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QUALITY AND QUANTITY OF SCIENTIFIC RESEARCH IN INDIA - A PERSPECTIVE

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1. ABSTRACT

This paper spells out some essential measures that are required to be introduced to save Indian Science and elevate its status. Promotion of quality consicousness and quantitative evaluation of research work are considered very important and necessary to be practised for bringing about a significant change in the working conditions in scientific laboratories, and in turn the growth of science and technology.

A perspective picture of improvements, modifications, radical reforms in the financing pattern of R&D institutions and their management, project planning to meet the aspirations of the people and the state, and the need for elevating the status of an ordinary researcher from that of a cog in the wheel position to a position of respectability are outlined with concrete and positive suggestions for implementation. These are proposed to ensure the future generations a better place of pride in scientific work, so that they could contribute their mite to reach the goal of a welfare state, based on the foundations of modern science and technology, as visualised by the successive Prime Ministers of India, shedding fear and supersition, and inculcating a spirit of reason, logic and scientific probing.

2. INTRODUCTION

This paper is inspired by the call of the Prime Minister (who is also the President of the Society for CSIR) that what the country needed was more innovation and less of imitation in the S&T field and his Government was for promoting indigenous capabilities in all spheres by way of Technology Missions among other measures. It ventures to spell out some essential measures that are considered necessary, from the point of view of the working scientists and that need to be introduced for saving Indian science, from its state of mediocrity to that of respectability. The incuication of quality consciousness amongst the scientists is a primary step that could elevate the level of research output. But the nurturing of quality consciousness is by no means an easy task. It has to be built, by bringing about a sea of change in the working atmosphere in the laboratories by the policies of the management, practising to support the earnest and hardworking for the quality of their R&D, while weeding out the unproductive and insincere. This is where, the promotion of quantitative evaluation of R&D, with certain standards and norms for wider practice

of the management, with a coded scaling pattern by the assignment of marks becomes important, to ensure the generation and maintenance of research atmosphere in the laboratories. A live atmosphere of academic pursuits, and its preservation, due to meaningful management by the right-thinking people alone can go a long way in assuring uniformly higher levels of delivered goods. It is not out of place and inappropriate to mention here at this stage that we, in India, have imported everything R&D and S&T, but not the academic and scientific atmosphere of the western advanced laboratories, whose derivative is the scientific culture and which is conspicuously missing in the Indian laboratories. There is no substitue to fostering scientific excellence and sustaining the interests of researchers, which go together and give rise to qualitative and quantitative R&D of a higher order, when once such a scientific atmosphere is made to prevail, allowing the S&T culture to grow freely.

3. PREVAILING DECELERATING ATMOSPHERE

Absence of performance standards (voluntary or mandatory) for the qualitative and quantitative evaluation of R&D and S&T work, say, based on stipulated yardsticks of rating due to assignment of marks, ranking etc.

Awards being given or showered rather than being earned by dint of proven output.

Lack of respect for the researcher as an individual, as a researcher and as a social being, nor for the R&D work of one researcher, with adequate weightage based on the quality and quantity of the work output being delivered.

Passive attitude of the scientists (barring exceptions), who bear all insults and do not come out of the shell easily, to voice concern for the improvement of science, and on the other hand doggedly follow the traditions set by superiors, rarely showing discontent, more due to the lingering fear of being trampled by the men in authority.

The system is devoid of trust in the individual scientist and his capabilities and there is more room for suspicion and doubts.

Lack of appreciation of the fact that the management and the scientists are working to achieve a common scientific goal, dear to both, and necessasry for the nation.

Prevalent of a wide communication gap and trust between the management, the middle order management, the working scientist, and amongst the working scientists themselves, both as regards managerial matters as well as scientific matters.

Unwidely expansion of projects, more to develop a hierarchy and to ensure ones own position, status, and elevation, rather than the interests than the interests of the project, and often at the expense of science itself.

Haphazard recruitment policy of induction of scientists at all levels, at times even on adhoc basis, often to meet individual interests suited to the management, but in the guise of promotion of science. This in turn acts as a double edged weapon, since the existing staff are affected in their seniority and promotional avenues on the one hand, and on the other hand, they tend to be non-cooperative with the new incumbent. With the result, the new incumbent is unable to adjust in the new environs, and fully utilise the existing facilities, and all these happen at the expense of science.

Constitution of EC and RAC at the suggestion of Directors and the Directors chairing the EC are able to bulldoze at the meetings to perpetuate their opinions and force decisions as if they are decisions of the committee.

Improper emphasis in planning, both in project formulation and objectives, and goals of the particular laboratory, if any.

Non-uniform yardsticks in assessment, applicable to different levels of scientists, scientific and technical staff, with different time periods and different percentage quotas applicable to different grades. The non-uniform implementation policies, varying from institute to institute, and the resulting hardships encountered by the scientists are factors that can not be ignored.

Concentration of too much power in the hands of Directors, their involvement in several other activities at the national level, allowing little time to be devoted to the parent institutions.

The prevalence of a culture, where survival on past academic glory and achievements has come to stay, rather than on the present pursuits, and the achievements of such recent pursuits.

Non-existence of input-output analysis of individuals, projects, infrastructure, laboratories etc.

Over emphasis on foreign collaborations in science.

Laying too much faith on foreign visiting scientists, and very often at the expense of the Indian counterparts, with motivated objectives.

Unrestricted import of instruments, technology and knowhow,

benefits being derived by the giver (pushing out at the expense of the developing countries their obsolete goods, and selling the knowhow to meet, at least part of their own on going R&D); than the receiver (who confronts great many impediments in their utilisation due to the want of operational spares and restrained imports, etc).

Unrestricted growth of projects, institutions and laboratories whose output is quite disproportionate to the inputs of men, materials and finances. In fact, it will not be difficult to isolate, very many institutions, whose research output in their years of infancy has not only been on a higher level both in quality and quantity, than of the recent past, proving that unwidely growth has diminishing returns (see figure).

The culture of plan, produce and publish/patent, that ought to be the motivating forces of R&D, hardly exists, and wherever it still exists, is confronting very rigid and discouraging management problems, primarily because they are not valued, or if valued only to suit the management interests.

Encouragement to self-reliance in science and R&D has been only verbal, and any result oriented output of such efforts is often described and meets very stiff opposition for any further continuation of efforts.

Similarly, indigenous innovative efforts,. however good they may be, are hardly taken notice of, leave alone their being recognised and rewarded.

Fellow culture hardly persists and researchers tend to be critical of each others work so very often, creating annoying situations; but rarely do they appreciate nor come out with positive and healthy comments to improve the scientific content to meet the goals of such investigations.

It is not uncommon to find financial support for construction of buildings, gardens, furniture, auxiliary infrastructural facilities but not for equipping the laboratories.

The inhouse culture tends to grow and develop more and more managers at different levels, inhibiting the prospering of working scientists. In reality, a working scientist remains a working scientist, whatever be the position he holds. In other words, there are very few committed working scientists, and who are in minority numbers, and who derived pleasure in R&D, and who are anxious to cover new ground to derive greater satisfaction through S&T.

The existing pattern of the junior scientist working under the senior scientist ought to be eroded to give rise to a feeling of working together for a common scientific pursuit. This is necessry for the creation

of a healthy atmosphere conducive to bring out the mite of each individual.

There is an over emphasis on seminars, symposia, workshops, as though they are the be all and end all of science. This has resulted in not only the easy drianing of institutional resources, but also the draining of considerable energies and time of individual scientists.

Acceptance of too many memberships of Institutional Committees, National Committees and allied activities (being viewed prestigeous), at the expense of the office being held, and at the expense of the project the scientist is involved in are quite common.

Restrictions on publication of results and parasitic practices.

Bureaucratic administration encroaching upon the free will of scientists in their pursuits of science.

The calculated and systematic disregard of both seniority and merit, under the guise of selection and review committee decisions, made applicable by the successive managements have perpetuated and demoralised working scientists, destroying even the little interest in R&D left with a minority percentage of researchers.

The prevailing system is devoid of positive approach and lacking in incentives to the right workers. In fact a situation has been reached where the working and non-working treated alike, the latter perhaps with an edge over the former.

4. CAUSES FOR THIS DECELERATING ATMOSPHERE

Perhaps, the divisions within India's population and society, differing from state to state, community to community, and the difficulties in containing such activism have had their role in inhibiting the S&T in the country. The existence of diversities and boundaries, as barriers for the growth do persist in R&D culture, and can not be denied. Separate identities and selfish interests at the cost of others and that of R&D are also not uncommon.

Reservations in recruitment have also contributed to an acceleration of the degeneracy of S&T. Educational reservations, donation admissions, protected religious admissions etc., in Universities and academic institutions have also had their influence on the gradual downfall of standards of R&D.

Superseding of the honest and sincere researcher by coteries

of the management may be seen in most R&D institutions. Any impartial appraisal is bound to come out with a sizeable number of such stories of a revealing nature of the suppressed and frustrated.

Amelioration of the few, who are forthright and straight forward in their expression without mincing matters and observing openness are quite common in R&D institutions.

Showering of awards to the favoured is often a normal practice, the beneficiaries in turn promoting the interests of bureaucratic management and knelling of the rightfully deserving.

The scientific community lacks in unity, since the pursuits in R&D are quite varied with diversified interests of individuals or groups of individuals, making objective numerical evaluation a difficult proposition. This is successfully exploited by the managements to push their own objectives and which are not in the interests of the nation or of science.

Even denigration of good work is practised at times by managements, wherever necessary to meet their own vested interests.

The new generation of scientists, who are devoted and committed to achieve higher objectives are dwindling, and they only exhibit itching impatience for recognition and promotions, but whose research works are only marginal.

Over centralisation of authority in the hands of Directors and Heads of Institutions in the name of autonomy has helped the watering down of recruitment standards and further pollution of the already existing unhealthy atmosphere prevalent in academic institutions.

Politics in science is largely about the distribution of promotions, awards, budgeting of projects, funding of infrastructural facilities, pushing of individual scientists in the name of thrust activities of relevance to national interests, sanction of avenues to foreign visits, staffing pattern for projects, approval of tours within the country, deputation to seminars, nomination to national committees, sponsoring to International seminars/ symposia, holding of workshops and funding such meetings etc.

Scientific population exploitation with too many job seekers for the few available posts (largely offered by Government funded R&D labs) and too meagre promotional avenues, the non-availability of alternate avenues for change in jobs to derive job satisfaction are also responsible for the stagnation in R&D.

The static state of the financial status of individual scientists is also a cause for the lack of enterpreneural abilities, inhibiting the dyna-

mic activity normally expected of the few experienced and pushful, and who have the capabilities of delivering the goods.

Majority of the state-run laboratories have reached a static stagnant state, thanks to the inheritance through successive managements catering the interests other than scientific pursuits and the nations requirements.

5. REMEDIES FOR CONSIDERATION TO IMPROVE THE SITUATION

Quantification of Research Output

Having suggested quantification of R&D output, as a solution to the existing maladies, requiring the highest priority, an attempt is made to present a rational picture of the scaling parameters, over which criteria for numerical evaluation could be evolved by the allocation of marks, for purposes of ranking and recognition. Table 1 denotes the mode of possible inputs to research work, while Table 2 enlists the possible criteria for consideration that could help the quantification of research output.

In fact, performance standards, whether they be voluntary or mandatory, can encourage competition, stimulate innovation, reduce or avoid anti-trust problems. An yearly chart on the basis of above criteria of Tables 1 and 2, for the time period under consideration by the assignment of marks against each category can go a long way in the proper assessment of scientists' work. This proposal for evaluation could also bring out clearly, the fact whether a researcher is uniform and consistent in his activity or not over a fixed length of time.

Finance Pattern of R&D

A radical change in the financing pattern of research and research institutions needs to be introduced. R&D of a nation can not grow for all time to come, purely on Government funding, central or state. Self-reliance of R&D institutions should be encouraged. The Government may fund new institutions, say for a period of 10 years, fully meeting 100% financial inputs, restricting it to 50% in the next five years, and to 25% in the following five years, such that by the time, the institution attains majority (20-21 years) it should be able to generate its own funds, as a result of the expertise, facilities and infrastructure, already developed. Unless, this measure is enforced in strictest possible terms, Indian science will have no salvation, since central finances can not meet the growing demands of more and more R&D institutions. When these measures are accepted, the existing institutions be given a period of 5-10 years, to reorient their activities, as to generate the requisite funds, for their self-reliance. In fact, individual incentives, collective incentives, institutional incentives, perhaps, could be evalved to kindle interest in not only the generation of funds, but also turning out work of the highest order. Over and above these measures, Government could release special grants to boost any particular R&D or S&T activity to meet an accelerated growth of a particular nature, considered to be necessary in the interests of the nation.

Project Planning

R&D project planning, and thereby the institutional planning should have the following components to meet (i) The S&T interests of the nation (regional or national); (ii) The R&D objectives of the institution the scientist is working for; and (iii) The scientific interests and aspirations of his own (the researcher), in R&D. Of these, the national priorities have to be set by the central or state governments, taking into consideration the larger interests of the community of the people. The management of institutions have to decide on the priorities and nature of R&D to be taken by the respective individual institutions. Project planning to meet the aspirations of the individual scientists should also find a place, to not only satisfy his own personal ambitions in R&D, but also to fully utilise his spare hours, when he is not fully kept busy and engaged with the national or institutional programmes.

This type of planning may be termed, the two way planning, since it has a component from the individual side (who has to deliver the goods) as well as from the institution or state side also to take care and ensure a steady progress of R&D of direct relevance to national interests, and the community at large.

Management

Recruitment be confined to the lowest cadres in the non-gazetted, gazetted categories, say junior scientific assistant and Scientist B. This could create a better climate in working conditions, shedding the fear of overnight overlordism due to sudden induction at all levels, as at present. At any rate, direct induction above scientist C should not be considered, in the interests of a proper working research atmosphere.

Formation of Executive Committee/Research Advisory Committee be objective based with equal representation of internal and external scientists.

To avoid monopolistic attitudes and satellite formations, emulating the universities the top management could be made rotational.

Allow the top management to have a two-day interchange of positions with universities, so that both the universities and the laboratories stand to gain due to their experience.

Project funding be based on the peer/PI's performance of the immediate past five years, taking ainto consideration the main power given, funding sanctioned, funds utilised, objectives and targets set and achieved, as this could bring out clearly which individual scientist, or group of scientists has been active, and thus ensure the funding of the deserving and earnest, that are so very necessary to build confidence and create the proper atmosphere.

Restrict the size of R&D groups and institutions to within manageable limits, arresting unwieldy growth, if necessary opening more number of institutions to cater to the fast growing scientific pursuits of research, but of different disciplines and faculties.

Let there be encouragement to plan, produce and publish and let these be the objectives for progress of R&D institutions.

Let there be recognition to indigenous R&D, innovative and creative research.

Allow technology transfer and consultancy freely, assuring due weightage and recognition.

Discourage scientists taking up management, by reducing unnecessary file work, introducing progressive ideas for quick decisions and action. In otherwords, there is a need to curb the growth of heirarchy in institutions, by generating administrative work, - very frequent report writing, project writing etc. and the attitude to become managers from a very young age, right from the level of Scientist B.

Management should strive to develop a culture for self-reliance amongst scientists and they should be able to handle their own typing, draftsmanship, plotting, computer feeding etc., so that the dependency habit on others is gradually reduced to a bear minimum in carrying out day-to-day research.

Assessments, merit promotions, incentives offered, if any be broad based with a code of practice based on allocation of marks on the research output produced, in the light of the model Tables 1 and 2 of this paper, and with 10% of the marks being set for the interview, if held.

Let there be complete freedom for publication of R&D results, making it obligatory to inform the institution, but curb the going to the press.

Management ought to balance and decide to enforce a definite ratio between basic, applied and applied oriented research, instead of allowing frequent discussion on these issues at all levels.

Since, necessity is mother of invention, management should strive to create the necessity and induce the scientist to come out with the invention. A sound research atmosphere can further ensure such creativity.

Management may strive to centralise major infrastructural facilities, say facultywise, to avoid duplication of facilities, and fuller utilisation of existing equipment, necessary for optimising the result oriented output.

6. SUMMATION

India, ranking third in terms of the man power availability devoted to R&D and S&T, no doubt needs to be directed by the Government, and by all those who believe in the proper utilisation of such capable, well edcuated and trained human resources are an asset, and who could forge a united thrust to boost the level and image of Indian Science.

The status of the working scientists deserves to be elevated at least to bring them on par with the administrative services, since creative and innovative culture require to be nurtured and made free from the feeling of want and a sense of secondary status, in the prevailing class conscious state.

India has the material base, in the large working forces of the scientific community, distributed in an equally large number of public institutions of R&D, and if only, a change in working atmosphere, devoid of skepticism is nurtured, great expections to enrich the nation, could materialise.

A revolutionary thinking in the younger working scientists has to be generated, to make them feel that they are the hopes of the future of science in India, and that they could shape the destinies of the country, by bringing about a visible and perceptible change in the standards of living through their works. To achieve these ends, a sense of sacrifice, devotion, responsibility and pride in the work that is helping the shaping of the future of the country, are the essentials, which are dependent on a R&D and S&T atmosphere or culture, very badly missing in Indian laboratories.

Indian science appears to be poverty striken, since it is all the time looking to the so called west or the developed countries to isolate the problems for research, which problems quite often yield some solutions helpful to the current academic activity of the west, and which neither have any relation to the requirements of India, nor do they make any impact on the citizens of India. This trend needs to be arrested, with due emphasis on the selection of projects of relevance to the country.

A pure researcher takes to R&D as a profession, with high objectives and hopes of doing creative work, new and innovative research, to derive self satisfaction resulting from such achievement, and with the fond hope of such work being utilised and giving rise to some recognition. In the prime of youth, this personal interest succeeds to some extent, but soon the prevailing decelerating forces overtake to play their

role, since man is a social being and can not live and survive in isolation. Other factors also come to play, such as the family pressures, social wants, comparitive self evaluation in relation to others who had joined during the same period and their status in relation to his own, cold war conditions in pushing the project programmes etc. All these generate a cumulative retrogressive influence, affecting the pace and quality of the work. Proper planning and management should be able to rectify this trend.

Intuition, investigation, innovation and interpretation from the foot steps to produce the best of R&D, and their substance depend on the scientific culture and level of progressive atmosphere nurtured, encouraged and maintained by the individual laboratories. The sooner, such values are recognised and striven to be maintained, the better it is, to improve the prevailing situation, which in turn could help the growth of a healthy, competitive and cultural atmosphere in science, with a positive outlook of assured returns of a high level and order (value based rather than need based).

TABLE - 1

INPUTS FOR RESEARCH

(Individual or Project or Institution)

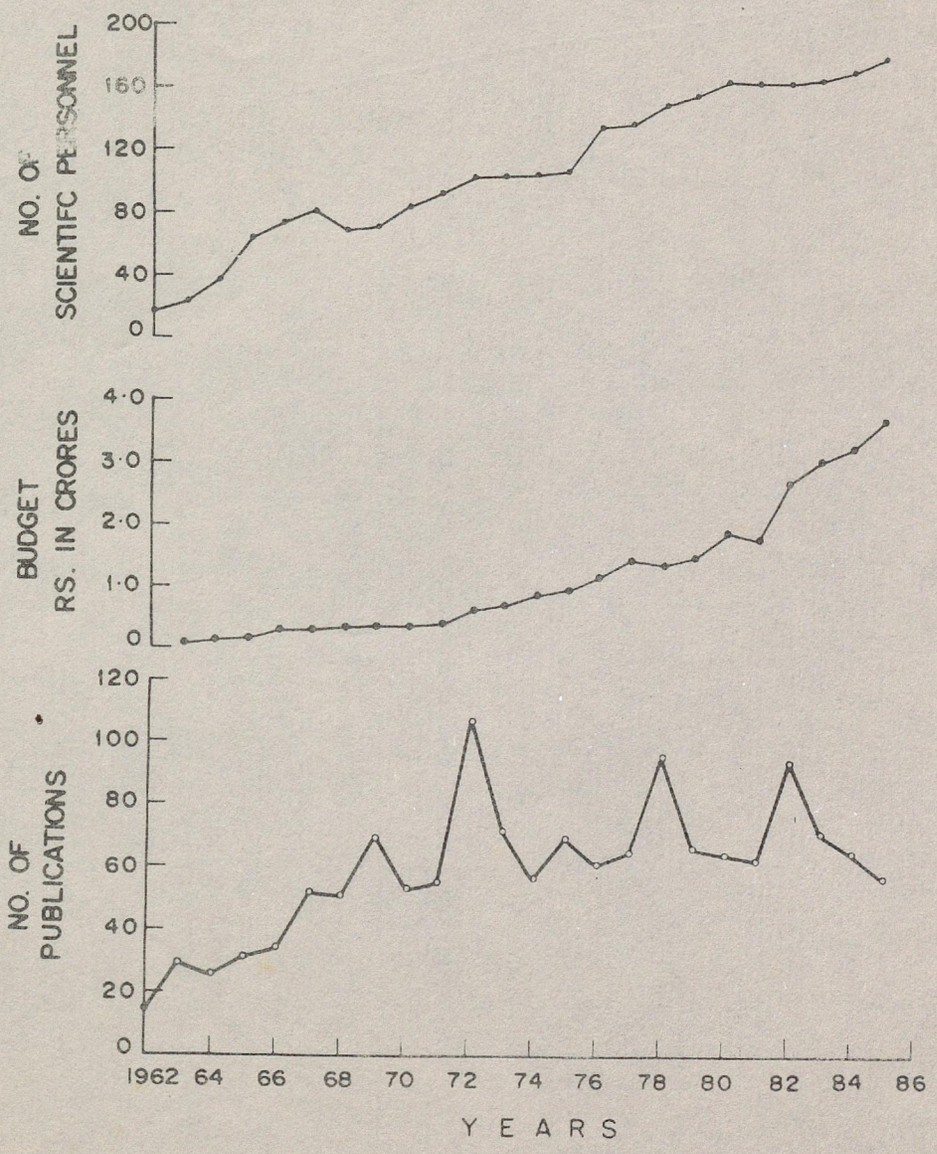
Staff	Man Months	Finances (Institutional)	Finances (Sponsored/ consultancy/ Industry)	Others, if any
i) Scientists		i) Equipment	Nature of	
ii) Technical		ii) Consumables	assignment	
iii) Others		iii) Infrastructure	Staff involvement	
		iv) Field work	Time involvement	
		v) Tours		
Total		Total		

TABLE 2: **STANDARD PARAMETERS FOR OBJECTIVE AND QUANTITATIVE EVALUATION OF RESEARCH OUTPUT IN SCIENCE.**

Applicable for the period under consideration only - of an individual scientist, or project, or group/ division or of an Institution)

1.	Awards:	i)	National
		ii)	International
2.	Visiting Professorships:	i)	National
3.	Book Published:	i)	Books
		ii)	Monographs
4.	Research publiations - No.	i)	National
		ii)	International
5.	Other Publications:	i)	Semi-technical
		ii)	Popular
		iii)	Others, if any, including seminars, symposia, work-shops.
6.	Patents:	i)	Indian
		ii)	Foreign
7.	Technology Transfer:	i)	To Indian industry, agencies
		ii)	To Foreign industry, agencies
8.	Technical Reports:	i)	National
		ii)	International
9.	Innovations if any, other than patents:	i)	Major
		ii)	Minor
10.	Consultancy works/ sponsored works:	i)	National
		ii)	International
		iii)	Annual returns of such works

11.	Collaborative works:	With -	
		i)	National Institutions
		ii)	International
		iii)	Universities
		iv)	Industry
12.	Membership of academic societies:	i)	National
		ii)	International
13.	Association with editorial boards of scientific Journals:	i)	National
		ii)	International
14.	Recognition as examinerships, paper setting, paper evaluation etc.	i)	National
		ii)	International
15.	Citations of R&D in Books:	i)	National
		ii)	International
16.	Relevance to socio-economic benefits:		
17.	Others, if any.		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