Chapter 4

Publication Pattern of PRL Scientists

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Publishing is one of the formal methods of communication and also the most important means of communication. It allows the scientist / researcher to verify the reliability of information, to assess the relative importance of a contribution and to obtain critical response to the research work done. It is through publication that researcher gets recognition for his/her work especially when it is cited by other colleagues. Scientists, like researchers in other fields, are strongly motivated to get recognition from their peers for having made a significant scientific contribution. There are several factors which put together motivate the scientists to publish their research work such as pleasure of making new discoveries, the urge to create new knowledge, the need to gain visibility for their work, economic gain, reaching the peak of the professional ladder and the institutional pride.

The book was considered the first instrument for publishing ones ideas, the medium through which new ideas, evidence and scientific theories were broadcast to a wide audience. Gradually, original research work started appearing in notebooks where data was noted down and analysed and results obtained. These results were conveyed to other scientists through letters. This method still exists and we often find scientists writing personal letters to each other conveying their result, and it continues to be an important venue for reporting new findings.

The journal came into existence in 1665 and many papers found their way to the scientific journal. The growth of the journal and the development of the scientific societies were simultaneous and the journal became the most convenient vehicle for the transmission of new ideas and research in science. Journals encourage the researchers to publicize their work, offer a forum for the continuous critical examination of hypotheses and theories, and

preserve the material which would otherwise have been dispersed through publication in individual tracts or pamphlets. The journal also helps to establish priority claims in research work. Since, in majority of cases, journal articles are subjected to strict review, the quality of work is much higher than other forms of publishing (Vagiswari, 1997).

Researchers / scientists also communicate the results obtained from data analysis by presenting papers at conferences or symposia before publishing in the journal. This is done for faster communication and wider visibility. Conferences are usually attended by senior researchers who present the papers on their behalf and on that of the younger researcher. Conferences provide an opportunity to meet other researchers working in the same field and to become acquainted with their work and as well discuss their work. Frequently, the rapport developed during the interaction becomes the basis for collaborative work. Very often, senior researchers / scientists are also invited to deliver talks for the plenary session or for keynote address of conferences depending on their high impact scholarly output and recognition amongst the peer group. Thus conferences serve a vital function in the transfer of knowledge.

Sometimes, before the paper is presented at the conference or sent for publication in a primary journal, it may be brought out as a pre-print (nowadays – Eprint). The main aim of the Eprint is to convey the results to the peers in the field much before it is published in the journal which generally takes a few months to one year to process. However, it must be remembered that, since the Eprint does not go through a peer review, there is a chance of its getting rejected by the referees when submitted to a primary journal.

Publication record of a research scientist can adequately reflect his research output (productivity). Consideration of the publication record for output measurements has a distinct advantage over other criteria. Articles published in refereed journals are not only of good quality but are also easy to count. Thus output measurement in terms of papers published in refereed journals is more precise. Several studies have used publication counts and have shown that meaningful and statistically significant positive relationships exist between publication data and progress of science.

Derek de Sola Price (1963) was the first one to discern a pattern in publications and elaborated it in his most influential work 'Little Science Big Science'. This book describes the exponential growth of the scholarly literature and scientific manpower. It covers various aspects of the productivity of scientists like authorship pattern, collaboration pattern, preference of a journal for publishing their results, etc. Narin (1976) surveyed 24 studies in which both bibliometric measures (measures using publication data) and non-literature measures were used and concluded that bibliometric measures are highly recommended for studies in productivity.

As reflected in the publications indexed in international subject databases, India's publications growth rate has been relatively much faster in recent years. As compared to 2.51% annually during 1985-2005, it has almost doubled to 5.4% annually during 1995-2005. India's publications as indexed in Web of Science (WoS) have grown from 14,405 papers in 1990 to 28,603 papers in 2005. The institutional participation in research has broadened from 1,734 institutions in 1985-86 to 3,443 in 2001-02. However, there were only 24 institutions which published 300 or more papers during 1985-86 or 2001-02 (Gupta & Dhavan, 2006).

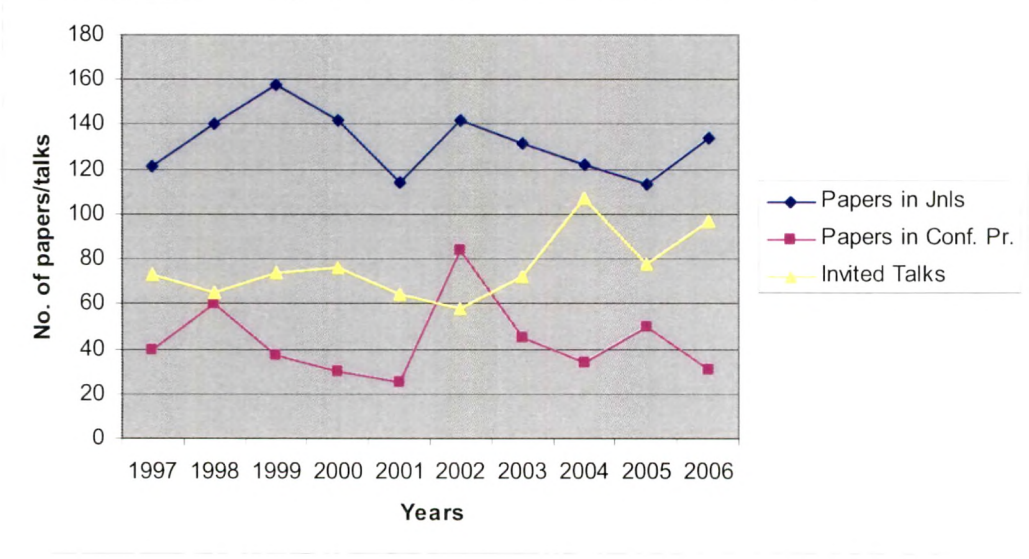
Research output of PRL

The above figures intrigued the researcher so much that she decided to study the research out put of one of the institutes of national importance. The present chapter attempts to identify the publication pattern of one institute – PRL. As mentioned in the previous chapter, the 10 year publication data has been gathered for the years 1997 through 2006. The research output in this period measured in terms of papers published and invited talks delivered consists of 2,518 records out of which 1,318 papers have been published in journals, 436 are published in conference proceedings and 764 are invited talks. This macro data is presented in Table 1.1 and Figure 1.1

Table 1.1 : Research output of PRL during 1997-2006

Year	Papers in Jnls	Papers in Conf. Pr.	Invited Talks	Total
1997	121	40	73	234
1998	140	60	65	265
1999	158	37	74	269
2000	142	30	76	248
2001	114	25	64	203
2002	142	84	58	284
2003	132	45	72	249
2004	122	34	107	263
2005	113	50	78	241
2006	134	31	97	262
Total	1318	436	764	2518

Fig 1.1 : Research output of PRL during 1997-2006



The above macro data is further analysed at micro level to give an idea about the **publication pattern** in terms of indicators such as authorship and collaboration in papers published in journals and conference proceedings, papers published as chapter of a book or in national / international journal, papers contributed in conferences held in India or abroad and invited talks delivered in India or abroad. The chapter concludes with a list of journals preferred by the PRL scientists for publication. For ease of understanding, the total number of publications for each indicator is represented first and then the pattern over 10 years is shown.

Tables 1.2-1.5 cover the authorship in journals and conference proceedings, Tables 1.6-1.9 cover the collaboration in journals and conference proceedings, Tables 1.10-1.15 cover the publication in national / international journals, national / international conference proceedings and national / international invited talks respectively. Last table gives the list of most preferred journals for publication of PRL scientists.

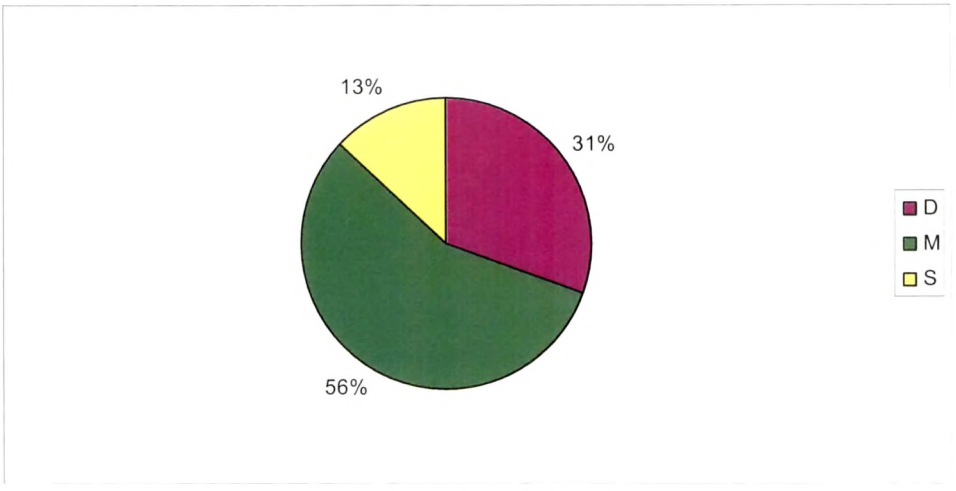
Authorship Pattern

Table 1.2 and Figure 1.2 give the overall picture of authorship during 1997-2006 for the research papers published in journals. It indicates that number of multiple and double authored papers far outweigh the single authored papers. This result is cognizant with the world pattern and confirms many earlier studies. Out of 1318 papers published in journals, 741 (56.22%) papers are multi-authored (M) and 404 (30.65%) are double authored (D) papers and 173 (13.13%) are single authored (S) papers. It can be inferred from this result that team effort in research has become integral part of PRL research.

Table 1.2: Authorship Pattern in Journals during 1997-2006

Authorship	Papers	%
Double authors	404	30.65
Multi authors	741	56.22
Single author	173	13.13
Total	1318	100.00

Fig 1. 2 : Authorship Pattern in Journals during 1997-2006



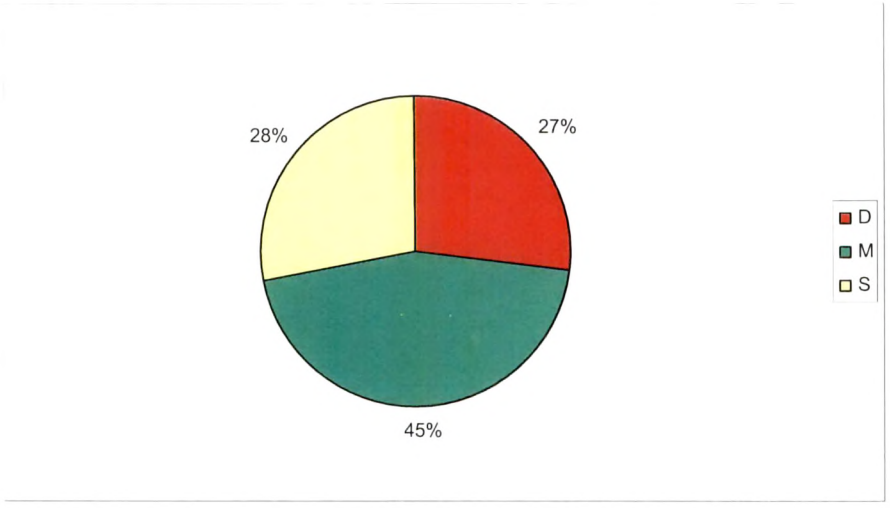
Note : D – Double authored papers, M – Multi authored papers, S–Single author papers

Table 1.3 and Figure 1.3 show the pattern of double authored (D), multi-authored (M) and single authored (S) papers in conference proceedings. Here again, similar scenario emerges, with multi-authored papers far out numbering the double and single authored papers.

Table 1.3 : Authorship Pattern in Conference Proceedings during 1997-2006

Authorship	Papers	%
Double authors	117	26.83
Multi authors	197	45.18
Single author	122	27.98
Total	436	100.00

Fig 1.3 : Authorship Pattern in Conference Proceedings during 1997-2006



Note : D – Double authored papers, M – Multi authored papers, S–Single authored papers

Comparing the data of papers in journals and conference proceedings, overall proportion of multi-authored and double authored papers are more in journals than in conference proceedings, while single authored papers are more in conference proceedings. High percentage of multi-authored and double authored papers in journals is in accordance with

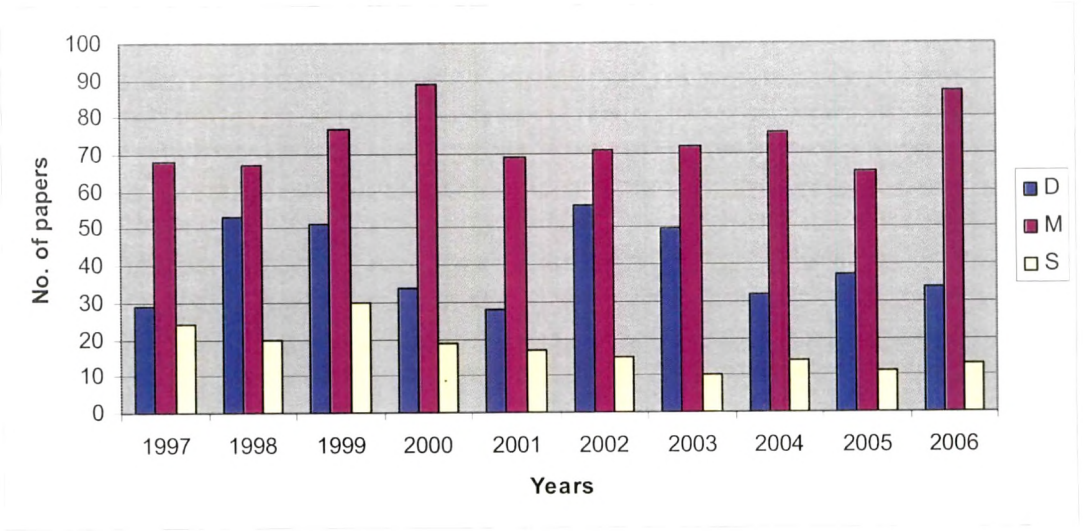
the world pattern and can be attributed to the fact that double and multi-authored papers are generally cited more than single authored papers (Lancaster, 1991).

Table 1.4 and Figure 1.4 give the year wise authorship pattern of papers published in journals through the years 1997 to 2006. Double authored and multi authored papers have increased during the years 1997-2006, on the other hand single authored papers have decreased over the years. Years 2000 and 2006 saw maximum number of multi-authored papers. A sharp decrease is seen in number of single authored papers from 2000 onwards. The reason for this could be that internet and email made it very easy for scientists to share and communicate and make changes in the manuscripts. Geographical location was not a hindrance anymore and hence more number of papers were generated which were either double authored or multi-authored.

Table 1.4 : Year wise Authorship Pattern in Journals from 1997-2006

Year	D	M	S	Total
1997	29	68	24	121
1998	53	67	20	140
1999	51	77	30	158
2000	34	89	19	142
2001	28	69	17	114
2002	56	71	15	142
2003	50	72	10	132
2004	32	76	14	122
2005	37	65	11	113
2006	34	87	13	134
Total	404	741	173	1318

Fig 1.4 : Year wise Authorship Patttern in Journals from 1997-2006



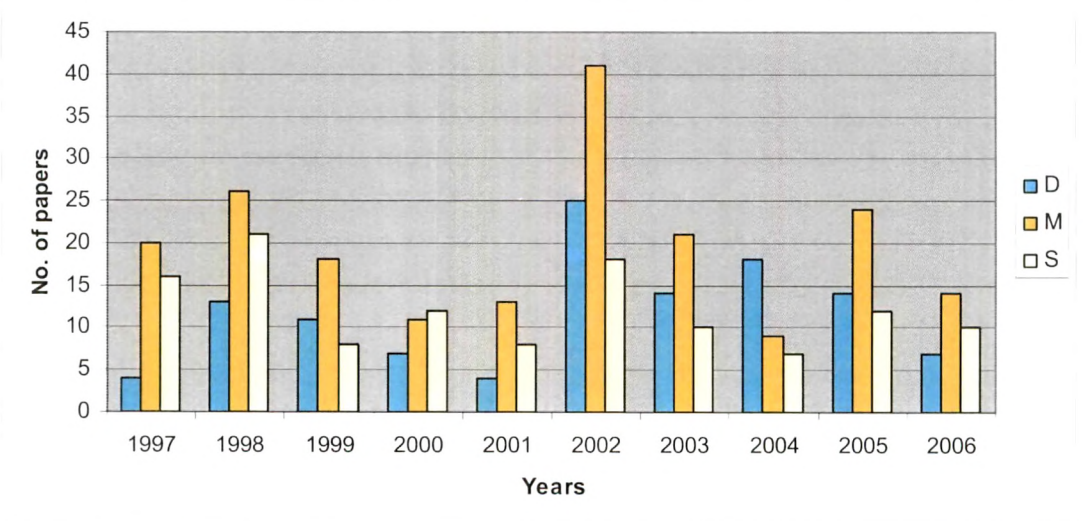
Note : D – Double authored papers, M – Multi authored papers, S–Single author papers

Table 1.5 and Figure 1.5 show the authorship pattern in papers published in conference proceedings from 1997 through 2006. Out of 436 papers, 197 papers are multi-authored papers followed by double authored and single authored papers. The year 2002 saw maximum number of papers in all three categories of papers.

Table 1.5 : Year wise Authorship Pattern in Conference Proceedings from 1997-2006

Year	D	M	S	Total
1997	4	20	16	40
1998	13	26	21	60
1999	11	18	8	37
2000	7	11	12	30
2001	4	13	8	25
2002	25	41	18	84
2003	14	21	10	45
2004	18	9	7	34
2005	14	24	12	50
2006	7	14	10	31
	117	197	122	436

Fig 1.5 : Year wise Authorship Pattern in Conference Proceedings from 1997-2006



Note : D – Double authored papers, M – Multi authored papers, S-Single authored papers

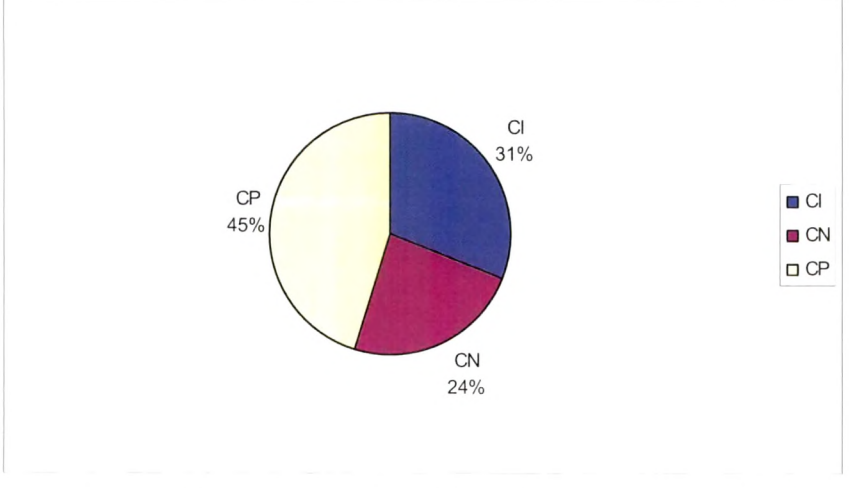
Collaboration Pattern

Table 1.6 and Figure 1.6 below give a graphical representation of the collaborative papers published in journals at PRL during 1997-2006. As seen from the table there are 596 (45.22%) papers with collaboration within PRL (CP) i.e. all the authors of a paper are affiliated to PRL, 411 (31.18%) papers with international collaboration (CI) and 311 (23.60%) papers with national collaboration (CN). The result shows that there is healthy culture of collaboration within PRL.

Table 1.6 : Types of Collaborative Papers in Journals during 1997-2006

Collaboration	Papers	%
CI	411	31.18
CN	311	23.60
CP	596	45.22
Total	1318	100

Fig 1.6 : Types of Collaborative Papers in Journals during 1997-2006



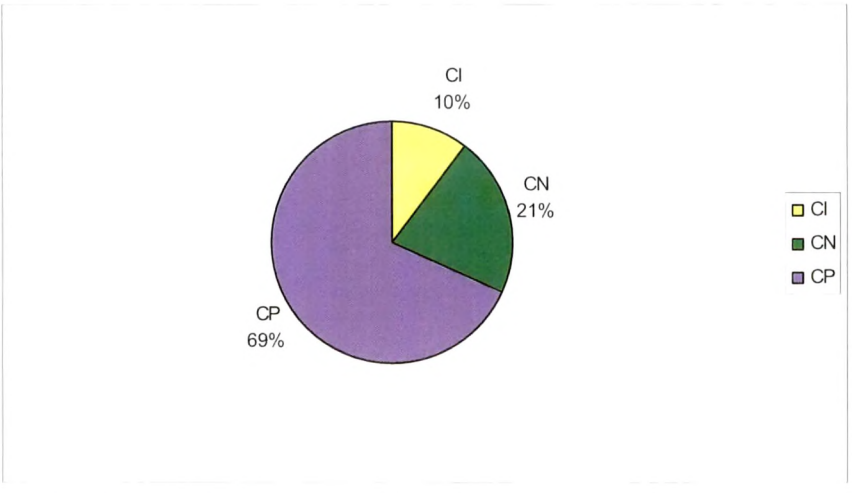
Note : CI - Collaboration International, CN – Collaboration National, CP - Collaboration PRL

Table 1.7 and Figure 1.7 below give an indication of collaborative papers published in conference proceedings. In this case, national collaborative papers (CN) are more than international collaborative (CI) papers. The reason could be that funding is available for national conferences but it is more difficult for international conferences. The domestic collaborative papers (CP) are in much higher proportion (69%) than national or international collaborative papers.

Table 1.7 : Types of Collaborative Papers in Conference Proceedings during 1997-2006

Collaboration	Papers	%
CI	45	10.32
CN	93	21.33
CP	298	68.35
Total	436	100.00

Fig 1.7 : Types of Collaborative Papers in Conference Proceedings during 1997-2006



Note: CI - Collaboration International, CN – Collaboration National, CP - Collaboration PRL

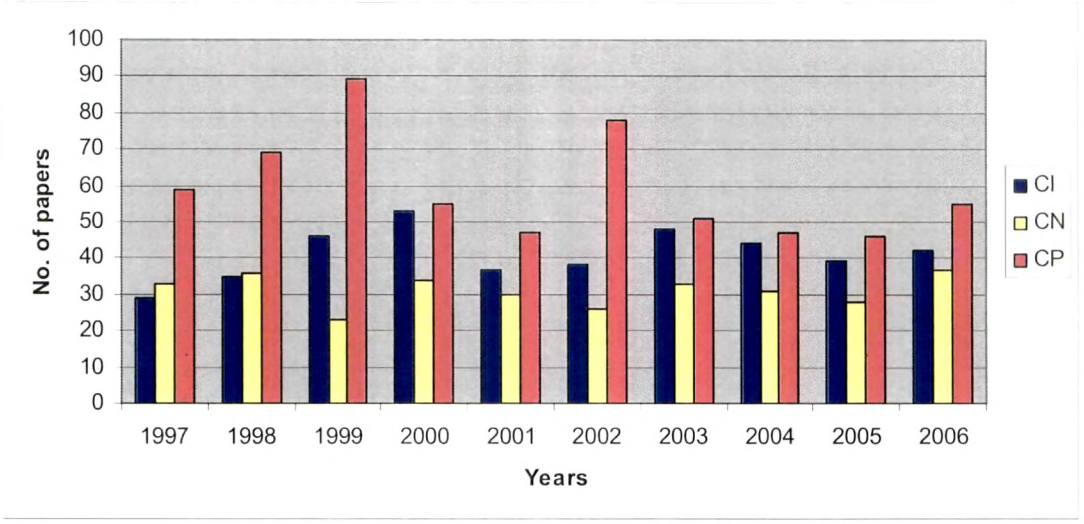
Comparing the data of collaborative papers in journals and conference proceedings, it is seen that international collaboration is higher in journals (31%) than in conference proceedings (10%), national collaboration is almost the same in journals and conference proceedings. Domestic collaboration (CP) is higher in conference proceedings (69%) than in journals (45%).

Table 1.8 and Figure 1.8 give year wise pattern of collaboration in papers published in journals from 1997 through 2006. There has been a general increase in international collaborative papers. National collaboration has increased slightly and domestic collaboration (CP) has decreased slightly over the years. Highest number of international collaborative papers (53) published in journals were in the year 2000. National collaboration was highest (37) in 2006.

Table 1.8 : Year wise Collaboration Pattern in Journals from 1997-2006

Year	CI	CN	CP	Total
1997	29	33	59	121
1998	35	36	69	140
1999	46	23	89	158
2000	53	34	55	142
2001	37	30	47	114
2002	38	26	78	142
2003	48	33	51	132
2004	44	31	47	122
2005	39	28	46	113
2006	42	37	55	134
Total	411	311	596	1318

Fig 1.8 : Year wise Collaboration Pattern in Journals from 1997-2006



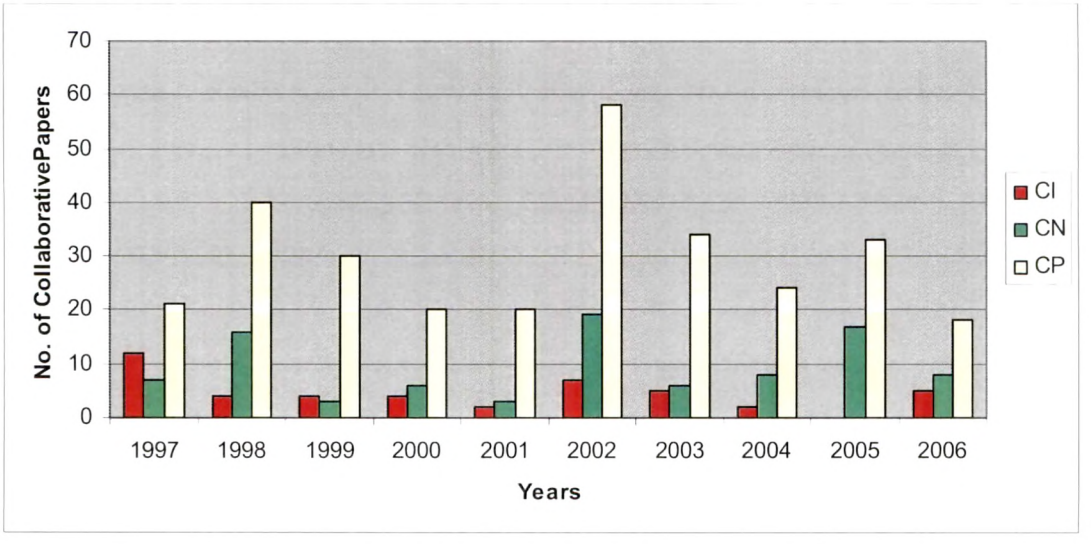
Note : CI - Collaboration International, CN – Collaboration National, CP - Collaboration PRL

Table 1.9 and Figure 1.9 below show the pattern of collaborative papers in conference proceedings during the years 1997-2006. The year 1997 saw highest number of international collaborative papers (12), while national collaborative papers (19) and PRL collaborative papers (58) were highest in 2002.

Table 1.9 : Year wise Collaboration Pattern in Conference Proceedings from 1997-2006

Year	CI	CN	CP	Total
1997	12	7	21	40
1998	4	16	40	60
1999	4	3	30	37
2000	4	6	20	30
2001	2	3	20	25
2002	7	19	58	84
2003	5	6	34	45
2004	2	8	24	34
2005	0	17	33	50
2006	5	8	18	31
	45	93	298	436

Fig 1.9 : Year wise Collaboration Pattern in Conference Proceedings from 1997-2006



Note : CI - Collaboration International, CN – Collaboration National, CP - Collaboration PRL

Also, there has been a decrease in the international collaborative papers over the years i.e. there were 12 papers with international collaboration in 1997 and only five papers with international collaboration in 2006. National collaboration has remained at the same level. In this category too, domestic collaboration has decreased slightly over the years from 21 in 1997 to 18 in 2006.

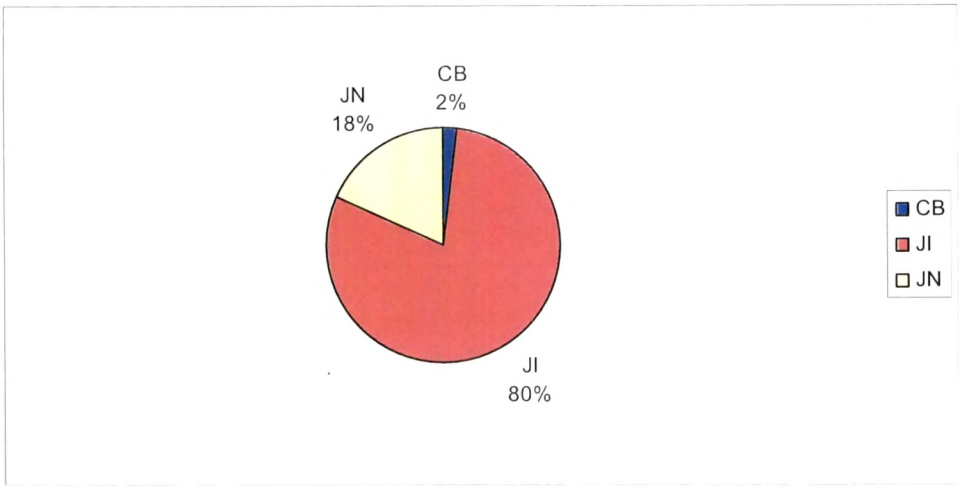
Publication Mode

Table 1.10 and Figure 1.10 give an overview of publication mode preference of researchers with articles published in national and international journals and as chapter of a book. Almost 80% of the papers are published in international journals. It may be noted that researchers at PRL do not seem to prefer to contribute chapters in books.

Table 1.10 : Publication Mode Preference during 1997 - 2006

Publication Mode	Papers	%
CB	27	2.05
JI	1051	79.74
JN	240	18.21
Total	1318	100.00

Fig 1.10 : Publication Mode Preference during 1997 - 2006



Note : CB – Book Chapter, JI – International Journal, JN – National Journal

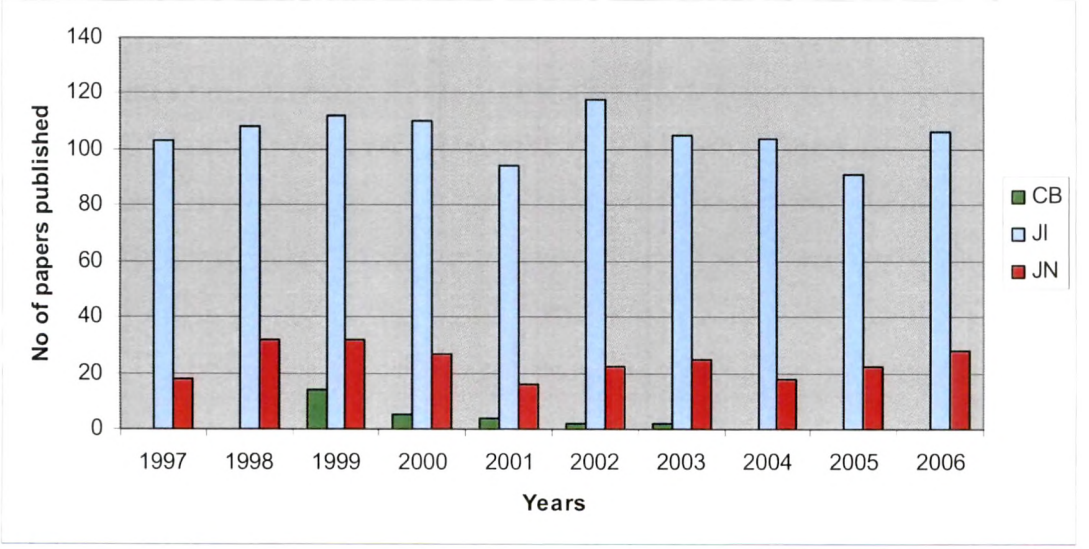
Table 1.11 and Figure 1.11 below give the year wise pattern of publication mode preference from 1997-2006. Out of 1318 papers published, maximum number of papers in international journals were pulished in 2002 (118). However, there has been only a marginal increase in the number of papers in international journals from 103 in 1997 to 106 in 2006. There has been an increase in papers published in national journals – from 18 in 1997 to 28 in 2006.

Jacobs (2001) states that most of the scientists in the developed countries are not aware of the research carried out in third world countries. Probably because of the fact that scientists from some of the third world countries fail to publish the results of their research in reputed international journals. However, the result of the present study is contrary to this, as out of 1318 articles published by PRL scientists, 1051 are in international journals (JI) and only 240 are in national journals (JN) and 27 are chapters of a book (CB). Thus, most preferred mode of publication of PRL scientists is international journal.

Table 1.11 : Year wise Pattern of Publication Mode from 1997-2006

Year	CB	JI	JN	Total
1997	0	103	18	121
1998	0	108	32	140
1999	14	112	32	158
2000	5	110	27	142
2001	4	94	16	114
2002	2	118	22	142
2003	2	105	25	132
2004	0	104	18	122
2005	0	91	22	113
2006	0	106	28	134
Total	27	1051	240	1318

Fig 1.11 : Year wise Pattern of Publication Mode from 1997-2006



Note : CB – Book Chapter, JI – International Journal, JN – National Journal

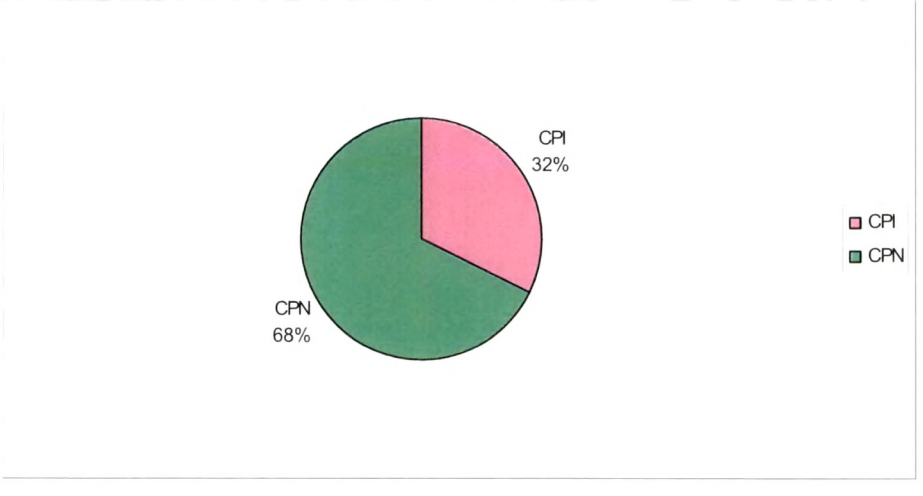
Papers in Conference Proceedings – National / International

Table 1.12 and Figure 1.12 give the proportion of papers published in conference proceedings of international and national conferences. Out of a total of 436 papers published in this period, 295 (67.66%) are in the proceedings of conferences held in India and 141 (32.34%) papers were published in the proceedings of conferences held abroad. Less proportion of papers published in international conference proceeding could be attributed to less number of scientists and students attending the international conferences than the national conferences.

Table 1.12: Papers in Conference Proceedings - National/International during 1997 - 2006

Conference Proceeding	Papers	%
CPI	141	32.34
CPN	295	67.66
Total	436	100.00

Fig 1.12 : Papers in Conference Proceedings – National/International during 1997 - 2006



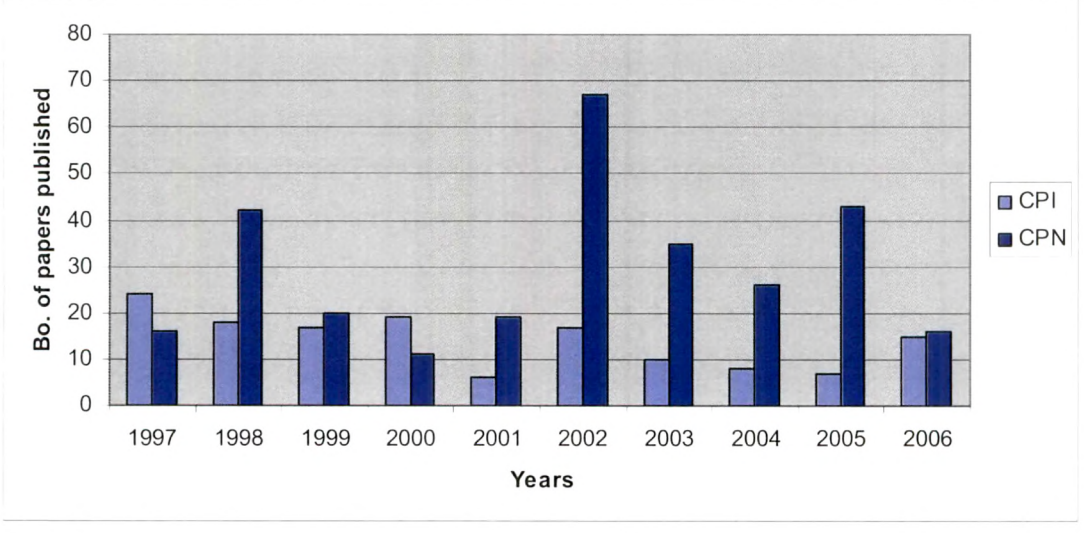
Note : CPI – International Conference Proc. CPN – National Conference Proc.

Table 1.13 and Fig 1.13 show year wise pattern of papers published in conference proceedings by researchers of PRL at international and national level.

Table 1.13 : Year wise Pattern of Papers in Conference Proceedings from 1997-2006

Year	CPI	CPN	Total
1997	24	16	40
1998	18	42	60
1999	17	20	37
2000	19	11	30
2001	6	19	25
2002	17	67	84
2003	10	35	45
2004	8	26	34
2005	7	43	50
2006	15	16	31
	141	295	436

Fig 1.13 : Year wise Pattern of Papers in Conference Proceedings during 1997 - 2006



The above table and figure show that there has been a decrease in number of papers in international conferences' proceedings (CPI) over the years 1997-2006 from 24 in 1997 to 15 in 2006 while almost no change is seen in number of papers in national conference proceedings (CPN).

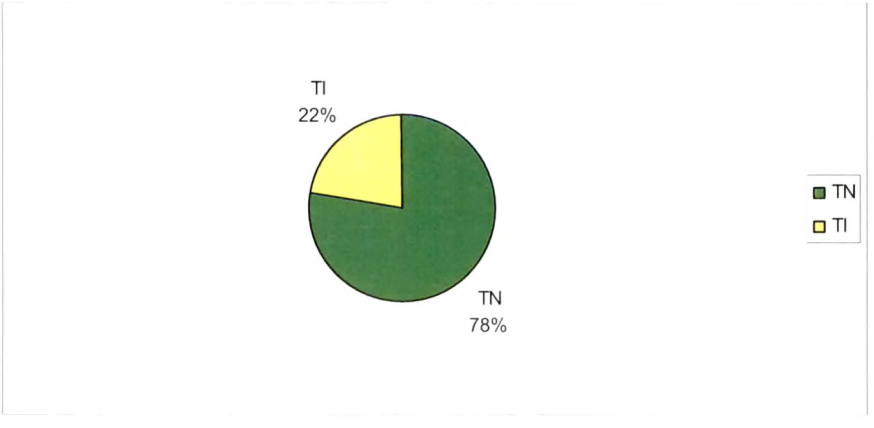
Invited Talks delivered – National / International

Table 1.14 and Figure 1.14 below give the number of invited talks delivered by PRL scientists in India and abroad. Out of 764 invited talks, 593 (77.62 %) were delivered in India (TN) and 171 (22.38%) were delivered abroad (TI).

Table 1.14 : Invited Talks delivered – National / International during 1997-2006

Invited Talks	No. of Talks	%
TN	593	77.62
TI	171	22.38
Total	764	100.00

Fig 1.14 : Invited Talks delivered – National/International during 1997-2006



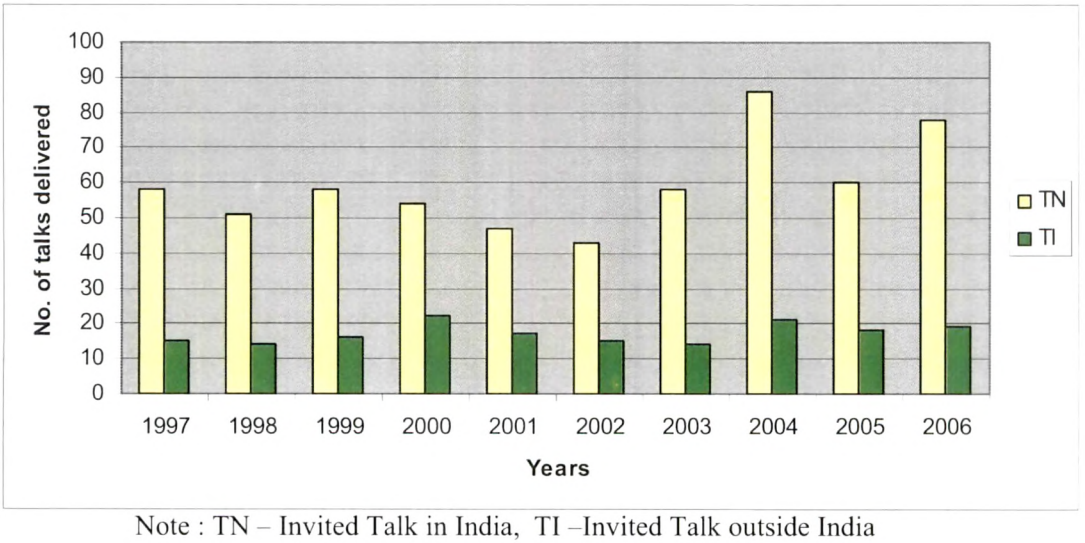
Note : TN – Invited Talk in India, TI –Invited Talk outside India

Table 1.15 and Figure 1.15 give year wise pattern of invited talks delivered at national and international level during 1997-2006. It is evident from the table that there is an increase in the number of invited talks delivered at national level, particularly since 2002.

Table 1.15: Year wise Pattern of Invited Talks – National/International from 1997 to 2006

Year	TN	TI	Total
1997	58	15	73
1998	51	14	65
1999	58	16	74
2000	54	22	76
2001	47	17	64
2002	43	15	58
2003	58	14	72
2004	86	21	107
2005	60	18	78
2006	78	19	97
Total	593	171	764

Fig 1.15: Year wise Pattern of Invited Talks – National/International from 1997 to 2006



Note : TN – Invited Talk in India, TI –Invited Talk outside India

The figure above indicates that peer recognition of PRL scientists seems to be on rise in India. However, there is only a marginal increase in number of invited talks delivered abroad during the years 1997-2006.

Journal Preference for Publication

According to Lancaster (1982) many scientists in developing countries prefer to publish in foreign journals rather than in their native journals for the sake of prestige and recognition. Half of the papers of Indian scientists are published in American journals. It is a matter of pride, if one's paper is accepted in high impact foreign journals like 'Nature' or 'Science'. This is confirmed by the result of the present study. Table 1.16 tells us about the journal preference of PRL scientists. It lists the journal titles which have more than 15 papers published during the 10 year study period. **Physical Review A** tops the list with 83 articles followed by **Current Science** with 68 articles and **Physical Review D** with 50 articles published during 1997-2006 by PRL scientists. Out of the 20 most preferred journals, 4 are Indian – Current Science, Journals of Earth System Science, Pramana, and Bulletin of Astronomical Society of India. All others are international journals of high impact as is seen from the high impact factors. Thus there is clear preference to publish in international journals because it brings recognition.

Table 1.16 : Most preferred journals for publication during 1997-2006

Journal Name	No of Pape	IF
		(2009)
Physical Review A	83	**2.866**
Current Science	68	**0.782**
Physical Review D	50	**4.922**
Journal of Geophysical Research (ALL)	47	**3.082**
Physics Letters B	41	**5.083**
Astronomy and Astrophysics	37	**4.179**
Solar Physics	37	**3.628**
Journal of Earth System Science	34	**0.819**
Physical Review E	33	**2.400**
Advances in Space Research	30	**1.079**
Geophysical Research Letters	25	**3.204**
Meteoritics and Planetary Science	23	**3.253**
Physical Review Letters	22	**7.328**
Pramana	22	**0.349**
Astrophysical Journal	21	**7.364**
Bulletin of Astronomical Society of India	20	**0.310**
Physics of Plasmas	20	**2.475**
Journal of Astrophysics and Astronomy	19	**0.580**
Physics Letters A	18	**2.009**
Geochimica Cosmochimica Acta	16	**4.385**
Monthly Notices of Royal Astronomical Society	16	**5.103**

Summary of results

- With the advent of Big Science has come research collaboration and collaborative authorship. The foregoing pages indicate that multiple authored and double authored papers are on the rise in PRL, especially from 2000 onwards probably due to ease of contact through emails and ease of writing and editing using the computers and the Internet. In 1961 Price had predicted the disappearance of single authored papers. Fifty years hence, this trend is more than obvious as scholarship becomes interdisciplinary, leading to greater cooperation among individuals and institutions.
- The research output of PRL in terms of publication record and invited talks summing upto 2518 units gives an average of about 250 research output units per year. Out of these, 1318 papers in journals give an average of about 130 papers published in journals per year. The average number of academic faculty being 60, gives the output of 2.17 papers per academic faculty per year. According to the study done by Raghuraman, et al (2010), PRL is ranked 9th amongst the autonomous R & D centres in India in terms of publication output.
- Comparing the data of collaborative papers in journals and conference proceedings, international collaboration is higher in journals than in conference proceedings. National collaboration is almost the same in journals and conference proceedings. Domestic collaboration is higher in conference proceedings than in journals. For conference proceedings, national collaborative papers are more than double of international collaborative papers.
- The journals most preferred by PRL scientists for publication are **Physical Review A** (83 articles) followed by **Current Science** with 68 articles and **Physical Review D** with 50 articles during 1997-2006 by PRL scientists. Out of the 20 most preferred journals, 4 are Indian – Current Science, Journals of Earth System Science, Pramana, and Bulletin of Astronomical Society of India. All others are international journals of high impact. Thus there is clear preference to publish in international journals because it brings recognition.

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