



Impact Statement

ProjectTitle: Precision Agriculture Certificate Program at Mississippi State University

Issue: In the Department of Plant and Soil Sciences, our undergraduate and graduate programs include degree programs in agronomy and horticulture with concentrations in integrated pest management, integrated crop management, golf and sports turf management, soil and water science, fruit and vegetable production, floriculture, and ornamental horticulture. While our students are routinely very marketable in various professions, employers have indicated many of them lack the 'hard skills' of knowing and understanding the 'hard skills' or the field application technology aspects of precision agriculture. We needed to address the need for enhancing our degree programs in this area through course development, funding to develop precision agriculture laboratories and supporting field equipment, and additional support personnel.

What has been done: We were provided private gifts from several donors for supporting this project in 2015-16. These unrestricted funds were used to employ a consultant who was charged with heading up the development of the precision agriculture certificate program, equipping a laboratory with state-of-the-art technologies to support equipment in the field (auto-steer tractors, spray equipment, fertilizer applicators, sensors, etc.), writing curricula and external grants for the program, and working with researchers across many disciplines in their programs. The first course in Precision Agriculture I was offered in the fall, 2016 semester and it was repeated along with Precision Agriculture II in the spring, 2017 semester. Courses in the program are cross-listed with five other departments in the College of Agriculture and Life Sciences.

Impacts/New Partnerships: This project has enhanced the knowledge of well over 100 students (undergraduate and graduate) in less than a year. We have developed partnerships with industries such as Wadsworth, Chore-Time, AgLeader, and others in enhancing this program. Additional donors have joined us to support this program. Internal silos have been torn down internally in developing this program across six academic departments. The next challenge is to develop relationships with entities such as crop consultants, producers, nursery managers and others in the field for continuing education units (CEU's) for their respective professional societies and employers.

Outcome of Project (societal impact/ measure of increased quality of life): The outcome of this project is to enhance the educational skills of graduates and users in the field, more effectively utilize production inputs in a sustainable and efficient manner, and increasing the quality of lives globally in feeding an increasingly growing population.

How has your project been aided by your FSLI experience? The FSLI experience has provided me with enhanced training in more effectively working with others through communication, leadership, and program development. As a cohort, we learned to address issues such as breaking down barriers to move a program forward. The FSLI experience has aided my ability to better understand how to assemble teams to accomplish tasks in a timely and efficient manner. I am indebted to many who supported me in this program; it was truly the best leadership program I could have ever hoped for and more. It has been a very positive life-changing experience for me.

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Precision Agriculture Curriculum Development Program
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Graduate and undergraduate students training in agriculture and biological engineering, agribusiness and economics, agriculture information sciences, agronomy, animal and dairy sciences, biochemistry and entomology, environmental science, horticulture, landscape architecture, and poultry sciences benefit from obtaining additional training, beyond their terminal degree, through the Precision Ag. Certificate Program.

The MSU Precision Ag. Program launched an aggressive curriculum development campaign in October of 2015 whereby Plant and Soil Sciences (PSS) faculty and staff collaborated to design a Precision Ag. Certificate program and core coursework. The certificate is cross-listed between PSS and ABE departments, and permits elective courses from eight separate university departments. The 18-credit certificate fulfillment is accomplished through enrollment in 10 credits core coursework and 6-8 credits elective coursework. Two core Precision Ag. courses were developed and launched by fall, 2016.

Precision Ag. I coursework is designed as a survey of precision agriculture to illustrate factors of production related farm production technologies. This two hours lecture and two hours lab introductory course highlights site-specific crop management techniques. Topics include: Best Management Practices, economic and physical farm production models, and measurement of variability.

Precision Ag. II coursework is a continuation to the survey of Precision Agriculture I, which is a prerequisite. This 2+2 hours lecture/lab advanced course reviews site-specific management techniques. Continuous decision-making processes of farm production are integrated using a whole-system, geospatial approach.

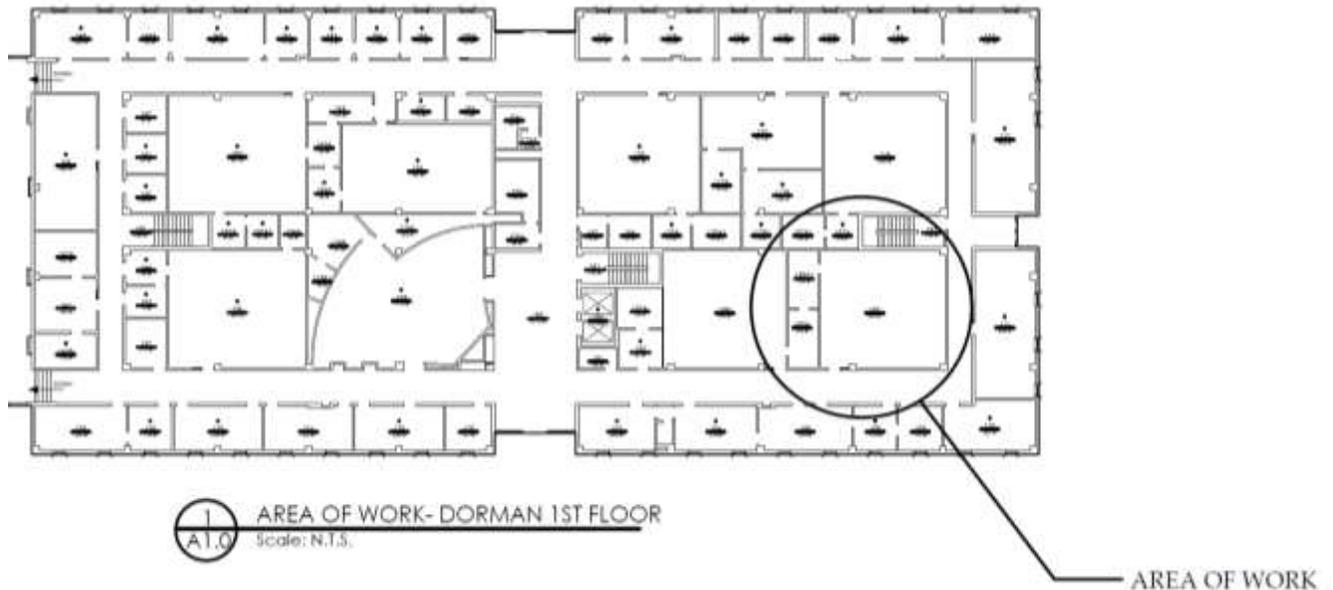
Students completing the MSU Precision Agriculture Certificate are expected to:

1. possess a comprehensive knowledge of data formats, types and structures,
2. work independently to create farm production scenarios from planning to harvesting stages,
3. integrate agriculture technology content knowledge within their chosen major, and
4. understand and incorporate advancing technologies into standardized workflows.

The Certificate places emphasis on spatial technology skills development in relation to Agronomy and Environmental Sciences coursework. The Precision Ag. Certificate documentation was completed by December, 2015 and approved the following spring by the UCCC. The first PA Certificate will be conferred in December, 2017.

Precision Ag. Facility Renovation

Dorman Hall lacked adequate classroom space and technology to support a Precision Ag. Initiative prior to 2015. The first phase of renovations to house the PSS Precision Ag. classrooms began in January, 2016 and were completed on August 11, 2017. Dorman 107 was remodeled to house the Geospatial Technology lab that features high-end computing capability and an advanced video conferencing system (Lifesize) that is used in broadcasting PSS and Precision Ag. events.



Dorman 107 and 105 classrooms are located on the northwest corner of the first floor. Both classrooms were previously used by Human Sciences but had been abandoned for two years and left unused (Figure 1).

Figure 1. Location of Dorman Hall Precision Ag. classrooms

Multiple external and internal partners collaborated in achieving the reconstruction in time to open the classrooms for the UCCC approved coursework. External vendors included (Table 1):

Table 1: External vendors for Phase I renovations

Vendor	Item	Expenditure
Dell Direct Computers	21 Precision T7810XL Workstations	\$78,000
Technical Innovations & Electronic Services Inc.	Lifesize Video Conferencing® and Smart Classroom-styled technology including 3-4K monitors, and SmartBoard®	\$85,000
Sullivan's Office Supply	Tables, chairs, and furnishings for computer workstations	\$23,000

Mississippi State University internal partners supervised the principal reconstruction of classroom amenities (Table 2):

Table 2: Internal partners for Phase I renovations

Partner	Item	Expenditure
Information Technology Services (ITS)	Internet port configuration, computer setup	\$10,000
Facilities Management	Stack drilling, electrical, painting, lighting, flooring	\$28,000

The Dorman 107 classroom was completed 5 days in advance to the start of the fall, 2016 semester. The Precision Ag. I (PA-I) course was filled to capacity (36 students) and both PA-I and PA-II are taught in fall and spring semesters; typically filling to capacity during each enrollment period. The Dorman 107 classroom design included handicapped accessible seating and visual displays. Lectures may be recorded live and broadcast through the videoconferencing system (Figure 2).

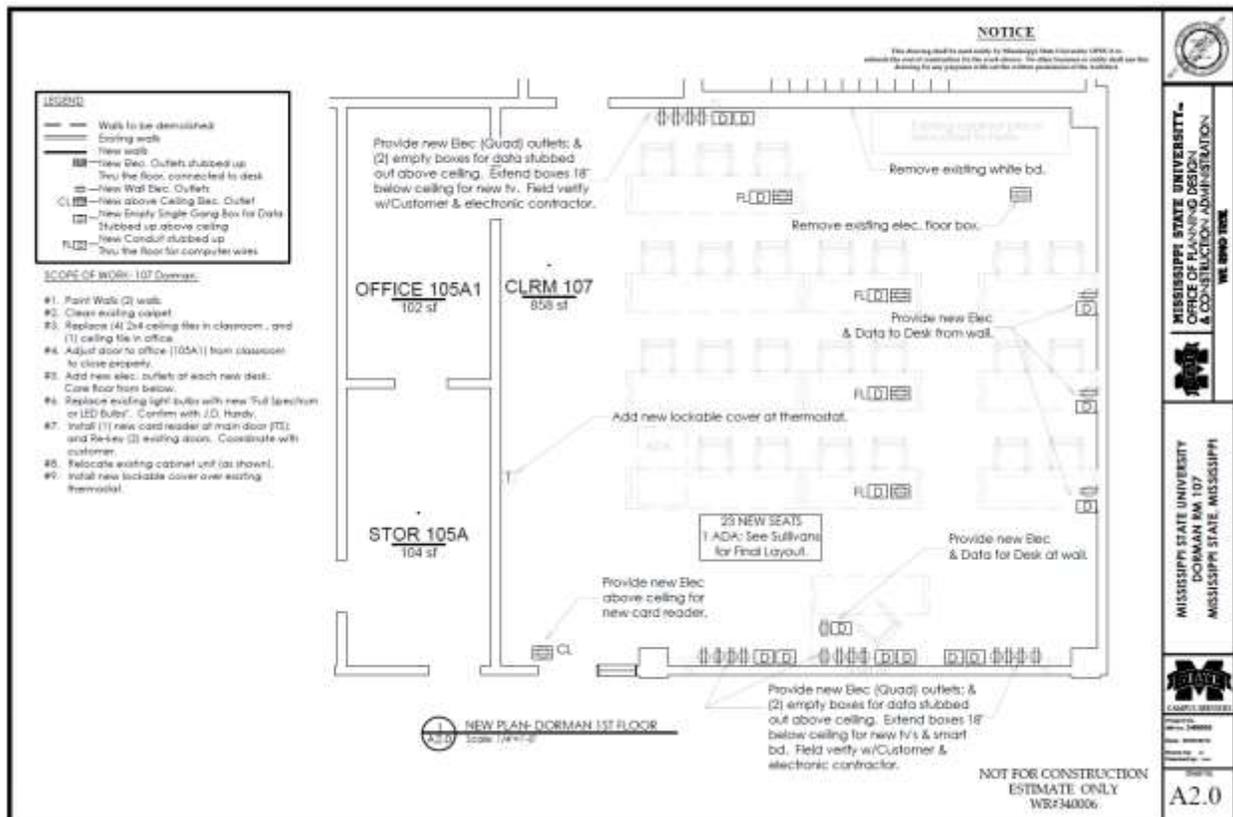


Figure 2. Dorman 107 final layout

Currently the Dorman 107 classroom can no longer support the number of students enrolling in the Precision Ag. core coursework. A new renovation has begun to outfit Dorman 105 with conventional seating to serve the Precision Ag. coursework lecture hours. Students will continue to take Precision Ag. laboratory hours in Dorman 107, which also serves as a proctored online test arena for other PSS classes (Figure 3).



Figure 3. Students taking online proctored exams in Dorman 107

Three textbooks were authored in early 2016 to support the Precision Ag. coursework: PA-I, PA-II, and Ag. Remote Sensing I. The books feature Mississippi regional datasets and related exercises that aid students in master geospatial technologies. The text include 9 to 10 full-length exercises totaling nearly 600 pages of text (Figure 4).



Figure 4. Precision Ag. program textbooks

Textbooks currently in production for 2017 include:

- Rural & Regional Site Analysis (Landscape Architecture)
- Ag. Remote Sensing II
- Farm Systems in SST Software

Software featured on Dorman 107 lab computers include:

- All Microsoft® products
- Adobe Creative Suite®
- Esri's ArcGIS Desktop®
- SMS Ag Leader®
- Farm Works®
- SMS Ag. Leader InCommand Liquid Console on valve display booth; SMS Cloud-based farm solution for broadcasting farm field data from tractor to classroom

Dorman 105 renovations are currently underway. The classroom will be fitted with conventional student seating (armchair desks) and 5 additional workstations. Added to these workstations will be several proprietary farm decision software packages including:

- SST®
- Field View® by Climate Corp
- Field X®
- Conservis®
- Farmers Business Network®

Both Dorman 105 & 107 will be employed for traditional face-to-face and distance learning classes. Furthermore, individual PSS faculty are being fitted with desktop software, cameras, and microphones so that they can access the videoconferencing system and both record lectures and make live presentations from their offices.

Precision Ag. Faculty and New Hires

Prior to the Precision Ag. Initiative in 2014, only limited PSS faculty engaged in Precision Ag. operations supported by computing technologies. The PSS department collaborated in the CALS Precision Ag. Cluster Hire between 2015 and 2017 and several new faculty were added to the Precision Ag. roster. Drs. Mike Cox and Jac Varco have long held the distinction of providing the PSS program the initial framework upon which the Precision Ag. program is developed. Furthermore, Dr. T.J. Bradford was hired as instructional to support PA-I and PA-II classroom instruction. Dr. Amelia A.A. Fox collaborates with all CALS faculty to increase Precision Ag. access to emerging technologies, and teaches remote sensing technologies related to farm production. Dr. Connor Ferguson joins PSS faculty in fall, 2017, to fill a vacant Weed Science position.

Other Related Projects

Novel technology projects are under development with external Precision Ag. industry partners. The goal of these partnerships is to expand current curriculum and decision-support capabilities across the entire College of Ag. & Life Sciences (CALs). Projects:

1. Future Grower Technology Program
 - a. For Horticulture: Wadsworth Greenhouse Controls (Arvada, CO) and USDA Dr. Jennifer Boldt (Virtual Grower decision support tool) are cooperating with PSS and CALs to developed advanced climate control interfaces for greenhouse production systems
 - b. For Poultry Science: Chore-Time Brock (Milford, IN, a Berkshire-Hathaway Corporation) is working with MSU PSS and Poultry Science to test conversion of outdated environmental controls with advanced climate control systems at State's South Farm production facility
 - c. The MSU Computer Science Engineering Senior Design Team is programming a computer interface for poultry and horticulture that will provide students and researchers advanced training and decision-support tools for enclosed, climate controlled agricultural enterprises
2. SST Corporation
 - a. MSU is entering into agreement with the agriculture software company to reciprocally design educational materials for traditional face-to-face and online learning opportunities, and provide decision-support tools for faculty researchers
3. Hinds Community College, Raymond, MS
 - a. MSU currently has 2+2 and 2+3 year transfer agreements to State in Precision Ag. and Aerospace, respectively
 - b. PSS is supporting the development of National Science Foundation Advanced Technology Education Small Projects Grant to benefit Hinds' programs for:
 - i. Curriculum development to interface Hinds' UAS and Precision Ag. Programs
 - ii. Research/Teaching site for UAS flight and precision prescription treatment of forage crops
4. Bell Schoolhouse Academy of Model Aeronautics Student Flight Club
 - a. A student-lead private training of MSU students in UAS flight is operated on a 1000-acre farm site owned by MSU alumni used on agreement with student club
 - b. PSS supports the student organization by housing flight materials and sponsoring meeting places for students to gather
 - c. The first pilot to graduate from the training program was immediately hired into the MSU Geosystems Research Institute

