About the Department

The Department of Agricultural and Biosystems Engineering (ABEN) is a part of the College of Agriculture, Food Systems, and Natural Resources, North Dakota Agricultural Experiment Station, and NDSU Extension Service. The department provides research, extension and education in machinery systems, precision agriculture, irrigation and drainage, water resource management, food and biofuel processing, agricultural waste engineering, grain drying, flood preparation and recovery, and energy. The department has over 150 undergraduate students, 12 full time faculty, 10 staff members, and 28 graduate students. The department is located in the Agricultural and Biosystems Engineering building with research labs in Hultz Hall, Waldron Hall, the Pilot Plant, and office space in Morrill Hall.

Challenges and Opportunities

- Precision agriculture and unmanned aerial systems (UAS) offer a great opportunity for economic development in the state and country. UAS application in agriculture alone is estimated to be an over $65 billion business nationwide. There is an overwhelming demand for Precision Agriculture research and education in the state, yet we do not have any dedicated researchers addressing this need.
- There is a great need for research and education in precision technology for chemical application (such as testing new nozzles, chemicals, and additives, studying drift, temperature inversion, remote sensing of crops for site-specific chemical application), particularly chemical drift as was evident when the Dicamba drift damage occurred.
- With increased occurrence of herbicide resistant weeds, timely identification and weed management is a major challenge. Remote sensing with UAS offers great potential for identifying weed species, their herbicide resistance status and other invasive weeds in crop fields and rangeland. Also, precision agriculture could offer spot spraying to manage resistant and/or invasive weeds and other pests.
- Further restrictions on migrant labor, the need for robotics and automation in agriculture will be acute in the near future. Currently, NDSU has a major gap in research and education in automation and robotics.

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HIGHLIGHTS

- ABEN faculty leads UAS research in agriculture in the nation, with a strong economic development component—a company will open a location in ND.
- Significant research productivity with over $10 million in cumulative grant funding from 66 projects last year.
- Prestigious grants from USDA, NSF and NASA on water resources.
- ABEN faculty published 31 refereed journal articles, 29 conference presentations and 14 invited presentations.
- Pilot plant helps to scale technology for a startup.
- Graduate research assistantships from the Agricultural Experiment Station supports 4-5 ABEN graduate students.
- ABEN's flood education website was visited over 30K times during July & August of 2017.
- ABEN faculty helps local company identify alternate agricultural raw materials for manufacturing particle boards & reduce raw material loss as dust.
- Developed value added products from corn DDGS.
- Developed a hulling and coating method for XLarge confection sunflower seeds.

Personnel Change

- ABEN lost two faculty members (Dr. Ganesh Bora and Dr. Scott Pryor), and one staff member (Sarah Ogundolani) during 2015-17.
Research Needs: Precision Agriculture

There are major gaps in precision agriculture research that need to be addressed in order for NDSU to become and continue as a leader in precision agriculture: These gaps include:

**Precision chemical application:**
Research is needed on monitoring and variable rate application technologies of chemicals for managing herbicide resistant weeds, insects and diseases, and nutrient problems. There is also a strong research need to study chemical drift, volatilization, effectiveness, chemical injury, and drift control technologies under different environmental conditions (wind, temperature, humidity, temperature inversion).

**Robotics & automation:**
As the labor shortage becomes acute, there is more need for automation and robotics in agriculture. Aerial and ground robots that could spot spray herbicide resistant weeds, or insecticide or fungicide at the onset of the problem before it becomes widespread. Automation of various farm operations and robotics are of great economic and environmental benefit to the agriculture community.

**Big Data in Agriculture:**
Today’s machineries, sensors and UAS generate large amount of data. We are flooding in data but starving for information. Crop producers and farm managers need actionable intelligence rather than data. Application of data science solutions to agriculture is key to producing actionable intelligence. Currently, NDSU lacks expertise in data science.

**Precision Water Management:**
Optimal water management is very important for increasing crop production efficiency. There are new variable rate irrigation technologies that need to be researched for effectiveness.

**Value of Precision Agriculture:**
There is a great demand from growers to identify precision agriculture technologies that makes the most suitable to their operation. Similarly, industries wants to know the precision agriculture applications that would make the most business sense to invest in. Evaluating economic benefits of precision agriculture is major need that we are not addressing at present.

**Precision Planting and Tillage:**
The agriculture machinery industry is trying to improve their machinery systems to be more intelligent by making decisions such as changing the depth and rate of planting based on soil conditions, or to adjust tillage (such as the amount of residue left on the surface, depth of tillage, etc) based on soil conditions. This requires research in sensors and machinery systems, including their field evaluations.

Extension Needs: Precision Agriculture

Currently, we are not able to meet the demand for extension education in various aspects of adopting precision agriculture technologies. Educational gaps exists in many areas:

- **Chemical drift reduction education:** A mobile pesticide application lab will be critical for educating producers and chemical applicators on best management practices and the latest technologies available for chemical application.

- **Farm data management and utilization:** There are too many software solutions for precision agriculture and farm management, and widespread need to train agricultural producers on selecting the best software solutions for their farm, and on how to use them properly.

- **Discovery Farm:** We need discovery farms that would evaluate and demonstrate precision agriculture technologies at commercial scale to crop producers and other constituents. Today’s farming generates large amounts of data, from soil textural and fertility data to yield and UAS data. There is a great demand for education on how to properly manage these data, and derive actionable intelligence.

There are many precision agricultural technologies available in the market. Producers also need education on how to select the technologies best suited for their farm, and unbiased information on the costs and benefits of these technologies.