average of 55 from year 2001 to 2006. International conference proceedings also has considerably increased during the period 2008-2010 with an average of 27.33 while the total average is 10.6 and the average for the period 2001-2007 is just 3.4. Year 2001 has the maximum number of 7 patents, while the average is 2.9 per year and a total patent of 29 during the period of study.

Patents by research scholars

There are 29 patents in the 124 doctoral theses NIIST researchers. The 29 patents belong to 18 scholars. Subject-wise distribution of patents is shown in the Table 8.

Conclusion

It has been reported that CSIR-NIIST has published 890 papers during the period 2004-2008. The present study finds that 914 research papers have been published by 137 Ph.D scholars during the period 2001-2010. CSIR-NIIST is among the top ranking

Table 7—Year-wise distribution publication of researchers

Publications	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Journal articles	71	73	17	70	49	50	152	129	142	161	914
Communicated journal articles	10	19	3	7	7	5	7	6	9	12	85
International conference proceedings	3	2	1	4	6	3	5	31	35	16	106
National conference proceedings	20	21	4	15	9	17	104	50	62	68	370
Reviews	0	0	0	0	1	2	0	1	0	0	4
Book/Book chapter	0	0	0	0	0	0	9	0	3	0	12
Patents	7	3	1	2	2	2	4	2	4	2	29
Popular articles	0	0	0	0	0	0	1	0	0	0	1
No. of Publications	111	118	26	98	74	79	282	219	255	259	1521
Percentage	7.30	7.80	1.70	6.40	4.90	5.20	18.50	14.40	16.80	17.00	100.00
Cumulative Percentage	–	15.10	16.80	23.20	28.10	33.30	51.80	66.20	83.00	100.00	100.00

Table 8—Subject-wise distribution of patents

Sl. No.	Subjects	No. of Patents	Percentage	Cumulative Percentage
1	Agro processing and Natural Products	1	3.45	–
2	Bio Technology	0	0.00	3.45
3	Chemical sciences and Technology	7	24.14	27.59
4	Materials and Minerals	21	72.41	100.00
5	Process Engineering and Environmental Technology	0	0.00	100.00
Total		29	100.00	100.00

CSIR institute and clearly, the present study reflects that the doctoral students have contributed largely to the R & D efforts of the institute.

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