

GROWTH OF SCIENCE AND TECHNOLOGY JOURNALS IN INDIA: STATUS BETWEEN 1947 AND 2004

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Abstract Since the attainment of independence, India witnessed a considerable progress in almost all the fields of knowledge especially in Science and Technology (S&T). Information was being generated before independence also, but the volume of new researches and the number of scientists were considerably less. The number of scientific institutions was also very small. The post-independent period saw an increase in the number of researchers, researches and formation of Learned Societies also. This led to the increase in the number of journals in various fields.

Journals are vital resource for scientific research and development. These are widely used by R&D workers. Infact, research and technical journals all are an essential input and lifeblood of any organization. Primary journals are the main source of research communication. The growth of periodicals has kept pace with the growth of knowledge, which in turn has grown to the extent that researchers find it difficult to keep pace with the latest developments in their own fields. Even some of them are not aware of the total number of journals published in their specific fields. So keeping all these things in view, it is of paramount importance to make an analysis of the growth and development in the number of S&T journals in India.

Keywords: Journals, Scientific Developments, Commercial Organizations, Publication Agencies, Growth, Development.

1. INTRODUCTION

At the time of Independence, the scientific and technological infrastructure of the country was neither strong nor was it organised as compared to the developed world, but the post-independent period witnessed progress both in infrastructure and human resources which gradually minimized India's dependence on other countries. India now possesses a reservoir of expertise in basic as well as in applied areas.

Before Independence, scientific information was generated at a low pace, since the number of scientists and scientific institutions were rare. The surge in scientific institutions and Learned Societies has led to tremendous growth of information in almost all fields of knowledge, thus making it difficult to remain at par with the latest developments. The information generated can be spread through various means, like verbal conversation during Seminars, Conferences, and public meetings, and by means of print media like journals, theses, reports, patents, reviews, etc. For centuries, journals have proved to be the best means of communication, and now in digital form they enable researchers to keep pace with the latest available information.

2. LITERATURE REVIEW

Price (1961, pp.92-97) observed that growth of the number of journals shows an exponential pattern. The study highlights that relationship between the number of scientists and the number of publications remained constant for 300 years and the rate of publication is higher in countries where government policies support scientific research. According to him the literature growth and the historical statistics of journals are same. Price estimated that there were 10 scientific periodicals in 1750 and since then the number of such periodicals increased by a power of 10 every half-century, which has led to a doubling every 15 years. Taking a longer view, he calculated that this corresponded to a factor of 1,000 in a century and a half and of one million since the mid-seventeenth century.

Bourne (1962) reviews an estimate of the total number of journals and their mutual production, their national and linguistic origin, and the subject breakdown by country. He estimates the total number of scientific and technical journals across the globe as 100,000. Estimations made by S&T division of Library of Congress for National Science

Foundation have been referred, according to which the number is between 30,000 and 35,000. Most of the literature is published in English followed by French and German. US produces maximum literature followed by Germany and France. The author refers to the fact that the increase in the number of journals per year increases the number of articles.

Gottschalk and Desmond (1963) have given a worldwide census of S&T serials. According to the study, the total population across the globe is 35,000, $\pm 10\%$ than the 50,000 of World list. US occupies top position with a sum total of 6,200 followed by East and West Germany with 3050. The total number of serials produced by India is 650. According to the study percentage of serials devoted to Technology outdistanced the other broad fields. US produced highest of 56% in Technology, 23% in Agriculture and 13% in Medical Science followed by France and Russia. Of the total journals, 2/3rd came into existence between 1900 and 1930 and 1/3rd ceased during the passage of time. The author concludes that at-least in one field; in half a century there is a 33% death rate for journals.

Banerjee (1963) explains that progress in scientific research depends on maximum effectiveness of information channels. The study has provided State-wise, subject-wise and language-wise distribution of the number of S&T journals. The total number of journals in Engineering and Technology published by different Indian States is 91 among which West Bengal produced highest number of 30 followed by Maharashtra and Delhi each scoring 21. In Science the total was 44, West Bengal producing highest of 19, followed by Delhi and Uttar Pradesh each contributing 7. In Agriculture the total was 118, Delhi producing highest of 31 followed by Maharashtra and West Bengal contributing 15 and 12 respectively. In all the fields English was the dominating language with 85 journals in Engineering and Technology, 38 in Science and 60 in Agriculture. A separate table giving the number of Indian journals included in Chemical Abstracts, Mathematical Review, Science Abstracts, Section A and Engineering Index assists the study. He concludes by remarking that number of Indian S&T journals is insignificant when compared with the Western Countries.

Mangla (1964) has tried to describe the implications of the scientific research. The study also traces the history of the growth of scientific literature in various forms and the changes in the structure of science. He explains that the number of scientific journals and periodicals was 100 at the beginning of 19th century, which reached 1000 in 1850, more than 10,000 in 1900 and approached 100,000 in 1960. He points out the fact that the present growth rate will touch a million by the end of 20th century.

Sengupta (1973) reveals the reasons for the growth of the number of periodicals in any branch of science. According

to him, journals appear only when a particular branch gains recognition as a distinctive discipline. He explains the growth of a subject occurs in three phases-i) increase in the size of established periodicals, ii) establishment of new periodicals for publication of research results from new geographical areas and iii) establishment of new journals to cover special areas of scientific discipline. The study reveals that after World War II a steady increase in the number of journals in Biochemistry has taken place. The author refers to the "World list of Scientific Periodicals" (4th ed.), which shows the following trend: 4 in 1900, 23 in 1920, 77 in 1940 and 201 in 1960.

Sengupta (1974) examines the growth of Physiological journals with the help of "World list of Scientific Periodicals" (4th ed.) and its Supplement (1968). The study analyses that exponential increase in the research activity led to the increase in the number of journals in the field during 1796-1968. Where the number between 1796-1880 ranged between 0-20, which rose to 40 till 1900, 80 till 1910, 140 by 1930, 220 by 1950 and it crossed 300 margin by 1968. A graphical presentation showing steep curve indicating an exponential growth has been provided.

3. STATEMENT OF THE PROBLEM

The study highlights the growth trend of Science and Technology Journals in India from a time period of 1947-2004.

4. SCOPE AND LIMITATIONS OF THE STUDY

The scope undertaken covers a period of 58 years (1947-2004). The growth of journals, bulletins, reviews, scholarly and academic publications in print and digital form have been undertaken for consideration whereas the Newspapers, Magazines, Annual budget reports, Almanacs, Bibliographies, Indexing and Abstracting Services and Standards have not been included.

5. RESEARCH METHODOLOGY

In order to identify the growth of S&T journals in post-independent India various sources of national and international repute were consulted. These are: -

- i. *Ulrich's International Periodicals Directory*. (1932). New York: R.R.Bowker.
- ii. *Directory of Indian Scientific Periodicals*. (1964). New Delhi: INSDOC.
- iii. *World List of Scientific Periodicals*. (1925). London: Butterworths.

Table 1: Decade-wise Growth of S&T Journals (1947-2004)

Subjects	1947	1957	1967	1977	1987	1997	2004
Agriculture	08	16	30	84	105	143	258
Building and Construction	03	03	19	45	46	67	38
Chemistry	04	04	09	22	19	24	31
Engineering	09	26	64	161	159	167	205
Home Sciences	0	0	0	02	07	11	04
Life Sciences	07	12	25	82	104	128	193
Management	01	01	05	32	27	35	39
Mathematics	02	02	04	12	12	24	46
Medical Sciences	15	12	55	145	153	145	260
Physics	02	05	09	25	32	44	70
Total	51	81	219	610	664	788	1144

The selection of the subject has been done according to the subdivision of classes 500 and 600 of Dewey Decimal Classification Scheme (DDC). The period from 1947 to 2004 has been conveniently divided into decades. A table of each decade indicating the growth of S&T journals in India was given. Only the first year of each decade was made the basis of study. Growth has been estimated in a number of ways namely by publication agency, by state and by periodicity.

5.1. Decade-wise Growth of S&T Journals (1947-2004)

For the purpose of study, the time period starting from 1947-2004 has been conveniently divided into decades from 1947 onwards.

5.2. Growth of S&T Journals

A year-wise table of each decade indicating the growth of S&T journals in India has been given. Only the first year of each decade has been made the basis of study. Using the data, thus collected, following studies have been conducted.

5.3. Publication Agency-wise Distribution

As the publication agencies play an important role in the growth of periodicals different types of agencies have been taken into account.

5.4. State-wise Distribution

The study relates to the state-wise distribution of S&T journals in each decade, thus giving an indication of the most productive states and also the subjects producing most journals.

5.5. Periodicity-wise Distribution

The study aims to find out the most favored periodicity of the journals in relation to the subjects. For the purpose, periodicity of each journal was recorded and categorized into different groups.

6. FINDINGS

6.1. Decade-Wise growth of S&T Journals (1947-2004)

To study decade-wise growth of S&T journals in general, data have been collected and placed in Table 1, which shows the cumulative number of journals at the onset of each decade starting from 1947-2004. The table depicts that the number of journals in 1947 in S&T was mere 51 which grew to 1144 by 2004.

A close look over the table reveals significant increase in the number of S&T journals from 81 to 219 during 1957-67. The period between 1967 and '77 also depicts similar increase in the number of journals from 219 to 610. This trend seems to have continued during 1997 and 2004 in which increase of journals from 793 to 1144 is clearly visible.

6.2. Distribution of Journals by Publication Agency

Table 2 reveals the part played by various publication agencies in the publication of S&T journals during the onset of each decade. Since 1947, Institutes, Commercial firms and Associations were found to dominate the other agencies, producing the maximum number of journals during the period of study. Institutes, Commercial firms and Associations contributed the maximum right from the beginning of the study. The Commercial firms produced the maximum

Table 2 Distribution of S&T Journals by Publication Agency and Decade (1947-2004)

Publication Agencies	1947	1957	1967	1977	1987	1997	2004
Institutes	21	22	56	129	160	191	311
Commercial firms	14	26	58	213	227	202	341
Associations	09	13	31	107	100	105	146
Government	02	07	15	38	28	48	23
Societies	02	07	27	65	90	132	199
Universities	02	05	14	45	50	74	98
Individuals	01	01	17	04	-	28	04
Others	-	-	01	09	09	08	22
Total	51	81	219	610	664	788	1144

number of journals in subjects like Engineering, Medical Sciences, Building and Construction, and Agriculture, while institutes produced the maximum in Engineering, Medical Sciences, and Agriculture. The associations were found to produce the maximum in Medical Sciences, Agriculture, and Engineering.

6.3. Distribution of Journals by State

Contribution by state shows that only a few states, namely New Delhi, West Bengal, and Maharashtra, have contributed to the production of S&T journals. Rest of the states either produced few journals or none at all. According to West Bengal, they produced the highest number of journals during the three decades 1947-56, 1957-66 and 1967-76. New Delhi dominated the other Indian States by producing more journals during 1977-86, 1987-96 and 1997-2004. Maharashtra's contribution had been significant during 1967-76, 1947-56 and 1977-86. All the three states produced maximum in Agriculture, Engineering and Medical Sciences (Table 3).

6.4. Distribution of Journals by Periodicity-

The distribution of journals by periodicity shows that the period 1947-77 witnessed the maximum number of monthlies. Maximum monthlies were published during the decade of 1947-56 in life sciences, and 1957-66 and 1967-76 in engineering. During the decades of 1977-86, 1987-96 and 1997-2004, the top position was occupied by quarterlies in the medical sciences

7. FACTORS RESPONSIBLE FOR GROWTH AFTER 1947

The growth in the number of S&T journals may be attributed to a number of factors, such as:

7.1. Proliferation of Educational Institutes

In India, the scientific and technological activities were carried out under a wide setup consisting of central and state governments, the higher education sector, public and private sector industries, and non-profit institutions or associations. Such institutions, with their research laboratories, are the main contributors to research and development carried out across the country. One of the institutions is the Council of Scientific and Industrial Research (CSIR), established in 1942. It undertakes research and developmental activities covering the entire canvas of S&T in the civilian sector through its R&D activities. It was established with the goal of providing industrial competitiveness, social welfare, and a strong S&T base for strategic sectors and the advancement of fundamental knowledge. Likewise, the Department of Science and Technology (DST) was established in 1971 to organize, coordinate, and promote S&T activities in the country. The department is promoting scientific research in frontline and priority areas of R&D.

Another significant institute is the Indian Council of Medical Research (ICMR), which is one of the oldest medical research bodies in the world. The Government of India (GOI) set it up in 1911 as the Indian Research Fund Association (IRFA) with objective to sponsor and coordinate medical research in the country.

The Indian Council of Agricultural Research (ICAR) is yet another organization established in 1929 as an autonomous apex national organization that plans, conducts, and promotes research, education, training, and transfer of technology for the advancement of agriculture and allied sciences. Over the years, it has developed a large research and training infrastructure to work on production and other emerging problems.

In addition to the above, there are various departmental laboratories of different departments/ministries. For example, the Indian Space Research Organization (ISRO) was established in 1969 with the objective of promoting

Table 3: Distribution of S&T Journals by State and Decade (1947-2004)

State	1947	1957	1967	1977	1987	1997	2004
West Bengal	20	28	59	111	113	121	110
Maharashtra	11	14	49	131	111	120	155
New Delhi	09	21	54	136	170	206	303
Uttar Pradesh	06	05	08	58	72	93	153
Tamil Nadu	02	05	12	33	37	34	61
Gujarat	01	01	11	20	20	20	26
Karnataka	01	05	14	43	44	42	72
Bihar	01	02	04	09	10	14	11
Madhya Pradesh	-	-	01	09	10	12	26
Andhra Pradesh	-	-	03	11	14	17	29
Punjab	-	-	03	13	09	11	24
Orissa	-	-	01	01	02	05	09
Kerala	-	-	-	15	23	34	32
Rajasthan	-	-	-	10	09	25	38
Haryana	-	-	-	06	11	20	31
J&K	-	-	-	01	01	01	10
Assam	-	-	-	01	01	04	03
Tripura	-	-	-	01	01	01	01
Goa	-	-	-	01	02	02	-
Himachal Pradesh	-	-	-	-	03	04	09
Meghalaya	-	-	-	-	01	01	01
Pondicherry	-	-	-	-	-	01	02
Uttaranchal	-	-	-	-	-	-	25
Jharkhand	-	-	-	-	-	-	08
Chhattisgarh	-	-	-	-	-	-	03
Sikkim	-	-	-	-	-	-	02
Total	51	81	219	610	664	788	1144

Table 4: Distribution of S&T Journals by Periodicity and Decade (1947-2004)

Periodicity	1947	1957	1967	1977	1987	1997	2004
Monthly	31	40	86	217	199	160	188
Quarterly	10	23	81	197	235	259	378
Bi-monthly	04	05	16	42	55	53	93
Irregular	03	05	02	04	02	35	43
Semi-annual	02	01	19	69	105	175	306
Weekly	01	01	02	34	27	33	03
Bi-annual	-	04	-	11	-	11	-
3/yr	-	02	09	24	26	19	50
Fortnightly	-	-	04	10	11	04	04
Annual	-	-	-	01	01	36	77
10/yr	-	-	-	01	02	01	01
5/yr	-	-	-	-	01	01	01
15/yr	-	-	-	-	-	01	-
Total	51	81	219	610	664	788	1144

research and development in Space technology. It supports research and educational activities at universities, individual colleges, and at the Indian Institutes of Technology (IIT's), as well as other research institutions. The Department of Space (DOS) has over the years built up a strong R&D and technology base with the necessary infrastructure and manpower to implement the space program.

Another such institute is the Bhabha Atomic Research Center (BARC). In 1944, H.J. Bhabha along with few scientists started nuclear science research in India with the goal of achieving self-reliance in the fields of nuclear science and engineering.

The Tata Institute of Fundamental Research (TIFR), Bombay, was established in 1945 at the initiative of Dr. Homi Jehangir Bhabha. The Institute has produced some of the finest scientists in India who have been involved in seminal research in fields ranging from mathematics, biology, chemistry, computer science, physics and science education as well as some aspects of public health.

Another category comprises private and recognized research institutions, which receive grants from the government. Some private sector undertakings, like the Indian Drug and Pharmaceutical Limited (IDPL) and the Indian Petrochemical Corporation Limited (IPCL) also have sizable R&D establishments. There were about 400 national laboratories and 1300 in-house R&D units of industries established by the year 2002 (Planning Commission, 1997-2002. p.1011), like Ranbaxy Laboratories, Tata Iron and Steel and its group of industries, etc.

In addition to the research activities taking place in these institutions, S&T education in the various educational institutions at the graduate and post-graduate level has also played its role. The first three Universities in the country were established in 1857 at Calcutta, Bombay and Madras to provide education mainly for the higher classes in India. Since then the number of Colleges and Universities in India has been increasing. The total number of Universities at the time of independence was just 20, which increased to 200 by the year 2002 (Planning Commission, 1997-2002, p.1011). Additionally, the University Grants Commission (UGC), established in 1956, takes measures to promote and coordinate University education and to determine and maintain standards in teaching, examination and research at the Universities. To fulfill its objectives, it provides annual grants to these institutes for research activities in different S&T disciplines. Presently, many Indian Universities and deemed Universities, such as IIT's, also undertake substantial research and developmental work.

Another example is the National Council of Educational Research and Training (NCERT), established in 1961 in New Delhi. It assists and advises the central and state government on academic matters related to school education

and is fully funded by the central government. The Council aids, promotes, and coordinates, as well as conducts research on school education and teacher education. It also develops and experiments in improved educational techniques, and assists the States and Union Territories in developing and implementing programs for the qualitative improvement of school education.

This increase in the number of R&D organizations called for the launch of journals to disseminate the research within and outside the country. Again, the increase in manpower engaged in these R&D programs also gave a fillip to the publication of journals, as the fraternity of scientists always aims to publish their research.

7.2. Socio-economic Factors

Certain sociological factors, such as the need to remain on a par with developed countries (as in the most recent move of the Government of India to get a permanent seat at the United Nations with veto power), have gradually increased the number of scientific research projects leading to an increase in the overall literature, making it incumbent on institutions to increase the number of journals, especially in S&T. Both the central and state governments have increased the funds allotted for research. Ever since the onset of five-year plans in 1951, provisions have been made to provide enough funds for research in successive plans to ensure the effective participation of the scientific community in the decision-making process at the national level.

Spectacular achievements made in the field of S&T during the last century brought unprecedented economic growth and social transformation in the country. Governments in developing countries like India started paying increasing attention to S&T on the assumption that an indigenous scientific and technological base would bring faster economic development and social transformation.

The increasing literacy rate has also contributed to the development of S&T journals in post-independent India. According to the census report, literacy in India has increased from 16.67% in 1951 to 65.38% in 2001. The census of India 2001 has shown that female literacy has reached 54.16%, while that of males exceeds 75.85%. Promotion of female education made it possible for women to excel in all fields, be it medical sciences, engineering, space technology, sports, or politics. The hike in the literacy rate may also be attributed to the standard of living of the people of the country because of which the progress in the economic condition of the people had a direct bearing on the growth and development of scientific research. Since the advancement of S&T in almost all fields of knowledge, and the consequent increase in the number of research projects promoted an increase in the number of journals.

7.3. Competent Human Resources

Competent human resources are considered the backbone of the scientific research that ultimately results in the published output, and hence the growth in scientific literature. It may be highlighted here that the US and the host of European countries provided facilities to India to equip S&T personnel in these countries. Some of these examples can be mentioned, like that of the Ford Foundation, which is a resource for innovative people and institutions worldwide. It is an independent organization whose aim is to strengthen democratic values, reduce poverty and injustice, promote international cooperation, and advance human achievement. Another is the United States Educational Foundation in India (USEFI), which promotes mutual understanding between the citizens of India and those of the US through and educational exchange of understanding scholars, professionals, and students. Also called the Fulbright Commission, it also enables research, lectures, and study, primarily through fellowships for Indian and US citizens.

Another one is the Commonwealth Fellowship Program, which since its inception in 1959, has given promising young researchers the opportunity for in-depth study of various health care policy topics, policy analysis, government officials, and others in a number of US and international settings. Their aim is to increase the leadership skills of people in education, and thus to have an impact on the quality of teaching and learning. It provides a network of study opportunities throughout the Commonwealth. Commonwealth Scholarships and Fellowships in India are offered through the Indian Council for Cultural Relations, based in New Delhi.

7.4. Publish or Perish Syndrome

One factor responsible for the sudden growth of S&T journals during various phases in post independent India has been the "Publish or Perish Syndrome," which has been a strong influence since 1947. It has been further strengthened by UGC's Career Advancement Scheme (CAS), vide its letter no. F.3-3/2000 (PS dated 16th July and 26th August 2003) prescribing mandatory requirements for promotion from Reader to Professor of "five research publications out of which two could be books/monographs/research reports from internationally reputed centers", whereas promotion from Senior Lecturer to Reader requires some work in the areas of scholarship and research."

8. CONCLUSION

The findings of the study make it amply clear that there has been an increase in the number of S&T journals between

1947 and 2004. Growth in certain subjects like agriculture, engineering, and the medical sciences has been more prominent than in other disciplines of S&T. This growth pattern may be attributed to prevailing socio-economic factors in the country. As India has always been regarded as an agrarian country, the government is compelled to invest in R&D in this field. Likewise, health has been a problem concerning the general public. The Indian government, therefore, has been sponsoring research in the medical sciences. International agencies like WHO have also been playing an important role in promoting R&D in that area. Since all the material progress of a nation depends upon growth and success in technology, the GOI has, therefore, taken steps to encourage scientific research by providing the infrastructure for state of the art facilities. The growing specialization of the subjects also has resulted in an increase in the number of research projects, and consequently in the number of journals.

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