CURRENT STATUS OF ENGINEERING RESEARCH AND CONSULTANCY IN INDIA WITH PARTICULAR REFERENCE TO WATER RESOURCES ENGINEERING

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Abstract

With 1250 million population, India is the largest democracy in the world. India possesses a large pool of technical manpower today with an annual intake of about 15,76,500 of graduates and post graduates from 10,949 technical institutions (as in 2013) spread all over the country. Quality of technical education is to be further improved for addressing the severe shortage of faculty and manpower to conduct engineering research and consultancy services including those in hydraulic and water resources engineering.

Keywords: Technical institutions, faculty, research, consultancy, water resources engg.

1.INTRODUCTION

India with a population of 1250 million is the largest democracy in the world. After the independence, India has made significant progress in engineering and technology benefitting not only our country but also other countries in the world. Dr. A.P.J.Abdul kalam, late president of India, said

‘Imagine a workforce able to meet the world’s entire shortage of technical and professional graduates. Imagine companies and universities from around the world gravitating to India as the premier scientific and technological research and development environment. Imagine an India in which cities are far clean and more modern, citizens are more enlightened and more responsible, entrepreneurs more dynamic and sophisticated, institutions far more effective and responsive’(India: vision 2020, towards a knowledge society).

India possesses a large pool of technical manpower today with an annual intake of about 15,76,500 graduates and post graduates from 10,949 technical institutions spread all over the country (Annexure-1). Unfortunately, however, the quality fraction (Rama Rao,2013) of the total intake is about 40,000 only (7,500 from 15 IITs, 5,000 from 30 NITs and 17, 500 from universities and other good institutions). 90 % of the technical institutions in our country belongs to private sector. They run mostly UG colleges which has no post graduate program except a few. Private engineering colleges are commercially run with the objective of making profit. It may be worthwhile to compare here the numbers of students admitted at different levels in India and USA (Sharma, 2014)

	India	USA
(a) At UG level	15,00,000	75,000 (5% of India)
(b) At Master’s level	75,000 (5% of UG)	37,500(50% of India)
(c) At Ph.D level	1500 (0.1% of UG)	7,500 (500% of India)

According to NASSCOM, only 25% of engineering graduates in India are employable. It seems appropriate guidelines and corrective measures are not being followed while giving approval to the technical institutions by AICTE established by MHRD, Govt. of India in 1986 to regulate quality of technical education. Some of the factors leading to poor quality of technical education in India are

. Shortage of quality faculty.

- Inadequate physical infrastructure and funds.
- Lack of autonomy.
- Rigid and outdated curriculum.
- Poor quality of training.
- Absence of R & D activities.
- Poor learner quality.
- Ineffective linkage with industry

The shortage of quality faculty is the most serious problem confronting Indian engineering education system. Responding to a question in the Upper House of Indian Parliament on 21 July 2015, the concerned minister told that even institutions like the IITs and NITs are facing faculty shortages of about 36% and 41% respectively (The Tribune,2014). It is a common sight in private engineering colleges for a person who passed with BE/B.Tech degree to start teaching in the following academic year. Table-1 presents faculty shortage in engineering institutes on national basis (Rama Rao, 2013). –

Table 1. shortage of quality faculty.

Annual intake -15,00,000

Faculty required -1,00.000
(@1: 15 faculty-student ratio)
Faculty shortage - 80,000

Shortage of Masters- 20,000

Shortage of Ph.Ds- 60,000

It is clear that there are ample job opportunities in academic institutions for engineering graduates possessing higher degrees. What is needed is to make the teaching profession more attractive and rewarding to attract the talented ones. There is a great deal of mismatch between the knowledge gained by the students in engineering colleges and practices followed in the field.

Knowing that it is easy to get a job with a good salary in the IT sector, students from other disciplines concentrate more on IT related courses at the cost of their core subjects. In addition, there has been too much dependence on software packages in some of the core disciplines, which has lead to poor understanding of concepts. It will not be out of place to point out that India is not a member of Washington Accord which stipulates a minimum standard of its post graduate and Ph.Ds. India's GDP per capita of PG is only US $ 1450 compared to a GDP of $33,400 in Japan. Numbers of Ph.Ds per thousand are 7, 4 & 0.35 in Japan, USA and India respectively.

In the above context, author wishes is to highlight the current status of engineering research and consultancy in India with particular reference to water resources engineering.

1.0 CURRNT STATUS OF ENGINEERING RESEARCH IN INDIA

R&D sector in India is largely dependent and controlled by the government bodies e.g. DST,DBT, UGC, AICTE ,CSIR etc. Unlike Japan where 95% of research funding comes

from industries, almost 99% of research funding in India comes from the Government. Basic and fundamental research carried out in our educational institutions mostly end in publication of papers in journals and conferences without much application in the field, mainly due to lack of investment, improper co-ordination and indifference by industries. Private sector is hesitant to invest in R&D due to inherent risks involved and a general apathy towards innovation. Although there is no dearth of talents in our country, the general trend is to purchase products of superior quality from abroad at exorbitant costs. It should be remembered that R&D privides the nucleus around which all other growths take place.

Our prime minister says migration of Indian talents are not ‘brain drain but brain gain’. But the question remains who gains. May be our country gains monetarily from the remittances sent by the skilled and semi skilled workers living mostly in the middle east countries. But the most talented lots of Indians who migrate to developed countries like USA, Europe, Canada, Australia etc. are being utilized by them to innovate, discover and develop their own institutions. While India imports equipments and products developed by our scientists and engineers abroad, these countries are importing the best brains from India. China has understood this game very well. Most of their reputed scientists and technologists are encouraged/inspired to return to their homeland after successful completion of studies and training abroad. Talented Indians who migrate abroad continue to stay and settle there partly because of high pay and perks but mostly due to a congenial atmosphere for research & development and also due to the recognition of the work done by them. It seems IITs are built to supply requisite manpower for further development of the advanced countries in the world. Unless this trend can be reversed, we will continue

to remain dependent on foreign knowhow and import foreign products at an exorbitant costs. Current status of research in engineering and technology in a vast country like India can be gauged from the fact that the annual out turn of Ph.Ds in engineering and Technology had decreased from 506 in 1979 to 374 in1996 (AICTE-1999). Although the current annual intake of Ph.D has now increased to 1500, actual production is much less. Approximately 400 research scholars complete their Ph.Ds in engineering and technology annually mainly due to lack of qualified and capable faculty. As per 1:2:4 ratio of cadres (between professors, associate professors and assistant professors), shortage of Ph.Ds in India in teaching institutions alone is estimated as 60,000 (Rama Rao,2013). Research and postgraduate education in engineering and technology is confined to only a few institutions like IITs. Despite attractive scholarships, nearly 60 per cent of over 19,000 sanctioned postgraduate seats (in 191 institutions) remained vacant while less than 7,000 completed the PG courses annually. Very few of IIT/NIT students join PG courses in India and majority of the PG students come from private state run colleges for getting an IIT/NIT stamp. Quality of our PG education has been discussed by the author in an earlier paper (Mazumder,2008). The low out-turn and poor quality of postgraduates who constitute the supply source of teaching and consultancy profession, is of major concern of our technical education system.

3.0 CURRENT STATUS OF ENGINEERING CONSULTANCY IN INDIA

Scope of engineering consultancy services are steadily increasing in our country because of the govt. policy of outsourcing jobs. The number of consulting companies in the

different disciplines in engineering and technology are steadily increasing day by day due to gigantic developmental projects being undertaken by the government for improving urban and rural infrastructures e.g. roadways, railways waterways, smart cities etc.. Consultancy organisations in India, in both public and private sectors, are rendering very useful services to the society by doing most of the jobs (which government departments used to do earlier) in a much more efficient, economic and time bound manner.

It is, however, unfortunate that majority of the consultants in India are reluctant to upgrade and modernize through collaborations with educational and research institutions in India for more effective use of their manpower, time and money. Currently, research and development in our country is generally confined to a narrow circle of academicians and end in conference or seminar & journal papers or reports with very little industrial participation. The main challenge of transfer of such R&D from laboratories to field lies in organizing, implementing and directing the research efforts in a well coordinated manner through appropriate collaboration (Diwan, 1999, Chakraborty,1999). Research and development must have strong linkages with industry for meeting our socio-economic goals (Mazumder, 2014). University professors and the young research scholars working under the professors comprise an enormous pool of expertise and resources which must be tapped to solve many a challenging problems faced by the society in the fast changing world with global competition.

A major problem being faced by our educational, research, consultancy and industrial institutions today is how to attract and retain qualified and meritorious persons (CEAI,2016). A large number of such persons leave the country for higher education abroad for better pay and perks, congenial environment for research, freedom of work

and above all due recognition of their achievements. Post graduate study for teaching and research is the last priority in India to-day. If this situation continues, our educational, research and consultancy institutions have no future and we are going to be dependent on foreign institutions for higher education, research and consultancy development for ever.

RESEARCH AND CONSULTANCY IN WATER RESOUCES ENGINEERING

Water resources engineering is a branch of civil engineering where there is a lot of scope of research and consultancy. A large numbers of consultants are needed in various disciplines in Civil Engineering e.g. (i)structural engineering (ii) geo-technical & foundation engineering (iii) highways & transportation engineering (iv) hydraulic & water resources engineering and (v) environmental engineering. Although there are good numbers of private consultants in the disciplines (i), (ii) & (iii) above , there are very few qualified and competent consultancy organisations under (iv) and (v) which are at present solely dealt with by the government departments. Author wishes to focus on discipline (iv) i.e. hydraulic and water resources engineering where there is a vast scope of research and consultancy at both private and public sector.

4.1 Hydraulic and Water Resources Engineering

Several areas which are covered under this discipline can be broadly subdivided in to

- Irrigation and Drainage
- Hydro-Power Development
- River Training and Flood Control
- Water transport and Navigation

- Water Supply and Sanitation
- Water and Soil conservation
- River Linking for Drought protection

4.1.1 Irrigation and drainage

Nearly 80% of our precious water resources are used for agricultural purpose for food production and food security. Fig.1 shows the Growth of Population, Food production and Irrigated area in India during 1951-2050. Since there is a lot of risk involved in water availability depending on natural rainfall, private consultants, except a few, are reluctant to invest in the area where currently there is very poor management of irrigation water (Mazumder & Kumar-2015) and field drainage resulting in extremely poor irrigation efficiency (Bharat Singh-1991,Mazumder,2010). There is a great opportunity for consultancy in the area.

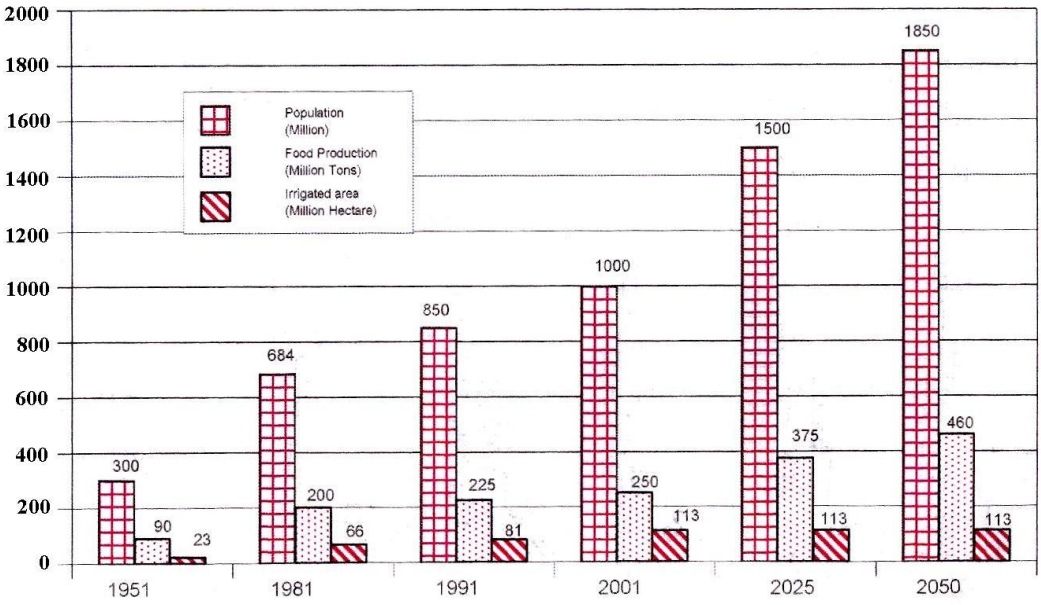

Fig. 1 Growth of Population, Food production and Irrigated area in India (1951-2050)

4.1.2 Hydro-power Development

India has a hydro–power potential of 90,000 MW at 60% load factor corresponding to a potential installed capacity of 1,50,000 MW. Currently hydro-power share is about 17 % against an ideal share 40% in hydro-thermal mix of power supply. Out of 1,45,320 MW of major hydro-potential of India, 94,900 MW i.e. 65.3% is yet to be developed in the country. State of Arunachal Pradesh with a major potential of about 50,000 MW has developed only 5-6% of its hydro-power potential so far. A large numbers of projects are in the pipeline in Arunachal, Himachal and Uttarakhand states.(Mazumder,2017). There is a great scope of private participation and consultancy services in the area which needs great amount of expertise and experience.

4.1.3 River Training and Flood Control

River and river water is in the concurrent list of Indian constitution. On an average, there is a flood damage of 40,000 to 50,000 million of rupees (in 2003 prices) due to recurring floods in all parts of our country apart from loss in communication and unimaginable sufferings of people. River training and flood control is at present under the exclusive domain of the state and central govt. There is a great deal of mismanagement , corruption and inefficiency in this sector. Consultants with proper knowledge in the subject can play a major role in the area in improving performance of the projects in a time bound manner.

4.1.4 Water Transport and Navigation

Water transport is the cheapest mode of transport (especially for bulk goods), compared to other modes of transport like airways, roadways and railways. Govt. of India is going to develop 106 national waterways (NW-1: Allahabad – Haldia stretch of Ganga, NW-2:

Sadiya-Dhubri stretch of Brahmaputra, Kollam-Kozhikode Stretch of West Coast etc.) for navigational purpose. Similar to Highway Authority of India, Govt. of India has entrusted the job to Inland Waterways Authority of India for proper planning, design, construction and maintenance of these projects at huge capital costs. It needs qualified and experienced engineers and consultancy services to expedite the timely implementation of these projects.

`4.1.5 Water Supply and Sanitation

Apart from agriculture, water supply is needed in other sectors like industries, power plants, municipal supplies etc. for building smart cities and providing improved infrastructures including 'Swatch Bharat'. Assured water supply and sanitation in a sustainable manner is an important task for improving quality of life for our urban and rural poor,. Function of ministry of water resources has been extended to rejuvenation of river Ganga and river development to face the immense challenges of river pollution and river development for water transport and water transfer from surplus to deficit basins. Consultants of high caliber and appropriate training are essentially needed for implementing the ideals of the Government of India.

4.1.6 Water and Soil conservation

Utilizable water resources of India is estimated as 1120 billion cubic meter (BCM) which comprises of 690 BCM of surface water and 430 BCM of replenishable ground water (Iyer, 1989). 748 BCM is lost to the atmosphere through evapo-transpiration from rain fed agriculture, barren lands, forests, natural vegetation, natural ponds and lakes etc.

Water conservation through rain water harvesting is a must to meet the ever increasing demand of water by our growing population. We have poor storage capacity of about 305 BCM only and many of the storage reservoirs built in 50s and 60s are fast depleting their capacities due to siltation of these reservoirs (CWC,1991). Soil conservation is badly needed not only for extending the life of the reservoirs but also for control of land slides, floods and associated calamities. The area is at present fully under government control. Considering its severe implications, private participation and consultancy are essentially needed.

4.1.7 River Linking for Drought protection

Average per capita water availability in India is estimated as 1545 cubic meter whickh is above 1000 cubic meter below which the area is considered to be water stressed. Considering the regional variation in precipitation, many parts of our country are already facing acute shortage of water and droughts as indicated in table-2 below. Many more states are soon going to be water stressed soon due to increase in demand of water with rise in population. Considering rapid growth of our population and increasing river pollution, Govt. of India has proposed 30 river link projects for water transfer from surplus to deficit basins of India (Annexure-II). Implementation of these projects is a herculean task and face many difficulties (Mazumder,2005). Obviously, execution of such projects need hosts of consulants in multiple disciplines of civil engineering from both public and private sectors.

5.CONCLUSION

Although India has made a phenomenal progress in engineering and technical education, there is an acute shortage of qualified faculty in the technical institutions 90% of which are privately run colleges. Except a few, sole motive of the private colleges in India is to

make profit. As a result, the current status of engineering research and consultancy in India is not up to the mark. A major concern being faced by the country today is how to attract and retain qualified faculty in the technical institutions to improve upon the current status in engineering research and consultancy in India. There is an ample scope of research and consultancy in the area of hydraulic and water resources engineering which is largely controlled by the government today.

Table-2: Surplus and Scarce Basins in India

SurplusBasins		ScarceBasins	
Basins	**PerCapita Availabilityin**	**Basins**	**PerCapita Availabilityinm^3**
BrahmaputraBasin	18,417	EastflowingRiversbetween	919
BarakBasin	7,646	Cauvery	666
estflowingRiversbetween	3,538	Pennar	648
estflowingRiversbetween	3,194	Westflowing RiverBasinof Kutch and Saurashtraincludin	631
Narmada	2,855		
Brahmani-Baitarni	2,696		
Mahanadi	2,546	East flowing River Basins between Pennar and Kanyakurnari	383
Godavari	2,026		
Indus	1,757		
Ganga	1,473		

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Annexure-I:Growth of Technical Institutions in India(As in 2012)

STATE	1980	1990	2000	2005	2006	2007	2008	2009	2010	2011	2012
Andamanand Nicobar Islands	0	0	0	0	0	0	0	1	1	1	1
Andhra Pradesh	83	112	463	852	907	1111	1450	1672	1769	1813	1840
Arunachal Pradesh	2	2	3	4	5	5	5	5	5	5	5
Assam	8	8	23	24	26	28	32	42	44	46	47
Bihar	25	29	44	53	53	55	63	71	76	82	88
Chandigarh	3	3	10	13	13	13	14	14	14	14	14
Chhattisgarh	9	16	31	43	48	57	82	105	109	109	109
Dadraand NagarHaveli	0	1	1	1	1	2	3	3	3	3	3
Damanand Diu	0	1	1	1	1	1	1	1	1	1	1
Delhi	0	14	59	71	74	79	83	83	86	88	89
Goa	2	4	11	15	15	16	16	16	16	17	18
Gujarat	36	48	121	196	223	244	280	349	399	430	443
Haryana	28	34	87	141	156	213	346	410	453	491	504
Himachal Pradesh	8	10	13	17	21	32	42	63	72	79	80
Jammuand Kashmir	9	12	27	31	34	34	35	38	39	42	47
Jharkhand	15	16	32	41	41	45	49	52	57	61	61
Karnataka	62	137	413	523	537	578	651	731	777	789	798
Kerala	30	37	106	244	250	252	263	291	315	345	358
Madhya Pradesh	36	47	150	278	311	379	432	510	546	563	569
Maharashtra	106	192	556	740	859	926	1087	1286	1461	1550	1598
Manipur	0	0	3	3	3	3	3	3	3	3	3
Meghalaya	1	1	1	3	3	4	4	5	5	5	6
Mizoram	0	1	2	3	3	4	4	4	4	4	4
Nagaland	0	0	0	0	0	3	3	3	3	3	3
Orissa	19	25	98	134	145	164	210	277	293	299	304
Puducherry	5	8	15	18	18	20	23	26	30	31	32
Punjab	21	25	80	178	189	209	262	313	354	386	402
Rajasthan	37	46	103	174	199	232	284	335	467	484	504
Sikkim	0	0	4	4	4	4	4	4	4	4	4
Tamil Nadu	88	160	578	784	817	900	1046	1220	1328	1382	1422
Tripura	4	4	5	7	7	8	8	8	9	9	9
Uttar Pradesh	93	111	287	428	470	537	688	879	1039	1101	1143
Uttarakhand	17	21	49	69	85	93	119	148	165	175	182
West Bengal	37	40	111	167	178	183	201	223	238	247	258
Grand Total	**794**	**1165**	**3487**	**5260**	**5696**	**6434**	**7793**	**9191**	**10185**	**10662**	**10949**

Annexure-II: Interlinking Indian Rivers