

PROGRAM SELF-STUDY REPORT

for the

AGRICULTURAL AND BIOSYSTEMS ENGINEERING DEPARTMENT

2011

NORTH DAKOTA STATE UNIVERSITY

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I. Mission Statement & Program Objectives

Teaching and Instructional Support: The Department's mission is to serve students and the profession by providing high quality teaching programs in Agricultural and Biosystems Engineering and Agricultural Systems Management that prepare graduates for 21st century living and career opportunities; recruitment of new students to the department; academic advisement and career counseling to new and continuing students; job placement and follow-up; and advanced and continuing education.

Research: The Department's mission is to develop and adapt knowledge and technologies that focus on the engineering and management of agricultural, food and biological systems and related natural resources through the conduct of strong research programs.

Extension and other Outreach: The Department's mission is to develop and deliver effective extension programs, continuing education, and other outreach that enable people to improve their lives through an educational process that uses scientific and research based knowledge focused on citizen and business identified issues and needs.

II. Overview of Program

A. Brief History

Historical records indicate that E.S. Keene was appointed Agricultural Engineer with the Agricultural Experiment Station in 1892, two years after the North Dakota Agricultural College was established. R.C. Miller organized the Agricultural Engineering Department as a degree granting department in 1924-25. The first BS degree in Agricultural Engineering was granted in 1931. The first MS degree was awarded in 1933. BS and MS degree programs in Agricultural Mechanization (AM) were initiated in 1951. This program also provided service courses to Agricultural Education majors and to other degree programs in the College of Agriculture. In 1980, an interdisciplinary Ph. D. program was established in the College of Engineering and Architecture. In 1989, the department hired its first food engineering faculty. The name of the Agricultural Mechanization program was changed to Agricultural Systems Management (ASM) in 1993. The Agricultural Engineering program name was changed to Agricultural and Biosystems Engineering (ABEN) in 1996. In 2000, a partnership was developed with John Deere to offer a “dealership management” specialization in the ASM program. This was one of only six such partnerships in the nation. John Deere discontinued these partnerships in 2009. Since the specialization was not contractually bound to John Deere, the specialization continues to be offered. The ABEN program was reviewed by ABET in 2006 and reaccredited to 2012. In June, 2002, a Ph. D. program in ABEN was approved by the State Board of Higher Education (SBHE). In Fall Semester 2007, two emphasis areas, Agricultural Engineering and Biosystems Engineering, were offered in the ABEN program to better serve the changing clientele of the program. The ABEN and ASM programs at NDSU are the only such programs offered in North Dakota. With very few exceptions, only the Land Grant institution in each state has such programs. Several states do not have such programs. The administration and functions of the department is complex, although it is very similar to like programs around the country. Fiscal responsibility is to the Dean of CAFSNR (Ken Grafton), director of the Agricultural Experiment Station (Ken Grafton), and director of the North Dakota State University Extension Service (Duane Hauck). The ASM program resides in the CAFSNR (Dean Grafton) and the ABEN program resides in the CEA (Dean Smith).

There have been significant changes in faculty since the 2004 report. In 2004, the two-year term as chair for Prof. Backer was modified to a permanent chair position. Vern Hofman, Extension Agricultural Engineer (100% EXT) retired in March, 2006. He was replaced by John Nowatzki (100% EXT) in July, 2006. Assistant Professor Lowell Disrud, who held CAFSNR and AES appointments, retired in January, 2008. Professor Suranjan Panigrahi resigned his position (CAFSNR and AES appointments) in August 2009 to take a position at Purdue University. Prof. Backer retired as Chair in 2010. Six assistant professors were hired in the period 2005-2011. Dr. Scott Pryor was hired as a bioprocess engineer (80% AES/20% CAFSNR) in March, 2006. Dr. Xinhua Xia was hired as a natural resources engineer (90% AES/10% CAFSNR) in April, 2007. Dr. Shafiqir Rahman was hired as a livestock waste engineer (80% AES/20% EXT) in April, 2008. Dr. Ganesh Bora was hired as a machine systems engineer (20% AES, 80% CAFSNR) in September 2008. Dr. Zhulu Lin was hired as a water quality engineer (55% AES/45% CAFSNR) in December, 2008. Dr. Igathinathane Cannayen was hired as a bioprocess engineer (60% AES/40% EXT) with offices located at the USDA-ARS Northern Great Plains Research Laboratory in Mandan and at the National Energy Center of Excellence on the campus of Bismarck State College in Bismarck. This arrangement is the result of a cooperative agreement between former NDSU President Chapman and BSC President Skogen to share resources in the area of renewable energy research and outreach.

B. Degrees Offered

- **Agricultural Systems Management (ASM)**
BS degrees granted through the CAFSNR
15 courses taught in department
- **Agricultural & Biosystems Engineering (ABEN)**
BS, MS, and PhD degrees granted through the CEA
21 Undergraduate and 19 Graduate courses taught in department

Some of the ABEN faculty also serve as major advisors to graduate students in the following interdisciplinary programs:

- **Engineering**
PhD degree through CEA
- **Natural Resources Management**
MS and PhD degrees through the Graduate School
- **Environmental Conservation Sciences**
MS and PhD degrees through the Graduate School
- **Food Safety**
MS and PhD degrees through the Graduate School

C. Students Served

The tables that follow provide information relative to undergraduate and graduate student enrollment and graduation for ABEN and ASM academic programs. ABEN enrollment has increased significantly in recent years (Table II-1). Enrollment in the ASM program has remained relatively stable through the same time period. Fluctuations in both programs are normal and expected. The demand for graduates of the ABEN program has been high for many years and the salaries have been near the top for all engineering disciplines. In addition, job opportunities locally and regionally are higher for ABEN graduates than for graduates of most other engineering programs. Enrollment in the ASM program fluctuates in response to the agricultural economy. Many graduates of the ASM program return to production agriculture for a career, or they become employed by industries and agencies that serve production agriculture. Opportunities in all these areas have been exceptionally good in recent years because of a strong agricultural economy. Salaries of graduates working in industry or in governmental agencies are typically near the top of the salaries of graduates from the CAFSNR.

Table II-1. Enrollment, student credit hours and graduates in ABEN programs.

i. Number of Majors	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Undergraduate ABEN	62	62	66	97	94	84
Undergraduate ASM	68	69	63	60	70	81
Total Undergraduate	130	131	129	157	164	165
Graduate ABEN Doctorate		7	7	6	5	3
Graduate ABEN Masters		1	1	5	6	9
Total Graduate ABEN	4	8	8	11	11	12

ii. Credit Hours	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Student Credit Hours	1789	1918	1843	2344	2261	2289

iii. Number of Graduates	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
Doctorate ABEN				1	5	0
Masters ABEN	1	3	0	1	1	4
Bachelors ABEN	24	19	6	13	26	11
Bachelors ASM	12	19	12	15	14	19

When compared to other similar programs across the United States, the NDSU ABEN program is about mid-size. A few programs are much larger; but many are much smaller. Even though the potential number of students to draw from is much lower, the NDSU program is similar in size to that of Kansas State and the University of Wisconsin-Madison. The program is about twice the size of programs at the University of Minnesota and the University of Idaho. The source of students in the ABEN undergraduate program has changed over time. For many years, as might be expected, the major source of ABEN students was rural white males from North Dakota. In recent years, the major source of students has been from Minnesota. A good number of students are now coming from the Twin Cities area. There are three reasons for this change. The first is that the number of high school

graduates in North Dakota has plummeted. Although the situation is similar in Minnesota, the total number of potential students is still higher than in North Dakota. The second reason is that the University of Minnesota no longer offers an agricultural engineering degree, and is located in a major metropolitan area. The third reason is an increased recruiting effort by NDSU and the department in the Twin Cities area. Also, rural students from Minnesota may be attracted to the smaller city of Fargo compared to the Twin Cities when choosing a program. The program will typically include one or more students from Montana and occasionally a student from some other state.

When compared to other similar programs across the United States, the NDSU ASM program is also about mid-size. Some are much larger and some are much smaller. The leading source of students for the ASM program continues to be North Dakota, although the split between North Dakota and Minnesota is nearly 50:50. Occasionally, one or more student comes from other states.

Few students from South Dakota enroll in either program. SDSU has similar programs of similar size and quality. Recruiting female students into both programs has been challenging. The percentage of female students in the ABEN program is similar to that in other engineering programs at NDSU. Unfortunately, that number is about one-half or less of the national average. However, the number of female students in ABEN has recently been rising, probably because of the introduction of the Biosystems Engineering emphasis area.

The number of graduates in the ABEN B.S. program varies from year to year (Table II-1 above). As with all engineering programs, a significant number of freshman and sophomore students are unable to be successful in the math and engineering courses and change majors. In addition, nearly all students in the ABEN program take part in one or more cooperative education experiences. This usually delays their graduation beyond the traditional four years. This often skews, positively or negatively, the expected normal graduation rate. Graduation rates for the ASM program remain relatively constant; similar to the enrollment.

Graduate students, for the most part, are international students. The employment opportunities and high starting salaries of ABEN BS majors makes it difficult to recruit domestic students into graduate programs. Graduate student numbers have increased over the time period. This is a reflection of the new faculty hires and their success in securing grants which provides the funding for graduate research assistants. As these faculty become more established in their programs and even more successful in grantsmanship, it is anticipated that graduate enrollment will continue to increase.

Student credit hours generated has tended to increase over time (Table II-1 above). SCH generation in the ABEN program is directly related to student enrollment in the program. Although ABEN students are required to take many classes offered by other engineering disciplines, it is rare for students in other engineering programs to take ABEN courses. On the other hand, although SCH generation in the ASM program is also dependent on ASM enrollment, it is also influence by student enrollment in CAFSNR and the university as a whole. A significant number of students in other CAFSNR programs take ASM courses. In addition, some ASM courses have special appeal to a small, though important, number of students from virtually any major in the university.

D. Success of Graduates

Until the last 1-2 years, ABEN students have each had multiple offers of employment with industry and government agencies and the placement rate has been at or very near 100% for many years. In addition, starting salaries have been at or near the top for graduates in programs in CEA. Offers have been up to \$70,000 (in North Dakota). However, data indicates that in the last several years, salaries have fallen (Table II-2). This can be attributed to several factors. The first is the downturn in the national economy. The second is that in the last several years, ABEN students who are in the partnership with the Ansal Institute of Technology (India) program have been graduating. Most of these AIT students have returned to India for employment and good data are not available. Even given these factors, placement in ABEN continues to be very good and starting salaries are also very good. It has been difficult to convince BS graduates to continue with graduate school given the many employment opportunities and the starting salaries. However, in the last several years, several students have pursued advanced degrees at NDSU and other universities around the nation (Table II-3). It is rather common for ABEN graduates to earn an MBA degree on a part-time basis while employed full-time.

Graduates of the ASM program also have enjoyed good job opportunities at relatively high salaries (Table II-4), at or near the top for programs in CAFSNR. However, a relatively large number of graduates return to production agriculture by choice. These graduates do not view themselves as employed and it is difficult or impossible to get employment information from them; particularly income (salary) information. Most ASM graduates find employment in the state or region. In recent years, a number of graduates have pursued graduate degrees. Unfortunately, the department does not offer an MS degree and these students look to graduate programs in Agribusiness, Crop and Weed Sciences, Natural Resource Management, or Animal Sciences. The MS degree in ASM was discontinued in the 1990s as a result of a program review recommendation. However, there is renewed interest in an ASM MS program by graduates and as a component of a fledgling graduate international program in CAFSNR. The department will need to take a serious look at redeveloping an ASM-MS degree program.

Graduate student placement is also very good (Tables II-5 and II-6). Students are finding employment with industries such as Microsoft Corp., PBS&J, Miller-Coors, and Air Products and Chemicals. Others find employment at other institutions such as Guru Nanak Dev University (India) and University of California-Riverside. Others find employment as Post-Docs at institutions such as the University of Florida, South Dakota State University, and North Dakota State University.

Table II-2. Job placement and salary for ABEN and ASM graduates (source: NDSU Career Center Annual Employment Reports)

Agricultural and Biosystems Engineering			
Year	Placement	Average Salary Accepted	High Salary Accepted
2007	100%	\$52,000	\$58,000
2008	100%	\$57,000	\$60,000
2009	88%	\$54,000	\$63,000
2010	88%	\$42,000	\$50,000

Agricultural Systems Management			
Year	Placement	Average Salary Accepted	High Salary Accepted
2007	100%	\$38,000	\$45,000
2008	100%	\$39,000	\$41,000
2009	100%	\$35,000	\$40,000
2010	100%	\$37,000	\$45,000

Table II-3. Placement of Agricultural and Biosystems Engineering B.S. graduates, 2009-2011.

	Last Name	First Name	Discipline	Year	Employer & Job Title	Job Title
Mr.	Dose	Mark	AGEN	2009	Minnesota NRCS - Area 1 Office	Agricultural Engineer
Mr.	Heimbuch	Joshua	AGEN	2009	Heimbuch Potatoes LLC	President
Mr.	Nagel	Ryan	AGEN	2009	Titan Machinery	Precision Farming Products Specialist
Mr.	Petersen	Ross	AGEN	2009	Cargill Inc.	Production Management Engineer
Mr.	Sheldon	Joseph	AGEN	2009	Pennsylvania State	GRA
Mr.	Stellpflug	Paul	AGEN	2009	Hormel Foods	Farming
Mr.	Tammen	Cory	AGEN	2009	Red Line Graphics	Custom Printing
Mr.	Thurlow	Drew	AGEN	2009	Jennie-O, Pelican Rapids	Associate Maintenance Engineer
Mr.	Verma	Vishal	AGEN	2009		
Mr.	Wold	Matthew	AGEN	2009	Univ. of Neb.-Lincoln	GRA
Mr.	Wolter	Derrick	AGEN	2009	Amity Technology	Project Engineer
Mr.	Agrawal	Rohit	AGEN	2010		
Mr.	Ansari	Mohammed	BSEN	2010		
Mr.	Bendickson	Nicholas	AGEN	2010	Bendickson Farms	Farming
Mr.	Curley	Thomas	AGEN	2010	CNH	Field Test Engineer
Mr.	Ellwein	Jake	AGEN	2010	RFA Minnesota Engineering	Design Engineer
Mr.	Giesler	Brandon	AGEN	2010	McLaughlins	Sales Representative
Mr.	Gross	Jason	AGEN	2010	Black Gold Farms	Systems Engineer
Mr.	Hagemeister	David	AGEN	2010	Farming	Farming
Mr.	Hanson	Reed	AGEN	2010	Basin Electric Power Co-op	

Mr.	Hawkins	Matthew	AGEN	2010	Amity	Design Engineer
Mr.	Hiedeman	Michael	AGEN	2010	Horsch Anderson LLC	Ag Product Engineer
Mr.	Johnson	Blake P.	AGEN	2010	USDA-NRCS	
Mr.	Kumar	Nikhil	BSEN	2010		
Mr.	Kumar	Mukesh	BSEN	2010	University of Minnesota	Student Intern
Mr.	Lang	Jeremiah	AGEN	2010		
Mr.	Mayfield	Chad	AGEN	2010	BTD Manufacturing	Manufacturing Engineer
Mr.	McLaen	Austin D.	AGEN	2010	Pursuing MBA at NDSU	
Mr.	Rastogi	Aakanksha	BSEN	2010		
Ms.	Sidhu	Harjot Kaur	AGEN	2010	North Dakota State Univ.	GRA
Mr.	Wardner	Jay R.	AGEN	2010		
Mr.	Weber	Dustin D.	AGEN	2010	Control Services	Commercial Maintenance and Landscaping
Mr.	Young	Thomas H.	AGEN	2010		
Mr.	Deters	Calvin	AGEN	2011	Superior or John Deere	
Mr.	Dierickx	Francis	AGEN	2011	Cargill, Indianapolis, IN	
Mr.	Frauenberg	Cody	AGEN	2011	Family Farm	Farming
Mr.	Holmes	Nate	AGEN	2011	Management	
Mr.	Rath	Tyler	AGEN	2011	Polaris	Test Engineer
Mr.	Readel	Paul	AGEN	2011	John Deere & Company	Product Engineer
Mr.	Schaley	Randy	AGEN	2011		
Mr.	Weisbeck	Clayton	AGEN	2011		
Mr.	Wolden	Brady	AGEN	2011	Montana Dakota Utilities	Engineer

Table II-4. Placement of Agricultural Systems Management B.S. graduates, 2009-2011.

	Last Name	First Name	Year	Employer	Job Title
Mr.	Borud	Matthew	2009	Gooseneck Implement	Sales Representative
Mr.	Caulkins	Brandon	2009	Fixin Farms	Farming
Mr.	Coffman	Daniel	2009	Osnabrock Farmers Co-op	Agronomist
Mr.	Erickson	Dustin	2009	Farming	Farming
Mr.	Fiedler	Owen	2009	Wes Fiedler Farms	Farming
Mr.	Leier	Preston	2009	Farming	Farming
Ms.	Norgaard	Celia	2009	Alliance Ag Cooperative	Agronomy Sales Trainee
Mr.	Aakre	Adam	2010	Rust Sales Inc.	Service Technician
Mr.	Blilie	Daniel	2010	Triangle Ag	Sales Agronomist
Mr.	Faul	James	2010	Faul Farming	Farming
Mr.	Hoffman	Brandon	2010	Hoffman Farms	Farming
Mr.	Maher	Robert	2010	Maher Farms	Farming
Mr.	Moxness	Matthew	2010	Beyer Seed Farm	Cropping Specialist and Seed Salesman
Mr.	Novak	Adam	2010	Black Gold Farms	Chip Sales Associate
Mr.	Pederson	Brent	2010	Pederson Farming	Farming
Mr.	Pranke	Steven	2010		Agronomist
Mr.	Qual	Tyler	2010	Farming	Farming
Mr.	Quandt	Justin	2010	Farming	Farming
Mr.	Roy	Anthony	2010	Langdon Implement	Sales
Mr.	Stansbery	William	2010	Titan Machinery	Sales
Mr.	Torrence	Michael	2010	Edmunds County Imp.	Service Clerk
Mr.	Tufte	Benjamin	2010	Farming	Farming
Mr.	Braaten	Adam	2011	Military	
Mr.	Bumgardner	Nathan	2011	Western Ag Service	Applicator
Mr.	Chevalier	John	2011		
Mr.	Dingman	Brandon	2011	John Deere	Sales Rep
Mr.	Grundstad	Andrew	2011	Farmers Union Oil	Agronomist
Mr.	Helmer	Jayne	2011	USDA	
Mr.	Hoppe	Aaron	2011	Graduate School	
Mr.	Maier	Alan	2011	S.D. Wheat Growers	Sales Agronomist
Mr.	Mudra	Alfred	2011	Farming	Farming
Mr.	Pietruszewski	Kyle	2011	Gavilon LLC	
Mr.	Roth	Spencer	2011	ADM	GTOM
Mr.	Stroh	Scott	2011		
Mr.	Thoreson	Bradley	2011		
Mr.	Trautman	Lee	2011	Quality Service	Mechanic/Farming
Mr.	Weinreis	Travis	2011		
Mr.	Wiegandt	Jared	2011	Weigandt Farms	Farming

Table II-5. Placement of Agricultural and Biosystems Engineering M.S. graduates, 2007-2011.

	Last Name	First Name	Year	Employer	Job Title
Mr.	Woznica	Szymon	2007	Microsoft Corporation	Software Development Engineer
Mr.	Yousaf	Mohammad	2007	PBS&J	Environmental Scientist
Mr.	Nelson	Kraig	2009	GK Technology	Precision Ag Consultant
Ms.	Overmoe	Kate	2009	University of North Dakota	Graduate Research Assistant
Mr.	Lin	Hongjian	2010	Dept. of Bioproducts and Biosystems Eng.	Graduate Research Assistant
Ms.	Rijal	Ishara	2010	Michigan State University	Graduate Research Assistant
Ms.	Rorick	Rachel	2010	Miller Coors	Quality Assurance Engineer
Mr.	Pang	Xiao	2011	Division for China ASEAN Cooperation	Environmental Engineer

Table II-6. Placement of Agricultural and Biosystems Engineering Ph.D. graduates, 2007-2011.

	Last Name	First Name	Year	Employer	Job Title
Mr.	Amamcharla	Jayendra	2008	South Dakota State University, Dairy Science Department	Post-Doctoral Research Associate
Mr.	Khot	Lav	2009	Univ. of Florida Citrus Research Education	Post-Doctoral Research Associate
Ms.	Sankaran	Sindhuja	2009	Univ. of Florida Citrus Research Education	Post-Doctoral Research Associate
Ms.	Dhillon	Bhavnita	2010	Guru Nanak Dev University, Punjab	Assistant Professor
Ms.	Espinoza-Perez	Judith	2010	Air Products and Chemicals	Polymer Scientist
Mr.	Manamperi	Wajira	2010	Initially employed as Scott's postdoc-see Sect. III	
Ms.	Mohapatra	Punyatoya	2010	University of CA	Lecturer

E. Number of Faculty (full-/part-time)

The ABEN department currently has a total of 12 faculty members at a professorial rank, four academic and extension staff, and 11 support staff shown in table II-7a-d. Retirements and resignations are summarized in table II-8. Past post-doctoral and visiting scientists are summarized in table II-9.

Department Personnel (August, 2011).

Table II-7a. Faculty:

Bon	Tom	Associate Professor of Practice
Bora	Ganesh	Assistant Professor
Cannayen	Igathinathane	Assistant Professor
Casey	Francis	Interim Chair
Hellevang	Ken	Professor/Extension Specialist
Jia	Xinhua	Assistant Professor
Lin	Zhulu	Assistant Professor
Pryor	Scott	Assistant Professor
Rahman	Shaifqur	Assistant Professor
Scherer	Tom	Associate Professor/Extension Specialist
Steele	Dean	Associate Professor
Wiesenborn	Dennis	Professor

Table II-7b. Academic & Extension Staff:

Johnson	Roxanne	Extension Water Quality Associate
Nowatzki	John	Extension Agricultural Machine Specialist
Pedersen	Carl	Extension Energy Educator
Solseng	Elton	Instructor

Table II-7c. Staff:

Buckhouse	Lori	Student Services Coordinator
Daeuber	Jana	Research Specialist
Flaagen	Myron	Custodian
Haagenson	Darrin	Research Specialist
Lin	Dongqing	Research Specialist
Moos	James	Maintenance Mechanic
Nahar	Nurun	Research Specialist
Perleberg	James	Research Specialist
Stroh	Nancy	Account Technician
Tuscherer	Sheldon	Research Specialist
Ziegler	Melanie	Administrative Assistant

Table II-7d. Current Post-Doctoral, Visiting Scientists and Adjunct Professor:

Baratov	Rustam	Visiting Scientist
Evans	Robert	Adjunct Professor
Karki	Bishnu	Post-Doctoral

Table II-8. Retirements* and resignations.

Backer	Les*	Professor Emeritus and former Chair	6/30/2011
Brudvik	Rachael	Research Specialist	1-30-2010
Disrud	Lowell*	Professor Emeritus	1-3-2008
Fox	Sheri	Extension Specialist	2-28-2005
Hofman	Vernon*	Professor Emeritus	3-31-2006
Kirkpatrick	David	Research Specialist	2-1-2007
Maher	George*	Extension Safety Specialist	9-15-2005
McDonough	Debra	Administrative Secretary	1-1-2005
Mita	Dath	Extension Specialist	6-30-2005
Panigrahi	Suranjan	Professor	8-11-2009
Quam	Janelle	Student Services Coordinator	02-15-2011
Rindy	Dennis	Information Technologist	6-30-2005
Schmidt	Bradley	Instructor	5-11-2011
Tostenson	Kristi	Research Specialist	12-3-2007
Venette	James*	Interim Chair	R7-2-2011
Xue	Qingwu	Research Specialist	11-15-2009

Table II-9. Past Post-Doctoral and Visiting Scientists (2004-2011)

Agrawal	Kamal	Visiting Scientist	08-01-2010
Bhattacharjee	Paramita	Post-Doctoral	3-28-2008
Buyukcangaz	Hakan	Visiting Scientist	10-12-2011
Chang	Young Ki	Visiting Scientist	2-1-2009
Chen	Qingchuan	Visiting Scientist	1-15-2008
Chu	Xian Feng	Post-Doctoral	9-26-2009
Dhillon	Bhavnita	Post-Doctoral	5-30-2011
Espinoza-Perez	Judith	Post-Doctoral	6-30-2011
Kumar	Mahesh	Visiting Scientist	11-18-2011
Muni	Durgi	Visiting Scientist	7-13-2005
Sengupta	Partha	Post-Doctoral	3-31-2008
Singh	Karan	Visiting Scientist	08-01-2010

F. Advisory Board/Steering Committee

Several attempts by the department chair have been made over about the past 20 years to establish a departmental advisory board to serve as a sounding board for department activities and as an advocate for the department. Unfortunately, these efforts met with limited success. This is due largely due to the complexity of our department, with two academic programs in two different Colleges, and faculty with appointments in CAFSNR, AES, and NDSU Extension Service. Although not specifically required by ABET accreditation criteria, an advisory board is very desirable to satisfy the new accreditation criteria. As a result, an advisory board (Table II-10) was established in January, 2008 to provide guidance and advice solely for the ABEN undergraduate program. The board has no responsibility for the ASM program or research and extension functions.

To date, all interaction with the committee has been via e-mail. The committee has provided valuable feedback on several academic/programmatic issues. The board could be more active if all committee members were able to meet in person. Unfortunately, some members of the committee need to take personal leave to conduct board business. It may be good to form a partial or completely new board to remove this barrier.

In addition to the advisory board, program feedback is provided to faculty via surveys of alums and employers as well as through exit interviews of graduating seniors. In addition, feedback is also collected by frequent interaction between faculty and alumni and industry and agency recruiters.

Table II-10. Members of the ABEN B.S. Program Advisory Board.

<p>Russell Stoltman Vehicle Systems Integration Manager & Engineering Site Coordinator CNH Fargo Plant 3401 1st Ave North Fargo, ND 58102 701.297.4314 701.293-4413 FAX Russell.stoltman@cnh.com</p>	<p>Erica Althoff Area Engineer USDA – NRCS Jamestown Area Office PO Box 2096 Jamestown, ND 58402 701.252.1460 ext. 101 701.252.9068 FAX Erica.althoff@nd.usda.gov</p>
<p>Alex Friedt Plant Engineer Dakota Growers Pasta Company One Pasta Avenue Carrington, ND 58421 701.652.2855 701.652.3552 FAX afriedt@dakotagrowers.com</p>	<p>Jeremy Mahowald Energy Management Supervisor Cass County Electric Cooperative 4100 32nd Ave S Fargo, ND 58104 701.356.4400 jmahowald@kwh.com</p>

G. Advising

All faculty with undergraduate teaching responsibilities serve as academic advisers. All but Mr. Solseng advise both ABEN and ASM students. Mr. Solseng advises only ASM students because he only teaches ASM classes. The ABEN department faculty prides itself on good academic advising. Students in our programs tell us about their friends in other programs who are envious of the relationship our students have with their advisers and of the service their advisers and department provide.

The department chair typically has assigned advisers to students. Advising loads typically are not the same for all faculty (Table II-11). A number of different criteria are used for determining advising assignments. Typically, junior faculty have lighter advising loads than do more senior faculty. It is felt that it takes faculty some time to become good advisers. It takes time for them to learn how to advise, learn the intricacies of the various curricula, learn about critical course sequences and course offerings, and to learn about how different courses necessitate course load adjustments. This also gives junior faculty needed time to develop their research programs. Some faculty are assigned higher advising loads simply because they do a better job and serve the students better than some other faculty; some faculty are better advisers than others. Some advisers are assigned specific students because the student's career interest is in the research and teaching area of particular faculty. In some cases, advisers are selected because of some "connection" between the faculty member and the student; both from the same part of the state, the faculty member was possibly the adviser for a student's father, friend, brother, sister, etc. Assignments are sometimes based on the chair's experience and/or gut feel for the right fit between student and faculty. Students are also free to select or change their adviser at any time if they wish.

Graduate students are typically on research assistantships and are therefore recruited and advised by their major adviser. In the rare instance of self-fund graduate students, the adviser is a faculty member with a background in the subject matter interest area of the student.

Table II-11. ABEN and ASM advising responsibilities, August 2011.

Fall 2011 Enrollment	ABEN (B.S.)	ASM (B.S.)	TOTAL (B.S.)	TOTAL (M.S. & Ph.D.)	Total Advisees (BS/MS/PhD)
Dean Steele	19	12	31	1	32
Dennis Wiesenborn	16	8	24	3	27
Elton Solseng	0	25	25	0	25
Ganesh Bora	7	9	16	2	18
Scott Pryor	17	10	27	3	30
Tom Bon	16	7	23	0	23
Xinhua Jia	9	8	17	0	17
Zhulu Lin	13	5	18	1	19
Igathinathane Cannayen	0	0	0	1	1
Shafiqur Rahman	0	0	0	2	2
Total	97	84	181	13	194

H. Recruitment

Student recruitment is a responsibility of all faculty, although primary activities have been performed by the department chair. This has been especially true in recent years because of the number of new faculty. New faculty need time to learn about the specifics of the programs and to establish their teaching and research programs before being assigned significant recruitment responsibilities.

Programs such as Electrical Engineering, Mechanical Engineering, and Civil Engineering or Plant Sciences, Animal Sciences, or Agribusiness are very visible and recognized majors. Unfortunately, the ABEN or ASM programs are not widely recognized by prospective students. As a result, active recruitment is necessary to maintain and increase student enrollment in these programs. Recruitment is accomplished through many different activities as noted below.

- For many years, the ABEN department chair has participated in the NDSU recruitment activity at the annual Minnesota College Fair in Minneapolis. This has provided the opportunity to represent the ABEN and ASM programs at one of the largest college fairs in the US. It is believed that this effort has resulted in diversifying the student body. It provides the opportunity to visit with prospective students who otherwise would not know about our programs. ABEN enrollment has increased, the number of female students has increased, and the number of urban students has increased. These are all very positive outcomes which can be attributed, at least in part, to this activity.
- Faculty members represent the department at all Discover NDSU events. This is an excellent activity that provides opportunities to explain our programs to students and parents that visit NDSU.
- A mailing (letter and recruiting materials) to all high schools (typically addressed to counselors, math/science/ag science teachers) in North Dakota, most of Minnesota, and to select schools in South Dakota and Montana is made each fall. This provides key individuals in these schools with information about our programs to assist them in guiding college bound students.
- Each month, the Admissions Office provides a list of students with potential interest in the ABEN program (the list for ASM goes to the Dean of CAFSNR). The chair immediately sends a personal letter with information about the ABEN program and about the option of the ASM program.
- When notice is received that a student is accepted into either the ABEN or ASM program, a congratulatory/welcome letter is sent to the student by the department chair.
- The department hosts two regional high school FFA contests each year. The department sends a letter and recruitment information to participating students. In addition, a congratulatory letter is sent to contest winners.
- Several groups of students from different schools contact the Dean of CAFSNR each year to arrange visits to NDSU. The ABEN department participates in these activities to use them as an opportunity to interact with these students and gain name and program recognition.

- Often colleges with pre-engineering programs (BSC, Itasca Community College, etc.) come to NDSU to explore engineering opportunities. The ABEN department participates in these activities as an opportunity to interact with prospective engineering students.
- The CEA occasionally hosts open house events. Although we are not immediately adjacent to the rest of the CEA, the department participates in these events as a means to interact with prospective engineering students and gain some degree of name recognition.
- Several times a year, the department is contacted by alums who want to represent NDSU and our programs at high school college/career fairs. Recruitment information and PowerPoint presentations are provided as appropriate to help with their presentations.
- Usually, one or more times weekly, the Dean's offices or the Admissions Office refers students and parents to the department for personal visits. Either the chair or a faculty member meets with these prospective students and their parents. This is particularly effective given the opportunity to personally tell about graduate placement records, the excellent starting salaries, and the opportunities for regional employment. These visits are viewed as critically important to department recruitment efforts.
- Department web pages are updated as necessary to present important up-to-date information about our programs and department in a clear, concise, and easy to follow manner. One section of the homepage leads to comments about the programs and NDSU by recent alums. Printed recruitment materials are updated annually.

I. Cost of Program/Resources

Budgeted and generated FTEs varied from 2.5 to 4.0 and 3.4 to 4.8, respectively, over the reporting period (Table II-12). Variation in budgeted FTE was due to the changes in faculty (retirements and hires) during that time. Generated FTEs were always higher than budgeted FTEs, similar to most NDSU programs in recent years. The cost per SCH also varied over time with a general upward trend. The SCH cost in ABEN is significantly less than other engineering programs with the exception of CME. The SCH cost is also significantly less than all departments in CAFSNR with the exception of AAE and VMS. When compared to other CAFSNR and CEA programs with similar laboratory requirements, the SCH cost is low.

Table II-12. Student credit hour cost for ABEN and ASM programs (combined) relative to other programs in CAFSNR and CEA (source: NDSU Office of Assessment and Institutional Research).

Year	ABEN				CAFSNR							CEA				
	FTE Budgeted	FTE Generated	FTE Ratio	SCH Cost	AAE	ANS	CFS	PP	PS	SNRS	VMS	CE	CME	ECE	IME	ME
2005/06	3.02	3.43	1.14	\$136	\$60	\$202	\$296	\$223	\$128	--	\$83	\$186	\$135	\$202	\$243	\$154
2006/07	2.51	3.72	1.48	\$121	\$61	\$227	\$299	\$210	\$158	--	\$86	\$190	\$121	\$214	\$257	\$169
2007/08	2.76	3.67	1.33	\$135	\$64	\$212	\$343	\$312	\$174	--	\$84	\$216	\$127	\$227	\$254	\$169
2008/09	4.01	4.76	1.19	\$140	\$68	\$248	\$304	\$270	\$181	\$174	\$74	\$223	\$135	\$248	\$259	\$175
2009/10	3.43	4.51	1.31	\$162	\$60	\$240	\$246	\$242	\$170	\$146	\$71	\$209	\$149	\$256	\$231	\$164
2010/11	3.94	4.56	1.16	\$147	\$61	\$226	\$343	\$254	\$174	\$159	\$66	\$199	\$127	\$234	\$236	\$171
Average	3.28	4.11	1.27	\$140	\$62	\$226	\$305	\$252	\$164	\$160	\$77	\$204	\$132	\$230	\$247	\$167

The allocated operating budget from the Agricultural Experiment Station has been about \$54,000 annually for about the last 10+ years. This is the operating budget for two academic programs and a graduate program. In addition, about \$2,700 (\$0 - \$5,000) has been allocated for equipment annually and \$15,000 for Extension operating allocation annually. These numbers are not adequate to cover needs. A single piece of equipment for a teaching laboratory may cost as much as \$25,000.

The College of Engineering and Architecture charges a student program fee of \$27.33 per credit or \$328 for full time students. Therefore, undergraduate and graduate ABEN students are charged this program fee. The fee is charged to every student; therefore, the amount of funds generated for the program is, in part, based on enrollment. Over the reporting period, the ABEN program has collected an average of about \$24,000 per semester in program fees. NDUS policy dictates that these funds can only be used for the benefit of those students paying the fees. ABEN program fees are mainly used to maintain a departmental computer cluster equipped with specialized software. This cluster includes about 12 computers. On a rotating basis, four computers are replaced each year. Specialized software must be purchased by the department and site-licenses must be purchased annually. The software includes Pro-E, ANSYS, MATLAB, and AutoCAD. In addition to computers and software, program fee funds have been used to replace computer cluster chairs, and study tables and chairs. Program fees were also used to install and maintain card key access to the ABEN building and the computer cluster and study room. This access is especially important for students working on design projects after normal building hours. Program fees have also been used to purchase laboratory equipment such as a PTO dynamometer (\$23,000) and data loggers and PLCs for the instrumentation lab. Program fees are also used to support student activities to include ASABE and Bison Pullers. These are activities open to all ABEN students and participation helps develop engineering skills and professionalism.

The department also partners with industry to secure some equipment for teaching. The North Dakota Agricultural Experiment Station has an agreement with Titan Machinery whereby departments can use a new Case-IH tractor for one year. At the end of the year, the tractor can be turned in for another new one. The ABEN Department has used this as an opportunity to have a modern (although small because of space constraints) tractor for instructional purposes. In addition, Bobcat provides a new skid steer loader annually. This unit is used for instructional purposes, although the agreement severely limits how it can be used. Rust Sales has provided a GPS unit and a Raven monitor for the Chemical Sprayer used as an Educational tool. Vermeer Inc. has donated a directional drilling machine as an educational tool.

J. External Funding

Table II-13. Grant and other awards (equipment gifts and loans) to ABEN, 2004-2010.

Year	Grant Awards	Equipment¹
2004/2005	615,811	115,760
2005/2006	743,004	26,000
2006/2007	869,000	116,000
2007/2008	368,985	127,600
2008/2009	913,572	56,675
2009/2010	1,209,357	550,000
2010/2011	1,072,411	470,000
Total	5,792,140	992,035

¹ Dollar values reflect equipment gifts and loans from agricultural industries (e.g. John Deere, Banner Electric, Melroe, Bobcat, Vermeer) that have provided tractors, skid steers, and other equipment on an annual basis.

K. Curriculum Development

The Agricultural and Biosystems Engineering Department (ABEN) is responsible for two academic programs: the Agricultural and Biosystems Engineering major and the Agricultural Systems Management (ASM) major. The ABEN program is an accredited engineering program, accredited by ABET, Inc. (formerly the Accreditation Board for Engineering and Technology). The ABEN program is administered through the College of Engineering and Architecture (CEA). Since 2007, two different concentrations have been offered in the ABEN program: the Agricultural Engineering Concentration (AGEN) and the Biosystems Engineering Concentration (BSEN). The ASM major is administered through the College of Agriculture, Food Systems, and Natural Resources (CAFSNR). All funding for the ABEN Department is through the CAFSNR.

All courses in the ASM program are offered on an annual basis. In the ABEN program all the required courses are offered annually. The elective courses in the ABEN program are offered on an alternate year basis with the exception of ABEN 473/673 – Agricultural Power which is offered annually due to student demand.

Since the last review of the ABEN Department, four new faculty members were hired who have particular teaching appointments. Three of the positions were new positions added to the department to meet increase teaching loads in the department and to enhance research opportunities available to the ABEN Department. One position was to fill an opening created by a faculty retirement.

Dr. Scott Pryor joined the ABEN Department in 2006. His areas of expertise are biofuel production from cellulosic feedstock's, biobased chemicals and materials, bioprocess engineering, process optimization, and solid state and liquid fermentation systems. His position was one of the new positions added to the ABEN Department. Dr. Pryor has a 20% teaching appointment and 80% research appointment.

Dr. Xinhua Jia filled the position opened by the retirement of Professor Lowell Disrud. She joined the ABEN Department in 2007 and has expertise in irrigation and drainage, hydrology, evapotranspiration, and water quality. Dr. Jia has a 10% teaching appointment and a 90% research appointment.

Dr. Ganesh Bora joined the ABEN Department in the fall of 2008. His position was one of the new positions created for the department. His position is 80% teaching and 20% research. He has expertise in precision agriculture, agricultural systems management, machinery systems engineering, agricultural energy, and instrumentation.

Dr. Zhulu Lin joined the ABEN Department late 2008. His position was the last of the new positions the ABEN Department has received. He has expertise in environmental systems analysis, surface and subsurface hydrology, and hydrologic, hydraulic, and water quality modeling. His position is 45% teaching and 55% research.

In 2007 the Agricultural and Biosystems Engineering program was changed to allow two concentration areas for students, the original program was designated the Agricultural Engineering Concentration (AGEN) and the Biosystems Engineering Concentration. (BSEN). Several new courses have been developed to provide courses for the two concentrations. The new courses developed to date are:

ABEN 450/650 – Bioprocess Engineering, 3 credits
ABEN 456/656 – Biobased Energy, 3 credits
ABEN 484/684 – Drainage and Wetland Engineering, 3 credits
ABEN 747 – Modeling Environmental Systems, 3 credits
ABEN 765 – Small Watershed Hydrology and Modeling, 3 credits

The development of these new courses has enabled greater differentiation between the AGEN and the BSEN concentrations.

ASM 323 – Post Harvest Technology was taught for several years by Mr. Bradley Schmidt who was hired on a yearly basis to teach this course. Mr. Schmidt announced he would resign at the end of spring semester 2010. This course was re-assigned to one of the full time staff within the department. This option became available due to the additional faculty who have joined the ABEN Department.

ASM 454/654 – Principles of Site Specific Agriculture has been redesigned and renamed in Fall 2010 as Principles and Applications of Precision Agriculture. This was done to keep updated with the transformation of Site Specific Agriculture into Precision Agriculture.

Cross-listed courses:

ASM 264 – Natural Resource Management Systems 3 credits, is cross-listed with Natural Resources Management and this course is being considered for cross-listing by the Soil Science Department although this cross-listing has not been finalized at this time.

ASM 468 – Golf Course Irrigation I – 2 credits is cross-listed with the Plant Sciences Department.

ASM 469 – Golf Course Irrigation II – 1 credit is cross-listed with the Plant Sciences Department.

ABEN 479 – Fluid Power Systems Design – 3 credits is cross-listed with the Mechanical Engineering Department.

L. Extension and Other Outreach

The Extension Agricultural and Biosystems Engineering program annually reaches about 6,000 people through about 120 educational presentations. Individual education and technical assistance annually is provided through about 1,000 telephone, electronic, office, and on-site consultations. Education also occurs through the media including about 90 news articles, and numerous radio and television programs, in addition to numerous magazine articles. Educational materials developed annually include about 20 technical articles, publications, videos and web site information. The use of the Extension ABEN site continues to grow with about 500 inquiries a day.

Major Efforts:

Flood Preparation and Recovery:

- Preparing for flooding webinars and conference calls were conducted for extension staff across the United States and within North Dakota during late winter.
- Educational materials were developed including a videos, narrated power point presentations on Flooded House Clean-up, publications distributed by FEMA, state agencies and NDSU.
- Several seminars were presented for home owners, contractors, and flood clean-up volunteers in Minot, Bismarck, Mandan and Mohall, North Dakota and Sioux City and Council Bluffs, IA. Two of the seminars in Minot each had about 600 participants and over 200 at one in Bismarck.
- Material was also developed for people dealing with continuing water problems near Devils Lake and other areas of the state.

Grain Drying and Storage:

- Grain drying and storage recommendations were provided through numerous presentations, consultations, news articles and was distributed through the web.
- Education was provided related to grain dryer selection primarily assisting people comparing the energy efficiency of grain dryers.
- A presentation on grain dryer selection and energy efficiency was placed on the web in addition to delivered through seminars in person and by distance education.

Energy Efficiency Education:

- An evaluation of current energy related residential building practices in North Dakota was conducted. These practices were compared to recently accepted national building standards, and the information was used to identify areas where concentrated educational programming can have the greatest impact on encouraging building practices to improve residential energy efficiency and energy code compliance. This information was also used during the amendment process of the North Dakota residential building code to support the inclusion of the energy efficiency provision in the code.
- In cooperation with the North Dakota Association of Builders, training was provided at several locations across the state on energy efficient building practices and the energy codes to their membership.
- In cooperation with the North Dakota Building Officials Association we provided energy code training for building code officials and local contractors. A series of educational videos were developed and packaged into a Home Energy Use 101 course that is available at <http://www.ag.ndsu.edu/energy>

Precision Agriculture / Remote Monitoring Technology:

- Educational presentations on various precision agriculture topics including LiDAR applications, variable rate fertilization of field crops, sprayer boom section control, developing field management zones and fertilizer application maps, and equipment requirements for variable rate application are given across North Dakota. John Nowatzki is the co-leader developing the precision agriculture resource area on the eXtension Web site. (<http://www.extension.org>)
- Coordinates wireless remote monitoring technology applications to monitor soil and ambient conditions in on-farm residue management and strip till research in collaboration with scientists from the NDSU Soils and Plant Sciences Departments. Real-time data from these projects are available on the Internet at <http://www.ageng.ndsu.nodak.edu/farmmonitor>.
- Educational programming and demonstrations using Web cameras to transfer live video image streams from remote sites to displays on the Internet using 802.11 wireless and cellular technologies.

Conservation Tillage:

- Coordinate NDSU Extension Service demonstrations at the annual Big Iron Show in West Fargo each September that draws approximately 70,000 people from North Dakota and the surrounding states.
- Recent field demonstrations include strip tillage, air seeder opener equipment demonstrations, and tile drainage installation.
- Collaboration on field research projects evaluating the effects of stubble height on soil moisture and temperature, and comparing soybean production under strip till and no till in North Dakota.
- Recent publications include: 1) AE-1370 Strip Till for Field Crop Production, Equipment, Production, Economics; 2) A-1364 Bringing Land in the Conservation Reserve Program Back into Crop Production or Grazing; and 3) FS 919 Selecting Drift-reducing Nozzles.

Oil Spill Prevention, Control and Countermeasures:

- The Environmental Protection Agency recently clarified its position that farms storing oil products in quantities exceeding 1,320 gallons need to have a plan to stop an oil spill from possibly affecting water quality. To assist farmers understand what was expected and provide assistance to them as they develop their plan, secondary containment information, a completed plan template, a listing of qualified businesses with expertise to test storage tanks and develop plans, and an educational presentation on the EPA expectations were developed and placed on the web. Education was conducted through numerous presentations, news releases, and media interviews.

Subsurface Drainage:

- Since the mid-1990s excess water in the form of rain and snow has impacted crop production significantly in eastern North Dakota. The excess water has increased the amount of saline affected soil throughout the state, which not only affects farmer's fields but also lawns, pastures, parkland and virtually all land uses in the state. The NDSU Extension Service has organized numerous educational events, tours and demonstrations to inform growers, government agency personnel, legislators and the general public about subsurface drainage to control high water tables in fields and reduce salt accumulation. These have included annual subsurface drainage design schools and drainage forums organized jointly with the University of Minnesota Extension Service and South Dakota State University.

- Extension has obtained two grants to document and monitor tile drainage water quality, installed an 8-acre controlled drainage research and demonstration plot on the NDSU campus and established a Discovery Farm where tile drainage is the main focus. The educational program has had a large impact on the state resulting in a change to the state drainage laws, unprecedented acreage being tiled and increased business activity.

Livestock Waste:

- Five extension publications have been written to address issues identified by discussions with producers and colleagues.
- Current research is being done in the areas of greenhouse gas emissions from livestock operations, demonstration of bio-methane potential of dairy manure and co-digestion with canola meal, monitoring air emissions from swine facilities, demonstration of new technologies to reduce odor emissions from anaerobic swine lagoons in ND, livestock and poultry carcass composting and demonstration and evaluation of vegetative buffer strips to minimize runoff pollution from feedlots.

M. Collaboration with Other Units

Personnel Name, Collaborative Activity	Collaborative Activity	Collaborating Unit(s)
Leslie Backer		
Grants	Research and Extension Project on Technology Development High-density Super-Bale for Efficient Transport and Storage of Crop Biomass.	Collaborations include the following NDSU Departments and RECs: <ul style="list-style-type: none"> • Agribusiness and Applied Economics • Streeter REC
Publications	2 publications	Collaborations include the following NDSU Departments: <ul style="list-style-type: none"> • Agribusiness and Applied Economics • Agricultural and Biosystems Engineering Collaborations include the following external units: <ul style="list-style-type: none"> • USDA • Mississippi State University
Joint Teaching	N/A	N/A
Curriculum Development	N/A	N/A
Extension/ Outreach	N/A	N/A
International Activities	Travel to India with Dean Gary Smith	Collaborations include the following external units: <ul style="list-style-type: none"> • Ansal Institute of Technology
Other	N/A	N/A

Personnel Name, Collaborative Activity	Collaborative Activity	Collaborating Unit(s)
Thomas A. Bon		
Grants	N/A	N/A
Publications	1 refereed journal article and eight presentation papers on two-row plot scale potato planter, quarter scale tractor, Fulbright scholarship to Uzbekistan, and several course improvements regarding software integration, proximity sensors, three-phase demonstration units and capstone course evaluations.	Collaborations include the following NDSU Departments: <ul style="list-style-type: none"> • Agricultural and Biosystems Engineering, NDSU Collaborations include the following external units: <ul style="list-style-type: none"> • Ansal Institute of Technology, India
Joint Teaching	Alternate every other year teaching ABEN/ME 479 Ethics 402	Collaborations include the following NDSU Departments: <ul style="list-style-type: none"> • Mechanical Engineering • College of Engineering and Architecture
Curriculum Development	N/A	N/A
Extension/ Outreach	N/A	N/A
International Activities	Fulbright Scholarship, Spring semester 2010	Collaborations include the following external units: <ul style="list-style-type: none"> • Ansal Institute of Technology
Other	N/A	N/A

Personnel Name, Collaborative Activity	Collaborative Activity	Collaborating Unit(s)
Ganesh Bora		
Grants	5 Successful grants in the area of Machinery Systems Engineering, Development, Field Testing and Training	
Publications	12 refereed journal articles on variable rate, site specific agriculture, rice cultivation and citrus. 2 are under review.	<p>Collaborations include the following NDSU Departments</p> <ul style="list-style-type: none"> • Agricultural and Biosystems Engineering • Soil Science • Mechanical Engineering • Civil Engineering • Food Science <p>Collaborations include the following external units:</p> <ul style="list-style-type: none"> • University of Florida • IFDC/USAID
Joint Teaching		N/A
Curriculum Development	Developed Curriculum for ASM454/654: "Principles and Applications of Precision Agriculture"	N/A
Extension/ Outreach	Presented about Adoption of Precision Agriculture in North Dakota, 2010 Field Days at Casselton and Dickinson, ND	N/A
International Activities	<p>Host three visiting scientists from India</p> <p>Adjunct Faculty at Kazak National Agrian University (KazNAU), Almaty, Kazakhstan</p> <p>Co-Advisor of a PhD student in KazNAU</p> <p>Working with NDSU's International Program to develop MoU with Kaziranga University, India</p>	<p>Visiting Scientists:</p> <ul style="list-style-type: none"> • Karan Singh, 2010 • K. N. Agrawal, 2010 • Mahesh Kumar, 2011 <p>PhD Student at KazNAU:</p> <ul style="list-style-type: none"> • Zhanat Khazimov <p>Collaborations included the following external units:</p> <ul style="list-style-type: none"> • Kazak National Agrian University (KazNAU), Almaty, Kazakhstan • Asian Institute of Technology, Bangkok, Thailand • Jinan University, Guangzhou, China • Kaziranga, University, India • Tezpur University, India
Other	Core Member and Representative of NDSU in Ag-Mechanization group of AGIDEA. AGIDEA is a national consortium of land grant universities offering programs and courses in agriculture discipline	N/A

Personnel Name, Collaborative Activity	Collaborative Activity	Collaborating Unit(s)
Igathinathane Cannayen		
Grants	3 Successful grants in the area of biomass testing and biomass feedstock's	Collaboration include the following NDSU Departments and RECs: <ul style="list-style-type: none"> • Agribusiness and Applied Economics • Agricultural and Biosystems Engineering • Streeter REC Collaborations include the following external units: <ul style="list-style-type: none"> • USDA-ARS • Northern Great Plains Research Lab
Publications	Peer-reviewed articles published = 9 (under review = 7) and 12 paper/posters	Collaborations include the following external units: <ul style="list-style-type: none"> • USDA • Northern Great Plains Research Lab • ADM Alliance Nutrition • University of Tennessee • Mississippi State University • University of British Columbia
Joint Teaching	N/A	N/A
Curriculum Development	N/A	N/A
Extension/ Outreach	Two presentations and one paper presented on various aspects of biomass	Collaborations include the following external units: <ul style="list-style-type: none"> • North Dakota State College of Science • PSCA • Dakota Spirit Ag Energy
International Activities	Machine vision applications to particle size measurement and particle size distribution	Collaborations include the following external units: <ul style="list-style-type: none"> • EWOS Innovation, Feed Process Technology, Dirdal, Norway • Department of Mining Engineering, Cumhuriyet University, Sivas, Turkey
Other	N/A	N/A

Personnel Name, Collaborative Activity	Collaborative Activity	Collaborating Unit(s)
Ken Hellevang		
Grants	4 Successful grants in the area of extension disaster education, flood, and energy	Collaborations include the following NDSU Departments: <ul style="list-style-type: none"> • Vet and Micro Collaborations include the following external units: <ul style="list-style-type: none"> • Auburn University • University of Wisconsin • Purdue University
Publications	3 Peer review journals and 5 extension publications	Collaborations include the following external units: <ul style="list-style-type: none"> • University of Wisconsin • Kansas State University • University of Minnesota • eXtension.org
Joint Teaching	N/A	N/A
Curriculum Development	N/A	N/A
Extension/ Outreach	Collaboration with several universities and businesses across the country in providing education and technical assistance.	Collaborations include the following external units: <ul style="list-style-type: none"> • Anheuser Busch • SCAFCO Grain Systems • University of Wisconsin • Extension Disaster Education Network • South Dakota State University • International Association of Operative Millers • USDA-GIPSA • Grain Elevator and Processing Society • American Crystal Sugar • University of Missouri • ND Department of Health
International Activities	Provided training on Barley Storage for a Chinese Trade Team Spoke to various international groups	Collaborations include the following NDSU Departments <ul style="list-style-type: none"> • Northern Crops Institute • Institute of Barley and Malt Sciences
Other	N/A	N/A

Personnel Name, Collaborative Activity	Collaborative Activity	Collaborating Unit(s)
Xinhua Jia		
Grants	8 Successful grants in the area of tile drainage, sub-irrigation, evapotranspiration and water quality	Collaborations include the following NDSU Departments and REC's: <ul style="list-style-type: none"> • Natural Resource Management • Soil Science • Plant Science • Agricultural and Biosystems Engineering • Civil Engineering • Carrington REC Collaborations include the following external units: <ul style="list-style-type: none"> • University of Minnesota • University of North Dakota • University of Montana • NASA Goddard Earth Science Center
Publications	7 referred journal articles on sub-surface drainage, tile drainage, evapotranspiration, and turf grasses	Collaborations include the following NDSU Department: <ul style="list-style-type: none"> • Agricultural and Biosystems Engineering Collaborations include the following external units: <ul style="list-style-type: none"> • University of North Dakota • University of Florida • University of New Hampshire • University of Pedro Rico • North Carolina University
Joint Teaching	ASM and NRM 264	Natural Resource Management
Curriculum Development	N/A	N/A
Extension/ Outreach	N/A	N/A
International Activities	N/A	N/A
Other	N/A	N/A

Personnel Name, Collaborative Activity	Collaborative Activity	Collaborating Unit(s)
Zhulu Lin		
Grants	N/A	N/A
Publications	11 refereed journal articles and two book chapters on structural modeling, hydrological modeling, calibration, environmental modeling, control systems, and phosphorus in the environment	Collaborations included the following NDSU Department: <ul style="list-style-type: none"> • Agricultural and Biosystems Engineering Collaborations include the following external units: <ul style="list-style-type: none"> • University of Georgia • Georgia EPD • Delaware River Basin Commission • Southwest Research Institute • Stetson Engineers
Joint Teaching	N/A	N/A
Curriculum Development	N/A	N/A
Extension/ Outreach	N/A	N/A
International Activities	N/A	N/A
Other	N/A	N/A

Personnel Name, Collaborative Activity	Collaborative Activity	Collaborating Unit(s)
Scott Pryor		
Grants	15 Successful grants in the area of biomass compositional analysis, biomass feedstock's, biomass densification, cellulose for biomass hydrolysis, canola bioproducts, renewable energy and ethanol production	Collaborations include the following NDSU Departments: <ul style="list-style-type: none"> • Plant Sciences • Cereal and Food Science • Animal and Range Science • Agribusiness and Applied Economics • Mechanical Engineering • Agricultural and Biosystems Engineering Collaborations include the following external units: <ul style="list-style-type: none"> • Clarkson University • CPM • MSU • Federal Machine • Ohio State University • USDA • University of Idaho • Michigan State University • NC AT&T • South Dakota State University • Northern Great Plains Research Lab • South Dakota School of Mines and Technology
Publications	16 refereed journal articles on saccharification, fermentation, canola, ethanol, switchgrass, cellulose activity, and antifungal compounds and activity	Collaborations include the following NDSU Departments: <ul style="list-style-type: none"> • Mechanical Engineering • Cereal Food Science • Agricultural and Biosystems Engineering • Agribusiness and Applied Economics Collaborations include the following external units: <ul style="list-style-type: none"> • Cornell University- Civil Environmental Engineering, Biological and Environmental Engineering, Plant Pathology, Food Sciences, Microbiology
Joint teaching		
Curriculum Development	N/A	N/A
Extension/ Outreach	N/A	N/A
International Activities	N/A	N/A
Other	N/A	N/A

Personnel Name, Collaborative Activity	Collaborative Activity	Collaborating Unit(s)
Shafiqur Rahman		
Grants	9 Successful grants in the area of managing animal manures under the context of energy production, gas emissions, and reducing environmental impacts	Collaborations included the following NDSU Departments and RECs: <ul style="list-style-type: none"> • Agricultural and Biosystems Engineering • Animal Sciences • Mechanical Engineering • School of Natural Resource Sciences (Soil Science) • Carrington REC
Publications	4 refereed journal articles and two book chapters on managing animal manures and evaluating crop tillage practices	Collaborations included the following NDSU Departments and RECs: <ul style="list-style-type: none"> • Animal Sciences • Carrington REC Collaborations included the following external units: <ul style="list-style-type: none"> • Texas A&M University • University of Manitoba • USDA
Joint Teaching	N/A	N/A
Curriculum Development	N/A	N/A
Extension/ Outreach	8 extension publications, 3 invited extension presentations, and 12 other extension presentations on various aspects of waste management in animal agriculture	Collaborations included the following NDSU Departments and RECs: <ul style="list-style-type: none"> • Animal Sciences • Carrington REC • Dickinson REC Collaborations included the following external units: <ul style="list-style-type: none"> • North Dakota Department of Health • Texas A&M University • University of Manitoba
International Activities	Visiting Scientists from Turkey Student intern from Malaysia (10-16-2010 to 10-30-2010)	Visiting Scientist: <ul style="list-style-type: none"> • Dr. Bilal Cemek (June 20 – September 19, 2011) • Dr. Unal Kizil (July 05 –August 2, 2011) Malaysian Students <ul style="list-style-type: none"> • Aimi Athirah Binti Aznan • Natasyah Hani Binti Misman • Shazelia Ashikin Binti Sulaiman
Other	N/A	N/A

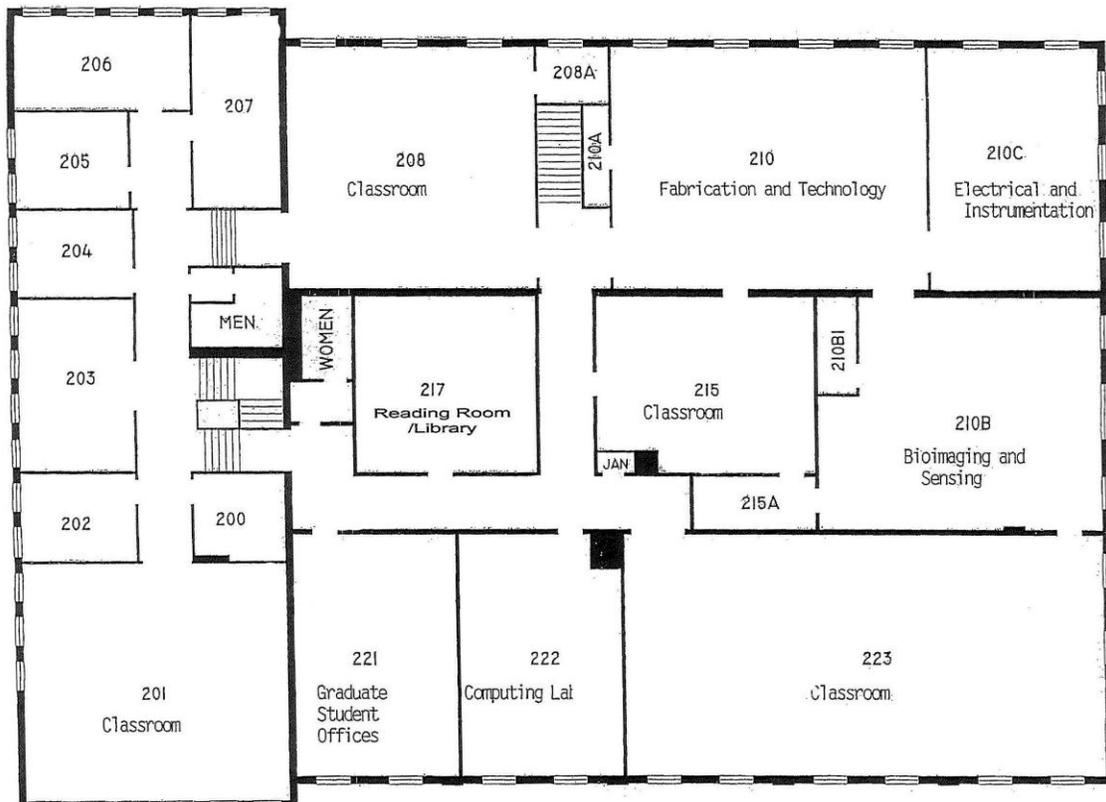
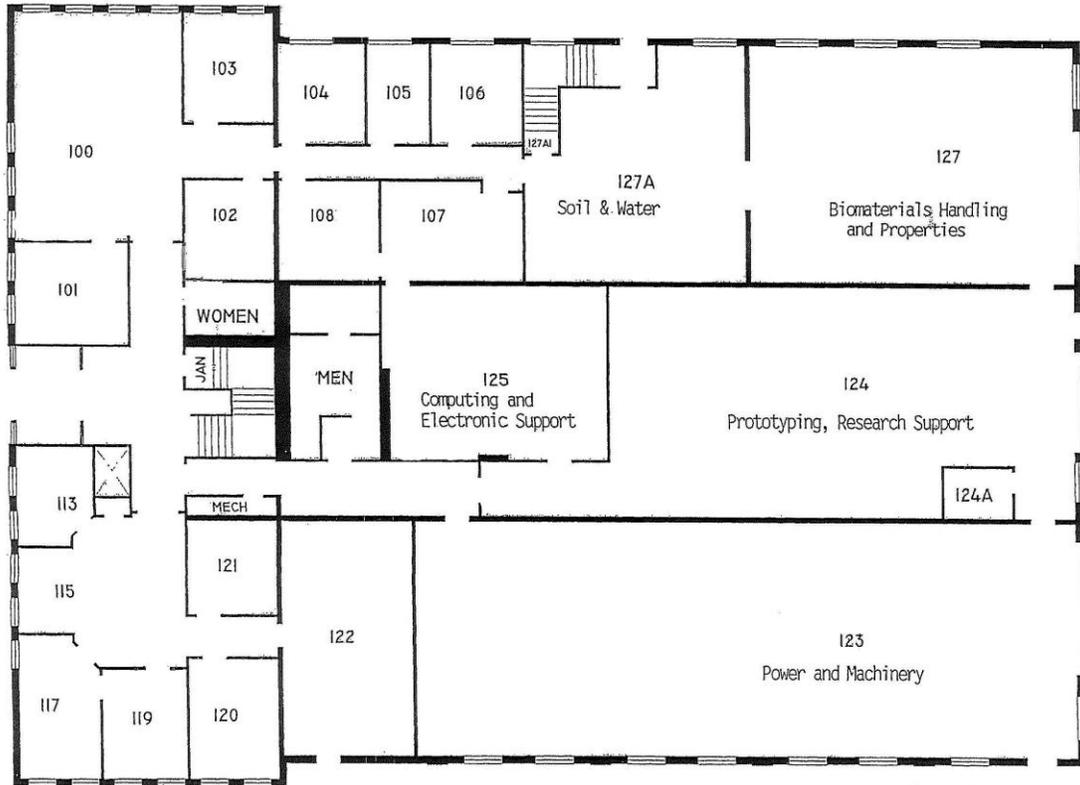
Personnel Name, Collaborative Activity	Collaborative Activity	Collaborating Unit(s)
Tom Scherer		
Grants	9 grants that deal with a variety of topics including irrigation scheduling, agricultural energy management, irrigation water conservation projects and water quality	<p>Collaborations included the following NDSU Departments:</p> <ul style="list-style-type: none"> • Soil Science • Agricultural and Biosystems Engineering <p>Collaborations included the following external units:</p> <ul style="list-style-type: none"> • ND Department of Health • ND Department of Commerce • USEPA • USDA/NRCS • US Bureau of Reclamation • Montana State University • University of Utah • University of Wyoming • South Dakota State University • Colorado State University • Eight County Soil and Water Conservation Districts
Publications	2 refereed journal articles, 1 book on private water systems (MWPS-14), 9 technical papers	<p>Collaborations include the following NDSU Departments:</p> <ul style="list-style-type: none"> • Soil Science • Agricultural and Biosystems Engineering <p>Collaborations include the following external units:</p> <ul style="list-style-type: none"> • Texas A&M University • University of Missouri • Kansas State University • University of Minnesota • Montana State University • Colorado State University • Five Universities in North Central Region
Joint Teaching	N/A	N/A
Curriculum Development	N/A	N/A
Extension/ Outreach	10 Extension publications, 5 tours, 6 magazine articles, 85 presentations, many news releases and published a monthly irrigation newsletter from April to October. These deal with a variety of subjects related to water such as irrigation, tile drainage, sump pumps, septic systems and private water supply	<p>Collaborations include the following NDSU Departments and REC's:</p> <ul style="list-style-type: none"> • Agricultural and Biosystems Engineering • Seven ND REC's • Soil Science • Agricultural Communications <p>Collaborations include the following external units:</p> <ul style="list-style-type: none"> • ND State College of Science • US Bureau of Reclamation • ND Water Education Foundation • ND Irrigation Association • Missouri Slope Irrigation Development Foundation • Numerous county and federal government departments
International Activities	Hosted a meeting with Canadian engineers and scientists on tile drainage concerns in the Red River Valley.	<ul style="list-style-type: none"> • 7 Engineers and scientists led by Bruce Shewfelt, AESB in Morden, Manitoba.
Other	N/A	N/A

Personnel Name, Collaborative Activity	Collaborative Activity	Collaborating Unit(s)
Dean Steele		
Grants	5 successful grants in the area of water climate, erosion, evapotranspiration, and soil change.	<p>Collaborations include the following NDSU Departments and REC's:</p> <ul style="list-style-type: none"> • Soil Science • Agricultural and Biosystems Engineering <p>Collaborations include the following external units:</p> <ul style="list-style-type: none"> • Minnesota Department of Ag • University of Minnesota
Publications	5 refereed journals on irrigation, watershed and planting.	<p>Collaborations include the following NDSU Departments and REC's:</p> <ul style="list-style-type: none"> • Soil Science • Agricultural and Biosystems Engineering • Carrington REC • Plant Sciences • Statistics <p>Collaborations include the following external units:</p> <ul style="list-style-type: none"> • University of Minnesota
Joint Teaching	N/A	N/A
Curriculum Development	<p>Revised ABEN 464/664, Resource Conservation and Irrigation Engineering, 4 credits, after retirement of previous instructor. Spring 2007.</p> <p>Department service for Accreditation Board for Engineering and Technology reviews.</p>	
Extension/ Outreach	10 Extension-related publications and 12 Extension-related publications in water, irrigation, and tile drainage.	<p>Collaborations include the following NDSU Departments and REC's:</p> <ul style="list-style-type: none"> • Agricultural and Biosystems Engineering • Plant Science • Soil Science <p>Collaborations include the following external units:</p> <ul style="list-style-type: none"> • University of Minnesota • ND State Water Commission • David's Engineering
International Activities	Visiting Scientist from Turkey.	Dr. Hakan Buyukcangaz (4/22/2010 – 10/17/2011).
Other	7 publications (research presentations) in water, irrigation, planting, and tile drainage.	<p>Collaborations include the following NDSU Departments and REC's:</p> <ul style="list-style-type: none"> • Agricultural and Biosystems Engineering • Soil Science <p>Collaborations include the following external units:</p> <ul style="list-style-type: none"> • David's Engineering

Personnel Name, Collaborative Activity	Collaborative Activity	Collaborating Unit(s)
Dennis Wiesenborn		
Grants	4 successful grants on biobased products	<p>Collaborations included the following NDSU Departments and RECs:</p> <ul style="list-style-type: none"> • ABEN • Mechanical Engineering • Agribusiness and Applied Economics • Center for Nanoscale Science and Engineering • Coatings and Polymeric Materials • Veterinary and Microbiological Science • Cereal and Food Science • Plant Sciences • North Central Research Extension Center • Carrington Research Extension Center <p>Collaborations included the following external units:</p> <ul style="list-style-type: none"> • Tecton, Fargo • Minn-Dak Growers, Grand Forks • Monsanto, ADM, Enderlin and Velve • Green Vision Group • American Crystal Sugar
Publications	<p>10 (+2 in process) Publications in the following areas:</p> <ul style="list-style-type: none"> • Vegetable oil-based resins for composite materials (2+1 in revision) • Antimicrobial Agents for Surface Treatment of Grains (2+1 in submitted) • Flaxseed Fractions for Food and Feed Uses (2) • Modeling production of Biodiesel and Field Pea Fraction (2) • Impact Dehulling of Oats (2) 	<p>Collaborations included the following NDSU Departments and RECs:</p> <ul style="list-style-type: none"> • ABEN • Agribusiness and Applied Economics Mechanical Engineering • Center for Nanoscale Science and Engineering • Veterinary and Microbiological Science • Cereal and Food Science • Carrington Research Extension Center <p>Collaborations included the following external units:</p> <ul style="list-style-type: none"> • Northern Crops Institute • USDA-ARS, Fargo
Joint Teaching	N/A	N/A
Curriculum Development	N/A	N/A
Extension/ Outreach	N/A	N/A
International Activities	<ul style="list-style-type: none"> • Extraction of Vegetable Oil with Surfactants (hosting MS-ECS student) • Fractionation of Neem for Larvicide (hosted visiting scientist, Dr. Vargas-Lopez for two 3-week stints) and was a main speaker at two week-long short courses in Mexico • Toured research center in India, hosted by former visiting scientist to NDSU, Dr. K. K. Singh; and toured a new college in India • Biodiesel Quality (hosted visiting scholar, Dr. Kim, for 1 year). • 5. Resins for Composites (co-hosted visiting scholar, Dr. Hao Wang for 4 weeks) 	<p>Collaborations included the following external units:</p> <ul style="list-style-type: none"> • Chulalongkorn University, Thailand • Universidad de Sonora, Mexico • Central Institute of Agricultural Engineering, India • Ansal Institute of Technology, India • Chonbuk National University, South Korea • University of Southern Queensland, Australia
Other	N/A	N/A

N. Facilities

- **ABEN Building** – Offices, labs, classrooms (All classrooms used by University). A modern tractor has not been able to fit in this building since 1970s.



Bio-Imaging and Sensing Center (210B):

This laboratory is in an intermediate phase of development. This facility is being developed to serve research and teaching needs for integrating emerging artificial intelligence technologies for biological and agricultural applications. This laboratory is housed in room 210B of the Agricultural and Biosystems Engineering Building.

At present, three PC-based computer vision systems and Sun' workstations with other electronic accessories (such as color video cameras, frame grabbers, video recorders, lighting research equipment, and lenses) are available in this laboratory. Additional computer-based motion control equipment and tactile sensors are also available. A multipurpose zoom microscope with fluorescence capability and a PC-based fluorescence spectrometer are recent additions to this lab.

Various computer software provides access to different artificial intelligence technologies, e.g., computer vision, neural networks, fuzzy logic. This computer software is SNNS' for neural networks, "Level 5" for expert systems, Optimas', ImagePro,' and Khoros for image processing and scientific visualization, and FIDE' is used for fuzzy logic.

The Bio-imaging and Sensing Center is committed to discovery, development and adaptation of cost-effective and workable solutions for problems in agriculture, food, feed, and fiber production, processing, and associated bio-systems.

Computer Laboratory (222):

The laboratory has 12 personal computers. All of the computers have Internet access and laser printing ability. Software in this facility includes: Microsoft Office 2007 including Access, Word, Excel, Power Point, Publisher and Outlook; AutoCad 2009; ProE; Ansys; Algor; MatLab-Simulink; ESRI (GIS program) and Automation Studio (hydraulic electronics).

Engine Power and Machinery (123):

This laboratory provides a wide assortment of engines (gasoline and diesel) ranging in size from small single cylinder (2 cycle and 4 cycle) to 3, 4, and 6 cylinder diesel models. Two tractors are available for laboratory use (one gasoline and one diesel). Several cutaway engines are available as are cutaway models of manual shift and power shift transmission.

Instrumentation available for laboratory exercises includes: engine analyzers, dynamometers, a diesel test stand, temperature and pressure sensing, data logging, sound level, load cell, engine timing, flowmeter, stress coat equipment, strain gage measurement equipment, accelerometers, an acoustic flowmeter, exhaust analyzer, and LABTECH notebook software.

Machinery available for laboratory instruction includes: planter and sprayer unit test stands, tillage implement comparison unit, portable-electric hydraulic pump, and hydraulic components. Analysis software packages available are ALGOR, Campbell data logging and support software for programming, and monitoring and file transfer.

Prototyping/Research Service (124):

This laboratory provides work space and shop facilities for students to develop and test prototypes (under supervision of faculty and department technicians) of design concepts or design project results. Facilities include: electric wire arc and gas welders, turning lathe, drill presses, shears and shaping tools, table, radial-arm and panel saws, metal-cutting saws, and a broad assortment of hand tools. In addition to department facilities for these purposes, a laboratory in the Industrial and Manufacturing Engineering Department provides extensive construction and fabrication facilities that are available to agricultural and biosystems engineering students via appropriate arrangements.

Environmental Measurements (127A):

This laboratory is used for teaching and research needs in the areas of irrigation engineering, environmental measurements, and natural resources management. Computers, data logging systems, and related equipment can be used here to test, calibrate, and monitor a variety of sensors for laboratory and field experiments. The lab is also used to set up and test sensors and data logging equipment prior to field deployment. Soil samples can be set up and run through wetting and drying cycles for testing and comparison of soil water sensors. Additional equipment includes a chest freezer, drying ovens, and a fume hood.

Instrumentation and Teaching Services Laboratory (210C):

This laboratory is used for teaching and research needs in the areas of irrigation engineering, environmental measurements, and natural resources management. Computers, data logging systems, and related equipment can be used here to test, calibrate, and monitor a variety of sensors for laboratory and field experiments. The lab is also used to set up and test sensors and data logging equipment prior to field deployment. Soil samples can be set up and run through wetting and drying cycles for testing and comparison of soil water sensors. Additional equipment includes a chest freezer, drying ovens, and a fume hood.

Electrical and Electronic Technology (210):

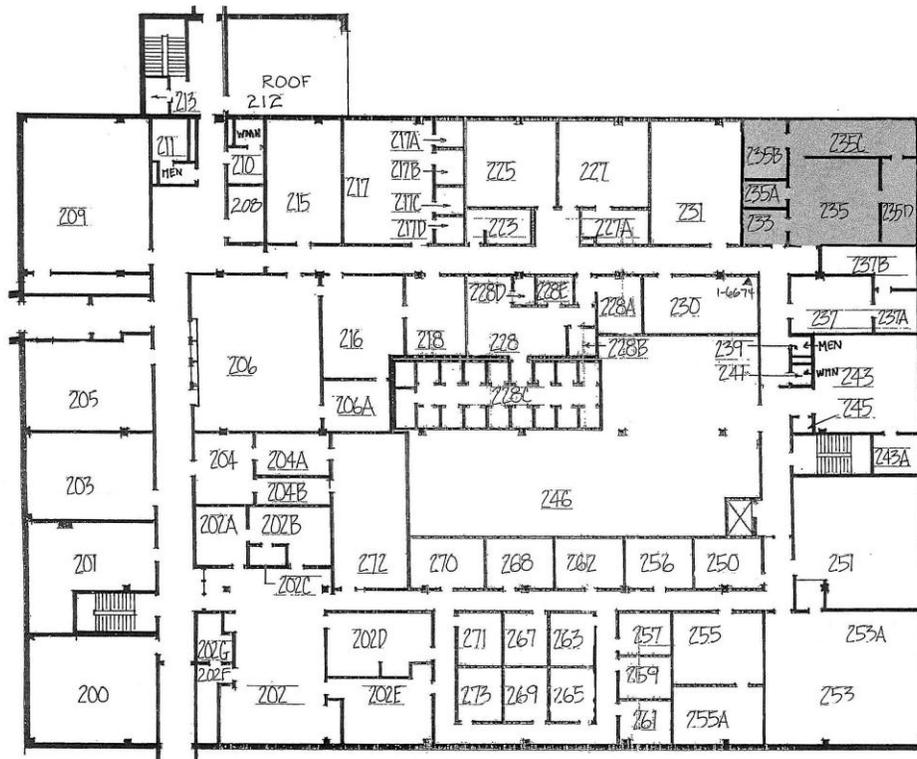
This laboratory includes four electrical wiring booths for use with several electrical wiring exercises and demonstrations, wiring exercise panels, single and three phase power supplies, electrical meters, demonstration boards, and programmable logic controllers. Available instrumentation includes: digital and analog oscilloscopes, digital and analog multimeters, kilowatt-hour meters, wattmeters, ammeters, and voltmeters.

This laboratory also provides work space areas for instrumentation and measurements exercises. Experiments in electrical measurement signal conditioning, computer-based data acquisition, sensor and transducer operation (measurement of strain, temperature, humidity, acceleration, sound level, etc.) and data analysis occur in this laboratory.

Other equipment available for laboratory instruction includes: power supplies, protoboards, oscilloscope, a frequency generator, a frequency counter, data acquisition boards, 16 channel multiplexer, 8 channel multiplexers, and an AC motor load surveyor.

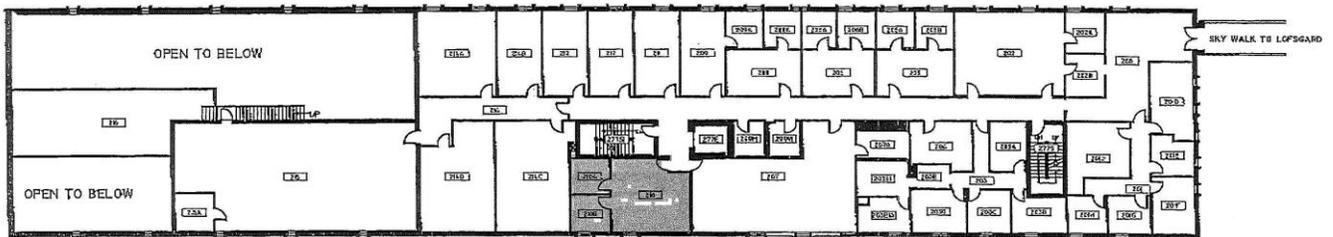
Software available includes electrical wiring demonstration and quizzing tools, and software for programming and monitoring PLCs. Software applications in ABEN 482 include Campbell CR-100 datalogging, communication and file transfer, and rosette stress and strain analysis.

- **Hultz Hall** – Labs (3) and Office (1)



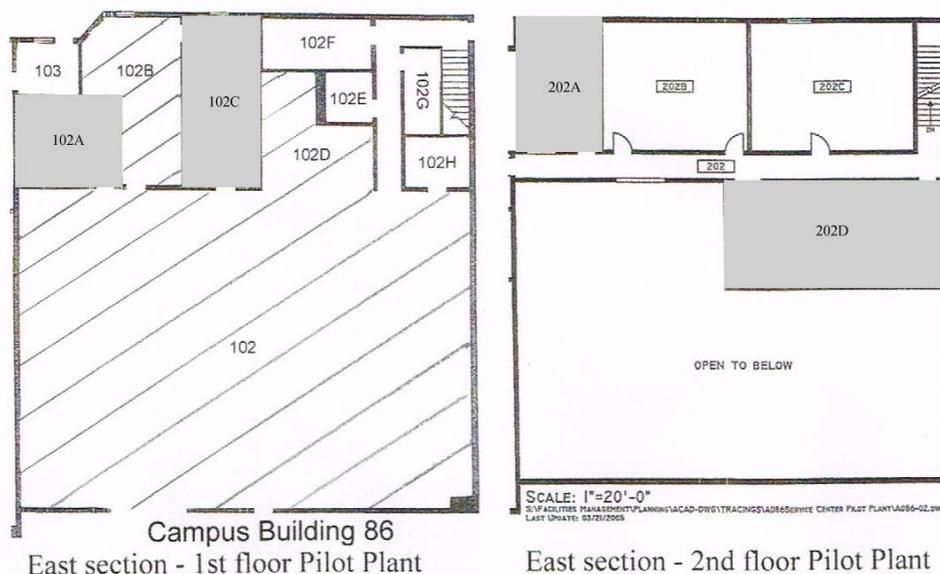
Soil and Water Engineering Laboratory (SWEL, shaded area of above map of Hultz Hall, 2nd floor) consists of three labs and an office. Computers, laptops, dataloggers, multiplexers, ovens, refrigerators, scales, various soil moisture sensors, EC/pH meters and their related accessories and software are available to design and conduct lab and field scale soil and water engineering experiments. Instrument calibration, repair, and testing prior of field installation for eddy covariance systems, radiometers, wind sensors, rainfall and snowfall gages are also conducted at the SWEL. Soil physical and simple chemical parameters can also be determined in the SWEL. An experienced technical staff stationed in the ABEN department is available for technical assistance.

- **Waldron Hall** – Labs (1)



The “Animal Waste Management and Agricultural Air Quality Lab” (shaded area of above map of Waldron Hall, 2nd floor) is equipped with different state-of-art equipment including LaChat QuickChem8500 analyzer, Spectrophotometer DR2800, ISCO 6712 Auto Sampler, YSI Professional Plus, Greenhouse Gas GC, Jerome meter 631X, Airmetric MiniVol Portable Air Sampler, Vac-U-Chamber, Drager Pack 7000, Portable Wind Tunnel, Flux Chamber, Hobo Weather Station, and other analytical instrument. This lab is used for measuring and quantifying manure properties, water quality from non-point source pollution, agricultural air quality and greenhouse gas emission. Also used for waste management and environmental pollution mitigation research.

- **Pilot Plant**



Shaded – ABEN
 Hatching – ABEN and CFS shared areas

The Agricultural and Biosystems Engineering Department has 2 wet laboratories in the NDSU Pilot Plant, as well as a large shared (with Cereal and Food Science) space serving as a general wet/dry processing laboratory (102, 3500 ft²), an explosion-proof processing laboratory (202A, 400 ft²), and 2 offices (102A and 102B). The Bioproducts Research Laboratory (202D, 650 ft²) and another wet chemistry process lab (102, 240 ft²) contain chemical fume hoods and sterile, laminar flow hood space. Standard utilities include 220 and 440 V power, steam, vacuum, compressed air, distilled water, and 18 mΩ NANOpure water. A walk-in cold room and freezer and an explosion-proof freezer are available for sample storage. Equipment available for process testing and scale-up includes basic incubators, a 1-L stainless steel Parr High Pressure Reactor (Parr Instruments; Moline, IL) and a 30-gallon mixed, sealed, stainless steel, steam-jacketed kettle with vacuum (30 D9MT, Lee Industries, Philipsburg, PA). Temperature controlled reactions (e.g. hydrolysis and fermentation) can be conducted in 4 water bath shaking incubators. Analytical equipment includes 2 Waters HPLC systems with refractive index and photodiode array detectors for analyzing chemical composition of liquid samples. All equipment necessary for compositional analysis of raw and pretreated biomass samples is available. Other useful equipment includes a refrigerated centrifuge and microfuge, spectrophotometer, microscope, and various incubators. A variety of equipment is available oilseed extraction and biodiesel production at testing. Biodiesel production can be conducted at the bench-scale as well as in 30-gal batches. Additional equipment available in the facility includes a variety of apparatuses for milling, drying, separation (soxhlets, Dionex ASE), and physical/chemical analyses (e.g. NIR, FTIR).

Library Annex

Extension storage – 270 square foot

National Energy Center of Excellence (Bismarck State College)

Office space – 126 square foot

Northern Great Plains Research Laboratory

Office space – 99 square foot

Biomass Processing Laboratory (NDSU State Shop) – 1800 square foot

Field Resources

Some of the field plots of the NGPRL, USDA-ARS, Mandan, ND. Details will be available with the Research Leader or the collaborating scientist of the NGPRL.

Computers

Laptop and docking station plus software resources

Research Capabilities

Physical, mechanical, and thermal characterization of biomass feedstocks; preprocessing of biomass feedstocks including mechanical drying, conditioning, size reduction, size and particle size distribution, and densification; machine vision application to biomass characterization; storage of raw and densified biomass.

O. Contact Information

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701-231-7265

III. Graduate Programs

A. Program purpose, objectives and outcomes

Agricultural and Biosystems Engineering (ABEN) plays an integral role in the mission of Land Grant Universities such as NDSU. The mission of the department is to develop and extend knowledge through research, teaching and extension programs in engineering and technology that advances the competitiveness and productivity of agricultural production, the value-added processing and new uses of agricultural commodities/biomaterials, and the sustainability of environmental resources management for the benefit of society. Future agriculture (including both on-farm and off-farm aspects) will be increasingly driven by bio-based technology involving integration of biological and natural sciences with engineering principles. The ABEN department must offer curricular and research programs at the M.S. and Ph.D. level to assure its continuing advancement in the capabilities needed to participate effectively in knowledge and technology developments for 21st century agriculture and related biological systems. M.S. and Ph.D. students are critical to successful grant funding and productivity of department faculty research programs. Engineers with an understanding of living systems are in demand to create the equipment, processes, and systems for production and use of biological materials. These programs are not offered elsewhere in the North Dakota University System.

The overarching objective of the ABEN M.S. and Ph.D. programs is to prepare men and women to apply scientific methods and engineering principles to gain significant, new insights into biological systems. The ABEN Ph.D. became available in 2002, succeeding the broader Engineering (ENGR) Ph.D. ABEN complements several interdisciplinary programs, especially Natural Resources Management (NRM) and Environmental Conservation Sciences (ECS); thus, ABEN faculty members advise graduate students in those areas, as well. These men and women will, in turn, improve production of agricultural and biological commodities; develop new or improved processes for food, feed, biofuels and other bioproducts; and manage environmental resources sustainably. Such expertise is of vital importance as global population continues to climb beyond 7 billion. Important elements of this program include innovative, multi-disciplinary education; discovery of knowledge; application of methods of experimental design and data analysis; and development of critical-thinking, speaking and writing skills at an advanced level.

These programs will provide a high quality engineering education experience and produce graduates that are well prepared to succeed in academic positions and in research and development positions serving needs of agricultural and related bio-industries. Graduates of the M.S. program will be able to undertake doctoral studies here or at other research universities and plan and perform industry research and development. Graduates of the Ph.D. program will be able to serve as educators and researchers at engineering colleges, develop extension engineering programming and supervise industry research and development. The program outcomes are summarized in Table III-1.

B. Program assessment

The assessment plan is carried out through the faculty advisor, graduate supervisory committee and NDSU Graduate School (Table III-1).

Program Outcome	Assessment Tool
1. Develop a knowledge base in Agricultural & biosystems engineering commensurate with the degree and research specialization.	a. Plan of study (approved by grad. supervisory comm.). b. Completion of course work (no grade <B). c. Oral and written examination for doctoral students.
2. Integrate and apply principles of engineering and biological systems in the pursuit of original research	a. Research proposal (presented to grad. supervisory comm.) b. Thesis or dissertation
3. Disseminate original research results to the scientific community	a. Presentation at scientific society meetings b. Publication in refereed journals

Students completing their M.S. or Ph.D. degrees within the department were generally successful at continuing to more advanced research positions (doctoral or post-doctoral research) or finding employment in industry or government suitable to their degrees (Table III-2). Fifteen students completed their M.S. degrees within the review period, of which 9 completions required three years or less (Table III-2). A main factor resulting in prolonged completions was acceptance of full-time employment before completion of all degree requirements. Eight students completed their doctoral degrees within the review period, and completions were within 3.5 to 4.5 years.

Name	Degree	Completion Date	Years to Completion	Occupation(s) since completion
Amamcharla, Jayendra	ENGR Ph.D.	2008	3.5	Post-Doctoral Research Associate South Dakota State University, Brookings, SD
Balasubramanian, Sundar	ABEN M.S.	2005	4	Research Associate Louisiana State University, Baton Rouge, LA
Dhillon, Bhavnita	ABEN Ph.D.	2010	3.5	Lecturer Guru Nanak Dev University, Punjab, India
Espinoza-Perez, Judith	ABEN Ph.D.	2010	3.5	Polymer Scientist Air Products and Chemicals, Allentown, PA
Gautam, Ramesh	ABEN Ph.D.	2005	4.5	Associate Land and Water Use Scientist California Department of Water Resources Sacramento, CA
Kasper, Matthew	ABEN M.S.	2009	4	Graduate Research Assistant, Department of Mechanical Sciences University of Illinois, Champaign, IL
Khot, Lav	ABEN Ph.D.	2009	3.5	Post-Doctoral Research Associate, Citrus Research and Education Center University of Florida, Gainesville, FL

Lin, Hongjian	ABEN M.S.	2010	2.5	Graduate Research Assistant, Bioproducts and Biosystems Engineering University of Minnesota, St. Paul, MN
Manamperi, Wajira	ABEN Ph.D.	2010	4	Postdoctoral Research Associate, Agricultural and Biosystems Engineering North Dakota State University, Fargo, ND
Mohapatra, Punyatoya	ABEN Ph.D.	2010	4.5	Part-time Lecturer University of California - Riverside
Monono, Ewumbua	ABEN M.S.	2011	2.5	Ph.D. Student NDSU, ABEN
Nelson, Kraig	NRM M.S.	2009		Precision Ag Consultant GK Technology, Halstad, MN
Nord, Ryan	ABEN M.S.	2006	4	Carpenter RJ Marco Construction, Little Canada, MN
Overmoe, Kate	ECS M.S.	2009	2	Graduate Student University of North Dakota, Grand Forks, ND
Pang, Xiao	ABEN M.S.	2011	3	Irrigation Engineer Beijing, China
Rijal, Ishara	ABEN M.S.	2011	2.5	Graduate Student Michigan State University, East Lansing, MI
Rorick, Rachel	ABEN M.S.	2010	2.5	Quality Assurance Engineer MillerCoors, Greenboro, NC
Sankaran, Sindhuja	ABEN Ph.D.	2009	3.5	Postdoctoral Research Associate, Citrus Research & Education Center University of Florida, Gainesville, FL
Tapasvi, Dhruv	ABEN M.S.	2006	2	Ph.D. Stipendiat Norwegian University of Science and Tech.
Wilhelmi, Andrew	ABEN M.S.	2008	2	Agricultural Engineer USDA-NRCS, Devils Lake, ND
Woznica, Szymon	ABEN M.S.	2007	2.5	Software Development Engineer Microsoft Corporation, Fargo, ND
Yousaf, Mohammed	NRM M.S.	2007	4	Environmental Scientist PBS&J, Jacksonville, FL
Venugopal, Manoj	ABEN M.S.	2005	4	Manufacturing Project Engineer Pella Corporation, Fairfield, OH

Graduate students in the department have been productive in terms of presentations at scientific society meetings and refereed publications in scientific journals (Table III-3). Nineteen students had either published such research or were expected to publish research, out of 26 students who enrolled before 2010.

Student	Faculty Advisor	Degree	Dates of Enrollment	Presentations	Publications
Amamcharla, Jayendra	Suranjan Panigrahi	ENG Ph.D.	2004-2008	**	2
Atandi, Eric	Shafiqur Rahman	ABEN M.S.	2009-Present	1	2*
Balasubramanian, Sundar	Suranjan Panigrahi	ENG Ph.D.	2002-2005	**	8
Bali, Sukhwinder	Ganesh Bora	NRM M.S.	2011-Present	0	0
Dhillon, Bhavnita	Dennis Wiesenborn	ABEN Ph.D.	2006-2010	3	2

Espinoza-Perez, Judith	Dennis Wiesenborn	ABEN Ph.D.	2006-2010	5	2
Kasper, Matthew	Suranjan Panigrahi	ABEN M.S.	2005-2008	**	0
Khot, Lav	Dennis Wiesenborn Suranjan Panigrahi	ABEN Ph.D.	2006-2009	**	1
Lin, Hongjian	Dennis Wiesenborn	ABEN M.S.	2008-2010	3	1
Manamperi, Wajira	Scott Pryor	ABEN Ph.D.	2006-2010	9	4
Moeller, Joshua	Dean Steele	ABEN M.S.	2008-Present	1	0
Mohapatra, Punyatoya	Suranjan Panigrahi Leslie Backer	ABEN Ph.D.	2006-2010	**	0
Monono, Ewumbua	Scott Pryor	ABEN M.S.	2009-2011	2	2 (in prep)
Nelson, Kraig	Lowell Disrud Dean Steele	NRM M.S.	2002-2009	1	1
Nord, Ryan	Suranjan Panigrahi	ABEN M.S.	2002-2006	**	0
Overmoe, Kate	Xinhua Jia	ECS M.S.	2008-2009	1	1*
Pang, Xiao	Xinhua Jia	ABEN M.S.	2008-2011	1	3
Rahman, Atikur	Shafiqur Rahman	ABEN Ph.D.	2009-Present	2	2
Rahman, Mohammed	Zhulu Lin	ABEN M.S.	2010-Present	2	3*
Rijal, Binod	Scott Pryor	ABEN M.S.	2010-Present	2	1
Rijal, Ishara	Xinhua Jia	ABEN M.S.	2009-2011	2	3*
Rorick, Rachel	Scott Pryor	ABEN M.S.	2008-2010	4	1
Samaratunga, Ashani	Scott Pryor	ABEN M.S.	2011-Present	0	0
Sankaran, Sindhuja	Suranjan Panigrahi	ABEN Ph.D.	2006-2009	**	2
Sidhu, Harjot	Dennis Wiesenborn	ABEN M.S.	2011-Present	0	0
Tapasvi, Dhruv	Dennis Wiesenborn	ABEN M.S.	2003-2006	3	1
Tuntiwiwattanapun, Nattapong	Dennis Wiesenborn	ECS M.S.	2011-Present	0	0
Vargas-Ramirez, Juan	Dennis Wiesenborn	ABEN M.S.	2010-Present	0	0
Wilhelmi, Andrew	Dennis Wiesenborn	ABEN M.S.	2007-2008	1	2
Woznica, Szymon	Suranjan Panigrahi	ABEN M.S.	2005-2007	**	0
Yousaf, Mohammed	Dean Steele	NRM M.S.	2003-2007	0	0
Yu, Manlu	Igathinathane Cannayen	ABEN Ph.D.	2010-Present	0	0
Zhou, De	Zhulu Lin	CAU Ph.D.		0	1***

*Denotes one manuscript in preparation

**Information not available

***De Zhou is co-advised by Dr. Lin, and spent one year of his doctoral program at NDSU (Sept. 2010 to August 2011). Mr. Zhou is working towards a doctoral degree in Land Management at China Agricultural University

C. Program administration

Departmental-level authority over the ABEN M.S. and Ph.D. programs, with respect to plan of study and graduate examinations, rests with the individual graduate advisory committees and the ABEN Chair. A graduate coordinator responds to inquiries about the ABEN M.S. and Ph.D. programs, refers prospective applicants to research faculty who may be able to serve as the research advisor, works with the ABEN chair and graduate faculty to clarify questions on program policy, helps resolve issues that arise from special circumstances, and coordinates the preparation of the Graduate Programs section of the ABEN Self-Study Report. Meetings of the ABEN graduate faculty are called as needed.

Responsibilities of an ABEN Student Services staff member includes the following: manages incoming graduate applications, ensures they are circulated to the appropriate graduate faculty, manages ABEN M.S. and Ph.D. graduate student records, ensures that the ABEN website provides current information to prospective new graduate students, and helps advertise openings for graduate research assistants.

Dr. Dennis Wiesenborn has served as ABEN Graduate Coordinator since fall 2009. Dr. Suranjan Panigrahi served in this capacity before fall 2009, and also undertook activities to advertise the position through visits to other universities and through an enhanced ABEN graduate programs website. Lori Buckhouse has served as Student Services Coordinator, following Janelle Quam's departure from the department in February 2011.

D. Faculty contributions

The ABEN Department has ten graduate faculty members, of which eight have formal research appointments. Eleven of the ABEN graduate faculty advised or co-advised graduate students in ABEN and/or other graduate programs at NDSU during the review period (Table III-4). This is a significant increase from the previous review period, during which five of the ABEN faculty advised graduate students. The addition of six new graduate faculty members during the current review period accounts for this growth, and will help ensure the continued growth and strengthening of ABEN graduate programs and of other NDSU graduate programs in which department faculty participate.

As noted above, ABEN is by nature a highly interdisciplinary field. The collaboration of ABEN faculty with other NDSU units, North Dakota Research Extension Centers, universities, companies and government research institutions was tabulated in section II.M. Incidentally, the ABEN faculty are increasingly international in background, hence a number of collaborations have an international scope. Coursework taken by ABEN graduate students draws from a number of departments in addition to ABEN. Graduate students have performed very well in departmental graduate level courses (Table III-5).

Table III-4. Number of graduate advisees per faculty member from Sept 2004 to Aug 2011.

Faculty	# of MS and Ph.D. students	Faculty	# of MS and Ph.D. students	Faculty	# of MS and Ph.D. students
Backer	1 Ph.D. (co-advised)	Jia	3 MS	Rahman	1 MS 1 Ph.D.
Bora	1 MS	Lin	1 MS 1 Ph.D.	Steele	2 MS 1 MS (co-advised)
Cannayen	1 Ph.D.	Panigrahi	5 MS 4 Ph.D.	Wiesenborn	5 MS 2 Ph.D.
Disrud	1 MS	Pryor	4 MS 1 Ph.D.		

Table III-5. Distribution of grades for graduate level ABEN courses offered fall 2009 to summer 2011.

Fall 2009

Instructor	Course # (Name)	A	B	C	D	F	P	S	U	I
Bon	652 Bioenvironmental Systems Design	1								
Steele	797 Masters Paper							1		
	798 Master Thesis							4		
	798R Thesis Continued Registration							2		
	799 Doctoral Dissertation							3		

Spring 2010

Instructor	Course # (Name)	A	B	C	D	F	P	S	U	I
Pryor	656 Biobased Energy	4								
Wiesenborn	682 Instrumentation and Measurements	2								
Jia	765 Small Watershed Hydrology and Modeling	6								
	798 Master Thesis							4		
	798R Thesis Continued Registration							2		
	799 Doctoral Dissertation							1		
	799R Dissertation Continued Registration							3		

Summer 2010

Instructor	Course # (Name)	A	B	C	D	F	P	S	U	I
	798 Master Thesis							4		
	798R Thesis Continued Registration							2		
	799 Doctoral Dissertation							2		

Fall 2010

Instructor	Course # (Name)	A	B	C	D	F	P	S	U	I
Wiesenborn	658 Food Process Engineering	4								
Jia	684 Drainage and Wetland Engineering	2								
Lin	747 Numeric Modeling of Env. and Biological Systems	7								
Wiesenborn	790 Graduate Seminar	8								
Steele	797 Master Paper							1		
	798 Master Thesis							5		
	798R Thesis Continued Registration							4		
	799 Doctoral Dissertation							2		

Spring 2011

Instructor	Course # (Name)	A	B	C	D	F	P	S	U	I
Pryor	650 Bioprocess Engineering	3	1							
Steele	664 Resource Conservation and Irrigation Engineering		1							
Steele	797 Master Paper							1		
	798 Master Thesis							7		
	798R Thesis Continued Registration							1		
	799 Doctoral Dissertation							2		

Summer 2011

Instructor	Course # (Name)	A	B	C	D	F	P	S	U	I
	798 Master Thesis							5		
	798R Thesis Continued Registration							2		

E. Student profile

Nearly all M.S. ABEN and Ph.D. ABEN students have a previous degree in engineering, come from abroad, and are full time students. These students are essential to the ABEN research programs; thus advisors invest much time in ensuring their students' success. In turn, the students are typically very productive, and very few fail to complete their graduate degree.

Prospective graduate students often correspond with ABEN faculty member in advance of application to determine the likelihood of graduate research funding in their area of interest. Students are typically encouraged to apply only if they show very good potential as researchers and the likelihood of graduate research assistantship (GRA) funding is good. Consequently, since 2008, the acceptance rate for ABEN M.S. was 36% (33 applied, 12 accepted) and ABEN Ph.D. was 23% (13 applied, 3 accepted). Students are not admitted to the ABEN M.S. and ABEN Ph.D. programs unless a department faculty member agrees to serve as advisor. Few faculty members agree to serve as an advisor unless they are able to provide a GRA or believe they will be able to offer a GRA in the near future. Only one student admitted since 2008 did not enroll; funding for this student failed to materialize. One student admitted since 2008 is on part-time status. Graduate enrollment is summarized by year in Table II-1.

The ABEN graduate programs receive a high proportion of its applicants from India, China and other Asian countries. Thus, about two-thirds of enrolled graduate students were from Asia, but the USA and other parts of the world were also represented (Table III-6). Female students constituted 30% of applicants and 38% of enrolled students.

Table III-6. Profile of students who applied to the ABEN M.S. and Ph.D. program since 2008 and of students enrolled in these programs during the review period.

	Applied since 2008	Enrolled since 2004*
Average GPA, time of application	3.4	3.4
Citizenship	37 Asian 5 USA 3 Africa 1 Latin America 1 Europe	15 Asian 3 USA 2 Africa 2 Latin America 1 Europe
Age Range, time of application	22-45	24-45
Gender	34 male 14 female	15 male 9 female
* Not included: students enrolled in NRM and ECS programs and advised by ABEN faculty		

F. Recruitment and retention

The ideal ABEN graduate student has an interest in one of the active research areas of the department, interest and ability in conducting and disseminating original research, and a previous degree in engineering. Students with a strong background in mathematics and physical science can be accepted on condition of taking some additional coursework in the engineering sciences.

Strategies used to recruit students are varied, and include department web pages devoted to ABEN graduate programs, graduate student research, faculty research, and when available, special notices about specific graduate research assistantships being offered. The research productivity of the

faculty, their participation in professional society meetings, their hosting of international scholars and their travel to other institutions are also believed to help recruiting. Students who inquire into the graduate programs are put in touch with one or more faculty members who have research programs in the student's area of interest.

A number of undergraduate students, including non-ABEN students, have worked in ABEN research labs. In some instances, the students are mentored in a research project that culminates in a student presentation at a scientific meeting. Some of these undergraduates continue as students in the ABEN graduate program. This approach may be the best strategy for increasing future numbers of American students in our graduate programs.

Retention since the last program review has been excellent. All students enrolled in the ABEN M.S. and Ph.D. since Fall 2004 either completed their degrees or are still actively working towards completion. As noted above, students are essential to the ABEN research programs. ABEN graduate students are typically awarded GRAs, and their thesis or dissertation objectives are aligned with the research objectives of the grants that funded the GRAs; thus, the faculty carefully mentor their graduate advisees, which ensures that the students are able to complete their degrees and the objectives of the research projects are met.

G. Professional development opportunities for graduate students

ABEN graduate students typically attend at least one professional society meeting at the national or international level, which enables them to both gain visibility for their research efforts and take advantage of a variety of professional development activities. The travel and registration expenses are typically borne by the advisor, though students are sometimes able to obtain a travel grant from NDSU or the society. The society meeting of choice is the annual international meeting of the American Society of Agricultural & Biological Engineers (ASABE), which provides excellent programming for young professionals. ABEN graduate students are also often involved in the North Central Section of ASABE/CSBE (Canadian Society of Biological Engineers) which meets once each year and brings together researchers from North and South Dakota, western Minnesota, Manitoba, and Saskatchewan. This meeting is hosted in Fargo once every four years.

Students often are able to interact through their research projects with faculty from outside the department, as well as scientists and engineers in industry and government agencies, farmers, ranchers and other stakeholders. Department seminars are provided by fellow graduate students and faculty, alumni and other representatives from industry, NDSU faculty with special expertise relevant to graduate students such as Dr. Sassi of the English Department, and visiting international scholars.

H. Financial support for graduate students

As noted above, ABEN graduate students are typically awarded graduate research assistantships funded through faculty research grants. One student was self-funded during the review period. The ABEN department did not award graduate teaching assistantships during the review period. The ABEN department began awarding two \$1,000 Frank Bain scholarships annually since 2008 to deserving graduate students.

I. Student productivity

Student completion and productivity in terms of research publications and presentations are our primary indicators for program assessment. Therefore, this was addressed above under section III.B.

J. Future directions

The graduate programs within ABEN are closely aligned with the mission of the department, and designed to ensure the professional success of its graduates. This will continue to be the primary focus of our graduate programs.

We anticipate that our graduate student numbers will continue to grow, because of the addition of new research faculty in recent years, and the anticipated addition of several more research faculty. The primary constraints to growth are the limited supply of graduate assistantships and laboratory space. The ABEN research faculty members support our graduate programs, and recognize their responsibility to develop research proposals to fund their research programs and future graduate students. However, improved research facilities, as noted elsewhere in this review, are critically needed. This will enhance the visibility and competitiveness of our faculty for both research funds and graduate students. Increased funding for graduate students will, in turn, result in the need for more active, visible graduate student recruiting.

The increase in student numbers will increase demand for new ABEN graduate level course offerings, especially 700-level courses. Although the research interests of our faculty are very diverse, we recognize a need to develop several new graduate level courses with broad appeal to our graduate students.

IV. Faculty Information

A. Head/Chair/Director Information

Since Les Backer's retirement on June 30, 2010, there have been two Interim Chairs serving the ABEN Department. Dr. Jim Venette (retired) first served as Interim Chair until April 1, 2011, when Dr. Frank Casey, Professor in the School of Natural Resource Sciences, took over as Interim Chair of ABEN.

The Department of Agricultural and Bio systems Engineering is responsible for two academic programs; a) Agricultural Systems Management in the College of Agriculture, Food Systems, and Natural Resources and b) Agricultural and Bio systems Engineering in the College of Engineering and Architecture, research in the North Dakota Agricultural Experiment Station and extension programming in the NDSU Extension Service. This position is administered through the CAFSNR, but the Chair reports to the Deans of the colleges for each of the respective academic programs.

The Chair has appointments in the CAFSNR (30%), the North Dakota Agricultural Experiment Station (65%), the NDSU Extension Service (5%), and is responsible for administrative, budgetary, and personnel actions within the Department consisting of 12 faculty members and 14 academic/support staff serving 12 graduate students, 194 undergraduates, and research/extension clientele.

The Chair oversees curriculum design and delivery, facility planning, resource allocation; takes an active role in recruiting students and faculty; maintains departmental records and prepares reports including ABET accreditation inputs; serves as a mentor and evaluator of the faculty; facilitates a collegial and productive work environment for faculty and staff; expedites relevant research and promotes extension programming; solicits external funding; and collaborates with other departments and Research-Extension Centers in achieving goals. The Chair is expected to interact with clientele and lead the faculty, staff and students in departmental quests for excellence in education, research and extension; have long-term goals for the department and a vision for attaining these goals. The Chair is responsible for building relationships with industrial and agricultural supporters and alumni and for representing the department to university administration, other NDSU units, outstate Research Extension Centers, other universities, state and federal agencies, and commodity/agribusiness organizations.

B. Faculty Information

Personnel	Title	%AES	%COA	%Ext	External Funding ¹	Unique Refereed Publications ²	Multiple Faculty Refereed Publications ³	Papers Presented
Leslie Backer, MS	Chair (Retired)	65	30	5				
Thomas A. Bon, PhD	Associate Professor of Practice		100		\$28,100		1	8
Ganesh Bora, PhD	Assistant Professor	20	80		\$111,475	13	0	24
Igathinathane Cannayen, PhD	Assistant Professor	60		40	\$450,000	9		13
Francis Casey, PhD	Professor (School of Nat. Res. Sci.) (April 2011–Present)							
Xinhua Jia, PhD	Assistant Professor	90	10		\$387,845	0	15	22
Zhulu Lin, PhD	Assistant Professor	55	45		\$2,000	13	0	5
Suranjan Panigrahi, Ph.D.	Professor (resigned 2009)	59	41		\$34,404			
Scott Pryor, PhD	Assistant Professor	80	20		\$1,126,866	11	7	27
Shafiqur Rahman, PhD	Assistant Professor	80		20	\$237,863	5		9
Elton G. Solseng, MS	Instructor	5	95					
Dean D. Steele, PhD	Associate Professor	75	25		\$671,869	3	3	6
James Venette, PhD	Interim Chair (Retired) (July 2010 – April 2011)							
Dennis P. Wiesenborn, PhD	Professor	85	15		\$1,069,578	14	8	33

¹ Funding acquired by faculty member where sources and dollars are attributable to the individual faculty member (e.g., if they are a true co-principal investigator on a two-person \$100,000 grant, their contribution should be listed as \$50,000).

² Unique publications are those with the author from the ABEN department and no other ABEN faculty member(s) as coauthor(s)

³ Multiple faculty publications are those with the author from the ABEN department and other ABEN faculty member(s) as coauthor(s)

Personnel	Title	%AES	%Ext	External Funding¹	Extension Presentation	Consultations	Media Items²	Publications & Electronic Items	Papers Presented⁴
Igathinathane Cannayan, PhD	Assistant Professor	60	40	\$275,285	1	-	-	-	1
Kenneth J. Hellevang, PhD	Professor		100	\$474,087	167	2456	201	43	2
					Extension ABEN website – 500 requests per day 2007 – 140,000 downloads of publications				
Shafiqur Rahman, PhD	Assistant Professor	80	20	\$119,436	15	20	-	8	2
Thomas F. Scherer, PhD	Associate Professor		100	\$583,114	85	2500	126	23	3

¹ Funding acquired by faculty member where sources and dollars are attributable to the individual faculty member (e.g., if they are a true co-principal investigator on a two-person \$100,000 grant, their contribution should be listed as \$50,000).

² Magazine articles, news releases, newsletter articles, articles distributed by electronic methods.

Personnel	Title	%AES	%Ext	External Funding¹	Extension Presentation	Consultations	Media Items⁵	Publications & Electronic Items	Papers Presented
Roxanne Johnson, B.S.	Water Quality Associate		100	\$104,341	100	Telephone 600	50	15	
John Nowatzki, MS	Ag. Machine Specialist		100	\$111,248	242	20	125	12	5
Carl Pedersen, M.S.	Energy Educator		100	\$4,630	104	125	65	34	

¹ Funding acquired by faculty member where sources and dollars are attributable to the individual faculty member (e.g., if they are a true co-principal investigator on a two-person \$100,000 grant, their contribution should be listed as \$50,000).

² Magazine articles, news releases, newsletter articles, articles distributed by electronic methods.

C. Course Load Information

Please provide summary faculty course load information for the past two academic years. An example is provided.

Course Load Information - Fall 2009 (1010)					
Faculty Name	Course Name	Credits	Days	Time	# Students
Backer, Les					
ASM 491	Seminar	1	T, Th	8-8:50	18
ASM 496-03	Field Exp.-Dealership Mgmt	1-15	TBA	TBA	1
ABEN 189	Skills for Academic Success	1	F	10-10:50	28
ABEN 491	Seminar	1	T, Th	8-8:50	24
ABEN 799R-01	Dissertation Continued	1-3	TBA	TBA	1
Bon, Thomas					
ABEN 110	Introduction to ABEN	2	M, W	10-10:50	34
ABEN 358	Electric Energy Appl. in Ag.	3	M, W	11-11:50	7
	Lab		Th	3-5:50	7
ABEN 452	Bioenvironmental Systems	3	M, W, F	8-8:50	20
ABEN 473	Agricultural Power	3	M, W	12-12:50	14
	Lab		M	2-4:50	14
ABEN 494	Individual Study	1	TBA	TBA	3
ABEN 652	Bioenvironmental Systems	3	M, W, F	8-8:50	1
Bora, Ganesh					
ASM 115	Fundamentals of ASM	3	M, W, F	12-12:50	46
ASM 454	Principles of Site Specific Ag	3	T, Th	11-11:50	19
	Lab		W	2-4:50	19
ABEN 486	Design Project I	2	T, Th	2-3:15	18
Goplin, Sherman					
ABEN 479	Fluid Power Systems Design	3	T, Th	3:30-4:45	8
Pryor, Scott					
ABEN 798-03	Master's Thesis	1-10	TBA	TBA	2
ABEN 799-02	Doctoral Dissertation	1-15	TBA	TBA	1
Solseng, Elton					
ASM 125-01	Fabrication/Construction Tech	3	M, W	9-9:50	17
	Lab		W	2-4:50	17
ASM 125-02	Fabrication/Construction Tech	3	M, W	9-9:50	16
			W	2-4:50	16
ASM 354	Electricity/Electronic Appl.	3	T, Th	9:30-10:20	22
	Lab		T	2-4:50	22
ASM 378	Machinery Principles/Mgmt.	3	M, W	10-10:50	35
	Lab		Th	2-4:50	35
Steele, Dean					
ASM 225	Computer Applications in ASM	3	T, Th	12:30-1:45	27
ABEN 255	Computer Aided Analysis/Design	3	T, Th	9:30-10:45	21
ABEN 797	Master's Thesis	1-3	TBA	TBA	1
Wiesenborn, Dennis					
ABEN 798-02	Master's Thesis	1-10	TBA	TBA	1
ABEN 799-03	Doctoral Dissertation	1-15	TBA	TBA	1
ABEN 799R-02	Dissertation Continued	1-3	TBA	TBA	1

Course Load Information - Spring 2010 (1030)						
Faculty Name	Course Number	Course Name	Credits	Days	Time	# Students
Backer, Les						
	ABEN 496-01	Field Experience - Ag Tech Expo	1-15	TBA	TBA	35
	ABEN 496-02	Field Experience	1-15	TBA	TBA	1
	ABEN 799R-01	Doctoral Dissertation	1-3	TBA	TBA	1
Bora, Ganesh						
	ASM 475	Management of Agricultural Systems	2	M, W	12-12:50	18
	ABEN 487	Design Project II	2	T, Th	11-12:15	18
Jia, Xinhua						
	ASM 264-01	Natural Resource Management	3	M, F	1-1:50	13
		Lab		Th	2-4:50	13
	ASM 264-02	Natural Resource Management	3	M, F	1-1:50	9
		Lab		T	2-4:50	9
	ABEN 765	Small Watershed Hydrology/Modeling	3	T, Th	8-9:15	6
	ABEN 798-03	Master's Thesis	1-10	TBA	TBA	1
Lin, Zhulu						
	ABEN 377	Numeric Modeling in ABEN	3	M, W, F	11-11:50	18
	ABEN 798-05	Master's Thesis	1-10	TBA	TBA	1
Pryor, Scott						
	ABEN 456	Biobased Energy	3	M, W, F	10-10:50	18
	ABEN 656	Biobased Energy	3	M, W, F	10-10:50	4
	ABEN 798-02	Master's Thesis	1-10	TBA	TBA	2
	ABEN 798R-01	Thesis Continued Registration	1-3	TBA	TBA	2
	ABEN 799-02	Doctoral Dissertation	1-15	TBA	TBA	1
Rahman, Shafiqur						
	ABEN 798-04	Master's Thesis	1-10	TBA	TBA	1
Schmidt, Brad						
	ASM 323	Post-Harvest Technology	3	M, W, F	8-8:50	44
Solseng, Elton						
	ASM 125	Fabrication/Construction Tech.	3	M, W	9-9:50	22
		Lab		M	2-4:50	22
	ASM 373	Tractors and Power Units	3	T, Th	8-9:15	48
	ASM 374-01	Power Units Lab	1	W	2-4:50	16
	ASM 374-02	Power Units Lab	1	T	2-4:50	18
	ASM 429-01	Hydraulic Power Principles/Application	3	M, W	11-11:50	7
		Lab		F	9-11:50	7
	ASM 429-02	Hydraulic Power Principles/Application	3	M, W	11-11:50	11
		Lab		T	2-4:50	11
	ASM 494-01	Individual Study	1	TBA	TBA	4
	ASM 496-01	Field Experience/Ag Tech Expo	1	TBA	TBA	35
	ASM 496-03	Field Experience	1	TBA	TBA	4
Steele, Dean						
	ABEN 494-01	Individual Study	1	TBA	TBA	1
Wiesenborn, Dennis						
	ABEN 263	Biological Materials Processing	3	W, F	1-1:50	25
		Lab		T	2-4:50	25
	ABEN 482	Instrumentation and Measurement	3	M, W	9-9:50	13
		Lab		Th	2-4:50	13
	ABEN 682	Instrumentation and Measurement	3	M, W	9-9:50	2
		Lab		Th	2-4:50	2
	ABEN 798R-02	Thesis Continued Registration	1-3	TBA	TBA	1

Course Load Information - Fall 2010 (1110)						
Faculty Name	Course Number	Course Name	Credits	Days	Time	# Students
Bora, Ganesh						
	ASM 115	Fundamentals of ASM	3	M, W, F	12-12:50	56
	ASM 454	Principles/Applications in Prec. Ag.	3	T, Th	11-11:50	30
		Lab		W	2-4:50	30
	ABEN 486	Design Project I	2	T, Th	2-3:15	16
	ABEN 494-01	Individual Study	2	TBA	TBA	1
Bon, Thomas						
	ABEN 473	Agricultural Power	3	M, W	12-12:50	8
		Lab		M	2-4:50	8
	ABEN 479	Fluid Power Systems Design	3	T, Th	3:30-4:45	11
Cannayen, Igathi						
	ABEN 799-02	Doctoral Dissertation	1-15	TBA	TBA	1
Jia, Xinhua						
	ABEN 484	Drainage/Wetland Engineering	3	M, W, F	8-8:50	5
	ABEN 684	Drainage/Wetland Engineering	3	M, W, F	8-8:50	2
	ABEN 798R-02	Thesis Continued	1-3	TBA	TBA	2
Li, Deying						
	ASM 468	Golf Course Irrigation I	2	M, W	9-9:50	1
Lin, Zhulu						
	ABEN 747	Numeric Modeling	3	Tu	9:30-10:45	8
		Lab		Th	8-9:15	8
	ABEN 798-01	Master's Thesis	1-10	TBA	TBA	1
Pryor, Scott						
	ASM 491	Seminar	1	T, Th	8-8:50	24
	ABEN 110	Introduction to ABEN	2	M, W	10-10:50	34
	ABEN 491	Seminar	1	T, Th	8-8:50	13
	ABEN 798-02	Master's Thesis	1-10	TBA	TBA	2
	ABEN 798R-03	Thesis Continued	1-3	TBA	TBA	1
Rahman, Shafiqur						
	ABEN 798-04	Master's Thesis	1-10	TBA	TBA	1
	ABEN 799-03	Doctoral Dissertation	1-15	TBA	TBA	1
Solseng, Elton						
	ASM 125-01	Fabrication/Construction Tech.	3	M, W	9-9:50	20
		Lab		W	2-4:50	20
	ASM 125-02	Fabrication/Construction Tech.	3	M, W	9-9:50	19
		Lab		W	2-4:50	19
	ASM 354	Electricity/Electronic Appl.	3	T, Th	9:30-10:20	16
		Lab		T	2-4:50	16
	ASM 378	Machinery Principles/Mgmt.	3	M, W	10-10:50	25
		Lab		Th	2-4:50	25
	ASM 494-01	Individual Study	2	TBA	TBA	1
	ASM 496-02	Field Experience	1-15	TBA	TBA	3
Steele, Dean						
	ASM 225	Computer Appl. In ASM	3	T, Th	12:30-1:45	24
	ABEN 255	Computer Aided Analysis/Design	3	T, Th	9:30-10:45	24
	ABEN 797-01	Master's Paper	1-3	TBA	TBA	1
Wiesenborn, Dennis						
	ABEN 458	Food Process Engineering	3	M, W, F	9-9:50	4
	ABEN 658	Food Process Engineering	3	M, W, F	9-9:50	4
	ABEN 790	Graduate Seminar	1	TBA	TBA	8
	ABEN 798-05	Master's Thesis	1-10	TBA	TBA	1
	ABEN 798R-01	Thesis Continued	1-3	TBA	TBA	1

Course Load Information - Spring 2011 (1130)					
Faculty Name	Course Name	Credits	Days	Time	# Students
Bon, Thomas					
ABEN 478	Machinery Analysis and Design	3	M, W	8-8:50	13
ABEN 482	Instrumentation and Measurement	3	M, W	9-9:50	19
	Lab		Th	2-4:50	19
Bora, Ganesh					
ASM 475	Management of Ag Systems	2	M, W	12-12:50	18
ABEN 487	Design Project II	2	T, TH	11-12:15	17
ABEN 496-01	Field Experience/Ag Tech Expo	1	TBA	TBA	42
ABEN 758	Applied Computer Imaging/Sensing	3	M W	3-4:30 4-5:30	1
Cannayen, Igathi					
ABEN 799-04	Doctoral Dissertation	1-15	TBA	TBA	1
Jia, Xinhua					
ASM 264-01	Natural Resources Management	3	M, F	1-1:50	21
	Lab		Th	2-4:50	21
ASM 264-02	Natural Resources Management	3	M, F	1-1:50	13
	Lab		T	2-4:50	13
ABEN 798-03	Master's Thesis	1-10	TBA	TBA	1
ABEN 798R	Thesis Continued	1-3	TBA	TBA	1
Lin, Zhulu					
ABEN 377	Numeric Modeling	3	M, W, F	11-11:50	13
ABEN 444	Transport Processes	3	M, W, F	12-12:50	10
ABEN 798-05	Master's Thesis	1-10	TBA	TBA	1
Pryor, Scott					
ABEN 650	Bioprocess Engineering	3	T, Th	9:30-10:45	4
ABEN 798-02	Master's Thesis	1-10	TBA	TBA	2
Rahman, Shafiqur					
ABEN 798-04	Master's Thesis	1-10	TBA	TBA	1
ABEN 799-01	Doctoral Dissertation	1-15	TBA	TBA	1
Solseng, Elton					
ASM 125	Fabrication/Construction Tech	3	M, W	9-9:50	25
	Lab		M	2-4:50	25
ASM 373	Tractors and Power Units	3	T, Th	8-9:15	38
ASM 374-01	Power Units Lab	1	W	2-4:50	14
ASM 374-02	Power Units Lab	1	Th	2-4:50	10
ASM 429-01	Hydraulics Power Principles/Appl.	3	M, W	11-11:50	3
	Lab		F	9-11:50	3
ASM 429-02	Hydraulics Power Principles/Appl.	3	M, W	11-11:50	9
	Lab		Tu	2-4:50	9
ASM 494	Individual Study	1	TBA	TBA	3
ASM 496-01	Field Experience/Ag Tech Expo	1	TBA	TBA	37
ASM 496-03	Field Experience	1	TBA	TBA	4
ASM 496-04	Field Experience	1	TBA	TBA	1
Schmidt, Brad					
ASM 323	Post-Harvest Technology	3	M, W, F	8-8:50	41
Steele, Dean					
ABEN 464	Resource Conservation/Irrigation	4	M, W, F	10-10:50	5
	Lab		W	2-4:50	5
ABEN 664	Resource Conservation/Irrigation	4	M, W, F	10-10:50	1
	Lab		W	2-4:50	1
ABEN 797-01	Master's Paper	1-3	TBA	TBA	1
Wiesenborn, Dennis					
ABEN 263	Biological Materials Processing	3	W, F	1-1:50	18
	Lab		T	2-4:50	18
ABEN 798-01	Master's Thesis	1-10	TBA	TBA	2

V. Student Evaluations/Assessment

A. Student Evaluations

ITS provides to departments (via deans) cumulative student evaluations of instruction grouped by course level. Please provide a table of evaluations covering the period since the past program review (by year), and also a paragraph placing these into institutional and disciplinary context.

Comparison of ABEN and ASM student rating of instruction for the period 2005-2011 with the respective colleges (ABEN = CEA; ASM = CAFSNR).

Q1 = Satisfaction with the instruction in this course;

Q2 = Instructor as a teacher;

Q3 = Ability of the instructor to communicate effectively;

Q4 = Quality of this course;

Q5 = Fairness of procedures for grading this course;

Q6 = Your understanding of the course content

		Q1	Q2	Q3	Q4	Q5	Q6	Average
2005-06	ABEN	4.3	4.3	4.3	4.1	4.2	4.3	4.2
	CEA	4.2	4.3	4.2	4.1	4.2	4.1	4.2
2006-07	ABEN	4.2	4.2	4.2	4.1	4.1	4.3	4.2
	CEA	3.9	4.0	3.9	3.9	4.0	4.0	3.9
2007-08	ABEN	4.1	4.2	4.1	4.1	4.1	4.1	4.1
	CEA	4.0	4.0	4.0	3.9	4.0	4.0	4.0
2008-09	ABEN	4.2	4.3	4.2	4.1	4.2	4.2	4.2
	CEA	3.9	4.0	3.9	3.9	4.0	4.0	3.9
2009-10	ABEN	4.0	4.1	4.0	4.0	4.0	4.1	4.0
	CEA	4.0	4.1	3.9	4.0	4.1	4.0	4.0
2010-11	ABEN	4.0	4.1	4.1	4.0	4.1	4.0	4.0
	CEA	4.0	4.1	4.0	4.0	4.1	4.1	4.0
Average Total		4.1	4.1	4.1	4.0	4.1	4.1	4.1
Average ABEN								4.1
Average CEA								4.0

		Q1	Q2	Q3	Q4	Q5	Q6	Average
2005-06	ASM	4.2	4.2	4.2	4.0	4.2	4.1	4.1
	CAFSNR	4.2	4.3	4.2	4.1	4.2	4.1	4.2
2006-07	ASM	4.2	4.2	4.2	4.1	4.1	4.3	4.2
	CAFSNR	3.9	4.0	3.9	3.9	4.0	4.0	3.9
2007-08	ASM	3.9	4.1	4.0	3.9	4.1	4.0	4.0
	CAFSNR	4.3	4.3	4.3	4.2	4.3	4.1	4.2
2008-09	ASM	4.1	4.2	4.1	4.2	4.1	4.0	4.1
	CAFSNR	4.2	4.3	4.2	4.2	4.3	4.1	4.2
2009-10	ASM	4.1	4.1	4.0	4.0	4.1	4.1	4.1
	CAFSNR	4.3	4.4	4.3	4.2	4.4	4.2	4.3
2010-11	ASM	3.9	3.9	3.8	3.9	4.2	4.0	4.0
	CAFSNR	4.3	4.3	4.3	4.2	4.3	4.1	4.2
Average Total		4.1	4.2	4.1	4.1	4.2	4.1	4.1
Average ASM								4.1
Average CAFSNR								4.2

C. Overview and Objectives

ABEN BS Assessment Activities Plan Overview – Program

The 2009-2010 ABEN program assessment activities were focused on the ABEN program educational objectives and outcomes that also reflect criteria for engineering program accreditation. These criteria have also guided the faculty in their definition and selection of methods and processes for learning outcomes assessment. The following summary of assessment results for 2009-2010 is based on the continuation of processes begun in 1999-2000.

The ABEN program objectives and learning outcomes are:

Educational Program Objective 1: Graduates will become engineers with the ability to use their technical knowledge, design, and problem solving skills throughout their careers. This objective addresses the following learning outcomes:

- ABET-a Apply knowledge of mathematics, science and engineering
- ABET-b Design and conduct experiments, as well as to analyze and interpret data
- ABET-c Design a system, component, or process to meet desired needs
- ABET-e Identify, formulate, and solve engineering problems
- ABET-k Use techniques, skills, and modern engineering tools necessary for engineering practice

Educational Program Objective 2: Graduates will become engineers who have interpersonal and collaborative skills and the capacity for productive careers.

This objective addresses the following learning outcomes:

- ABET-d An ability to function on multi-disciplinary teams
- ABET-f An understanding of professional and ethical responsibility
- ABET-g An ability to communicate effectively
- ABET-h The broad education necessary to understand the impact of engineering solutions in the global and societal context
- ABET-i Recognition of the need for and an ability to engage in lifelong learning
- ABET-j Knowledge of contemporary issues

Educational Program Objective 3: Graduates will become engineers who can use their disciplinary knowledge and educational depth and breadth to deal with changing career opportunities in agricultural and closely related biological industries.

This objective addresses the following learning outcomes:

- ABEN-1 (i) Ability to apply engineering skills to agricultural systems
- ABEN-1 (ii) Ability to apply engineering skills to biomaterials systems
- ABEN-1 (iii) Ability to apply engineering skills to environmental systems

VI. Changes Implemented

The last program review resulted in five recommendations, which are stated below together with changes which have been implemented in response to those recommendations.

1—The funding of at least two and, ideally, three faculty positions to allow more equitable distribution of teaching loads and to encourage further expansion of departmental research and publishing efforts.

Through the appointments of Pryor, Jia, Bora, Lin, offset by the retirement of Disrud and resignation of Panigrahi, the department experienced a net gain of two faculty members with full-time teaching and research appointments since the last program review. Furthermore, through the appointments of Drs. Rahman and Igathinathane, the department has gained its first faculty with research and extension appointments. Consequently, the department has made marked improvements towards (1) more equitable distribution of teaching load, (2) research productivity, (3) advising of graduate students and (4) integration between resident teaching, research and extension missions.

2—The active attempt to recruit one or more female faculty members when the next department hires are approved, even if this requires supplementing the department's new-faculty budget allocation.

During recent faculty searches, the following websites were used to encourage applications from women

Rice University - www.advance.rice.edu/database

Doctoral Scholars - www.sreb.org/programs/dsp/directory/directoryindex.asp

The department hired its first female faculty member, Dr. Jia, since the last program review, and will continue to actively recruitment additional female faculty when positions become available. Dr. Sreekala Bajwa will begin service in February 2012 as the first female chair of the department, and was personally encouraged to apply for the position.

3—The detailed planning of a new building (eventually to be constructed on the 18th Avenue site already designated for that purpose) to house departmental offices and improved research facilities and to provide sufficient garage space and convenient traffic access for contemporary farm machinery.

Faculty were surveyed in 2009 regarding space and other facility needs for their teaching, research and extension programs, and the results compiled.

4—The establishment of a committee to plan and implement the recruitment of new undergraduate majors and graduate students, especially from presently underrepresented student populations. (This committee might approach existing campus entities, like the Women's Studies Office or the International Students Office, for assistance in its planning and might also seek financial underwriting for its efforts, including scholarship and internship funding, from regional businesses seeking to diversify their work force.)

The ABEN Curriculum developed a special concentration of courses in "Biosystems Engineering," which has subsequently been offered since 2007. ABEN-type programs at other universities have

found such concentrations to be highly effective in boosting enrollment of female and urban students, both groups that were not well represented in the past. Current proportion and numbers of female undergraduate students in ABEN are now the highest in the history of the department, and trends suggest this will rise further.

The department cooperated with NDSU efforts to bring 12 international undergraduate students into the ABEN B.S. program in cooperation with Ansal Institute, India. Backer and Wiesenborn visited Ansal Institute before the arrival of the students to ensure adequate preparation and a smooth transition for these students. With respect to graduate programs, four of eight engineering doctoral candidates who completed their degrees in the review period were women, as were three of 15 M.S. students who completed their degrees under ABEN advisors.

5—The examination of means, beyond those already in place, for preparing department students to make the kinds of oral presentations likely to be required in their future employment.

ABEN students prepare and give formal oral presentations in the following required (R) and elective (E) undergraduate ABEN courses:

ABEN #	Credits	R/E	Nature of Presentation(s)
458	3	E	Two oral presentations per team (teams of 2) on design project 1 st presentation: 5-7 min/team, may be presented by one team member 2 nd presentation: 12-15 min/team, speaking duties shared evenly
473	3	E	4-6 min/student, engineering topic related to course
478	3	E	4-6 min/student related to engineering standards
486	2	R	Two oral presentations per team (teams of 3) 1 st presentation: Capstone Project Proposal. 12-15 min/team, speaking duties shared evenly 2 nd presentation on project to ABEN 110, 4-5 min/team, may be presented by one team member.
487	2	R	Oral Final Capstone Project Report, 25-30 min/team (teams of 3), speaking duties shared evenly

ABEN alumni who responded to a survey in December, 2011, rated their preparation in communication as follows:

- Excellent – 6 responses
- Good – 4 responses
- Adequate – 2 responses
- Fair – 0 responses
- Poor – 0 responses

Appendix F lists more results in detail.

VII. Strengths and Challenges

Strengths

ABEN faculty members are productive in securing research funding, publishing their work, and graduating successful students. Six of ten ABEN faculty members are Assistant Professors. Active research and teaching grants in 2010 totaled over \$1.78 million. ABEN faculty (5.4 research FTEs) produced 7 PhD students in the past 3 years and published 27 peer-reviewed journal publications. The Department has an employment rate of nearly 100% for ABEN graduates over the past 10 years, and 70-80% of graduates establish careers in agriculture-related fields in the region. For academic year 2010/11, ABEN was allotted 3.94 FTEs but generate more FTEs than were allotted (4.56 FTEs generated).

In 2008 the Biosystems Engineering (BSEN) concentration was created within ABEN. After developing a distinct BSEN curriculum in 2007/2008, we have seen a steady increase in female students from 2% in 2006 to 14% in 2011. Further, 64% of females and 24% of all students are enrolled in the BSEN curriculum. Total ABEN enrollment has increased from 62 to 102 during that time.

Our graduates have contributed substantially to the regional agricultural and allied industries. In 2008, Department alumni received the Distinguished Alumni awards for both CEA and CAFSNR. Several industries have recognized the value of our graduates and have contributed back to ABEN's teaching programs. Department faculty members have demonstrated their ability to secure external grants from a variety of sources; a summary of active grants from 2010-2011 is shown below:

<p><u>Industry Support of Teaching (Total: \$105,799)</u></p> <ul style="list-style-type: none"> -Melroe grant of Bobcat: \$32,999 -Concord- 30 hydraulic motors: \$3,000 -Caterpillar - hydraulic drives and motors: \$8,000 -Eaton - Hydraulic vane pumps: \$750-\$800 -Bobcat A220- research and teaching: \$26,000 -Vermeer Inc.: \$35,000 	<p><u>Energy and Bioindustries (Total: \$834,646)</u></p> <ul style="list-style-type: none"> - NSF: \$125,000 - ND APUC : \$62,890 - ARS: \$51,790 - USDA/NIFA Special Grants: \$183,224 - USDA/CSREES: \$60,406 - North Central Sun Grant Initiative: \$49,336 - ND Energy Commission: \$225,000
<p><u>Precision Ag/Machinery Systems Eng. (Total: \$96,267)</u></p> <ul style="list-style-type: none"> - Indian Council for Agr. Research: \$11,550 - NASA/Univ. of North Dakota: \$48,000 - ND Soybean Council: \$11,903 - Int. Fertilizer Dev. Center/USAID: \$24,814 	<p><u>Water Resources (Total: \$751,020)</u></p> <ul style="list-style-type: none"> - ND Health Department: \$304,361 - USDA/NIFA/Colorado State: \$185,549 - ND State Water Commission: \$61,404 - NCR-SARE 2011 R&E: \$199,706

Challenges

Research and Teaching Personnel:

For academic year 2010/11, ABEN was allotted 3.94 FTEs but generated 4.56 FTEs indicating that teaching efforts exceeded academic appointments and that our research appointments are augmenting the teaching.

Although total graduate and undergraduate enrollments have increased at similar rates, the ratio between PhD and MS students has decreased (Fig. 1).

Several factors may explain this shift including a shortage of assistantships and high numbers of new faculty in the department; historically all graduate students have been grant-funded and the increasing challenge of securing grants that cover a 4-yr time frame encourages an emphasis on MS students.

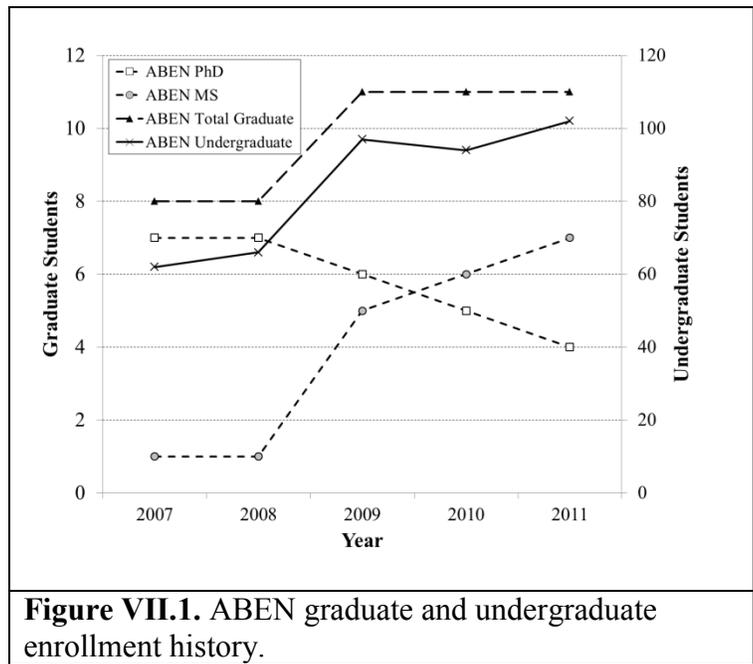


Figure VII.1. ABEN graduate and undergraduate enrollment history.

Over 80% of ASM credit hours are taught by two faculty members with heavy teaching loads and a combined research appointment of 0.25 FTE. The program is vulnerable from heavy dependence on a small number of faculty. Currently, the loss of a single primary faculty member would be severely detrimental to the program as a whole. The ABEN program also relies heavily on a single instructor to teach all machinery-related courses and is thus similarly vulnerable. Agricultural engineering is a strength of the department that must be maintained while increasing Biosystems, or the department will lose students desiring that degree as has occurred at the University of Minnesota. The department has lost faculty who taught structures and building environment and traditional grain drying and storage. These are core areas of a traditional agricultural engineering degree. We traditionally have not had personnel to support significant research through machinery systems or agricultural management because of the high teaching loads of ASM faculty. Departments at Iowa State University, University of Illinois, and Oklahoma State University have machinery systems faculty teaching ABEN and ASM courses and they have published an average of 2 manuscripts per year (2008-1010). This demonstrates the need for machinery system research and the availability of external funding. Additional faculty would strengthen both ABEN and ASM undergraduate programs and enable development of an ASM graduate program.

Extension Support: Two positions are grant supported which makes them and the programs that they provide vulnerable. Obtaining more stable funding would make these positions more secure.

The NDSU Extension Service does not have anyone providing education and assistance related to agricultural structures. A survey of field staff identified a need for structural design, layout, siting, and environmental (heating, ventilation, insulation, lighting, energy efficiency, etc.) aspects of farmstead buildings (shops, machinery storage, etc.) including livestock buildings and facilities. Vern Anderson, Carrington REC, recently shared that the livestock industry has expressed the need for a livestock facilities engineer to work with building environment and associated areas.

Learners today want education and assistance as it is needed. The first place people seek education and assistance today is on the web. The internet and electronic communication need to be one of our top methods of conveying education and information to clientele as they need it. To enable our extension education to be most productive and convey a modern professional look, faculty need support in using electronic technologies such as the web, Facebook, videos and etc.

Extension faculty members are expected and need to conduct more applied research to obtain information needed by our clientele. We need technician support to efficiently conduct the needed research. A technician could also do much of the supporting literature review and information gathering to efficiently provide relevant information and education expected by our clientele.

Space: Space is a challenge across campus, but this challenge is particularly keen to ABEN. The current building is energy inefficient, and filled with asbestos and lead paint. Our faculty manages to conduct teaching and research activities that include power and machinery, soil and water, livestock waste, bio-imaging, electricity and electronics, fabrication, prototyping, biomass processing, precision agriculture, etc. However, there are no wet laboratory facilities to do these activities within our own building. Instead, laboratories of ABEN faculty are dispersed throughout the campus.

Furthermore, our current building will not accommodate modern agricultural equipment. Even if it were retrofitted to accommodate modern agricultural equipment, the current location in the center of campus makes it impossible to maneuver modern agricultural equipment to our building. Without access to modern agricultural equipment, students are being short-changed an education experience. A building committee was established in 2008.

VIII. Goals

Opportunities:

ABEN: Strengthening the Biosystems Engineering (BSEN) concentration within ABEN will increase quantity, quality, and diversity of ABEN students and improve research output. After developing a distinct BSEN curriculum in 2007/2008, we have seen a steady increase in female students from 2% in 2006 to 14% in 2011. Further, 64% of females and 24% of all students are enrolled in the BSEN curriculum. Total ABEN enrollment has increased from 62 to 102 during that time. Additional personnel would allow us to diversify and strengthen undergraduate BSEN course offerings, expand research capacity, and increase the number of 700-level courses for our PhD students.

Undergraduate Students: If we aim to maintain current academic strengths in Agricultural Engineering (AGEN) and accelerate growth in the BSEN curriculum, we need to increase the number of personnel in this academic area. An increase of two faculty specializing in BSEN would have a strong positive impact on the department. The University of Nebraska is a good example of the opportunities available for growth in BSEN program. That ABEN/BSEN department focused on strengthening BSEN and transformed from a traditional ABEN program similar to ours to one with strong BSEN and AGEN options; 40% of those students are female. The NDSU ABEN program could conservatively increase enrollment to 150 students and increase female student numbers to 25%. We have already begun to see this trend. In 2006, we had 1 female ABEN student in ABEN while this fall alone we enrolled 6 new female first-year students. Over the past five years, the number of undergraduates in ABEN has increased markedly and coincides with an increase in students affiliating with the BSEN curriculum that began in 2008.

The loss of traditional AGEN programs in the region followed by the emergence of increasingly robust agricultural industries presents an excellent opportunity for future graduates. New faculty members are needed in the areas of precision agriculture, and engineered facilities to maintain adequate livestock environment and food safety and quality.

Graduate/Research Program: For academic year 2010/11, ABEN was allotted 3.94 FTEs but generated 4.56 FTEs indicating that teaching efforts exceeded academic appointments and that our research appointments are augmenting the teaching. An addition of two lecturers will allow us to lower teaching loads and increase concentration on research. Furthermore, the additional GRA support would allow faculty to leverage 2 and 3-yr grants to train PhD students and increase the quality of research work and the output as measured by scholarly publication.

Adding faculty and instructors would also lead to development of 3 new 700-level courses that would allow us to attract more PhD students and provide them with stronger training. The research specialists will be used to assist with the research projects and increase publication rates of 2 current assistant professors and the requested tenure-track faculty positions.

ASM: The Agricultural Systems Management (ASM) program is an area where an increase in human resources would lead to improvement in the quality of the educational program and an increase department graduate student numbers and publications. Nearly half of current ASM courses (17 of 35 credits) are taught by a single faculty member. The addition of 2 faculty members with significant research appointments would provide students a more balanced education while growing the department's research output. The addition of new faculty with machinery expertise would also

enable development of an ASM graduate program and would augment the ABEN academic program.

Training ASM students is valuable to state and regional agricultural industry. To continue training students in ASM while increasing department graduate student numbers and research publications, we should need to increase the number of faculty and or lecturers in ASM. Over 80% of ASM credit hours are taught by two faculty members with heavy teaching loads and a combined research appointment of 0.25 FTE. Adding faculty with more balanced research /teaching loads will have several direct benefits. Students' education would be strengthened due to diversity of instructor experience and expertise and the program would not be vulnerable from heavy dependence on a small number of faculty. Currently, the loss of a single primary faculty member would be severely detrimental to the program as a whole. In addition to strengthening the ASM program, faculty with machinery system expertise could augment the ABEN teaching program with additional undergraduate or 700-level graduate courses. The ABEN program also relies heavily on a single instructor to teach all machinery-related courses and is thus similarly vulnerable.

Diversifying the appointments of ASM program faculty would lead to quantifiable improvements in research output. We traditionally have not been able to support significant research through machinery systems or agricultural management because of the high teaching loads of ASM faculty. Departments at Iowa State University, University of Illinois, and Oklahoma State University have machinery systems faculty teaching ABEN and ASM courses and they have published an average of 2 manuscripts per year (2008-1010). This demonstrates the need for machinery system research and the availability of external funding. Additional faculty would strengthen both ABEN and ASM undergraduate programs and enable development of an ASM graduate program.

Increases in graduate student numbers assume 2-3 graduate students per ASM faculty and 1-2 additional graduate students from lowered teaching loads of current faculty. Increases in publication rates assume 2 additional publications per year for new faculty and an increase in publication rate for existing faculty with high teaching loads. The table below summarizes the potential increases in measures of academic success.

ABEN Program	Projected increase	ASM Program	Projected increase
ABEN students:	102→150	ASM faculty* research FTEs:	0.25→1.85
% female students:	14%→25%	Primary ASM faculty*:	2→5
% BSEN students:	24% →40%	ABEN pub. rate (#/academic FTE/yr.):	1.2 →1.5
Graduate students:	11→20	Graduate students:	11→17
PhD students:	4→10		
700-level courses*:	3→6		
*(as typically offered)			

Another focus that industry and students are looking for is related to precision agriculture. The program needs to be a blend of the science and fundamentals with hands-on application electronics. The program needs to be taught by faculty who are a blend of scientist, engineer and technician with real world experience.

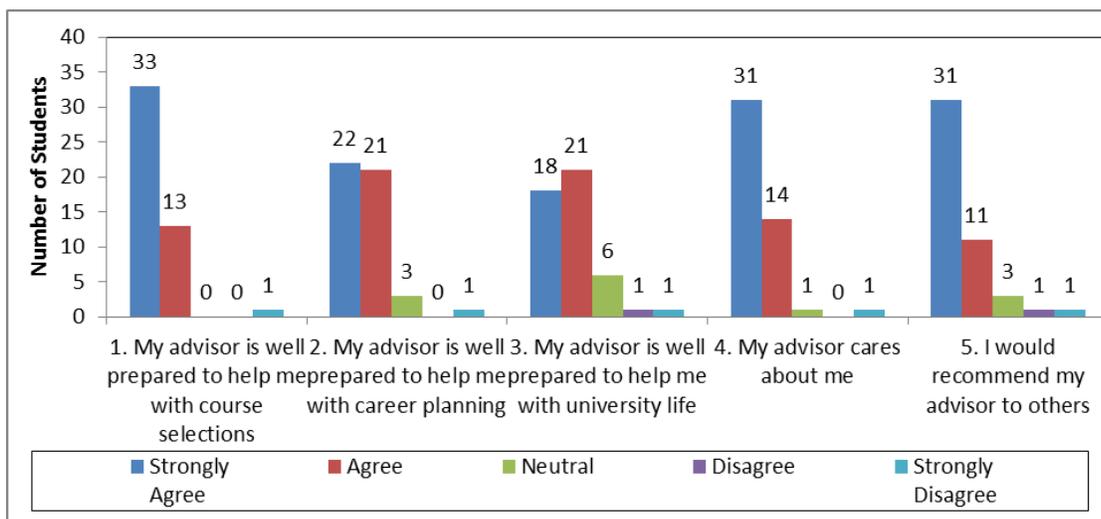
IX. Quality of Program

A. Quality of teaching and advising

Faculty in the department take pride in their teaching and advising and make efforts to improve each. Several faculty were nominated and/or earned awards for teaching and advising over the past 6 years. Student rating of instruction data are shown in section V; evaluations of ABEN courses were on par with or better than average when compared to CEA courses. ASM course ratings have trended slightly lower compared with other CAFSNR courses but evaluations still average greater than 4.0 on a 5-point scale.

High-quality advising and student/faculty interaction have been a strength in our department. Faculty often here from incoming transfer students or students with close friends in other departments that ABEN and ASM students know their advisors and have stronger relationships with faculty than in other departments.

Students are encouraged to complete an advising survey to assess the advising service they are provided. The surveys are prepared anonymously. Data from our advisor ratings from 2011 are shown below and confirm our anecdotal evidence of general satisfaction with advising in academic advising, career counseling, and assistance. With 47 students returning the advising survey, over 90% agreed or strongly agreed that advisors were well-prepared in helping with academic and career planning. Nearly 96% recognized that their advisors care about them and 90% would recommend them to others.



Fall 2011 advisor satisfaction survey results.

B. Collaborative Activities

Our faculty work often and work well with industry, government, commodity groups, and other faculty researchers at NDSU and throughout the country and world. As noted in Section II.M faculty have current or recent collaborations with 12 other departments, 27 US colleges and universities, 8 international universities, 8 businesses, and several commodity groups and state or federal agencies. Collaborations include external grants for education, research, and extension work.

C. Relationship with other departments/programs/units

The ABEN department is interdisciplinary by nature and has ties to 2 colleges, several interdisciplinary programs (section II.B), and the NDSU Extension Service. The department is responsible to CAFSNR for the ASM program and research through the Agricultural Experiment Station. The ABEN program is tied programmatically to the CEA and faculty participate fully CEA committee activities. Faculty within the department affiliate with and have advised students in the Natural Resources Management (NRM) and the Environmental and Conservation Science (ECS) interdisciplinary programs. Two faculty have served on the ECS steering committee in recent years.

D. Programmatic Needs

The ASM program is an area where an increase in human resources would lead to improvement in the quality of the educational program and an increase department graduate student numbers and publications. Nearly half of current ASM courses (17 of 35 credits) are taught by a single faculty member.

Over 80% of ASM credit hours are taught by two faculty members with heavy teaching loads and a combined research appointment of 0.25 FTE. Adding faculty with more balanced research /teaching loads will have several direct benefits. Students' education would be strengthened due to diversity of instructor experience and expertise and the program would not be vulnerable from heavy dependence on a small number of faculty. Currently, the loss of a single primary faculty member would be severely detrimental to the program as a whole. Improvement in program quality is difficult to quantify but base numbers of faculty and total research and teaching FTEs for faculty with majority ASM academic appointment can be used as a baseline indicator.

In addition to strengthening the ASM program, faculty with machinery system expertise could augment the ABEN teaching program with additional undergraduate or 700-level graduate courses. The majority of ABEN undergraduate students come to NDSU with an expressed interest in agricultural machinery and this program, although successful, is similarly vulnerable in that it relies heavily on a single faculty member to teach nearly all machinery-related courses.

Strengthening the Biosystems Engineering (BSEN) concentration is another area which could reap benefits for the program and lead to increases in quantity, quality, and diversity of ABEN students and improve research output. Low gender diversity has been noted as a particular problem within all engineering departments. After developing a distinct BSEN curriculum in 2007/2008, we have seen a steady increase in female students from 2% in 2006 to 14% in 2011. Further, 64% of females and 24% of all students are enrolled in the BSEN curriculum. Total ABEN enrollment has increased from 62 to 102 during that time. Additional personnel would allow us to diversify and strengthen undergraduate BSEN course offerings, expand research capacity, and increase the number of 700-level courses for our PhD students.

E. Future of the program

Please refer to Section VIII - Goals

F. Employer and professional evaluations of students

In December, 2011 and alumni and employer survey was sent out to graduates between the years of 2005-2009. Information is summarized below and all data gathered is included in the appendix.

Alumni and employers were generally positive about many aspects of the program, including graduates' preparation for designing systems, components, or processes; preparation for effective communication in a job setting; and development of engineering skills for application in agricultural, biomaterial, and environmental systems.

A common theme among graduates' responses was that they appreciated the broad engineering education they obtained in the ABEN program. Some employers expressed appreciation for the broad education apparent in their ABEN employees and they also mentioned other positive traits in our graduates. Alumni generally assessed the program education objectives, defined for accreditation with the Accreditation Board for Engineering and Technology (ABET), as suitable for the ABEN program.

Slightly more than half the alumni and slightly less than half the employers indicated professional engineering licensure would be helpful to their careers. Just over half of the alumni indicated that they have participated in continuing education opportunities; most of the employers indicated continuing education was important. Approximately two-thirds indicated that they have been promoted to engineering positions of more responsibility than when they first started their employment and all of the employers indicated ABEN graduates under their supervision were promotable.

The ABEN teaching faculty gleaned the following areas for improvement in the program from the surveys. Presentation and writing skills should be improved. There needs to be a continual effort to keep up with industry trends and developments, including six sigma and other quality topics. Although we as a faculty cannot respond to every employer's request for a particular class or training area in every student's background, we could improve our advising by steering students interested in test engineering, for example, into a specific set of recommended classes. The faculty also discussed requiring the Fundamentals of Engineering exam, but enforcement would be problematic.

G. Faculty and student honors

Both faculty and students have been recognized within NDSU and at a national level. Specific honors include the following:

2005 NDSU College of Engineering and Architecture Teacher of the Year

Dr. Tom Bon, Associate Professor of Practice

2005 Priestler Multi-State Award for Outstanding Extension Health Programming

Dr. Kenneth Hellevang, Professor and Extension Specialist

2006 ASABE Outstanding Leadership Recognition: Meetings Council Chair

Dr. Kenneth Hellevang, Professor and Extension Specialist

2006 ASABE President's Citation

Dr. Kenneth Hellevang, Professor and Extension Specialist

2006 North Dakota Water Wheel Award, ND Water Users Convention

Dr. Thomas Scherer, Associate Professor and Extension Specialist

2007 Oct., Midwest Ag Energy Network Professional Development Grant: to attend Biobased Industry Outlook Conference (Ames, IA)

Dr. Scott Pryor, Assistant Professor

2008 Mid-America GIS Consortium (MAGIC)

Dr. Thomas Scherer, Associate Professor and Extension Specialist

2008 Research Support Award – College of Agriculture and Life Sciences and Mississippi Agricultural and Forestry Experiment Station (MAFES) - Mississippi State University, US
 Dr. Igathinathane Cannayen, Assistant Professor

2009 Gordon A. Larson Agricultural Research Award, NDSU Development Foundation
 Dr. Scott Pryor, Assistant Professor

2009 College of Engineering and Architecture Teacher of the Year
 Dr. Dean Steele, Associate Professor

2010 Fulbright Scholarship to Uzbekistan
 Dr. Thomas Bon, Associate Professor of Practice

2010 ASABE Outstanding Reviewer – Food and Process Engineering Division. American Society of Agricultural and Biosystems Engineers, Saint Joseph, MI, US
 Dr. Igathinathane Cannayen, Assistant Professor

2010 Outstanding Reviewer - Bioresource Technology. Elsevier Ltd, Oxford, UK
 Dr. Igathinathane Cannayen, Assistant Professor

2010 Outstanding Reviewer, Biological Engineering Division of ASABE
 Dr. Scott Pryor, Assistant Professor

2010 MWPS-14 Private Water Systems\
 Dr. Thomas Scherer, Associate Professor and Extension Specialist

2011-2012 ASABE Nominating Committee, Biological Engineering representative
 Dr. Scott Pryor, Assistant Professor

2011 ASABE Honorable Mention Paper Award; Included on NDSU “Fulbright Wall” in 2010, for service as a Fulbright Senior Scholar to University College Cork, Ireland in 1997-98
 Dr. Dennis Wiesenborn, Professor

TOP 25 Hottest Articles from Elsevier publications. Five citations received.
 Dr. Igathinathane Cannayen, Assistant Professor

ASABE Blue Ribbon Education Aids
 Dr. Thomas Scherer, Associate Professor and Extension Specialist

Innovation in GIS Award
 Dr. Thomas Scherer, Associate Professor and Extension Specialist

One undergraduate student was awarded a prestigious Astronaut Scholarship
 Matthew Wold, ABEN 2009 graduate

Two undergraduate students were awarded the annual ASABE Foundation Engineering Scholarship
 2008 – Matthew Wold
 2009 – Tyler Rath

H. Grants and contracts

A total of 44 successful research grants and 13 extension grants are reported in section II.M. It is worth noting that 6 of the 8 faculty members with research appointments are assistant professors who were all hired since the last program review and several within the past 3 years. Active research grants in the past year total \$1.78 million.

I. Research outcomes (e.g., papers, presentations)

Faculty successfully publish in refereed journals. Section II.M shows 85 peer-reviewed journal publications or book chapters and 39 extension publications or magazine articles. Faculty actively participates in regional and national/international ASABE meetings and most give presentations annually. As noted above, most department faculty has been at NDSU for less than 6 years.

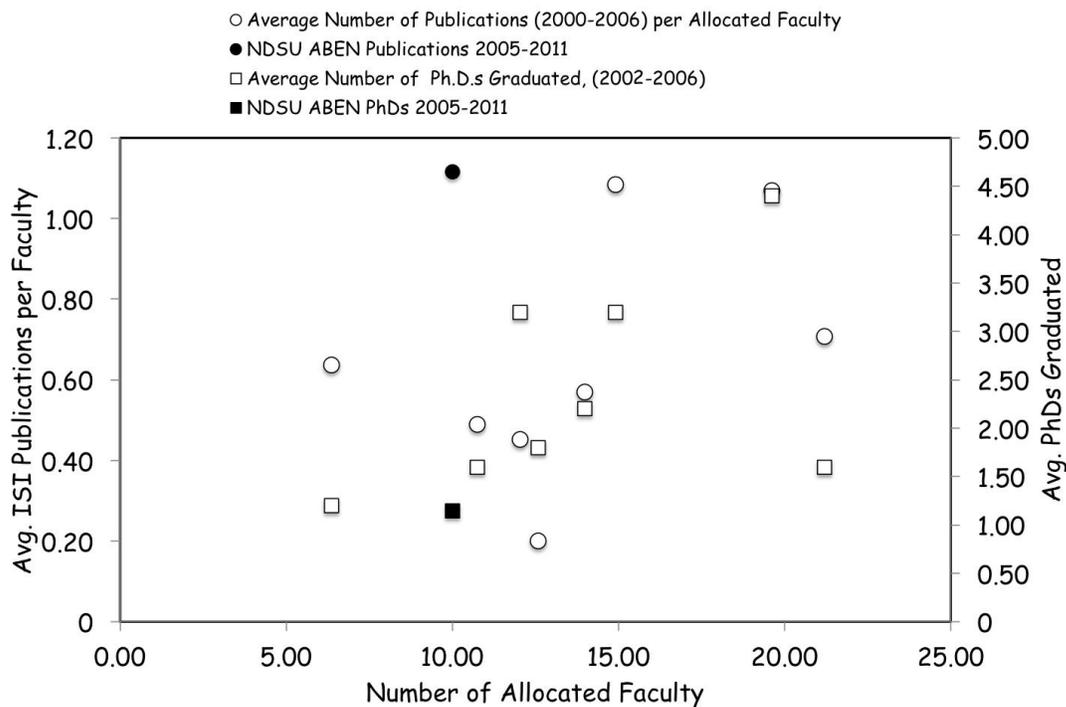
J. Exemplary service to university, profession, and public

Faculty members are active both on campus and through national professional organizations. Faculty actively serve on committees with both CEA and CAFSNR. Two junior faculty serve as associate editors for ASABE journals and 1 was elected to the Nominating Committee which identifies national society leaders.

K. Comparisons with programs at comparable institutions

Data below shows how NDSU ABEN compares with other ABEN or similarly-named departments throughout the country. We have fewer faculty than nearly all peer departments but our publication records per faculty member per year is the highest among the group and 60% higher than the average. NDSU ABEN graduates fewer Ph.D. students than other departments. When expressed on a per faculty basis, NDSU still ranks 8th of 9 although that may again be explained by the high percentage of junior faculty and faculty with high teaching appointments.

Program	University	Number of Allocated Faculty (2006)	Average Number of Publications per Allocated Faculty (2000-2006)	Average Number of Ph.D.'s Graduated, (2002-2006)
Agricultural & Biosystems Engineering	University of Arizona	12.04	0.45	3.20
Agricultural Engineering	University of Illinois at Urbana-Champaign	19.62	1.07	4.40
Biological and Agricultural Engineering	University of Idaho	12.58	0.20	1.80
Biological Systems Engineering	University of Wisconsin-Madison	6.37	0.64	1.20
Biological Systems Engineering	Virginia Polytechnic Institute and State University	21.20	0.71	1.60
Biosystems Engineering	Michigan State University	13.98	0.57	2.20
Biosystems Engineering	University of Tennessee	10.74	0.49	1.60
Food, Agricultural and Biological Engineering	Ohio State University Main Campus	14.91	1.08	3.20
Agricultural & Biosystems Engineering	NDSU	10.00 (2011)	1.12 (2005-2011)	1.14 (2005-2011)



X. Appendices

- A. Annual Report
- B. Assessment Report
- C. Faculty Vitae
- D. Previous Program Review
- E. Accreditation Report
- F. Employer/Alumni Survey
- G. Equipment Materials List