XI Plan, higher education and recommendations of the science academies

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Since 1951, the Government of India has been formulating five-year plans for the development of the country. The task of formulating successive five-year plans is steered by the Planning Commission. We are now at the threshold of the XI Plan and the past few months have seen a flurry of activity related to budgetary allocations for various sectors. Allocations for education, and research and development (R&D) are certainly a major concern at this juncture.

To guide national policy and to rationalize resource allocation for higher education and for science and technology, the Indian National Science Academy, New Delhi and the Indian Academy of Sciences, Bangalore jointly prepared a document, 'Higher Education in Science and Research & Development: The Challenges and the Road Ahead', which contains extensive proposals for revamping and restructuring of higher education. The document has been prepared after extensive discussions and incorporates inputs from the members of the two Academies and a large number of educationists and researchers. The document also took into consideration some comprehensive reports like the India Science Report (2005) and Report of the Task Force for Basic Scientific Research in Universities (2005). The document was submitted jointly by R. A. Mashelkar and T. V. Ramakrishnan, Presidents of the two academies, to the Planning Commission on 8 August 2006. The full text of the document is available at the sites http://www.insa.ac.in and http://www.ias.ac.in.

Unlike the situation in many countries, where the advice of the academies is either sought by the Governments or the academies on their own tender advice on vital national issues, academies in India have generally stayed mute spectators in the process of the formulation of national policies. The initiative taken by the two academies is, therefore, a welcome development and hopefully will set the trend for their active participation in developing policy frameworks for education and R&D. Wider availability of the document will hopefully bring forth new and innovative ideas for future discourses and implementation.

The document proposes a total outlay of Rs 7334 crores for enhancing competitiveness of select college and university education and to promote a culture of R&D in the universities. Given the size and population of the country and the enormously large number of Institutions of higher learning (universities, deemed universities and colleges), it is obvious that even with the proposed budget, developmental activity will have to be selective; otherwise the resources will get thinly spread and the critical level essential for a quantum jump in standards will not be available. The proposal from the academies, therefore, suggests identifying ten universities and funding these substantially 'to establish world-class premier universities in the country'. The proposal, however, goes further and recommends reasonably increased allocations for all universities. It further suggests that every state of India should have an university at par with the best of the Central Universities with respect to funding and academic standards.

The proposal recommends integrated B Sc and M Sc degrees to attract meritorious students to science courses and suggests involvement in undergraduate education of those universities which currently only cater to postgraduate education. In addition, it is proposed that 'at least 200 undergraduate colleges in science, technology and social sciences be provided additional assistance to develop into Colleges of Excellence'. An important and timely suggestion in the document is aimed at providing wider options to B Sc students and to develop new avenues of industrial R&D so as to 'encourage interdisciplinary movement between science and technology streams, and industrial R&D by establishing 20 engineering schools that admit students with a Bachelor's degree in sciences for a two-year B Tech degree in selected areas requiring a strong science–technology interface'.

Several suggestions have been made in the document to attract young students to the basic sciences. These include merit scholarships, summer schools for undergraduate and postgraduate students, exposure of school students to research activities, teaching assistantships for meritorious doctoral students in addition to research fellowships and promotion of postdoctoral work through enhanced fellowships, housing facilities and due recognition for research conducted in India.

For attracting bright young people to careers in teaching and R&D at the universities and colleges, a slew of recommendations have been made which include upward revision of salaries, attractive 'start-up' grants, 'advance-increments' to deserving candidates, appropriate facilities for women researchers, contractual positions with an initial appointment for five years, provision of a third promotion in colleges for meritorious teachers, support for attending international conferences and payment of honoraria in projects sponsored by the industry. The document recommends introduction of VRS for those who no longer enjoy teaching and creation of a cadre of 'National Professors' to recognize the meritorious.

The document calls for strengthening of the Competitive Grant System being run by the Department of Science and Technology, the Department of Biotechnology, CSIR and other departments of the Government. To make research more viable at the universities, it recommends that overheads should be pitched at 30% of the total grant. All proposals should be placed on a Proposal Tracking System and the time from submission to the release of funds should not be allowed to exceed six months.

The document also calls for a set of 'accountability norms and administrative reforms' to make the best use of enhanced funding possibilities. The proposed reforms include a term of five years for Vice-Chancellors of state universities, upgradation of one state University in every state to a Central University with the President of the country as the Visitor to these upgraded universities, regular evaluation and grading of teaching, curricula and research, putting an end to inbreeding (hiring own students immediately after their Ph D) and close monitoring of affirmative action.

While launching the Knowledge Commission in 2005, Prime Minister Manmohan Singh spelt out succinctly the challenges and directions for our future as a knowledge economy – 'At the bottom of the knowledge pyramid, the challenge is one of improving access to primary education. At the top of the knowledge pyramid, there is need to make our institutions of higher education and research world class… The time has come for India to embark on a second wave of nation building… Denied the investment, the youth will become a social and economic liability'. These are wise and sagacious words. Since the launching of the Knowledge Commission many new developments have taken place, which include extension of reservations to OBCs and an increase of 54% in the number of seats at the Central universities. To carry out expansion, inclusion and maintaining excellence at the same time will be a demanding and challenging task indeed.

The recommendations from the two academies will hopefully be considered carefully by the Planning Commission and the Government for achieving the avowed goals of expansion, inclusion and excellence in higher education. Decisions taken now for the XI Plan will have enormous repercussion on human resource development, innovation and economic growth of the country.

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Soil in action

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Earthwork forms the largest activity of a Civil Engineer. All structures, buildings, highways, bridge abutments, piers, industrial structures, and the like, have to have their foundations resting on soil. Besides this, a large amount of earth work is involved in the construction of earth retaining and earthen structures like earth dams, earth and rock fill dams, embankments and retaining walls. Highways, hill roads, tunnelling for various purposes including metros and buried oil pipelines deal with the handling of a large quantity of soils of various types. Thus soil has been used as foundation/supporting medium and as a construction material since the earliest days of recorded history. By the time scientific and rational methods became generally recognized as a fruitful approach to the solution of engineering problems; monumental buildings, bridges, dams, canals and roads had not only been built, but the same had served their useful purpose for many centuries. Therefore, it was inevitable that Soil Mechanics and Foundation Engineering, now called Geotechnical Engineering developed primarily as an art steeped in tradition and empirical practices based on earlier successful accomplishment until Karl Terzaghi (1883–1963) an engineering teacher in Constantinople, later in Harvard University, began some laboratory experiments on sand to discover the nature and the laws of its internal friction and volume changes under load. His searching studies on sand and clay reached a stage where the results began to group themselves into a full and highly enlightening explanation of how both plastic and granular soils behave.

From 1930 to 1970, four decades saw the development of Soil Mechanics and Foundation Engineering as a full fledged branch of Civil Engineering based on a rational basis and understanding of the behaviour of soil under stress. Terzaghi's 'Effective Stress Concept' formed the basis of 'stress definition' to be used to analyse any problem dealing with soil under stress. Laboratory methods have been fully standardized to characterize the soil depending upon the nature of the problem in the field.

The basic understanding of the behaviour of soil under stress as dictated by field drainage conditions brought a significant development in earth dam construction, the scenario changing from concrete/masonry as construction materials for a dam, to soil as a construction material. This is primarily due to significant developments in material testing procedures in the laboratories dictated by sound theoretical considerations. In the present scenario, most of the large dams of height more than 1000 feet (300 m) are being constructed with earth and rock as material in view of the large reduction in cost. Economical dam construction with soil and rock as materials to tackle the seasonal floods is of tremendous practical significance and has significant scope for further work. With the development of new synthetic materials that are available at competitive rates, the scope for use of the same as core material opens up challenging new research areas. Any breakthrough in this development will not only reduce the overall cost but also increase the safety factor. Similar scope exists for the use of drainage materials synthetically developed as toe drain materials. These developments will not only economize the project costs but will also improve the quality of the design with a reduced section. There is a significant development in the production of construction equipment opening up the possibility of achieving good compaction of soils and rock, which will further reduce the overall cost. Thus the scope of further research for more and more use of soil and rock in dam construction will be tremendous.

With the advent of 'earth reinforcement' technique using steel and other synthetic materials as reinforcement, the limitation that soil under tension is weak has been overcome. Typical reinforced earth or soil structures are retaining walls, embankments, nailed slopes, sub-grades beneath pavements, etc. There has been tremendous development in building reinforced earth structures with optimum size leading to substantial economy and space saving. This technique is being used extensively in big cities as a part of abutments for flyovers. Embankments could be constructed with this technique with side slopes almost vertical. Embankments resting on soft soils are now feasible by reinforcing