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VARIOUS ASPECTS OF POST-GRADUATE HYDROLOGICAL STUDIES AND RESEARCH IN INDIA

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INTRODUCTION

After attaining independence in the year 1947, India faced the stupendous task of revitalizing and developing its shattered economy. A country which once attracted all the nations of the west because of its prosperity and wealth had reduced to a poor nation with its vast hunger striken, uneducated population. After a long debate, the country chose the path of a socialistic pattern of developmental approach through a planned economy under a 'mixed economic model'. This economic model clearly defined the role of private and public sectors to avoid concentration of 'nations wealth' in the hands of a few. Safeguards were also provided to ensure that the task of nation building does not suffer. With these aspects in view, policies for planned and economic developments were launched. Top priority was given to agriculture and in the First Five Year Plan major allocations were made for water projects. Emphasis was given to river training and water conservation works on major rivers of India.

For planning, construction, execution and operation of a water project, a vast technical manpower is needed. This saw the development of engineering education in a big way. A number of engineering institutions were opened up to provide the technical manpower at technician, diploma and degree levels. Though this period saw a phenomenal growth of technical education in India at all levels, still the quality of education continued to be somewhat sub-standard and much was desired to be done to improve the same. For example, take the case of hydrology. In the syllabi of various bachelor's degree programmes, hydrology generally formed a small chapter in the Irrigation Engineering of the Civil Engineering curricula. Thus, our education system lagged behind and could not catch up fast with the developments which were taking place in the field of Hydrology and Water Resources in general. The policies of the governments at the central as well as at the state levels too were not clear. Sometimes "Irrigation" was given a separate status, where as at times it was clubbed with Power, Agriculture, Food etc. It was only very recently that a separate Ministry of Water Resources came into existence at the Center and many provincial governments also followed the suit. In fact, it was the need of the hour. With the population explosion, water was needed for diverse uses i.e. for drinking, irrigation, industry, power, navigation, recreation etc. Further, water being a "state" subject with its ever increasing demand by various sectors for its different uses, it became the subject of disputes at international, national and state levels. Further, there is a need to realise that water can not be considered as an independent renewable natural resource. Rather, there is a reason to see it as an abiotic component (i.e. hydrosphere) in overall ecological context. With ever increasing stress on this natural resource, not only its quantity but its "quality" also became a matter of concern. Over the years, many of the Indian rivers crossed the permissible pollution limits and their waters became a cause of worry and alarm. Of late, the Ministry of Environment & Forest came up with a strict programme of keeping under check the contamination of river waters. To accomplish the same, in May 1994 the Prime Minister has proposed that the Ganga Action Plan be renamed as Indian River Action Plan - and its scope of functioning be enhanced accordingly.

HYDROLOGICAL EDUCATION AND RESEARCH

To meet the challenges of pressures poised by the rapid growth of population on all natural resources and particularly on water, all the world over the governments, educational institutions, technical personals, technocrats and politicians started paying attention to this problem. In sixties, this resulted into participation of India in the International Hydrological Decade (IHD). At the end of it, it was rightly realised that a mere ten year programme is not going to reap long term benefits as the problems are of perpetual nature and their proportions will be increasing manifolds in future. Therefore, as recommended by international agencies, our country was also obliged to convert her IHD programme into International Hydrological Programme (IHP).

Based on one of the recommendations, the contents of Water related subjects in the curriculum at Bachelor's level were increased. In those institutions where this was not existing at all, the same were introduced. At the Post graduate and Master's level, Hydrology oriented courses were either included in the list of optionals or were introduced as core courses.

ESTABLISHMENT OF POST GRADUATE HYDROLOGY COURSES

In course of time, it was realised that mere introduction of hydrology and hydrology related courses does not meet the requirements of those user agencies which need a thoroughly trained manpower in various aspects of hydrological sciences. For example, in the early fifties and sixties due to insufficient knowledge of hydrology, many irrigation and water projects suffered from the defects of either being "over safedesigned" or unsatisfactory due to being "under designed". As a result of it, many reservoirs did not fill up to their capacities or the spillways had to be redesigned and reconstructed to provide safety downstream. This problem was not confined to our country only. Further, in many newly independent countries of Asia and Africa great demand was felt for trained engineers and scientist in specialised subjects relating to water. Consequently, during 1965 to 1974, UNESCO recommended the establishment of International Hydrology Courses in different regions to develop trained manpower having in-depth knowledge, well equipped with technical information and details for the planning and design aspects of the water projects. One such course came into existence at the Department of Hydrology (DOH) at University of Roorkee which as formerly known as School of Hydrology (SOH). So far, it has provided advanced training at Post Graduate level to 516 engineers and scientists drawn from 32 countries of the world.

POST GRADUATE EDUCATIONAL PROGRAMMES

Keeping the above background in view, it would not be wrong to conclude that advanced hydrologic education and research in India lags behind at least 50 years when one compares it with advanced countries of the western region. Most of the text books, research finding, theories developed are relevant to meteorological and physiographical conditions prevailing in the western part of the globe. These are quite different from the conditions prevailing in the equitorial and tropical regions. Therefore, our educational and research programmes in hydrology should be such that these cater to the needs of our country/ region. Keeping this aspect in view and also the requirements of user agencies, the SOH chalked out its Post-graduate Diploma curriculum leading to Master's Degree in hydrology. No curricula of advanced education can be standardized and it has to be up-dated from time-to-time keeping in view the rapid developments taking place through technology and information transfer process. Accordingly, the syllabus of the courses offered by DOH was kept revising keeping in view the past deliberations which later came up as recommendations of international organizations (Ayibotele (1988), Nash et al. (1990), Allaburtan (1991), Gilbrich (1991), Maniak (1993), Bruen (1993), Bekan (1993)]. The present day programme thus consists of specialised courses in Surface Water Hydrology, Groundwater Hydrology and Watershed Management. There is a need to strengthen this programme by diversifying it to include Coastal Hydrology, Snow and Glacial Hydrology, Arid Zone Hydrology, Urban Hydrology, Environmental Hydrology in it.

RESEARCH PROGRAMMES IN HYDROLOGY AND GOVERNMENT POLICIES

In tropical regions particularly in India, the prevailing temporal and spatial variations in pre-

cipitation and physiographical features make the research scenario quite different from those of temperate zones. Hydrological quantities and variations in them are so significant that in most cases new approaches need be developed even if the well known relationships (e.g. the rainfall-runoff relationships, flood routing etc.) do exist. Among the various handicaps to carry out the much needed research programmes, to quote a few, are the non-existence of accurate and reliable data base, inadequate funding, non- availability of enthusiastic researchers as well as shortage of sophisticated instrumentation. Many of the problems do crop up because the government has declared water as a "State subject", not open to private sector for planning and management. This is why, funding from private sector is practically non- existent. With changed economic scenario, with ongoing economic liberalisation and reforms, there is a need to throw open the water sector' to private enterpreneurs so that much needed funding of private sector is also available.

ORGANISATION ASPECTS

There is a need for a proper policy statement for the implementation of the relevant clauses on education and training aspects as stated in National Water Policy (1987) of Government of India. Much coordination is needed to avoid unnecessary duplication in educational and research programmes. This becomes all the more necessary so as to ensure optimal utilization of scarce financial resources. It may not be out of place to mention that a duplicate programme of an International Hydrological Course, on the copy-book pattern of Roorkee Course was started in the South at Guindy in the eighties. As a result of this duplication, Roorkee course suffered quite a bit and the initiative taken in the South did not succeed. In the recent past, many Government Sponsored training centers have been started or these are in the process of being setting up at different places of the country. Someone, some day will have to take the stock of the situation in order to streamline the whole gamut of higher education, training and research programmes in hydrology to avoid duplication of efforts and to meet the needs of the regions. With so many Continuing Education Programmes already in existence, is there really a need to open up new training centers under the auspicies of Government Ministries and Departments? A rational approach need be adopted which should be mutually beneficial to the educational institutions as well as to the Government agencies.

INTERNATIONAL, REGIONAL OBLIGATIONS & PARTICIPATION PROGRAMMES

An International understanding should be reached for solving waxed problems of sharing the water resources between the nations/ states. An atmosphere of mutual confidence is necessary which can lead to solution of such problems. The Government of India through its various International Participation Programmes viz. the Indian Technical Economic Programme (ITEC) and Special Commonwealth African Assistance Plan (SCAPP) of the Ministry of External Affairs and TCS Colombo Plan of the Indian Council of Cultural Affairs (ICCR) have done a commendable job in providing finances to participants from many developing friendly countries of Asia, Africa and Latin America. At Roorkee alone, upto 1993, two hundred foreign participants drawn from 32 countries have participated in International Post-graduate Hydrology Courses. International organisations like UNESCO, WMO, IDRC (Canada), Govt. of Netherlands etc. have also made significant contributions in the past towards this objective. During the last two years, due to severe budgetary constraints, the Ministry of External Affairs and the UNESCO could not contribute towards this noble cause. As a result of it, the programme has suffered a great deal. I am of the firm opinion that the ex-participants to such courses from various countries are in fact our 'Technical Ambassadors'. In the past, they have helped our economy by employing our technical manpower, purchased the equipments from this country and have supported our cause at various fora. With the economic liberalisation, the benefits are likely to swell further and it is earnestly hoped that the Government of India will restart and continue funding to ensure foreign participation in various educational and training programmes offered by various technical institutions particularly keeping in view the latent potential benefits stated above.

Indian participation in higher hydrological study programmes has not reaped full benefits because of lack of incentives for the same. The

sponsored candidates to such programmes should be given short term as well as long term incentives as a motivation. This is justified as the sponsored officers face dislocation of families as well as in place of their postings later on. Under the new GATT, employment opportunities will be available far beyond the frontiers of our country. Also, for the faster development, the eco-friendly water projects have to be taken up in a big way. This will increase the demand of trained hydrologists all over the world. For these reasons, admission to International Courses need not be restricted to 'Sponsored' candidates only. Rather, fresh graduates should be enrolled to grab the future employment opportunities in the developed as well as in the developing countries of the world.

PRESENT SCENARIO AND FUTURE PROJECTIONS

India is a big country with huge population, and therefore, the multifacet problems need be tackled in such a manner that all sections of the society share the benefits but simultaneously the path of progress is also smoothened to ensure the needed development and economic upliftment. At present, the Ministry of Human Resources Development (MHRD), Govt. of India deals with EDUCATION which covers the broad spectrum ranging from 'Operation Black Board' and 'Adult Education' to the 'Post-graduate Education and Research' in India. Thus, the budgetary allocations to the MHRD are distributed among innumerable institutions. When it comes to higher education and research oriented courses, the financial allocations turn out to be totally inadequate for desired growth and development. With the formation of All India Council of Technical Education (AICTE), it is hoped that the post-graduate educational programmes in engineering will receive due attention. In the field of hydrology, the broad fields of specialization which have the potential of 'economic returns' in terms of international employment, research, R & D activities and consultancy are as under:

(i) Urban Hydrology

(ii) Environmental Hydrology

(iii) Snow & Glacial Hydrology

(iv) Hydrogeology

(v) Marine & Coastal Hydrology

(vi) Watershed Management

(vii) Island Hydrology

(viii) Remote Sensing Hydrology

(ix) Mountain Hydrology

It is proposed that the Indian National Committee on Hydrology should take up the cause of establishment of full fledged Master's Courses in above mentioned broad fields of Hydrology. It would not be out of place to mention that the direct beneficiary from higher educational courses of the type under discussion will be the Water Resources Sector. Therefore, the Ministry of Water Resources, Govt. of India should share the major burden of providing the infrastructure as well as of meeting the running expenditures. Such expenditures should be taken in the light of efforts of the Ministry of Water Resources towards the R & D activities. It is needless to stress that grants needed for the purpose would involve insignificant amounts when compared with the total budget of the Ministry.

SUMMARY & CONCLUSIONS

In the past, the Government of India acted favorably to the suggestions given by international agencies in establishing Post-graduate Courses in Hydrology in India. This helped in raising the desired technical skill and manpower. However, there is a need of further strengthening the post-graduate education and research in India to grab the opportunities which will be available with the globalisation of the economy of our country. For this purpose the following proposals are made.

- Full fledged Master's Courses and research facilities be developed in the fields of Urban Hydrology, Environmental Hydrology, Marine & Coastal Hydrology, Watershed Management, Island Hydrology, Remote Sensing Hydrology, Mountain Hydrology, Snow & Glacial Hydrology, Hydrogeology in various educational institutions.

- Development of software in specialised fields of Hydrology mentioned above.

The Ministry of Water Resources is the nodal Ministry with overall responsibility for planning, management and to some extent the execution of Water Resources project in the country. The Post-graduate Hydrologic Educational and Research directly finds its application in the plans and proposals of this ministry. The personals trained also perform and participate in the activities of this Ministry. Therefore, it is proposed that development of higher education and research in water sector in the educational institutions need be funded as an R& D activity of the Ministry of Water Resources.

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