

A QUANTITATIVE ANALYSIS OF CITATIONS OF RESEARCH REPORTS PUBLISHED BY NATIONAL INSTITUTE OF HYDROLOGY, ROORKEE

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Quantitative analysis of citations has immense value in library management, specially in selection of periodicals for subscription. Periodicals as primary sources of information have more importance in research libraries than other sources of information. The cost of the periodicals is increasing day by day and hence its judicious selection is essential. Citation analysis is a useful tool for the modern libraries in this regard. In present study, an analysis has been made of 20,046 citations mentioned in 777 scientific and technical reports published by National Institute of Hydrology, Roorkee, since its inception i.e., December 1978. The paper gives an account of year-wise break-up of different categories of reports. Different bibliographic forms of literature cited in the reports such as journals, books, conference proceedings, technical reports, IAHS publications and other documents like Ph.D. Thesis, M.E./M.Tech dissertation, bulletins, standards etc. have been analysed and presented. A ranked list of 56 most important journals related with hydrology and water resources, out of 140 cited journals in the reports has been prepared. This ranked list of journals covers 92.7% of the total journal citations. The analysis have revealed that 40% of total journal citations relate to only 3 journals namely Water Resources Research (19.01%), Journal of Hydrology (13.43%) and ASCE's Journal of Hydraulic Engineering (7.56%). The country-wise distribution of most cited journal has also been prepared and categorised.

INTRODUCTION

Research reports constitute the most significant category of primary literature even though they are not readily available through normal book trade channels. Report literature may become the most important media of scientific information. The rapid and multidimensional growth of science and technology has now proved and emphasized the inadequacies of the periodicals. Research reports issued as separate documents have emerged as the most successful supporting literature to periodicals. Furthermore, a research report is usually

detailed, whereas, an article in a periodical is subject to space limitations [1].

An essential part of research papers or reports is the list of references or citations appended at the end of the body of document, indicating the previous publications related to that particular topic. No research usually stands alone and is based on other related researches conducted in that field and this relationship is reflected through citations, when collected in a large number, from their own body of literature. Analysis of these citations help in the picturisation of these relationship and characteristics of that body of literature. Citations are the indicators of usage of information sources observable and quantifiable. Any set of documents which contains the list of references can provide the base materials for citation analysis. These citation counts based on a given set of documents are precise and objective [2].

The National Institute of Hydrology (NIH) is a Government of India Society under the Ministry of Water Resources and has been functioning as a premier research Institute in the area of hydrology and water resources in India since December 1978. Based on the studies and research conducted by the various Scientific Divisions/Regional Centres of the Institute (containing about 85 scientist) 777 scientific and technical reports have been published since its inception upto March 2003, under various categories. The scientists of the institute also publish important finding of their research in the journals of international repute, conferences, seminars and symposia [3].

The present paper attempts to analyse quantitatively the citations of different bibliographic forms of literature appended at the end of scientific and technical reports published by National Institute of Hydrology during the last 25 years. The emphasis is given on the analysis of citations of journals.

OBJECTIVES

Quantitative analysis of citations has long been popular to study the characteristics of a subject literature. The result of these studies may provide useful indications for further use of information sources, and have been found very helpful and useful to manage information sources and services, especially in special libraries and information centres for their effective use. Keeping in view the above perspective, it was decided to undertake the present analysis with the following main objectives:

- a) to obtain an overall perspective of scientific and technical reports published by National Institute of Hydrology;
- b) to identify the different bibliographic forms of literature cited;
- c) to prepare a ranked list of most cited journals;
- d) to obtain country-wise break-up of most cited journals.

METHODOLOGY

The method of reference analysis has been adopted for the study. There were twenty thousand forty six (20,046) references appended to seven hundred seventy seven (777) scientific and technical reports published by National Institute of Hydrology (printed upto March 2003) which have been compiled and analysed. The data has been collected, classified, organised and presented in the form of tables. Further, with the help of Ulrich's Periodical Directory and from journals available in the library, the country of origin of journals has been determined. Thus, by counting frequency of occurrences of referred journals, a ranked list of 56 most frequently cited journals

is prepared in a decreasing order of frequency of occurrences as references.

DISCUSSION AND RESULTS

Year-wise break-up of reports

The year-wise break-up of various categories of scientific and technical reports is presented in Table 1. National Institute of Hydrology publishes research findings of various scientific divisions of the institute, in the form of reports since 1981-82 in various categories namely- Review Notes (RN), Technical Notes (TN), Technical Reports (TR), State -of-the-Art Reports (SA), Status Reports (SR), Case Studies (CS), User Manuals (UM), Manuals (M) and Documentation of Programme (DP). Some new categories like Technical Reports/Basic Research (TR/BR) and Case Studies/Applied Research have been introduced later on. Total number of 777 research reports of these categories have been published till March 2003 by about 85 scientists. It can be observed from the table that a maximum number of reports i.e. 67 have been published in the year 1994-95, followed by 62 in the year 1996-97 and 60 in the year 1992-93. The period 1981-86 shows the increasing trend and the period 1987-2000 shows the zig-zag trend of publication output of research reports. Since the reports are being printed after taking into consideration the reviewer's/referee's comments, the reports prepared in 2000 shall be printed in 2003 due to time taken by the reports to go through the Working Groups meetings/presentations by the scientists, comments of reviewers et.

Since 1993-94, the publication trend of reports has been changed. From these years, the institute has emphasised the studies in the form of Technical Reports/Basic Research (109) and Case Studies/Applied Research (223). User's Manuals (48) are being published regularly as and when any software is developed by the institute for hydrological studies. Publication of State-of-the-Art Reports (2), Manuals (3) and Documentation of Programmes (7) have been stopped. This shows that information provided by such type of documents, is not required furthermore. The institute has also stopped

Table 1 — Yearwise break-up of reports of different categories

Year	RN	TN	TR	TR/BR	SA	SR	CS	CS/AR	UM	M	DP	TOTAL
1981-82	-	1	-	-	-	-	1	-	-	-	-	2
1982-83	1	-	-	-	1	-	2	-	-	-	4	8
1983-84	-	4	-	-	1	5	1	-	-	-	3	14
1984-85	12	8	-	-	-	-	4	-	11	2	-	37
1985-86	22	15	-	-	-	4	7	-	6	1	-	55
1986-87	11	2	27	-	-	1	3	-	6	-	-	50
1987-88	-	7	18	-	-	1	1	-	3	-	-	30
1988-89	1	15	16	-	-	2	4	-	4	-	-	42
1989-90	-	3	7	-	-	-	10	-	-	-	-	20
1990-91	-	5	11	-	-	-	18	-	-	-	-	34
1991-92	-	4	11	-	-	8	12	-	-	-	-	35
1992-93	-	7	23	-	-	11	17	-	2	-	-	60
1993-94	-	10	-	11	-	8	-	27	1	-	-	57
1994-95	-	2	-	22	-	2	-	36	5	-	-	67
1995-96	-	-	-	16	-	3	-	30	3	-	-	52
1996-97	1	-	-	15	-	4	-	40	2	-	-	62
1997-98	-	-	-	17	-	5	-	27	3	-	-	52
1998-99	-	-	-	14	-	6	-	38	1	-	-	59
1999-2000	-	-	-	14	-	1	-	23	1	-	-	39
2000-01*	-	-	-	-	-	-	-	2	-	-	-	2
2001-02*	-	-	-	-	-	-	-	-	-	-	-	-
2002-03*	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	48	83	113	109	2	61	80	223	48	3	7	777

RN: Review Notes ; TN: Technical Notes; TR: Technical Reports; TR/BR: Technical Reports/Basic Research; SA: State-of-the-Art Reports; SR: Status Reports; CS: Case Studies; CS/AR: Case Studies/Applied Research; UM: User's Manuals; M: Manuals; DP: Documentation of Programmes.

(* The reports prepared by the scientists are either with reviewers for comments or with the scientists for inclusion of reviewer's suggestions, or under the printing process).

further printing of Review Notes (48), Technical Notes (83), Technical Reports (113) and Case Studies (80) because slight changes in orientation of studies into basic and applied research. The Status Reports (61) are continuing their status.

Bibliographic form of literature

The importance of information can not be denied in research work. The valuable sources of information from the point of view of researchers are periodicals, books, reports and

Table 2 — Bibliographic form of literature cited

Different categories of Reports	Total Number of Reports Published	Number of Citations						Total
		Papers in Jour.	Books	Papers in Reports Conf.Proc.	Tech.	IAHS Pub.	Other Documents	
Review Notes	48	1025	452	353	195	42	603	2670
Technical Notes	83	1047	1271	359	224	103	554	3558
Technical Reports	113	973	728	221	221	55	355	2553
Technical Reports/ Basic Research	109	1427	881	280	265	56	355	3264
State-of-the-Art Reports	2	170	64	33	15	1	59	342
Status Reports	61	714	592	519	294	77	1001	3197
Case Studies	80	330	219	142	244	7	245	1187
Case Studies/ Applied Research	223	909	582	271	407	46	594	2809
User's Manuals	48	77	130	23	46	2	64	342
Manuals	3	41	22	1	5	1	16	86
Documentation of Programmes	7	10	11	4	4	-	9	38
Total	777	6723	4952	2206	1920	390	3855	20046

similar other types of documents. The knowledge contained in books is usually dated and upto date information about current research and technology is available only in primary periodicals. The original reports of scientific investigations form the bulk of what is known as the primary literature. The records may be observational, descriptive or theoretical. However, they are the accounts of experiments with findings, inferences and conclusions. Every person who writes an advanced scientific document might be a user of such document at one time or the other. The producers of scientific information would certainly use this information for further elaboration, experimentation or even denial. These results in general are available in most specialised scientific documents.

In this paper, the distribution of cited literature in different bibliographic forms is presented in

Table 2. There were in all 20,046 citations scattered in different bibliographic forms, viz Papers in Journals (6723), Books (4952), Papers in conference Proceeding (2206), Technical Reports (1920), IAHS Publications (390) and other documents like Ph.D. Thesis, M.E./M.Tech. Dissertations, Bulletins, Standards, etc (3855). It can be observed that 33.53% of the total citations are from the journals which are the most preferred sources of information used by the scientists of National Institute of Hydrology. Books (24.70%) were the second most cited sources followed by papers in conference proceedings (11%). The remaining sources were responsible for 30.75% citations.

Ranking of most frequently cited journals

Rank distributions of scientific journals continue to be of interest for theoretical and practical

Table 3 — Ranked list of most frequently cited periodicals

Sl. No.	Rank	Journals	Country of Origin	No. of Citations	Cumul No. of Citations	%age of Citations	Cumul, %age
1.	1	Water Resources Research	USA	1278	1278	19.01	19.01
2.	2.	Journal of Hydrology	Netherlands	903	2181	13.43	32.44
3.	3	Journal of Hydraulic Engineering	USA	508	2689	7.56	40.00
4.	4	Journal of American Water Resources Association	USA	229	2918	3.41	43.41
5.	5	Transactions of American Geophysical Union	USA	229	3147	3.41	46.82
6	6.	Hydrological Sciences Journal	UK	203	3350	3.02	49.84
7.	7	Nordic Hydrology	Denmark	154	3504	2.29	52.13
8.	8	Journal of Irrigation and Drainage Engineering	USA	152	3656	2.26	54.39
9.	9	Ground Water	USA	149	3805	2.22	56.61
10.	10	Journal of Geophysical Research	USA	145	3950	2.16	58.77
11.	11	Monthly Weather Review	USA	117	4067	1.74	60.51
12.	12	Transactions of American Society of Civil Engineers	USA	105	4172	1.56	62.07
13.	13	Photonirvachak	India	86	4258	1.28	63.35
14.	14	Mausam	India	84	4342	1.25	64.60
15.	15	Indian Journal of Agricultural Sciences	India	73	4415	1.08	65.68
16.	15	Water Research	UK	73	4488	1.08	66.76
17.	16	Hydrology Journal	India	72	4560	1.07	67.83
18.	17	Journal of Soil and Water Conservation	India	70	4630	1.04	68.87
19.	18	Transactions of American Society of Agricultural Engineers	USA	69	4699	1.03	69.90
20.	18	Remote Sensing of Environment	Netherlands	69	4768	1.03	70.93
21.	19	Journal of Environmental Engineering	USA	68	4836	1.01	71.94
22.	20	Bulletin of the Geological Society of America	USA	68	4901	0.97	72.91
23.	21	Journal of Water Resources Planning and Management	USA	65	4901	0.92	73.83
24.	22	Hydrological Processes	UK	61	5024	0.91	74.74
25.	23	Journal of Glaciology	UK	60	5084	0.89	75.63
26.	24.	International Journal of Remote Sensing	UK	57	5141	0.85	76.48
27.	25	Journal of the Atmospheric Sciences	USA	56	5197	0.83	77.31
28.	26	Journal of Sanitary Engineering Division (ASCE)	USA	52	5249	0.77	78.08

29.	27	Journal of Chromatography	Netherlands	51	5300	0.76	78.84
30.	27	Nature	UK	51	5351	0.76	79.60
31.	28	Photogrammetric Engineering and Remote Sensing	USA	50	5401	0.74	80.34
32.	29	Science	USA	49	5450	0.73	81.07
33.	30	Indian Journal of Environmental Health	India	46	5496	0.68	81.75
34.	31	Soil Science Society of America Journal	USA	45	5541	0.67	82.42
35.	32	Irrigation and Power Journal	India	41	5582	0.61	83.03
36.	33	Acta Ecologica Sinica	China	40	5622	0.59	83.62
37.	33	Journal of the Geological Society of India	India	40	5662	0.59	84.21
38.	34	Water Science and Technology	U.K.	39	5701	0.58	84.79
39.	35	Journal of Applied Meteorology	USA	38	5739	0.56	85.35
40.	35	Journal of Indian Society of Soil Science	India	38	5777	0.56	85.91
41.	36	Climate Change	Netherlands	37	5814	0.55	86.46
42.	37	Jal Vigyan Sameeksha	India	34	5848	0.50	86.96
43.	37	Journal of Climate	USA	34	5882	0.50	87.46
44.	38	Indian Journal of Soil Conservation	India	33	5915	0.49	87.95
45.	39	Annals of Arid Zone	India	32	5947	0.47	88.42
46.	40	Journal of Institution of Engineers (India) - Civil Engineering Division	India	31	5978	0.46	88.88

reasons. The theoretical reasons concern the attempts to describe the distributions mathematically, whereas the practical importance of the distributions follows from the possibility offered for selecting the core journals out of an overwhelming multiplicity of journals for the purposes of research institutions [4].

In this paper, there are 56 titles of journals in Table 3 arranged according to their rank, for selecting the core journals from the point of view of water resources scientists. Although, the total number of journals were 140, only the first 56 (40%) most cited ones with minimum of 20 citations have been included in the list covering 92.7% of the journal citations. The remaining 84 (60%) journals are excluded, as they only cover 7.27% citations. It may be noted that 14 journals have been cited only once and equally 14 journals twice. From the ranked list it can be seen that the journal "Water Resources

Research" with 1278 (19.01%) citations occupied the 1st position. Next to it comes "Journal of Hydrology" occupying 2nd place and has been cited 903 times accounting for 13.43% of the citations. Journal of Hydraulic Engineering comes third in the ranked list with 508 citations accounting for 7.56% of the total journal citations. Because, these three journals cover 40% of the total journal citations, it can be interpreted that these are the main sources of information for water resources scientists/engineers.

Geographical Distribution of Cited Periodicals

Table 4 contains an alphabetical list of countries from where the most cited 56 journal are produced. These most frequently cited journals originate from seven countries. Out of these twenty two are produced by United States and

Table 4 — Countrywise distribution of cited periodicals
(based on table 3)

Sl. No.	Country	No. of Periodicals	Percentage	No. of Citations	Percentage
1.	China	1	1.78%	40	0.64%
2.	Denmark	1	1.78%	154	2.47%
3.	India	17	30.35%	788	12.64%
4.	Japan	1	1.78%	27	0.43%
5.	Netherlands	6	10.71%	1105	17.72%
6.	U. K.	8	14.28%	570	9.14%
7.	U. S. A	22	39.28%	3550	56.94%

seventeen by India. The remaining seventeen are produced by five countries viz, China, Denmark, Japan (One each). Netherlands and U K (six and eight respectively). The number of citations of periodicals published from United States are highest with 56.94%.

CONCLUSIONS

The following specific conclusions have been drawn from the present study

1. The aforesaid analysis takes into account the fact that the researchers in the field of hydrology and water resources use different type of literature in which journals are the main source followed by books and conference proceedings. The use of publications like theses, bulletins, standards, technical reports etc. should be considered as a special feature of this subject area.
2. The journal referred by NIH Scientists are 140 in number. However 92.7% of their citations are from only 56 journals which shows that they refer to these journals very frequently.
3. The journal *Water Resources Research* occupies the first rank in this list with 19.01% of the total journal citations and

Journal of Hydrology, which is considered as main journal in the area of hydrology comes in the second position with 13.43% journal citations and ASCE's *Journal of Hydraulic Engineering* is occupying the third position with 7.56% of citations. These three journals cover the 40% of the total journal citations and these can be considered as the main sources of information for hydrologists in the country.

4. In addition to the main journals of the discipline, NIH Scientists (about 85) also on journals of other related disciplines such as *Journal of Geophysical Research*, *Monthly Weather Review*, *Indian Journal of Agricultural Sciences*, *International Journal of Remote Sensing* and multidisciplinary journals such as *Nature* and *Science* for their research work.
5. Among the most cited journals, maximum journals are published from the United States of America.

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