

involving subjective assessment of either the 'standards' of respective publishers or the relevance of the work (pure versus applied) or both¹. There is thus a need for an unbiased estimator, unrelated to the so-called 'goodwill' of publishers etc., to assess the quality of our research. An insight into the quality of our research, as a whole, can be gained by examining the number of recent works quoted in our research papers as compared to the world at large.

For this, a sample of 50 research papers each was randomly drawn (by generating pseudorandom numbers) from all research papers appearing in four journals published in India and four from abroad in 1991. Data on references quoted in both sets of research papers are summarized in the form of frequency distribution for the last 60 years, with a class interval of 5 years (Table 1).

The picture which emerges from the above table is highly revealing and, far from being flattering, is rather damning. To understand the implications of the information in Table 1, first contrast the total 987 references quoted in 50 papers published in India with the 2465 for the same number of papers published from abroad, yielding an average of 20 and 50 references per paper respectively. While it certainly reflects the relative zeal of the two groups to learn and incorporate whatever that has already been published in their respective fields, one wonders if it does not as well reflect the relative tendency of the two groups to honour the concept of copyright, to accord due credits. Secondly, notice that references older than 1971, i.e. 20 years, account for 27% in Indian research papers as compared to the 13.6% in papers from abroad. Thirdly, also notice that work done/reported in

Table 2. Absolute frequencies of references cited in a set of 50 research papers, each published in India (column 1) and from abroad (column 2) in 1991

Year	(1)	(2)	Difference factor
1991	4	32	× 8
1990	13	88	× 6.7
1989	31	184	× 6
1988	54	170	× 3.1
1987	54	193	× 3.6
Total	156	677	× 4.3

most recent years, i.e. in the last 5 years, accounts for only 15.8% in Indian research papers as compared to the 27% in western literature, the figures for the last 10-year interval being 38.8% and 57.1% respectively.

The focus on significance of the observations made above becomes sharper when a year-wise frequency distribution for the last five years, beginning 1991, is considered (Table 2). An almost complete blackout of contemporaneous works in our research papers is too obvious. Here one can, with some justification, argue that library facilities in India are extremely inadequate. Yet conceding this argument would only serve to legitimize and perpetuate the malady.

In the national science scenario, if the field of earth sciences, instead of being in the forefront, appears to be 'waiting in the corridor, unheard and unrecognized'¹, the blame, of course, rests squarely on us, we the writers and the publishers. One would indeed not need any fancy, sophisticated instruments at enormous costs to visit a library. Similarly, merely having words like 'Current...' or 'Recent...' in the

titles of our journals would not suffice. We have the following two suggestions to make to the publishers of our journals:

(a) The percentage of citations made in an article for the last 10 years should be indicated in a box right above the title of the article, under the heading Update Index (UI). The authors should be made to supply the figure along with the manuscript. The update index would serve two purposes. First, it would make the authors themselves conscious of the aspect and, secondly, a look at the figure would tell a discerning reader whether the article incorporates recent works or not.

Proof: A review paper of Gupta *et al.*² contains as many as 84 citations, yet for the last five years there is none, for the last 10 years there are only 6 citations, yielding an update index of 5. Compare it with the statistics of even the Indian papers alone (Table 1). Interestingly, all authors are from the Geological Survey of India, considered to be bestowed with one of the richest (earth sciences) libraries in India.

(b) It should be made an editorial policy of every journal not to accept an article with an update index less than 50, unless otherwise explained by the author(s).

- 1 Radhakrishna, B. P., *J. Geol. Soc. India*, 1991, 37, 325-328.
- 2 Gupta, S. N., Mathur, R. K. and Arora, Y. K., *Rec. Geol. Surv. India*, 1992, 115, 63-85.

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Constraints affecting development of an integrated strategy for environment and development issues

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Rise in human population, growth of technology, industry and agriculture during this century have been associated

with progressive degradation of the quality of global environment. There has been a rapid over-exploitation of the

renewable and non-renewable natural resources and presently the living and waste disposal spaces overlap each

other. The main cause of extensive and gross degradation of environment is the lack of appreciation of the holistic concept of environment and interlocking, interdependent concept of ecosystem particularly by the industrialist, planners, decision makers, politicians and the common man, who go for short-term gains and growth only in the desired direction. Important constraints which affect sound environmental and developmental activities may be broadly taken up under the following headings.

Long-term investment

To restore the quality of environment efforts on a long-term basis are required. Although it is currently fashionable to talk of long-term strategies, yet the economic and political constraints override it and result in a short-term quick return investment activity. The financing agencies also require quick returns even at the cost of environmental degradation. The losses cannot be easily quantified in terms of money.

Less opportunity for creative freedom

Scientists generally value the opportunity for creative freedom. They also enjoy satisfaction in conducting research that has direct relevance to developmental problems. But these days research is driven by wishes of granting agencies. The reason lies in the manner in which research work is assessed. Scientific community recognizes research by the discovery of new and valuable information and the publication of research results in peer-approved media. But policy-makers hardly consider the merit of technically excellent publications. They go by newspaper publicity values.

No security for career structure

To the scientists and researchers, there must be an assured employment, personal securities and a career structure. In developing countries like India research is restricted by financial constraints and researchers often are unable to pursue a career in research while still retaining promotional prospects.

Insufficient cooperation between government body and non-government organisations (NGOs)

In government organizations, although there are very efficient, trained and qualified personnel, they have limitation for taking decisions under certain rules and laws. They have very limited options. NGOs are free from this and play important roles. They are free to take immediate decisions regarding capital investment, expense, suitability of place for running a project etc. They can act as a tight link between micro-level or grass-root level to policy-makers of governmental body. The government must take the benefit of these organizations and should provide strength. The performance of NGOs should of course be assessed and should be answerable.

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COMMENTARY

Technology development: The role of the State

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The strategic importance of technology

Increasingly, independent access to technology and control over its deployment are becoming determining factors in the kinds of roles nations can play in the global arena. Control over technology is vital not only for national development but for success in bilateral and multilateral trade negotiations and, also, in political bargaining in international fora. In this modern world 'technology literacy' - that is, a thorough understanding of the potentials and implications of existing and emerg-

ing technologies - is an essential prerequisite for effective diplomacy. Technology literacy, coupled with a perceived strength in developing and deploying cutting-edge technology, is essential for a country to be heard and treated as an equal partner by highly industrialized countries.

In the recent past, on more than one occasion, India has had to learn this lesson the hard way. In the recently concluded GATT negotiations India found herself having very little leverage with the highly industrialized countries to renegotiate the terms of the Dunkel Draft. Senior Indian government officials closely involved in the GATT

negotiations admitted that India had no choice except to sign the Draft as agreed on by the Western countries (including Japan)¹.

India, again, cut a sorry figure in her attempts to purchase cryogenic rocket engine technology from Russia. In bilateral negotiations with the US government for accessing the so-called dual-use technologies and equipment, India has invariably been a loser. Significantly, in analogous contexts, China has been able to succeed in negotiating from a position of technological strength.

Notwithstanding serious failures in the diplomatic front as indicated above, the developmental and political impli-