

Progress Report

Title:	Leveraging Technologies to Enhance Rural Alabama`s Leading Agricultural Industries		
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Submitted By		Date Submitted to NIFA	

Program Code: RP778**Program Name:** Sec 778-Institute for Rural Partnerships**Project Director**

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Agricultural Economics and Rural Sociology
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{NO DATA ENTERED}

Non-Technical Summary

Alabama is a global leader in two primary agricultural industry sectors - poultry production and forest products. The annual contribution of both industries to Alabama's economy is \$43 billion. A significant percentage of the 210,000 jobs created in the state by these two industries are in rural Alabama. Therefore, the goal of this project is to leverage modern technologies to advance rural Alabama through these two leading agricultural industries. Our inter-disciplinary approach will develop technology solutions that will assist producers and processes of poultry and forest products to improve their competitiveness and sustainability while addressing cyber-physical vulnerabilities due to use/adoption of modern technologies. This project also aims to reduce pollution of water bodies in rural Alabama by developing systems that manage upcycling waste streams emanating from agricultural processing facilities. Ultimately, we will develop case studies that showcase new technologies and opportunities for agricultural and forest production in the rural South. We will develop and deliver project findings that summarize and evaluate project impacts on rural Alabama to target stakeholders and the public. The objectives and the expected outcomes of this project are well-aligned with the Goals 2 (Equitable, Resilient and Prosperous America's Agricultural System), 3 (Fostering Equitable and Competitive Marketplace for All Agricultural Producers), and 5 (Expanding Opportunities for Economic Development and Improve Quality of Life in Rural Alabama) of the USDA's Strategic Plan.

Accomplishments**Major goals of the project**

The main goal of the project is to utilize inter-disciplinary approach to develop technology solutions that will assist producers and processes of poultry and forest products to improve their competitiveness and sustainability while addressing cyber-

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physical vulnerabilities due to use/adoption of modern technologies. A related goal is to reduce pollution of water bodies in rural Alabama by developing systems that manage upcycling waste streams emanating from agricultural processing facilities.

What was accomplished under these goals?**1. Issue or problem that the focus area is addressing**Focus area 1:

This focus area aims at developing technology solutions and market intelligence that will help producers and processors of agricultural and forest products improve their competitiveness and sustainability. An additional goal of this focus area is to understand the factors that affect how small and medium-size timber products businesses and poultry processors do business in the state of Alabama. Technologies currently in use by the poultry industry have been identified to be automation, optical/imaging technologies, sensors and Internet of things, machine learning and robotics. Other issues that are being addressed is understanding of the challenges faced by poultry processing companies and wood products mills in rural Alabama including recruiting and retaining employees with sufficient technical background.

Focus area 1, Task 1:

Our strategy entails commencing interviews with the forestry industry as an initial focus, driven by the interest and recruitment that occurred during our meeting with the Alabama Forestry Association (AFA) in Montgomery on July 21st, 2023. Following the completion of the forestry interviews around August 2024, we anticipate immediately beginning the poultry industry interviews and concluding the poultry interviews around August 2025. The findings from these interviews will continue to inform the other tasks and objectives.

Focus Area 3, Task 1:

Cyber-physical vulnerabilities of the systems and equipment used in the poultry and forestry industries are increasing and are not well understood. Both sectors are historically "non-connected" and have enjoyed a separation from Internet-centric threats. However, in recent years more of the control systems and processing systems are digital and connected via public data circuits to remote managing centers, vendors, and other business partners. Exposures to online threats are rapidly increasing.

Focus Area 4:

Manage water and wastewater, and upcycle waste streams from poultry and forest production processing facilities for beneficial use.

2. Who or what will be most immediately impacted by results from this focus area and how?

Rural Alabamians should benefit from the knowledge produced from this project and data shared with policymakers and organizations.

Focus area 1:

Researchers and policy makers will be impacted by the results from these industry interviews. Currently, there is no systematically collected data to identify the factors that influence how these industries conduct business, and the factors that the business owners, employees, and communities take into consideration with regards to poultry and wood industries. Our goal is to understand and identify which of these factors with appropriate modification have the greatest potential to improving the lives of Alabama citizens in the communities where these poultry and wood industries are located. Poultry producers, poultry processors, wood products companies and forest landowners will also be impacted by results from this focus area because by developing technology solutions that improves competitiveness and result in sustainability of these two industries, the working conditions, labor retention and overall wages for the rural residents of the state of Alabama are improved.

Focus Area 3, Task 1:

The small business owners and operators in rural communities will benefit most from the results of this focus area. Most are not financially able to support large in-house cybersecurity teams and rely on managed service providers or other third parties to protect their systems.

Focus Area 4:

General public that are downstream of poultry and forest production processing facilities. Operators/owners of poultry and forest production processing facilities. The living conditions of the individuals living close to the processing plants are improved because of development of solutions to treat wastewater emanating from these plants. The upcycling of DAF solids from poultry processing plants will eliminate odor and pathogen issues and also may lead to creation of a new industry that can invariably provide additional revenue to residents of rural Alabama.

3. Major activities accomplished/experiments conducted, data collected, and summary of results.Focus area 1:

A review of related literature on poultry processing technologies was conducted to identify the current processing technologies in use in the industry. In academic journals, automated systems, robotics, sensors, machine learning and internet of things are technologies reported, discussed, and explored to solve pressing challenges in the processing system. These technologies were used for environmental control, quality inspection, poultry processing operations such as rehousing,

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loading and unloading with the goal of improving the productivity of the industry. Some technology solutions companies such as Markel and FoodPro were also explored as they provide advanced digital technology solutions for the industry some of which include the production planning software and automated processing systems. Articles from poultry industry trade journals such as FeedStuffs, Wattpoultry were also explored to identify the additional technologies used by firms in the business. Digital wearable trackers to enhance employee safety, autonomous delivery trucks for product transportation, a virtual reality cobot system for robot control in production, smart control environmental monitoring system, automated poultry weighing system, to improve productivity and bird welfare while reducing manual labor and X-ray inspection for quality control in packaging amongst others. The poultry industry currently leverages optical and imaging technologies, automation, robotics, machine learning and the internet of things with sensors to enhance efficiency, quality, safety, and sustainability. These technologies are mostly used by large-scale chicken meat producers.

Semi-structured interviews of four people in the timber products industry have been conducted so far. We have also visited two sawmills and attended the Alabama Forestry Association Annual meeting where we collected field notes. The data have not been fully analyzed to provide a summary of the results to date.

Focus Area 3, Task 1:

Conducted an initial verbal conversation with the plant managers of the three companies the team visited concerning the security of their existing cyber/physical systems. In all three cases the plant managers pointed to their corporate information technology (IT) teams for further information. Interviews of the IT teams will happen in CY2024.

Focus Area 4:

We have developed the system that will be used to produce hydroponic lettuce from poultry processing wastewater. We have developed the system that will be used to valorize the solid residues from dissolved air flotation (DAF) utilized in poultry processing plants.

4. Were there issues or problem encountered during the report period (past one year) and how was this addressed.**Focus area 1:**

The social science team did not have personal or professional relationships with people in the timber products or poultry industry. Therefore, two team members (Dr. Dozier and Dr. Gallagher) secured invitations to visit poultry plants and sawmills. These invitations have led to other interactions that have resulted in securing interviews with people in the timber products industry.

What opportunities for training and professional development has the project provided?

1. Graduate student training for 3 students
2. Research and work experience for 3 undergraduate students
3. Other funded projects were utilized to leverage stipends for additional graduate and undergraduate students.

How have the results been disseminated to communities of interest?

The technical report detailing the results obtained is being completed.

Consideration is being given to the most effective methods for disseminating this information.

What do you plan to do during the next reporting period to accomplish the goals?**Focus area 1:**

In the future, an Overall equipment effectiveness (OEE) capability will be developed and implemented for the poultry industry. OEE is aimed at optimizing production efficiency and quality by evaluating how effectively resources in the process are utilized. The important performance indicators in poultry meat processing will be determined and used to develop an encompassing OEE metric to monitor performance. This will then be implemented for real time monitoring and modeled to identify best practices, enabling poultry processors to make informed decisions about their operations. Additionally, the return on investment for each category of technology will be determined. This is aimed at providing a basis for an economic analysis of investments made in these technologies by the firms thus enabling them to make informed decisions about their adoption. Secondly, the social science team will complete the interviews for individuals in the timber products industry and conduct qualitative analysis of the interview data. Reports of results will be used to determine the next steps in the research process and the direction of future efforts by the Social Science team. We also plan to conduct similar interviews for people in the poultry industry to determine the interactions between businesses, employees, and communities in rural Alabama.

Focus area 3:

Interviews of technology and security teams at businesses in the forestry and poultry industries begin in January. The research will be open-ended, seeking to collaboratively isolate cyber vulnerabilities in current and planned technologies. Several visits to the same sites may be required to build trust and develop a deeper understanding of the industry's concerns. A web page to host security bulletins and information for business owners in the forestry and poultry industries is planned for the second half of the year.

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Focus area 4:

The ongoing research aims to delve deeper into the valorization of poultry processing wastewater, exploring its potential in cultivating hydroponic lettuce. Additionally, the focus involves developing effective strategies to address odor and pathogen concerns associated with the application of poultry wastewater using a dissolve air floatation (DAF) system. These efforts underscore a comprehensive approach, aiming not only to explore innovative uses for this wastewater but also to ensure its safe and environmentally responsible management throughout the process.

Participants**Actual FTE's for this Reporting Period**

Role	Non-Students or faculty	Students with Staffing Roles			Computed Total by Role
		Undergraduate	Graduate	Post-Doctorate	
Scientist	0.6	0	0	0	0.6
Professional	0.5	0	0	0	0.5
Technical	0	0	2	0	2
Administrative	0	0	0	0	0
Other	0	1.2	0	0	1.2
Computed Total	1.1	1.2	2	0	4.3

Student Count by Classification of Instructional Programs (CIP) Code

Undergraduate	Graduate	Post-Doctorate	CIP Code
1	1		14.45 Biological/Biosystems Engineering.
	2		14.35 Industrial Engineering.
1	1		45.14 Rural Sociology.

Target Audience

Individuals, groups, communities that efforts during this reporting period (last one year) were focused upon.

- Alabama Poultry and Egg Association (APEA)
- Alabama Farmers Federation (ALFA)
- Alabama Forestry Association (AFA)
- Two poultry integrator companies
- Two sawmill companies
- Forest landowners
- AU research team
- SRDC (Southern Rural Development Center)

The efforts during this reporting period also focused on understanding the challenges faced during poultry processing operations and wood product companies, and identifying technology solutions available for adoption by the companies in these two sectors. Additionally, the social science team focus was on small and medium-sized business owners in the forest timber industry.

Products

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Type	Status	Year Published	NIFA Support Acknowledged
Other	Other	2023	NO

Citation

•WIRED article <https://www.wired.com/story/us-food-agriculture-isac-cybersecurity/>

Type	Status	Year Published	NIFA Support Acknowledged
Other	Other	2023	YES

Citation

Congressional Report by Rural Partnership Consortium of the Three Universities/Institutes (Auburn University, University of Wisconsin-Madison, and University of Vermont)

Type	Status	Year Published	NIFA Support Acknowledged
Other	Under Review	2023	YES

Citation

Technical Report on Technologies in Use in Poultry Processing Plants and Growing Houses.

Other Products

Product Type

Other

Description

AURPI Workshop on Cybersecurity in Poultry and Forest Industries, Feb 14, 2023.

Product Type

Other

Description

AURPI Workshop on State of Forestry Industry, Feb 28, 2023.

Product Type

Other

Description

AURPI Workshop on State of Poultry Industry, April 11, 2023.

Product Type

Models

Description

Kelli Russell attended the 2023 Rural Sociology Annual Meeting.

Product Type

Other

Description

Kelli Russell attended the Federal Research Bank of St. Louis Conference in Investing in Rural Prosperity Responding to Demographic Shifts in Rural America

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Product Type

Other

Description

Fasina and Whiting attended the kick off meeting and ribbon cutting of the Leahy Building that houses the University of Vermont Institute for Rural Partnership. A meeting of the three funded Institute for Rural Partnership was also held.

Changes/Problems

{Nothing to report}