AGRICULTURAL ENGINEERING EDUCATION IN INDIA

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ABSTRACT

The paper discusses the development of agricultural engineering education in India. A number of meetings and workshops were held to review and revise the curriculum of BS Agricultural Engineering keeping in view the emerging trends and opportunities. Based on discussions a model Indian Council of Agricultural Research (ICAR) curriculum and proposed All India Council of Technical Education (AICTE) curriculum are presented. Post-graduate education in agricultural engineering has also been described with suggestions for specializations to meet the future needs.

Keywords: Agricultural Engineering, Education, India, Curriculum

INTRODUCTION

The Agricultural Engineering education addresses issues relevant to socio-economic and technological development of a country. The quality and quantum of agriculture inputs and their management techniques and also quality of farm produce and methods of value additions would keep on changing with advancement of industrialization in general and with

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improvement in economic condition of farmers and processors in particular. It is in this context that the agricultural engineering curriculum needs to be modified from time to time to serve the changing needs of the agriculture and agro-industry sector. In general, it takes about 6-8 years before the new entrants to engineering profession are able to contribute effectively and efficiently. The education planning should, therefore, be based on the future requirements of at least eight years ahead.

Development of Agricultural Engineering Education in India

The first program in agricultural engineering education in India was introduced in 1942 with Bachelor of Science degree at the Allahabad Agricultural Institute, Naini, Allahabad, Uttar Pradesh. The curriculum was drafted to train engineers to help meet the needs of Indian farmers: (I) to mechanize their farms using more efficient tools, implements and machines and (II) to conserve soil and water for efficient use. The farm equipment was mostly traditional or imported and proper use and maintenance were primary concerns. The processing of products was mainly confined to dairy products and animal feeds.

The second program in agricultural engineering education in India was established in 1952 with Bachelor of Technology (B.Tech.) degree at the Indian Institute of Technology (IIT), Kharagpur, West Bengal. IIT introduced Master of Technology (M. Tech.) and Ph. D. degrees in agricultural engineering in 1957 and 1962, respectively. IIT provided an engineering orientation in course curriculum. Other disciplines like agronomy, soil science and botany were added to the Department of Agricultural Engineering to support it.

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With the establishment of State Agricultural Universities (SAUs) during 1960's, on the pattern of Land Grant Universities in the United States, the agricultural education in India changed significantly. The teaching, research and extension became integral part of the faculties. The first agricultural engineering program under this new pattern was started in 1962 at the Uttar Pradesh Agricultural University (now G B Pant University of Agriculture and Technology), Pantnagar.

Presently, there are 24 institutions offering degree programs in agricultural engineering. Of these 16 offer programs leading to master degree and eight offer Ph.D. degree (Yadav et.al, 1997). These institutions have annual intake capacity of about 860 at bachelor, 280 at master and 70 at Ph.D. degree level (Table 1). Numbers of students graduating from these institutions with different degrees are given in Table 2 (Singh, et. al, 1995 and Yadav, et. al, 1997). The annual averages for the period 1984 to 1996 are 403, 88 and 15 for bachelor, master and Ph.D. degree, respectively. The specialization's include, farm machinery and power, soil & water conservation engineering, irrigation and drainage engineering, post harvest and process engineering, dairy engineering, renewable energy and rural engineering.

The graduates are employed in academic and R&D activities, agricultural production, equipment sales and service, financial management and consultancy and some are self-employed. The profession has made significant contribution in the development of appropriate farm machinery, irrigation and post harvest equipment and energy appliances.

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Efforts to Improve Agricultural Engineering Education

The Academic Council of each teaching faculty has been improving the agricultural engineering curriculum from time to time. The Indian Society of Agricultural Engineers (ISAE), the Indian Council of Agricultural Research (ICAR), and the All India Council of Technical Education (AICTE) have been equally concerned to streamline and improve agricultural engineering education in the country. The ICAR appointed a Committee to bring uniformity in education and curriculum. The Committee was mainly concerned with the proper inputs of basic sciences, agriculture sciences, basic engineering, applied engineering and agricultural engineering in the course curriculum. The Committee also made recommendations to introduce electives to have limited specialization at undergraduate level. Through these electives, universities are expected to orient their teaching programs in favor of specific developmental needs of the region. The eastern states of Bihar, Orissa and West Bengal, for example, would require technology for development of rainfed agriculture as well as drainage technology. The teaching plan may focus on these, along with appropriate irrigation and watershed development. The Western and Central regions (Maharashtra, Gujarat, Rajasthan, Madhya Pradesh and Karnataka) may pay more attention to arid agriculture technology for oilseeds, millet, cotton and fruits suitable for low rainfall conditions along with precision irrigation and covered cultivation. The Northern region (Punjab, Haryana and Uttar Pradesh) is comparatively mechanized with better irrigation facilities. Wheat, rice, oilseeds, pulses, fruits and vegetables are major crops. The teaching plan in these universities may have greater focus on issues related to these. Southern region (Andhra Pradesh, Tamil Nadu and Kerala) and parts of Orissa and West

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Bengal have rice, coconut, arecanut, spices and groundnut as major crops. Wetland cultivation and processing of rice, spices and fruits should find special place in their teaching plan. Hill regions namely Jammu and Kashmir, Himachal Pradesh and North East Hill region may concentrate more on technology related to soil conservation and horticulture in hills. Water management and energy may be other major considerations.

Based on the guidelines proposed by the ICAR Committee the deans and heads of agricultural engineering colleges and departments developed a curriculum during their meeting on June 2-3, 1997 held at the Rajasthan Agricultural University, Udaipur (ICAR, 1999). Model curriculum for bachelor degree (160 credits) and suggested electives are given in Table 3 and Table 4, respectively. This curriculum was further discussed at a workshop held during December 1-3, 1997 at the Indian Institute of Technology, Kharagpur. The proposed semester-wise distribution of subjects for four-year degree course in agricultural engineering (201 credits) is given in Table 5 (Das, 1998). This agreed curriculum should meet the accreditation requirements of both the AICTE and the ICAR.

The overall content of two curricula is almost the same. The difference in number of credits is mainly due to a difference in the definition of a credit. In ICAR system one credit is equivalent to one hour of lecture or three hours of practical session. No credit is assigned to a tutorial. Under AICTE system two hours of practical session is equal to one credit. Tutorial session is also given credit. It works out that one credit of ICAR system is equivalent to about 1.25 credit of AICTE system.

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Post Graduate Specialization in Agricultural Engineering

The Indian farmers realize the importance of engineering inputs for increasing productivity and reducing human drudgery in farming operations. The industries have helped the farmers by manufacturing improved farm equipment and processing machinery by adopting suitable designs. As a result of GATT agreement and WTO, the Indian industries have access to importation of modern technology. The trade in agriculture is changing significantly. The multinational companies are also introducing new food products. However, thousands of small-scale industries and village artisans will still look for indigenous technology developed by Indian institutions. This also requires rethinking in research and education in agricultural engineering.

During the last 10-15 years, it is observed that more than one third of the positions in academic and research institutions could not be filled. Suitable persons with relevant experience and qualification are scarcely available. Trained persons to handle research projects in the renewal energy, draught animal power, oil seed processing and expulsion technology, human engineering and ergonomics, post-harvest and value addition are diff1cult to find. The academic institutions should look at the activities in which agricultural engineers are engaged and modify their curriculum to serve not only traditional organizations better but also look for better avenues in the field like oilseeds and pulses, feeds, fibers, horticultural and plantation crops. To cater to these specialized technological requirements, the following specialization are suggested.

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1. Farm Machinery Design and Manufacture

The specialization should include technology for appropriate mechanization, covered cultivation, reducing drudgery in farm operations, improving quality of farm produce and reducing cost of production, manufacturing technology, quality and standardization, testing and evaluation, machinery management, safety and health hazards and man-machine-power interaction.

2. Energy and Power in Agriculture

The specialization should include animate and mechanical power sources, bio-fuels, renewable energy, energy application and conservation, energy efficient appliances and equipment.

3. Post Harvest and Process Engineering

The specialization should include technology for post harvest, primary processing and value addition of food, feed, fiber and industrial crops, fermentation technology, controlled atmospheric packaging and low temperature storage.

4. Agricultural Structures and Environment Control Engineering

The specialization should include technology of rural dwellings, farm godowns, storage structures, warehouses, Mandi (agricultural produce market) mechanization, animal shelters and poultry houses, greenhouses and farm ponds for aquaculture.

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5. Irrigation and Drainage Engineering

The specialization should deal with technology for water resources development, water lifting, conveyance and utilization, conservation, controlled precision application of water through drip and micro-sprinkler, prevention of accumulation of excess water, flood control, reclamation of water logged soil using surface and sub-surface drainage.

6. Soil & Water Conservation Engineering

The specialization should deal with technology for land development, hydrology of natural precipitation, watershed development, accumulation and conservation of water, prevention of soil erosion from water and wind.

7. Dairy Engineering

The specialization should deal with animal husbandry, milk handling, processing and plant design, milk product development and freeze-drying.

8. Aquacultural Engineering

The specialization should deal with development of water bodies, pond structure and aeration, water quality management, feed development and management, fishing equipment, processing and preservation, storage, drying, packaging and handling.

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CONCLUSIONS

Agricultural engineering has been accepted as one of the major disciplines which contributes significantly in increasing the productivity of agriculture in the country by way of increasing efficiency of inputs, conservation of resources and reducing post harvest losses besides value addition of agro-produce.

To increase the scope of agricultural engineers further additional specialized academic training would be necessary in areas like minor and precision irrigation, watershed management, forestry, post harvest technology, aquaculture, food engineering, value additions of farm produce, agro-waste utilization and energy management in agriculture. Adequate flexibility may have to be incorporated in the syllabus to enable the students to select their specialization at undergraduate level through the selection of appropriate electives. This, however, would require proper guidance and counseling by the university teachers.

At postgraduate level, the specialization being offered by Indian universities in agricultural engineering should be increased. Few suggestions include; Farm machinery design & manufacture, Energy and power in agriculture, Soil and water conservation engineering, Irrigation and drainage engineering, Post harvest and process engineering, Agricultural structures and environment control engineering, Dairy engineering and Aquacultural engineering.

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Table 1. Intake Capacity in Agricultural Engineering Institutions

Year	University/Institute	B.Tech. B.E.	M.Tech. M.E.	Ph.D.
1942	Allahabad Agricultural Institute, Allahabad, UP	46	10	-
1952	Indian Institute of Technology, Kharagpur, WB	20	64	10
1962	G. B. Pant Univ. of Agri. & Tech., Pantnagar, UP	45	40	12
1964	Punjab Agricultural University, Ludhiana	50	36	12
1965	Orissa Univ. of Agri. & Tech., Bhubaneshwar	40	20	-
1965	Rajasthan Agricultural University, Udaipur	48	12	15
1967	Indian Agricultural Research Institute, New Delhi	-	6	6
1967	National Dairy Research Institute, Karnal, Haryana	-	-	5
1967	J. N. Krishi Vishwa Vidhyalaya, Jabalpur, MP	40	12	-
1969	M. P. Krishi Vishwavidhyalaya, Rahuri, Maharashtra	55	10	-
1969	P. D. Krishi Vidhyapeeth, Akola, Maharashtra	60	8	-
1972	Tamil Nadu Agricultural University, Coimbatore	-	33	12
1983	A.N.G.R. Agricultural University, Bapatla, AP	30	-	-
1983	Rajendra Agricultural University, Pusa, Bihar	30	9	-
1984	Gujarat Agricultural University, Junagarh	50	4	-
1985	Kerala Agricultural University, Tavanur	33	8	-
1986	Marathwada Krishi Vidhyapeeth, Parbhani, Maharashtra	32	-	-
1987	Haryana Agricultural University, Hissar	30	8	-
1988	University of Agricultural Sciences, Raichur, Karnataka	28	6	-
1992	N. E. Reg. Inst. of Sci. & Tech., Nirjuli, Arunachal Pradesh	20	-	-
1992	M. G. Gramodaya Vishwavidhyalaya, Chitrakoot, MP	30	-	-
1994	C. S. A. University of Agriculture & Tech., Etawah, UP	60	-	-
1994	Tamil Nadu Agricultural University, Tiruchirapalli	100	-	-
1995	B. C. Krishi Vishwavidhyalaya, Mohanpur, WB	15	-	-
Total		**862**	**286**	**72**

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Table 2. Graduates in Agricultural Engineering

Year	Bachelor	Master	Ph.D.
1984	361	70	17
1985	377	71	18
1986	401	74	15
1987	401	97	19
1988	418	116	18
1989	418	164	14
1990	423	130	5
1991	377	73	7
1992	395	88	7
1993	389	67	5
1994	438	79	21
1995	404	69	14
1996	431	51	33
Average	**403**	**88**	**15**

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Table 3. ICAR Model Curriculum for Bachelor Degree in Agricultural Engineering

SEMESTER I	**18**	**SEMESTER II**	**20**
Mathematics I	3	Mathematics II	3
Physics	4	Workshop Technology	3
Chemistry	4	Engineering Mechanics	4
Workshop Practice	2	Surveying & Leveling	3
Animal Science	3	Engineering Drawing	3
Computer Literacy	3	Soil Science	2
		Thermo.& Heat Engines	2
SEMESTER III	**21**	**SEMESTER IV**	**21**
Agronomy	2	Statistics	3
Mathematics III	3	Agricultural Business	
Horticulture	2	Management	3
Food Science	3	Electrical Engineering III	3
Strength of Materials	3	Fluid Mechanics	3
Heat & Mass Transfer	2	Hydrology	3
Agr.Eco.& Farm Manag.	3	Kinematics of Machines	3
Electrical Engineering I	3	Soil Mechanics	3
SEMESTER V	**21**	**SEMESTER VI**	**21**
Computer Applications	3	Building Materials and	
Electronics & Instrumentation	4	Structural Design	4
Soil & Water Conservation		Machine Design	3
Engineering	3	Refrig. & Air Conditioning	2
Systems Engineering	3	Farm Power	3
Farm Machinery	3	O&M of Tractors & Engines	1
Post Harvest Technology of		Technical Writing	2
Cereals, Pulses and Oil Seeds	4	PHT of Horticultural Crops	3
O&M of Farm Machinery	1	Elective – I	3

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SEMESTER VII	20	SEMESTER VIII	18
Irrigation & Drainage Engineering	4	Irrigation & Drainage Equipment Design	2
Farm Machinery Design	2	Process equipment Design	2
Dairy & Food Engineering	3	Advanced Farm Power	2
Renewable Energy	3	Standardization & quality Control	2
Environ. Control Engg.	2	Extension Education	3
Elective-II	3	Elective-III	4
Project-I	3	Project-II	3

Table 4. List of Electives for ICAR Curriculum

Farm Power and Machinery

1. Ergonomic principles and practices
2. Farm power and machinery management
3. Land development machinery
4. Testing of agricultural machinery and tractors
5. Farm machinery manufacturing
6. Design of agricultural tractors

Soil and Water Engineering

1. Minor irrigation and command area development
2. Ground water hydrology
3. Watershed management
4. Remote sensing and G.I.S.
5. Rural water supply and sanitation
6. Small dams and reservoirs

Post Harvest Process and Food Engineering

1. Bio-process engineering
2. Seed processing
3. Food industry management
4. Storage engineering
5. Food engineering

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Table 5. Proposed AICTE Curriculum for Bachelor Degree in Agricultural Engineering

SEMESTER I	**25**	**SEMESTER II**	**25**
English for Professional Communication	5	Engineering Chemistry	5
Mathematics I	4	Mathematics II	4
Engineering Physics	5	Computer Literacy	5
Workshop Practice	3	Principals of Management	3
Engineering Graphics	3	Engineering Graphics II	3
Basic Electrical Engineering	5	Engineering Thermodynamics	3
SEMESTER III	**26**	**SEMESTER IV**	**25**
Basic Electronics	6	Electrical Machines	6
Food Science	6	Fluid Mechanics	6
Principals of Biotechnology	5	Soil Science	4
Crop Production	5	Kinematics & Dynamics	4
Engineering Mechanics	4	Strength of Materials	4
SEMESTER V	**25**	**SEMESTER VI**	**25**
Heat & Mass Transfer	6	Post Harvest Engineering	5
I.C. Engines	5	Food Products & Process Technology	4
Surveying	5	Farm Machinery	5
Hydrology	4	Refrigeration & Airconditioning	5
Soil & Water Conservation Engineering	4	Material Science & Engineering	3
		Operations Research	3
SEMESTER VII	**25**	**SEMESTER VIII**	**25**
Pumps & Blowers	5	Irrigation & Drainage Engineering	6
Ground Water & Well Engineering	3	Instrumentation & Control Engineering	6
Tractors & Power Units	5	Tillage & Traction Engineering	4
Dairy & Food Processing Operations	6	Elective II	3
Project I	3	Elective III	3
Elective I	3	Project II	3

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Table 6. List of Suggested Electives for AICTE Curriculum

Environmental Engineering
Seed Technology and Processing
Remote Sensing and G.I.S.
Process Equipment Design
Renewable Energy
Human Factors Engineering
Plantation & Horticultural Products Processing
Fish Preservation & Processing Technology
Milk & Milk Products Processing
Bioprocess Engineering
Aquacultural Engineering
Fats & Oil Processing
Concentration & Dehydration of Foods
Food Plant Utilities & Sanitation
Physical Properties of Biomaterials
Convenience Foods & Beverages

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