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The Evolution of Agricultural Engineering Education and Curriculum Reform at Sultan Qaboos University*

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The objective of this article is to describe the evolution of agricultural engineering education at Sultan Qaboos University, including curriculum changes and employment status of its graduates. The agricultural mechanization program was established in the Department of Mechanization in 1986. After a decade, the department name and program were changed to Bioresource and Agricultural Engineering (BAE). Most recently, the department has been merged with the Department of Soil and Water Sciences to form a new Department of Soils, Water, and Agricultural Engineering. The name change in 1996 was considered to represent a paradigm shift from a focus on 'technology' content to greater emphasis on 'engineering' content and this re-orientation was further reflected by changes in the curriculum to increase the content of mathematics and basic engineering courses. Including the word 'engineering' in the name of the major appears to enhance its appeal and attractiveness to students. A comparison between the BAE curriculum and a generalized framework within which most accredited engineering curricula can be evaluated showed that the BAE undergraduate curriculum meets the minimum requirements of ABET professional program. Employment of graduates in the public sector has been very good, but appears to be recently stagnating.

Keywords: agricultural engineering; bioresource engineering; curriculum reform; ABET accreditation

INTRODUCTION

IN A GLOBAL CONTEXT, the discipline of agricultural engineering has undergone considerable changes in orientation during the past decade in response to both external and internal pressures affecting universities and agriculture-related programs [1–7]. At Sultan Qaboos University (SQU), the national university in the Sultanate of Oman, the academic program in Agricultural Engineering (AE) is an integral part of the College of Agricultural and Marine Sciences. A challenge facing AE in Oman and similar arid countries is to develop appropriate and innovative solutions for sustainable exploitation and management of agricultural and marine bioresources and to mitigate the impacts of human interventions on the environment. Although the oil and gas sectors dominate the national economy, both the 5-year national development plan and the 2020 Vision of the government underscore the importance of increasing the contributions of agricultural and marine sectors in ongoing efforts to diversify the economy.

As the premier academic institution in the country, SQU is expected to play a leading role in the realization of the government's development plan for the agricultural and marine sectors. One of the objectives for engineering education established at the opening of the university in 1986 was to widen the horizons for the use of modern engineering science and technology to advance agriculture through a program in AE [8]. Such program was established in 1986, and the first graduates were produced in 1990. Since its beginning, the AE program has undergone significant changes in philosophy, curriculum content and name. The objectives of this paper are to describe the evolution of the AE undergraduate program at Sultan Qaboos University and to propose future directions to strengthen it in response to the agricultural, food and environmental challenges facing the Sultanate in the 21st century.

AGRICULTURAL MECHANIZATION PROGRAM (1986–95)

The Department of Agricultural Mechanization (and its academic program) was among the pioneering departments when the College of Agriculture was set up at Sultan Qaboos University. The academic major offered was a 4-year Bachelor of Science (BSc) Agricultural Mechanization program which focused on hands-on technical aspects of farm power, machinery, and irrigation systems as related to tillage, crop planting and

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protection, harvesting and processing, irrigation and management of water conservation structures.

Students took courses in applied mechanics, engineering science, surveying, electrical systems, design, utilization and management of power units and machinery, and computer applications. Lectures, laboratory and workshop activities and fieldwork were integrated in the program. Table 1 shows a typical curriculum of the agricultural mechanization program offered during the period 1985-95. Although the total number of credit hours required was comparable to standard engineering programs, the total credit of courses offered in Mathematics & Basic Sciences was about 50% less than the minimum requirement for accredited professional engineering programs. Thus, the agricultural mechanization curriculum offered at Sultan Qaboos University was deliberately designed to produce engineering technologists who have the technical skills to work with professional engineering personnel.

The objective of the agricultural mechanization program was to produce graduate specialists who would provide technical and applied engineering services in solving operational problems of mechanized agriculture and fisheries resource exploitation. Graduates were expected to develop their skills in field crop production and processing, selection, utilization, maintenance and repair of equipment and structures, and mechanization extension and advisory services to farmers. In 1990, the first batch of seven students (out of 10 originally enrolled) graduated from the Agricultural Mechanization degree program.

BIORESOURCE AND AGRICULTURAL ENGINEERING PROGRAM (1996–2003)

The Agricultural Mechanization program underwent extensive internal reviews in efforts to replace it with a new program that is more engineering oriented. It was initially proposed to replace the mechanization program with a new major in Bioresource Engineering [8], but eventually the name Bioresource and Agricultural Engineering (BAE) was adopted. Many faculty and students still use only the word 'Bioresource' to refer to the

Table 1. The 1986 Degree Plan for BSc in Agricultural Mechanization, College of Agriculture, Sultan Qaboos University

University requirements (Cr = Credits):			Departmental requirements:		
University requirements		Cr	Departmental requirements		Cr
ARAB1001	Arabic	3	AGRN2502	Introduction to Agronomy	3
HIST1010	Oman and Islamic Civilization	2	AMEC1201	Introduction to Agricultural Mechanization	3
LANC****	As defined by College	6	AMEC2301	Mechanics I	3
SOCI3320	Contemporary Omani Society	1	AMEC2302	Workshop Practice I	3
Electives Requirement			AMEC2303	Materials	3
********	The Student chooses 6 credits from any University electives	6	AMEC2304	Electrical Systems	3
			AMEC2306	Land Surveying	3
Total credits defined: 18			AMEC2311	Mechanics II	3
			AMEC2312	Workshop Practice II	3
College requirements			AMEC2313	Engineering Science	3
BIOL1009	Introductory Biology	3	AMEC3401	Mechanics III	3
BOTN2001	Introductory Plant Biology	3	AMEC3402	Power Units	3
CHEM1009	Introduction to Chemistry	3	AMEC3404	Machinery Applications	3
CHEM2201	General Chemistry I	4	AMEC4403	Machine Design	3
COMP2001	Microcomputers in Agriculture	3	AMEC4405	Automatic Controls	3
LANC2040	English For Agriculture I	3	AMEC4406	Farm Machinery Management	3
LANC2041	English for Agriculture II	3	AMEC4412	Soil–Machine Relations in Tillage and Traction	3
MACS1010	Foundation Mathematics	6	AMEC4413	Hydraulic And Pneumatic Systems	3
PHYS1009	General Physics	3	AMEC4414	Special Problems	3
PHYS2207	Physics for Agriculture	4	ECON4500	Agricultural Extension Methods and Techniques	3
Total credits defined: 35			MATH2296	Mathematics for Agriculture	3
			SWAT2201	Introduction to Soil and Water	3
Elective requirement—choose 3 credits from			SWAT3301	Soil Physics	3
ECON3001			SWAT3402	Irrigation Principles	3
ECON4001	Introduction to Agricultural Economics	3	SWAT4406	Irrigation Systems	3
ERSC2901	Farm Management	3		Total credits defined: 75	
HORT2515	Earth Sciences for Agriculture	3			
PLNT3005	Introduction to Horticulture	3			
SWAT3303	Statistical Methods and Experimental Design	3			
SWAT3305	Hydrology	3	Total credits defined for the degree: 131		
	Agroclimatology	3	Total Credits Required For The Degree: 130		

department and/or its academic major. This might partly explain the inconsistency observed in official records on the exact name of the major. For instance, departmental record in the 1997 College Annual Report lists the new major enrolled by students as 'Bioresource and Agricultural Engineering', while the Annual Reports for 1998 and 1999 contained 'Bioresource Engineering' [9].

The new program name was considered a shortened form of biological resources engineering, a new terminology that was rapidly emerging as one of the names adopted (partly or in full) by some agricultural engineering programs in North American universities [1–8]. In the Omani context, the term Bioresource Engineering was also considered to imply engineering related to activities such as soil and water conservation, forestry and range production and management, fisheries habitat enhancement, wild lands management and other activities directed toward conservation of biological resources such as food and agricultural products [8]. The objective of the Bioresource Engineering program was to produce professional engineers.

In 1996, a new department name and undergraduate program in Bioresource and Agricultural Engineering (BAE) was approved by the University Council to replace the mechanization program. The Mission of the new department was 'To produce professional engineering graduates in Bioresource and Agricultural Engineering, to carry out research with emphasis on regional concerns and to provide services that lead to an improvement in the quality of life' [10]. The BAE curriculum was designed as a four-year program (excluding the period of one or more semesters of intensive English language courses at the university).

Students enrolled in the program complete the majority of core engineering courses (such as Drawing and Computer Graphics, Thermodynamics, Statics, Dynamics and Fluid Mechanics) alongside their peers in the College of Engineering (Table 2). The program was designed to produce graduates who are able to integrate scientific knowledge with engineering science and skills to solve practical problems in agriculture, food industry and the environment. The philosophy behind the restructuring was to develop and implement an educational program that is rigorous on the engineering aspects of production agriculture, but also broad enough to prepare students to find careers in other industries that are not directly related to production agriculture. The approach required a curriculum that integrates lectures with practical design experience, hands-on laboratory exercises, mechanical workshop practice and field production activities. The suite of departmental electives offered in the program enables graduate to complete their studies in one of three focal areas, namely, power and machinery engineering, soil and water engineering, and food and process engineering.

The teaching and learning philosophy promoted across all BAE courses places great emphasis on exposing students to complex problem-solving techniques, which should enable our graduates to be 'trouble shooters' and 'system integrators' who are able to work as members of multi-disciplinary technology teams Class sizes in BAE courses rarely exceed 20 students and this enables faculty to interact closely with students to provide them with personalized learning experiences.

CURRICULUM AND DEGREE PLAN FOR BSC IN BIORESOURCE AND AGRICULTURAL ENGINEERING

The undergraduate BAE curriculum consists of 120 credits, which students usually take over a period of eight semesters. The degree program approved and implemented in 1996 is shown in Table 2. The courses are divided into three main categories: the university requirements (18 credits); the College requirements (38 credits); and the Departmental requirements (remaining 64 credits). Each of these course requirements is reviewed below.

COLLEGE OF AGRICULTURE, SULTAN QABOOS UNIVERSITY

University requirements

Arabic is the official language in the Sultanate of Oman. However, all courses in the BAE degree plan are taught in English. Before students are allocated to the degree plan, they must achieve a basic level of English proficiency. When students are admitted into the University, they take an English language test to determine their level of placement in the Intensive English Language Program (IELP). This program is divided into six levels and is designed to help prepare the students for their academic studies by raising their level of 'general' English. Students enrolled in IELP concentrate on English and are not allowed to take other courses at the same time. Those who score exceptionally well on the placement test may go straight into the Credit English Language Program (CELP). Usually students move out of the intensive program after two semesters.

After completing the IELP, students are required to pass two additional English language courses, each of which is worth 3 credits and consists of 6 teaching hours per week. Students enrolled in credit English courses usually take other university-required courses and/or basic science courses at the same time. The university-required courses include social and historical topics on the Omani Society and Islamic civilization as well as 6 credits of elective courses of the student's choice.

Basic science and college requirements

The College of Agricultural and Marine Sciences requires students to take basic mathematics and science courses (22 credits) and 16 credits of introductory courses covering topics such as crop science, agricultural machinery, agricultural extension methods and techniques, etc. The remaining 64 credits in the curriculum consist of specialist courses that focus on aspects of Bioresource and Agricultural Engineering. All BAE students are required to take General Chemistry (CHEM 1091) and Introduction to Physics (PHYS 1091) from the elective courses listed under the College requirement (Table 2).

Other features of the BAE degree plan

The number of students admitted into the BAE Major each academic year depends largely on the total number allocated to the College and students' performance in selected basic science courses during their first semester in the College. After completing two basic science courses, students in the College of Agricultural and Marine Sciences

Table 2. The 1996 degree plan for BSc in bioresource and agricultural engineering

University requirements (Cr = Credits):			Departmental requirements:		
University requirements		Cr	Departmental requirements		Cr
ARAB1001	Arabic	3	BIOR4301	Design Project	6
HIST1010	Oman and Islamic Civilization	2	BIOR4800	Bioresource Engineering Internship	3
LANC2040	English for Agriculture I	3	MATH2108	Calculus II	3
LANC2041	English for Agriculture II	3	PHYS2001	General Physics II	3
SOCI3320	Contemporary Omani Society	1	MECH2101	Basic Mechanics I (Statics)	4
			MECH3152	Thermodynamics I	3
Electives Requirement			MECH3202	Dynamics	3
********	General Electives	6	MECH5540	Unit Operations	3
Total credits defined: 18			**Department core electives—choose 36 credits** from the following courses or any other approved by HoD		
College Requirement					
			BIOR3003	Soil Water Concepts in Irrigation Engineering	3
COMP2001	Microcomputers in Agriculture	3	BIOR3004	Agricultural Watershed Hydrology	3
ECON4500	Agricultural Extension Methods and Techniques	3	BIOR3005	Land Surveying	3
LANC0990	Intensive English I	0	BIOR3101	Properties of Foods and Agricultural Materials	3
MATH1192	Mathematics for Agriculture I	4	BIOR3102	Elements of Food Engineering	3
MATH2193	Mathematics for Agriculture II	3	BIOR3201	Power Units	3
– choose 13 credits from			BIOR4003	Soil Engineering for Agriculture	3
BIOL1091	Plant Biology for Agriculture	3	BIOR4004	Design of Irrigation Systems	3
BIOL1092	Animal Biology for Agriculture	3	BIOR4005	Specialized Applications in Soil & Water Engineering	3
CHEM1091	General Chemistry for Agriculture	4	BIOR4900	Bioresource Eng Special Problems	3
CHEM2091	Organic Chemistry for Agriculture	3	CIVL2000	Remote Sensing and Geographic Information Systems	3
PHYS1091	Intro to Physics for Agriculture	4	CIVL4046	Fluid Mechanics	3
– choose 12 credits from			ECON3010	Production Economics and Business Management	3
ANSC2001	Principles of Animal Science	3	FOOD3076	Food Processing I	3
BIOR2001	Introduction to Bioresource Engineering	3	FOOD4076	Food Processing II	3
BIOR2201	Introduction to Agricultural Machinery	3	FOOD4077	Food Product Development	3
BIOT2201	Introduction to Agricultural Biotechnology	3	MATH3304	Ordinary Differential Equations	3
CROP2510	Introduction to Crop Production	3	MECH3027	Fluid Mechanics	3
ECON2003	Introduction to Agricultural Economics	3	MECH3146	Engineering Drawing and Computer Graphics	3
FISH2001	Introduction to Marine Science & Fisheries	3	MECH4160	Numerical Methods for Engineers	3
FOOD2071	Principles of Food Science	3	MECH4171	Control Engineering	3
NUTR2301	Introduction to Human Diet	3	SOIL3311	Soil Physics	3
SOCI3821	Principles of Rural Sociology	3	STAT3001	Statistical Methods in Agriculture	3
SOIL2201	Introduction to Soil and Water	3	WATR3402	Irrigation Principles	3
	Total credits defined: 38			Total credits defined: 64	
			Total Credits defined for the Degree: 120		

are required to nominate an area of specialization. Only those who achieve good results in Mathematics, Physics and Chemistry courses are allowed to register for the major in Bioresource and Agricultural Engineering.

The senior (final-year) engineering design project course (6 credits) is another important component of the undergraduate program. The objective of the engineering design project is to enable the students to develop their integrative skills in creativity, problem solving, teamwork, communication, and use of information and computer technology. Under the supervision of faculty, students work in groups of 2–4 students over two semesters on a practical engineering problem in one of the major focal areas in the department (power and machinery engineering, food and process engineering, and soil and water engineering).

Several changes have been made in the administration of the design project course. Originally, the Fall semester was devoted to a teaching component on engineering design project and preparation of design proposals, which were then implemented and tested during the Spring semester. In recent years, the credit hours have been formally split into 3 credits per semester. At the beginning of the Fall Semester, final year students were given introductory lectures (usually 3 weeks) by the coordinating faculty on aspects of engineering design and teamwork, and then assigned in teams to individual faculty. During the remaining 12 weeks of the Fall semester, each group of students works together to develop and present a design project proposal. A complete written report as well as an oral presentation is required for completion of the course at the end of each semester. Starting from the 2003/2004 academic year, we have gone back to the original model of one semester for taught course in engineering design project and another semester for design implementation and testing.

Originally, only faculty carried out course evaluation but in recent times both faculty and students participate in grading the oral presentation while each faculty awards a mark for the report prepared by his/her project team. Based on the approved design proposal, each design project team is provided with the necessary guidance and resources to facilitate the implementation of their design project during the Spring Semester. Initially, students enrolled in one design project course (BIOR 4301; 6 credits) over the entire academic year; however, the course was later split into two (BIOR 4300 and BIOR 4301, for Fall and Spring, respectively). Members of each design project team are usually awarded the same final mark or grade at the end of each semester; however, some students have been awarded different grades where faculty showed evidence to the Department Board that an individual student's contribution was either exceptional or below the minimum expectation. Final year students are also required to complete an internship course (3 credits) to provide them with practical experience in a relevant industry sector or government agency.

BENCHMARKING AND PURSUIT OF ABET ACCREDITATION

The criteria of the Accreditation Board for Engineering and Technology (ABET) on professional engineering certification require a minimum of three years for mathematics and basic sciences, basic engineering, and general education components. Earlier degree plans of the BAE provided total credits which fell within the ABET requirement but had insufficient mathematics and basic science credits. As an example, a comparison is made between the degree plans for the 1999 and 2000 cohorts and the standard ABET requirement for professional engineering education (Table 3). It should be noted that a number of universities in the US offer agricultural (and related) engineering programs with 135 credits.

Although the 1996 curriculum was an engineering-based program, ongoing review and evaluation of the departmental program showed that the basic engineering and science components needed to be strengthened. In 1999, the degree plan and courses offered in the curriculum were reviewed extensively and a new curriculum was proposed. The department held a workshop toward meeting the ABET criteria for accreditation, and agreed to revise and strengthen the curriculum by including more mathematics and engineering-based courses in order to meet ABET requirements (BAE, 2001). The revised BAE program (135 credits), which contains adequate mathematics and basic sciences

Table 3. Comparison of the curriculum in bioresource and agricultural engineering (2000 Degree Plan) with ABET Requirements

Subject area (Component)	ABET requirement		BAE CURRICULUM	
	Credits	(Year)	Credits	(Year)
Mathematics and basic sciences	32	(1.0)	16	(0.5)
Basic engineering	48	(1.5)	50	(1.6)
General education	16–48	(0.5–1.5)	57	(1.8)
Intensive English	–	–	0	(0.5–1.0)
Total	96–128	(3–4)	123	(4.4–4.9)*

* Include at least one summer session for Internship.

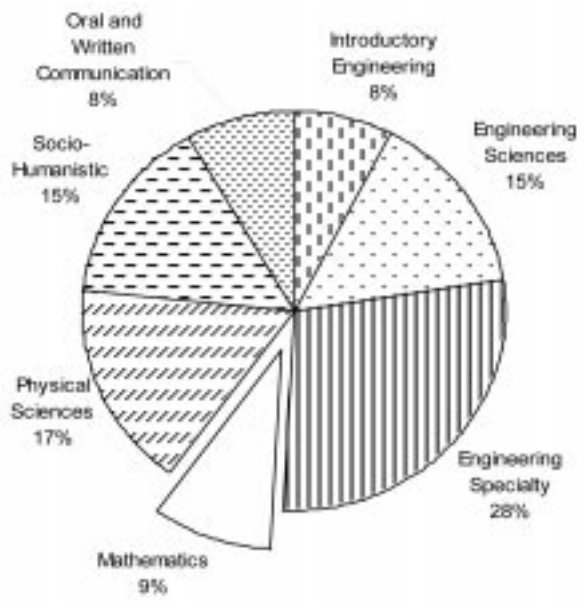

Fig. 1. Elements of the bioresource and agricultural engineering degree program at Sultan Qaboos University (2003 cohort).

(35 credits), basic engineering course (51 credits) and general courses (49 credits) was developed and implemented (Table 3).

Comparison of the new BAE curriculum (Fig. 1) with a generalized framework for similar programs certified by ABET (Fig. 2) shows that both follow the same distribution of courses, except that the mathematics courses in the BAE curriculum are a little (7%) less. This difference is partly accounted for by additional courses included under the physical sciences and engineering specialty. The desire to pursue ABET accreditation of the agricultural engineering program developed at Sultan Qaboos University is still ongoing; however, further refinement of the curriculum and a strategic review of

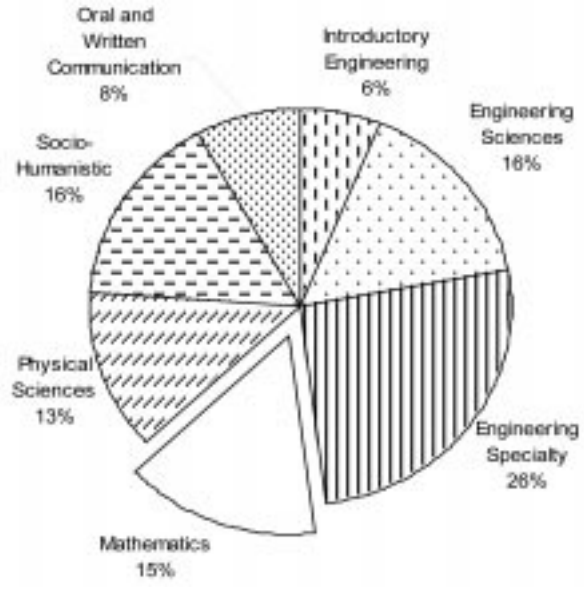

Fig. 2. Elements of an ABET certified engineering degree program [11].

the BAE program are required before a full application for ABET accreditation can be developed. Given the very low appeal of courses in the College of Agricultural and Marine Sciences among Omani students [6–7], a curriculum that is more closely aligned with the College of Engineering offers more prospects for success in terms of student recruitment and program accreditation.

Number of graduates and graduate destinations

Sixty-two students have graduated from the department during the first 12 years (period 1990–2001). About 88% of the graduates qualified with BSc in Agricultural Mechanization, with over 95% of all graduates employed. Analysis of the distribution by sector showed that nearly 86.5% are employed in the public sector, 10.2% in the private sector, and 3.3% are self-employed. The Ministry of Agriculture and Fisheries, and Sultan Qaboos University are by far the largest employers of agricultural engineering graduates in Oman (Table 4); however, current indications are that the employment opportunities in government ministries are highly limited and the situation may continue in the near future.

Available records also showed that among the 30 students who graduated during the period 1995–2001, 10% reported that they were unemployed. Given that these unemployed students graduated four to five years ago, it is most likely that they are gainfully employed by now or pursuing further studies. The small proportion of graduates employed in the private sector (including self-employment) underscores the government's ongoing efforts to diversify the economy and deregulate many industrial sectors that are largely dominated by government corporations. The employment rate of agricultural mechanization graduates (1990–2001) was impressive (Fig. 3), presumably as they were the pioneer 'agricultural engineers' in Oman who were highly sought after by the ministries to support its agricultural and fisheries development and extension programs. Further studies will be required to assess the employment status and destinations of the graduates who completed the major in Bioresource and Agricultural Engineering.

IMPACTS OF CURRICULUM REFORM

During the mid- to late 1990s, the number of students majoring in the agricultural mechanization program rarely exceeded five (Fig. 4) as evidenced by the low number of graduates produced (Fig. 3). Following the introduction of the new program in Bioresource and Agricultural Engineering in 1996, the number of students enrolled in the new major has continued to increase dramatically. Our recent study [6–7] on the perceptions and preferences of senior undergraduate students in the department indicated that the inclusion of the word 'engineering' in the

department name and program title is a major contributing factor in attracting more students. Students' preference among the ten majors offered in the College in 1998 typifies the trend. Out of the 143 students who completed the standard College questionnaire to indicate their preference for a Major, the overall preference for Bioresource and Agricultural Engineering was as follows: 1st choice = 16.78%; 2nd choice = 13.29%; 3rd choice = 14.68%. More detailed data collection, monitoring and evaluation are required to fully assess the long-term impacts of the curriculum restructuring on students retention and employment.

AGRICULTURAL ENGINEERING PROGRAM (2003 AND BEYOND)

During the summer of 2004, the University Council approved a proposal to merge the Department of Bioresource and Agricultural Engineering and the Department of Soil and Water Sciences. Subsequently, the University President issued a Qarar (order) making the merger effective on 1 September 2004. This includes a change in the name of the major in 'Bioresource and Agricultural Engineering' to 'Agricultural Engineering', and a new department name called 'Soils, Water, and Agricultural Engineering'.

The original proposal to merge small departments (average size of six faculty) in the College was recommended by a team of external assessors in 2001. The merger was also pursued to bring together related disciplines, reduce duplication and minimize administrative and service responsibilities within the College [9]. The new department maintains the existing three majors offered by the two former departments, namely: Water Technology, Soil and Water Sciences, and Agricultural Engineering. Given the higher number of faculty and related teaching and research activities in the soil and water areas, there is some concern that the agricultural engineering program may gradually lose its visibility and attractiveness unless concerted efforts are made to market and promote it among students and industry.

CONCLUSIONS

Agricultural engineering education has been an integral part of the suite of programs offered in the College of Agricultural and Marine Sciences since the establishment of Sultan Qaboos University nearly two decades ago. In this paper, we have presented a chronological evolution of agricultural engineering education over this period, including curriculum reforms and program name changes. The first major curriculum reform represented a significant paradigm shift from technology to engineering-based education. The change from a mechanization program to an engineering program enhanced the appeal (and enrolments) of agricultural engineering among the students. Based on a comparison with a generalized framework on the elements of ABET-certified engineering curriculum, the new program in Bioresource and Agricultural Engineering meets the minimum ABET requirements for professional accreditation. To enhance the prospects of achieving the goal of ABET accreditation and to further expand the 'catchment base' for new students, it is proposed

Table 4. Graduates employment destinations, by year and sector

Place of employment	Year of employment												Total
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
Ministry of Agriculture & Fisheries	6	7	3	1	1	1	4	2	1	3	0	2	29
Diwan of Royal Court	1	0	1	0	0	1	1	0	0	0	0		4
Sultan Qaboos University	0	1	1	1	0	1	1	0	0	1	1		7
Muscat Municipality	0	0	1	0	0	0	0	0	0	0	0		1
Ministry of Regional Municipalities, Water Resources & Environment	0	0	2	1	0	0	0	0	0	1	0		4
National Bank of Oman	0	0	0	0	0	0	0	0	0	1	1		2
Royal Navy of Oman		0	0	0	1	1	0	0	0	0	0		2
Private company	0	0	0	1	1	0	0	1	0	0	0	3	6
Self employment	0	0	0	1	0	0	0	0	0	0	1	0	2
Total employed	7	8	8	5	3	4	6	3	1	6	3	5	59*

* Includes the two graduates employed in the public sector in 2001 whose actual places of employment are not yet known.

Fig. 3. Employment rate of agricultural mechanization graduates.

that a closer alignment of the program with the College of Engineering be explored.

Graduate employment rate has been very good and comparable to other applied science disciplines at the university. The majority of graduates are employed in the public sector, particularly in the Ministry of Agriculture and Fisheries. There is increasing evidence that employment opportunities in the public sector have declined or at best stagnated. Future employment prospects for agricultural engineers in Oman lie in the private sector, including self-employment in providing consultancy and support services to a wide range of enterprises. The success of the government's ongoing efforts in promoting economic diversification and liberalization will, to a large extent, impact on future employment opportunities for agricultural engineering graduates.

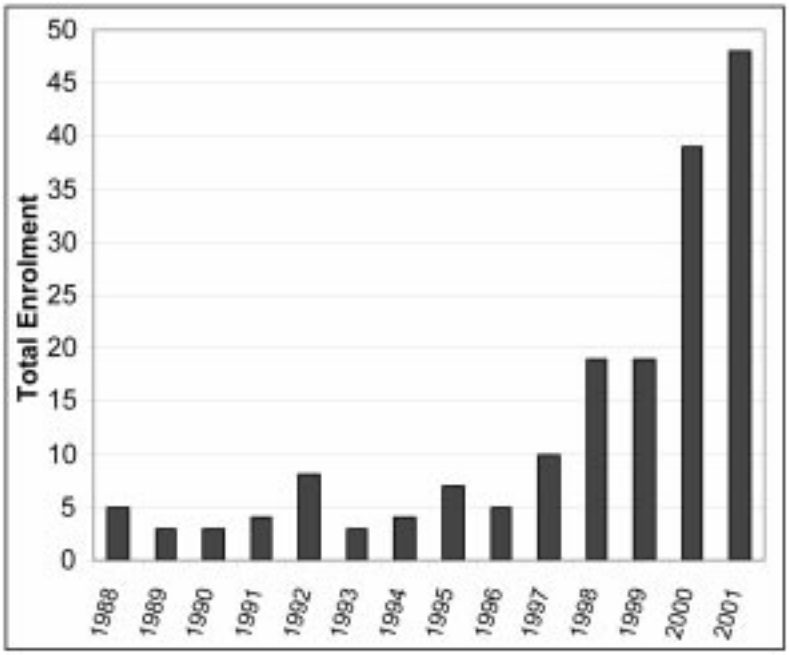

Fig. 4. Total enrolment in the department (Years 2–4 only). Note that the new curriculum in Bioresource and Agricultural Engineering was introduced in 1996.

The recent merger of the department with the former Department of Soil and Water Sciences and the change of the program name to Agricultural Engineering are significant recent developments. Our experiences elsewhere suggest that concerted efforts will be required to enhance the visibility (and future) of the Agricultural Engineering program in its new environment in order to maintain its current appeal and interest among the students.

Although the oil and gas sectors dominate the Omani national economy, agriculture and marine industries have continued to be a very important part of the country's overall economy, particularly in the remote areas. The prevailing arid tropical climate presents unique engineering challenges for profitable and sustainable exploitation of land, water and marine bioresources. Efforts by the government to diversify the economy and promote private sector enterprise also assure a future demand for professional engineers with good integrative skills to fully realize these national development goals.

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