Int. J. Engng Ed. Vol. 22, No. 1, pp. 79–85, 2006
Printed in Great Britain.

0949-149X/91 $3.00+0.00

The Need to Reform Agricultural Engineering Curricula in Developing Countries*

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Currently there are over 164 universities in 31 countries offering undergraduate degree programs (or as an emphasis) in agricultural engineering (AE). Many of these programs are not offered through engineering colleges and thus are not accredited as engineering degrees. Some of the AE curriculums have less than 50% of the coursework in engineering and as a result, inadequate training in engineering is given to AE graduates to compete with those with traditional engineering degrees. Many AE programs place very little emphasis on the areas like bioprocess engineering or biomedical engineering that can make the graduates more marketable. National engineering institutions of some of the developing countries do not welcome agricultural and biological engineers on board for professional membership. This manuscript will critically evaluate such problems and the current situation of agricultural engineering education in developing countries and will attempt to create awareness among universities and professional organizations of what is necessary for a thriving agricultural and biological (systems) engineering profession.

Keywords: agricultural degrees; developing countries; declining enrolments

INTRODUCTION: BACKGROUND OF AGRICULTURAL AND BIOLOGICAL ENGINEERING

THE PROVENANCE of Agricultural and Biological (Systems) Engineering is from the basic engineering discipline of Agricultural Engineering. In the late 60s, US engineering schools initiated incorporation of the biological engineering component into traditional agricultural engineering programs. Mississippi State University is the first US University to initiate a biological engineering program in 1967. As a result, many other traditional agricultural engineering programs started incorporating biological engineering into their programs which also resulted in change of departmental names to reflect program changes. Currently there are over 164 universities in 31 countries offering undergraduate degree programs (or as an emphasis) in agricultural engineering [1].

Traditionally, agricultural engineering departments had emphasis on areas of farm mechanization, precision agriculture, food, and soil and water resources engineering. Graduates from these programs were trained to utilize scientific principles to design systems and equipment in order to manage numerous resources that provide food and fiber with the objective of reducing labor, improving productivity and raising the standard of living of the farmer [2, 3]. However, the biological engineering programs have brought in a broad array of diversified fields into the traditional agricultural engineering arena ever since. In general terms, biological engineering is the application of engineering principles to solve biological and medical problems. Typical biological engineering programs have emphasis on areas like biomedical engineering, food and bioprocess engineering, instrumentation and controls, and environmental engineering.

A closer look into many programs offered by US universities suggest that there is a considerable amount of overlap between the agricultural engineering and biological engineering programs. Owing to this, one could see a variety of different naming systems that are being used. Some examples are agricultural and biological engineering, biological systems engineering, biosystems engineering and bioresource engineering. Also, it will be helpful to note that there is still confusion even in the developed world on the distinctive definition and boundaries of the terms 'biological engineering' and 'biomedical engineering'. In addition, evidence of the breadth and cross-disciplinary nature of this discipline is found by incorporation of many different fields in biological engineering curriculums including chemistry, physics, biology and engineering [4–6]. For the sake of clarity, the term 'biological engineering' is used to signify collective science of biological (systems) engineering while treating biomedical engineering as a sub-element within biological engineering.

* Accepted 21 August 2005.

TRENDS AND PROBLEMS ASSOCIATED WITH AGRICULTURAL ENGINEERING CURRICULA IN DEVELOPING COUNTRIES

According to Opara [7]:

> Agricultural engineering (AE) is one of the disciplines that have been adversely affected by declining enrolments and popularity among school leavers, not only in developed countries but also in developing countries. Efforts to reverse the downward trend must consider curriculum changes, which broaden the currently narrow and shrinking sources of potential students, as well as providing them with skills for lifelong learning and employment opportunities beyond the agricultural sector.

Many AE programs in developing countries have agricultural machinery, soil and water resources engineering, and food engineering as the core areas in the curriculum. In contrast, many curricula in US universities include courses related to biomedical engineering and bioprocess engineering in addition to the above areas, which make the graduates more marketable. A closer look at the course content of various agricultural engineering specializations will make it easy to reveal the limited exposure a graduate with a traditional agricultural engineering degree would possess in engineering.

The specialization of farm machinery and precision agriculture includes 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. Unlike AE programs in developing countries, several US agricultural and biological engineering programs have diversified into more timely topics like bioenegy, bio-fuels, renewable energy, energy application and conservation, energy-efficient appliances and equipment and geographical information systems (GIS). The specialization in food engineering includes technology for post-harvest and value-added processing of food, feed, fiber and industrial crops. The soil and water resource engineering emphasis deals with technology for land development, hydrology, watershed development, accumulation and conservation of water, and prevention of soil erosion. It also encompasses 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 waterlogged soil using surface and sub-surface drainage.

The agricultural engineering graduates in developing countries who hold specializations in the more traditional areas of AE find it difficult to survive in today's job scenario because engineers with an emphasis on agricultural machinery would have to compete with mechanical engineers, water resource engineers with civil engineers, and food engineers with chemical engineers. The AE curricula in the developing countries put very little emphasis on the areas like bioprocess engineering or biomedical engineering that gives the agricultural and biological engineering graduates an edge over other engineering graduates. Also, many of the industries in developing countries are still unaware of the capabilities of agricultural and biological (systems) engineers and this further aggravates the situation.

To provide a deeper insight into the way in which the education system featuring agricultural engineering operates in developing countries, a typical case study of India has been presented. Currently, 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 [8]. These institutions have an annual intake capacity of about 860 at bachelor, 280 at master and 70 at Ph.D. degree levels (Table 1). Numbers of students graduating from these institutions with different degrees are given in Table 2 [8, 9]. The annual averages for the period 1984 to 1996 are 403, 88 and 15 for bachelors, masters and Ph.D. degrees, 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.

In a fair number of cases, agricultural engineering (AE) programs are not offered through engineering colleges and thus are not accredited as engineering degrees. Since economies of most of the developing countries including India still rely heavily on basic agriculture, undergraduate AE programs tend to be geared towards giving students a wide spectrum of knowledge in agriculture and biology shifting the balance of the curriculum more into biology than an engineering degree. As a result, these programs do not give adequate training for AE graduates to compete with those holding engineering degrees in traditional engineering disciplines.

Table 3A presents Indian Council for Agricultural Research (ICAR) model curriculum for Bachelors degree in Agricultural Engineering [10]. (Table 3B presents a typical Biological Engineering curriculum adopted from Department of Biological Engineering at Mississippi State University as a comparison.) In this model, the balance is shifted more towards engineering and lacks the much needed biological background that an agricultural and biological engineering student should possess. There is hence an immediate need to develop a curriculum model that would help the student acquire necessary engineering skills without compromising too much on the biological perspective. In fact, the strong background in biology is the edge that an agricultural and biological engineering graduate would have in comparison to an engineer in another discipline.

Table 1. Intake capacity in agricultural engineering institutions in India

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

Source: Singh, G. Agricultural Engineering Education in India, *Agricultural Engineering: the CIGR Journal of Scientific Research and Development*. Vol. II, October 2000.

The agricultural sector in many developing countries is beleaguered with problems which limit productivity. One such factor is rudimentary technologies taught in schools and therefore applied in the field. Most institutions are located in rural, poor agricultural regions and need support to increase the quality and quantity of agricultural workers. Designing and implementing curricula that are responsive to the socio-economic problems of such countries are extremely important if the AE profession is to thrive. In addition, training and upgrading the staff to enable implementation of new curricula is equally important.

Table 2. Number of students graduated in agricultural engineering from India

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

Source: Singh, G., Agricultural Engineering Education in India, *Agricultural Engineering: the CIGR Journal of Scientific Research and Development.* Vol. II, October 2000.

One problem that all developing countries are facing is brain drain of trained scientists and teachers to developed countries. It is important to state that it is very crucial for higher education agencies of developing countries to provide university teachers with competitive incentives if they are to retain them.

The relatively low importance given to agricultural engineers in the developing countries could be directly linked with existing problems related to agriculture in these countries. Some of the problems listed below might help clarify the reason why the scope for survival of agricultural engineers is lesser in developing countries

1. The abundant manpower coupled with the low per capita land availability are the major impediments that prevent adoption of large machinery in the agriculture of developing countries. In contrary, the low population growth rate and the consequent shortage of manpower together with the large tracts of land for agriculture facilitates the employment of machinery and other innovative techniques into farming in developed countries. Again, the food habits of the people in developed countries are such that they tend to rely heavily on packaged foods. Moreover, the people of developed countries have diversified tastes as compared to those in developing countries, who can afford only cheap and fresh commodities procured directly from the farm. The rampant poverty and the illiteracy yet again thwart the steps for the implementation of the costly and high-tech

Table 3A. ICAR model curriculum for Bachelor Degree in Agricultural Engineering

SEMESTER I	SEMESTER II	SEMESTER III	SEMESTER IV
Mathematics I	Mathematics II	Agronomy	Statistics
Physics	Workshop Technology	Mathematics III	Agricultural Business
Chemistry	Engineering Mechanics	Horticulture	Management
Workshop Practice	Surveying & Leveling	Food Science	Electrical Engineering III
Animal Science	Engineering Drawing	Strength of Materials	Fluid Mechanics
Computer Literacy	Soil Science	Heat & Mass Transfer	Hydrology
	Thermo.& Heat Engines	Agr.Eco.& Farm Manag.	Kinematics of Machines
		Electrical Engineering I	Soil Mechanics
SEMESTER V	SEMESTER VI	SEMESTER VII	SEMESTER VIII
Computer Applications	Building Materials and	Irrigation & Drainage Engineering	Irrigation & Drainage
Electronics & Instrumentation	Structural Design	Farm Machinery Design	Equipment Design
Soil & Water Conservation Engineering	Machine Design	Dairy & Food Engineering	Process equipment Design
Systems Engineering	Refrig. & Air Conditioning	Renewable Energy	Advanced Farm Power
Farm Machinery	Farm Power	Environ. Control Engg.	Standardization & quality Control
Post Harvest Technology of Cereals, Pulses and Oil Seeds	O&M of Tractors & Engines	Elective-II	Extension Education
O&M of Farm Machinery	Technical Writing	Project-I	Elective-III
	PHT of Horticultural Crops		Project-II
	Elective—I		

agricultural implements. These problems put together diminish the scope of survival of an agricultural engineer in developing countries.

2. Subsidies on agriculture and its related issues are quite less in developing countries. A poor farmer cannot afford engineering applications with costly implements. The farmers of developed countries have an edge when it comes to the government aids either in the form of subsidy or the benefits at times of drought or flood.
3. The other major impediment for an agriculture related profession is the lesser recognition the society gives to agriculture. Farming is the most common profession among majority of the rustic dwellers. Unfortunately, some school leavers are forced into farming only when their quest for more 'elegant' professions ends fruitless. This perception can only be defeated by introduction of new technology with effective extension practices.
4. The lack of proper insurance in agriculture and its technology.

PROBLEMS WITH PROFESSIONAL REGISTRATION

One other unfortunate fact is that the national engineering institutions of some of the developing countries do not welcome agricultural and biological engineers onboard for professional engineering membership. This is partly due to the prejudice and bureaucracy prevalent with governing bodies that are unwilling to accept the fact that engineering as a whole is becoming multidisciplinary. It is very important to have professional recognition for a growing profession. If the situation does not improve, establishment of exclusive boards pertaining to the growing profession—biological engineering, which, in fact, will attract members of other engineering disciplines who have complementary interests will be unavoidable.

WHAT IS THE BEST WAY TO DEVELOP AGRICULTURAL AND BIOLOGICAL ENGINEERING IN DEVELOPING COUNTRIES?

The present international scene suggests that two models may be adopted [11]. The first model suggests that agricultural, biological (systems) engineering/bioengineering, biomedical engineering and chemical engineering be pursued in a parallel and mutually beneficial manner. The biomedical engineering component would typically be centered on medical devices, imaging, biomechanics and biophysics, prostheses and radiology. Biomedical engineering integrates physical, chemical, mathematical, and computational sciences and engineering principles to study biology, medicine, behavior and health. It advances fundamental concepts, creates knowledge from the molecular to the organ systems levels, and develops innovative biologies, materials, processes, implants, devices, and bio-informatics for the prevention, diagnosis, and treatment of diseases, for patient rehabilitation, and for improving health [12].

The broader bioengineering area encompasses

Table 3B. The curriculum of a typical biological (systems) engineering program (source: Department of Biological Engineering, Mississippi State University)

Biological Engineering Curriculum with no Emphasis

SEMESTER I	SEMESTER II	SEMESTER III	SEMESTER IV
Fund. Of Chem I	Fund. Of Chem II	Social/Behav. Sci. Elec.	Public Speaking
Inv. Of Chem I	Inv. Of Chem II	Phyics II	Physics III
Bio. Sci. Elective	Physics I	Engr. Mech. I	Engr. Mech. II
Engr. In Life Sci	Bio. Sci. Elective	Calculus III	Calculus IV
Calculus I	Calculus II	Comp. Prog. With C	Thermodynamics
English Composition I	English Composition II		Biosystem Simulation
Humanities Elec.	Analytical Methods		

SEMESTER V	SEMESTER VI	SEMESTER VII	SEMESTER VIII
Elementary Organic Chem.	General Microbiology	Elem. Biochem.	Technical Writing
Elementary Organic Lab	Biophysical Prop. Of Matls.	Engineering Seminar	Fine Arts Elec.
Fluid Mechanics	Transport in Bio. Environments	Treatment of NPS Pollution	Engr. Elec.
Mechanics of Materials	Engr. Elec.	or Phy. Sys. Biomed. Engr	Humanities Elec.
Differential Equations	Bioinstrumentation II	Engr. Elec.	BE Practices Lab
Bioinstrumentation I	Graphics Communication	Social/Behv. Sci. Elec.	
Bio. Sci. or Engr. Elective		Prin. Of Engr. Design	
		BE Prin. Lab	

Biomedical Engineering Curriculum

SEMESTER I	SEMESTER II	SEMESTER III	SEMESTER IV
Zoology instead of Bioscience elective	—ditto—	—ditto—	—ditto—
All others are same as above			

SEMESTER V	SEMESTER VI	SEMESTER VII	SEMESTER VIII
—ditto—	Elem. Biochem. in place of Eng. Elective	Engineering Seminar	Technical Writing
	—ditto—	Biomed. Mtls	Fine Arts Elec.
		Phys. Sys. Biomed. Engr	Engr. Elec.
		Engr. Elec.	Humanities Elec.
		Biomechanics	BE Practices Lab
		Prin. Of Engr. Design	
		BE Prin. Lab	

medical and industrial applications of biological systems where chemical reactions are a fundamental determinant. It comprises multi-scale biological systems and applications ranging from the molecular to the cellular and equipment levels, such as, biotechnology, bioprocessing, metabolic engineering and cellular–molecular biomedical applications defined by equilibrium or rate (reaction and/or transport) processes. Bioprocess engineering component deals with value-added processing of agricultural raw materials for food and industrial applications. Bioprocess engineering curriculums would include courses similar to those offered in chemical engineering programs with an emphasis on materials and processes of living systems [13].

The second model suggests planting of seeds from different curricula (including chemical engineering, mechanical engineering, biomedical sciences, molecular biology, etc.) into new organizational units to encourage the evolution of new versions of biological engineering. This could be an iconoclastic approach if any history pertaining to the evolution of engineering disciplines or the needs of the industry is not taken into account.

Regardless of the subject emphasis, all agricultural and biological engineering curriculums should include foundational courses of physics, chemistry, biology, pure and applied mathematics and principles of engineering courses in its core curriculum. Curriculum reform is needed to reflect this fundamental change primarily in a contextual sense aiming at introducing agricultural and biological engineers to basic concepts of engineering applications in living systems. Such a curriculum reform would enrich biological engineering as an engineering discipline and profession that would serve well the needs of the new chemical, biotechnology and pharmaceutical industries. According to Lauffenburger [14], a diverse spectrum of traditional engineering disciplines, including chemical engineering, have important roles to play in addressing opportunities and challenges from perspectives of biomechanics, biomaterials, bioelectronics, and computational biology along with biochemical engineering to establish biological engineering as a distinct biology-based engineering discipline. Following the analogous example of chemical engineering being developed a century ago as a novel chemistry-based engineering discipline, departmental curriculums should be revised to incorporate courses from these disciplines to strengthen their programs.

When introducing these courses, it is not necessary to reinvent all of the courses since most of these courses are already taught in other departments. However, there is another major obstacle that the curriculum developers would have to face when introducing courses from different departments. This is the inability of students to take cross-departmental courses when the departments are affiliated to different subject streams. A student majoring in chemistry may not be allowed to take a course in chemical engineering. Consequently, when a student selects a particular subject stream (e.g. natural sciences) the doors to all other departments in other streams (e.g. engineering) get closed.

The higher education system in Sri Lanka (and several other developing countries) is a prime example. The education system in Sri Lanka separates students into four main subject streams when the students are in the 11th grade, i.e. arts, business, science and engineering. Under no circumstances are these students allowed (by the state education system) to change the career they selected when they were 15 years olds. Those who selected science stream could major in areas such as basic sciences (natural sciences and physical sciences), agriculture (including agricultural engineering), veterinary medicine or medicine. Those who selected the engineering stream could major in traditional engineering disciplines and physical sciences. Upon entering the university, when these students are required to take basic science courses, the courses would be offered through departments within the subject streams (faculties) rather than in the basic science departments. This means that Agricultural Engineering students affiliated to the agriculture stream may not take any course offered through a department affiliated to the traditional engineering stream or vice versa. Consequently, at any given time, courses (for example organic chemistry) at the same level would be offered in the medical college, engineering college, agricultural college and basic sciences college within the same campus. As sad and inefficient as it sounds, this is the truth. A major reason behind this segmentation is the bureaucracy and prejudice prevailing among administrators who are unwilling to diverge from the anachronistic education system. The gloomy element in this drama is that it is impossible to bridge biology and engineering together at the undergraduate level. And as a result, it is an intricate task to incorporate into engineering curricula areas like bioprocess engineering and biomedical engineering that demand equal knowledge of biology and engineering.

CONCLUSIONS

Agricultural engineering is one of the disciplines affected by declining enrolments and popularity in both developing and developed countries. AE programs in developing countries are still heavily based on traditional curricula. Efforts to reverse the downward trend must consider curriculum changes that provide them with skills for competitive employment opportunities beyond the agricultural sector. Many agricultural engineering programs in developing countries have agricultural machinery/precision agriculture, soil and water resources engineering, and food engineering as core areas in the curriculum. If agricultural engineering is to thrive, areas like bioprocess engineering and biomedical engineering should be incorporated along with subsequent name changes to reflect program changes. Also, the perceptions of members from more traditional engineering professions should be changed to help the engineers of this emerging disciple rise from the shadows of their counterparts. It is very important to realize that problem-solving pertaining to living systems is exceedingly critical which requires the expertise of both physical engineers and biological engineers. In addition, it should be realized that the world is increasingly moving towards finding bio-based means for solving physical problems. Also, professional agricultural engineering organizations should be more active in disseminating information about the strengths and capabilities of agricultural and biological (systems) engineers to the industry and the public if the agricultural and biological engineering profession is to sustain.

REFERENCES

1. S. Fernando (2004). Unpublished data.
2. Purdue University. The Engineering Specific Career Planning and Problem-Solving Environment, Purdue University, Freshman Engineering, 2004. https://engineering.purdue.edu/FrE/ESCAPE/fields/agricultural/defn.html.
3. Krishiworld. *Agricultural Engineering*, 2004. http://www.krishiworld.com/html/agri_engg1.html.
4. C. Craig, Biological engineering: From blue roses to space suits, *Abstracts of Papers, 225th ACS National Meeting*, 2003, New Orleans, LA, American Chemical Society.
5. Native access to Engineering Programme, Faculty of Engineering and Computer Science, 2004. http://www.nativeaccess.com/types/chem_bio.html.

6. Louisiana State University, White Paper On Biological Engineering, 2004. http://www.bae.lsu.edu/information/whitepaper.html.
7. L. U. Opara, Outlook for agricultural engineering education and research and prospects for developing countries, *Outlook on Agriculture,* **33**(2). 2004, pp. 101–111.
8. B. G. Yadav, S. S. Tomar and G. Singh, Agricultural Engineering Education and its Programmes in India, *Agricultural Engineering Today,* **21**, 1997, ISAE, pp. 74–98.
9. G. Singh and G. Singh, *Agricultural Engineering Education in India—An Approach to Meet Emerging Needs,* Indian Council of Agricultural Research, 1995.
10. G. Singh, Agricultural Engineering Education in India*, Agricultural Engineering: the CIGR Journal of Scientific Research and Development,* **2**, 2000.
11. G. Stephanopoulos, Invited comment: Chemical and Biological Engineering, *Chemical Engineering Science,* **58**(22), 2003, pp. 4931–4933.
12. NIH Working Definition of Biomedical Engineering, NIH, 2002. http://www.cvrti.utah.edu/~macleod/bioen/bme-definition.shtml.
13. *Advances in Bioprocess Engineering*, Biospace, 1998. http://www.biospace.com/publication_detail.cfm?RID=215904.
14. D. a. Lauffenburger, Biochemical engineering and biological engineering: Siblings but not twins, *Abstracts of Papers, 224th ACS National Meeting*, 2002, Boston, MA, American Chemical Society.

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