This project was conducted in cooperation with the State of Georgia, Environmental Protection Division.

EPD Grant Number:
SFY2018 Regional Water Plan Seed Grant
751-180202

Project Title:
Innovative Agricultural Irrigation Scheduling Tools for Increasing Water Use Efficiency in the Lower Flint – Ochlocknee and the Upper Flint Regional Water Council Areas

FINAL REPORT

Submitted by:

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Period of the Project:

07/01/2018 – 06/30/2021

Approved by: Barbara Stitt-Allen

Barbara Stitt-Allen, Contract Administrator
NonPoint Source Program
Watershed Protection Branch

EXECUTIVE SUMMARY

Innovative Agricultural Irrigation Scheduling Tools for Increasing Water Use Efficiency in the Lower Flint – Ochlocknee and the Upper Flint Regional Water Council Areas

EPD Grant Number 751-180202

PROJECT START DATE: **July 1, 2018**
PROJECT COMPLETION DATE: **June 30, 2021**

FUNDING:

State amount allotted	$ 74,000.00
Match amount allotted	$ 48,860.00
Cash amount allotted	$ 22,000.00
State amount expended	$ 73,948.31
Match amount expended	$ 48,839.32
Cash amount expended	$ 22,632.34

EXECUTIVE SUMMARY

The purpose of this project was to develop a Phase 2 – Pilot Project and focus on the Lower Flint – Ochlocknee and Upper Flint Regional Water Council regions of Georgia to address demand management practices in both water plans that seek to address the need for continuous improvements in agricultural water use efficiency (more crop per drop). The Project worked with UGA Extension county agents and a crop consultant in 9 counties across the LFO and UF regions (Colquitt, Crisp, Decatur, Dooly, Mitchell, Miller, Sumter, Terrell, and Thomas) and each worked with 2 cotton farmers per county to learn about and implement 2 advanced ag irrigation scheduling tools – soil moisture sensing systems (SMSS) and UGA's SmartIrrigation Cotton App (SI App) for smartphones with the goal of improving the scheduling of center pivot irrigation of cotton fields. Specifically, the following primary goals/activities were proposed:

- Expand and deploy advanced agricultural irrigation scheduling tools for cotton to a broad and diverse group of farmers in LFO and UF regions.
- Coordinate and train UGA Extension agents (and one crop consultant) on the use of two irrigation scheduling tools (SMSS and SI App) who would then identify and work closely with the participating farmers to deploy the scheduling tools.
- Incorporate 'social science' activities to learn more about agent and farmer opinions/beliefs and/or behavioral changes related to perception and adoption of the tools.
- Produce an educational website related to the project results.

The team considers the project successful as the original goals were met and much was gleaned from carrying out this project. Activities performed were as follows:

- Nine counties, nine UGA Extension agents (plus one crop consultant), eighteen farmers, and eighteen fields identified.
- Nine UGA Extension agents (plus one crop consultant) and eighteen farmers trained on use of SMSS.

- Nine UGA Extension agents, one crop consultant, and eighteen farmers trained on use of the SI App.
- Eighteen soil moisture sensing systems and SmartIrrigation App setups installed.
- Two years of results from cotton irrigation scheduling research studies at Stripling Park completed.
- Social science surveys of 9 agents and 18 farmers conducted.
- Webpage developed covering project overview and results.

Final Report

Innovative Agricultural Irrigation Scheduling Tools for Increasing Water Use Efficiency in the Lower Flint – Ochlocknee and the Upper Flint Regional Water Council Areas

1.0 INTRODUCTION

Research shows that properly scheduling agricultural irrigation applications can lead to increased water use efficiency (WUE), i.e. more crop yield per unit of irrigation water applied, and can often lead to water conservation and/or increases in yield. Numerous studies conducted by the University of Georgia (UGA), including many at the Stripling Irrigation Research Park (SIRP), have shown that advanced irrigation scheduling tools such as soil moisture sensors and evapotranspiration (ET) –based models will significantly improve WUE under all types of weather conditions. Yet, many farmers are hesitant to adopt such technologies. Based on results from other projects, farmers are more inclined to try a technology if their local UGA Extension county agent recommends the technology.

The Lower Flint – Ochlocknee Regional Water Council (LFO) and the Upper Flint Regional Water Council (UF), in their respective Regional Water Plans (updated 2017), specify several demand management (DM) practices, for both surface water and groundwater, to address potential gaps in water resources in their respective regions of Georgia. The DM1 and DM4 demand management practices in the LFO along with the DM4 and DM5 demand management practices in the UF demonstrate the need for continuous improvements in agricultural water use efficiency (more crop per drop) and water conservation in the two regions.

Through the use of advanced irrigation scheduling tools, agricultural farm irrigators can increase water use efficiency and water conservation. These efficiency and conservation gains are important as there are in excess of 13,000 center pivot systems in these two regions of Georgia and forecasts in the Regional Water Plans predict by 2050 that agriculture will account for 79% and 78% of the total water demand in the LFO and UF regions, respectively.

In 2017, UGA Extension initiated a Phase 1 - Pilot Project to advance cotton irrigation scheduling tools on center pivot agricultural systems in an eleven (11) county area throughout southern Georgia (Appendix 1). The Phase 1 - Pilot Project was not restricted to specific regional water planning council areas. The irrigation scheduling tools deployed in the Phase 1 project included the SI App developed by UGA's Dr. George Vellidis (Co-PI on this project) and an SMSS from the Trellis company (Peachtree Corners, GA).

In 2018, UGA College of Agricultural and Environmental Sciences (UGA CAES) faculty members Calvin Perry and Dr. George Vellidis were awarded a Regional Water Plan Seed

Grant to develop a Phase 2 – Pilot Project. Georgia's Environmental Protection Division of DNR managed the grant program. This Seed Grant project built upon the 2017 Phase 1 Project and expanded its activities while concentrating the work (farmers and extension agents) within the Lower Flint – Ochlocknee Regional Water Council (LFO) and the Upper Flint Regional Water Council (UF) regions of Georgia (Appendix 1) - as these two regions are the most intensively irrigated in the state. This Phase 2 project deployed updated versions of the same SMSS and SI App used in the Phase 1 project.

2.0 PROJECT OBJECTIVES, GOALS, AND ACTIVITIES

The goal of this project was to expand a 2017 University of Georgia Extension (UGA) Phase 1 - Pilot Project into a Phase 2 – Pilot Project and focus on the Lower Flint – Ochlocknee and Upper Flint Regional Water Council regions of Georgia – to address demand management practices in both water plans that seek to address the need for continuous improvements in ag water use efficiency. The Project worked with UGA Extension county agents (and 1 crop consultant) in 9 counties across the LFO and UF regions (Colquitt, Crisp, Decatur, Dooly, Mitchell, Miller, Sumter, Terrell, and Thomas) and each worked with 2 cotton farmers per county to learn about and implement 2 advanced irrigation scheduling tools – soil moisture sensing systems (SMSS) and UGA's SmartIrrigation Cotton App (SI App) for smart phones.

Specific Project Objectives:

- Expand and deploy advanced agricultural irrigation scheduling tools for cotton to a broad and diverse group of farmers across nine counties in the LFO and UF areas.
- Coordinate and train UGA Extension agents (and one crop consultant) on the use of two irrigation scheduling tools (SMSS and SI App). Agents will then identify and work closely with the participating farmers to deploy the scheduling tools and help collect data and provide education and outreach activities related to the tools.
- Incorporate 'social science' activities by conducting interviews, focus groups, and surveys to learn more about agent and farmer opinions/beliefs and/or behavioral changes related to perception and adoption of the tools – before and after the project.
- Produce an educational website related to the project results which is freely available to any interested parties and directly to the LFO and UF councils.

Specific Project Activities:

Project Activity #1: Select Counties, Agents and Participating Farmers.

Task 1.1: Work with UGA Extension district administration to identify potential counties and agent participants in LFO and UF regions.
Worked with Extension administration and identified a total of 9 counties and 9 agents in LFO and UF regions to participate in the project over the two years (2019-2020) – see Appendix 1. In 2019, identified 9 counties, 8 agents and one crop consultant to participate in the project. In 2020, identified 8 counties and 7 agents to work in the project. For 2020, one agent/county chose not to continue in the project. Another county lost their agent but that county continued in the project as an existing project agent covered that county as well.

Task 1.2: Coordinate with the nine (9) county agents in their respective counties to identify farmers willing to participate in Phase 2 - Pilot Project and obtain Producer Agreement from the farmers.
Coordinated with 8 county agents and 1 crop consultant in 2019 (9 counties) and 7 county agents in 2020 (8 counties) to identify 2 cotton farmers in each of the counties (18 in 2019, 16 in 2020) to participate in the project. One county opted to not participate in 2020. "Producer Agreements" were not utilized – see Section 7.

Task 1.3: Conduct training workshop for the county agents and crop consultant on the proper use of the two scheduling tools and automated rain gages.
Conducted two in-person preseason workshops (Bainbridge and Plains) in 2019 to train participants on use of soil moisture sensing systems (SMSS) and SI App. The Bainbridge workshop included 4 project agents along with 10 others while the Plains workshop included 4 project agents and 1 crop consultant (acting as an agent) plus 8 others. Worked with Trellis, vendor for the SMSS, to incorporate a rain gauge into their SMSS for this project. Conducted a virtual preseason workshop in 2020 for agent refresher and training.

Task 1.4: Conduct preseason 'social science' activities by assessing initial behaviors and attitudes of at least nine (9) county agents and at least eighteen (18) farmers related to agricultural water use practices and the perception and adoption of advanced irrigation scheduling tools.
In late 2018 and early 2019, as part of a MARS Wrigley Confectionery funded project, a team of UGA social science collaborators, including an agricultural economist and agricultural communication specialists, interviewed 10 farmers and surveyed 86 additional "irrigators" in southern Georgia (all non-participants in this project) – see Section 3.0. In addition, participating agents (and 1 crop consultant) were surveyed in 2019 (preseason) with all 9 completing surveys. Despite repeated requests, agents did not get farmers to complete pre-season surveys. Results from agent surveys are provided in Appendix 5. Unfortunately, the lead social science collaborator (ag economist) resigned from the University of Georgia early in the project and failed to complete any social science reports, despite repeated entreaties from the project's PI. Therefore, a formal "preliminary social science report" cannot be provided. However, despite the lack of a formal report, the results provided in Appendix 5 provides insights into the knowledge levels of the agents and farmers involved in the project.

Project Activity #2: Implement and Demonstrate Irrigation Scheduling Tools (SmartIrrigation Cotton App and Soil Moisture Sensor System) and Automated Rain Gages with wireless telemetry in Center-Pivot Irrigated Cotton Fields.

Task 2.1: Coordinate with the nine (9) county agents and eighteen (18) farmers to identify appropriate cotton fields for project.
Coordinated with 8 county agents and 1 crop consultant in 2019 (9 counties) and 7 county agents in 2020 (8 counties) to identify 2 cotton farmers in each of the counties (18 in 2019, 16 in 2020) that have center pivot irrigated cotton fields to participate in the project. One county opted to not participate in 2020.

Task 2.2: Procure Soil Moisture Sensor Systems (SMSS) with automated rain gages with wireless telemetry from vendor(s). Coordinate with vendor(s), agents and farmers to install SMSS and rain gages in all fields, calibrate and test equipment to confirm working properly, and confirm data transmittal to web-based data portal is active. Assist agents in training farmers on use of SMSS and rain gages.
Purchased SMSS gear (including automated rain gauges) with wireless telemetry from Trellis. The SMSS gear included 3 soil moisture probes, rain gauge, and associated telemetry per field

to collect data and transmit to web-based data portal. Coordinated with Trellis, agents and farmers to get SMSS gear properly installed and functioning in 18 fields in 2019 and 16 fields in 2020. Assisted agents as necessary to provide training to farmers. Soil moisture data from multiple soil depths per probe along with precipitation data from rain gauge was available to the farmers via data portal. Appendix 2 provides photos of SMSS gear being installed. Appendix 3 provides example graphs of data from SMSS and rain gauge gear deployed in this project.

Task 2.3: Coordinate with county agents to install the App on county agents' and farmers' smartphones. Confirm installations of the App are operating properly and being used by agents and farmers. Assist agents in training farmers on use of the App and SMSS scheduling tools (which included automated rain gages).
Completed installation of SI App on 8 county agent, 1 crop consultant and 18 farmer smartphones in 2019. In 2020, installed SI App on 7 county agent and 16 farmer smartphones. Made sure installations of the App and SMSS (including automated rain gauges) were working properly and being used. Assisted agents as they provided additional training of farmers when necessary. Appendix 2 provides a photo of the SI App installed on a smartphone.

Project Activity #3: Evaluation and Assessment of Project Activities.

Task 3.1: Obtain sufficient data results from fields irrigated using scheduling tools vs. farmer standard fields.
Communicated the need for data gathering to participating county agents on numerous occasions in both 2019 and 2020 crop seasons. Agents were able to obtain only a limited amount of data from the fields involved in the project. More on this in Section 7.

Task 3.2: Evaluate data results from Phase 2 - Pilot Project and compare with results from replicated plot study at SIRP (Extension checkbook, App and SMSS plots) as farmers could not be expected to have all scheduling methods represented in each field.
For 2019 and 2020, a randomized, replicated plot study was conducted at SIRP. Study included UGA Extension checkbook, SI App, and SMSS irrigation scheduling methods. Results from SIRP studies were compared to limited amount of Pilot Project data obtained. Appendix 2 provides a photo of cotton research plots at SIRP being irrigated and Appendix 4 provides cotton yield data from 2 years of plot research.

Task 3.3: Conduct postseason 'social science' activities by assessing post-project behaviors and attitudes of participating county agents and farmers related to agricultural water use practices and the perception and adoption of advanced irrigation scheduling tools.
As noted in Task 1.3, in 2019 all 8 agents and 1 crop consultant completed preseason surveys but not postseason surveys. In 2020, 7 agents completed postseason surveys. All participating farmers were surveyed postseason in 2019 (18 farmers) and 2020 (16 farmers). However, only 4 farmer surveys were returned in 2019 and 14 surveys were returned in 2020. Results from agent and farmer surveys are provided in Appendix 5. As noted in Task 1.4, the lead social science collaborator (ag economist) resigned from the University of Georgia early in the project. As such, the project was unable to carry out needed postseason social science activities and unable to complete social science reports. Therefore, a formal end-of-project social science report cannot not be provided. However, despite the lack of a formal report, the results provided in Appendix 5 provides insights into the knowledge levels of the agents and farmers involved in the project. Find more on this in section 3.0

Project Activity #4: Conduct Outreach and Education Activities.

Task 4.1: Conduct one (1) workshop (in-person or virtual, as required) to share results from Phase 2 – Pilot Project with county agents and participating farmers near end of each project year.
Conducted an in-person wrap-up workshop in 2019 and a virtual wrap-up workshop following the 2020 season (due to COVID protocols). Unfortunately, no farmers attended either wrap-up workshop despite being invited by their county's UGA Extension agent – see Section 7.

Task 4.2: Develop and launch a website to include information about the project, the irrigation scheduling tools, experiences of the participating farmers and county agents, and outcomes of the social science component.
Developed and launched a website to provide information and data related to this project. See Section 8.1 for the website URL. Appendix 6 shows the website's main page.

Task 4.3: Develop and publish a project summary and other related materials including project results to be distributed widely throughout the region upon project completion. Final project summary will be available electronically (PDF published on project website).
Developed and published a project summary (including results) and made it available on the website described in Task 4.2.

Task 4.4: Update the Lower Flint – Ochlocknee and Upper Flint Water Councils on the status of the project. Attend at least (1) council meeting and four (4) additional meeting or other email correspondence with council members.
Met in-person with councils on four occasions and once in virtual format to update councils on project status.

Project Activity #5: Administrative Contracts, Invoicing & Reporting to GA EPD.

Task 5.1: Submit quarterly financial and progress reports to GAEPD.
Quarterly invoices and reports were submitted to GAEPD.

Task 5.2: Submit final close-out report to GAEPD.
This report serves as the final close-out report.

Specific Project Outputs:

- UGA Extension agents and farmers trained on use of SMSS.
- UGA Extension agents and farmers trained on use of SI App.
- Soil moisture sensing system installs (Appendix 2).
- SmartIrrigation Cotton App installs (Appendix 2).
- Two years of results from cotton irrigation scheduling research studies at Stripling Park (Appendix 4).
- Social science surveys, interviews of agents and farmers (Appendix 5).
- Website with project overview and results.
- Quarterly reports.
- Closeout report.

2.1 PLANNED AND ACTUAL MILESTONES, PRODUCTS, AND COMPLETION DATES

Milestones	Starting Dates	Completion Dates
Milestone 1 Task 1.1: Work with UGA Extension district administration to identify potential counties and agent participants in LFO and UF regions.	07/18	12/18
Milestone 2 Task 1.2: Coordinate with the nine (9) county agents in their respective counties to identify farmers willing to participate in Phase 2 - Pilot Project and obtain Producer Agreement from the farmers.	10/18	05/19
Milestone 3 Task 1.3: Conduct training workshop for the county agents and crop consultant on the proper use of the two scheduling tools and automated rain gages.	04/19 & 06/20	04/19 & 06/20
Milestone 4 Task 1.4: Conduct preseason 'social science' activities by assessing initial behaviors and attitudes of at least nine (9) county agents and at least eighteen (18) farmers related to agricultural water use practices and the perception and adoption of advanced irrigation scheduling tools.	01/19	06/19
Milestone 5 Task 2.1: Coordinate with the nine (9) county agents and eighteen (18) farmers to identify appropriate cotton fields for project.	01/19	05/19
Milestone 6 Task 2.2: Procure Soil Moisture Sensor Systems (SMSS) with automated rain gages with wireless telemetry from vendor(s). Coordinate with vendor(s), agents and farmers to install SMSS and rain gages in all fields, calibrate and test equipment to confirm working properly, and confirm data transmittal to web-based data portal is active. Assist agents in training farmers on use of SMSS and rain gages.	03/19	07/19
Milestone 7 Task 2.3: Coordinate with county agents to install the App on county agents' and farmers' smartphones. Confirm installations of the App are operating properly and being used by agents and farmers. Assist agents in training farmers on use of the App and SMSS scheduling tools (which included automated rain gages).	04/19	07/19
Milestone 8	10/19	12/19

Task 3.1: Obtain data results from fields irrigated using scheduling tools vs. farmer standard fields.		
Milestone 9 Task 3.2: Evaluate data results from Phase 2 - Pilot Project and compare with results from replicated plot study at SIRP (Extension checkbook, App and SMSS plots).	03/20 & 06/21	03/20 & 06/21
Milestone 10 Task 3.3: Conduct postseason 'social science' activities by assessing post-project behaviors and attitudes of participating county agents and farmers related to agricultural water use practices and the perception and adoption of advanced irrigation scheduling tools.	03/20 & 02/21	03/20 & 02/21
Milestone 11 Task 4.1: Conduct one (1) workshop (in-person or virtual, as required) to share results from Phase 2 – Pilot Project with county agents and participating farmers near end of each project year.	04/20 & 02/21	04/20 & 02/21
Milestone 12 Task 4.2: Develop and launch a website to include information about the project, the irrigation scheduling tools, experiences of the participating farmers and county agents, and outcomes of the social science component.	03/20	11/21
Milestone 13 Task 4.3: Develop and publish a project summary and other related materials including project results to be distributed widely throughout the region upon project completion. Final project summary will be available electronically (PDF published on project website).	12/19	11/21
Milestone 14 Task 4.4: Update the Lower Flint – Ochlocknee and Upper Flint Water Councils on the status of the project. Attend at least (1) council meeting and four (4) additional meeting or other email correspondence with council members.	03/19	11/21
Milestone 15 Task 5.1: Submit quarterly financial and progress reports to GAEPD.	12/18	11/21
Milestone 16 Task 5.2: Submit final close-out report to GAEPD.	06/21	11/21

2.2. EVALUATION OF GOAL ACHIEVEMENT AND RELATIONSHIP TO THE REGIONAL WATER PLAN

Overall, this was a successful Phase 2 – Pilot Project. During the course of the 2+ year project, 9 agents (and 1 consultant) worked closely with 18 unique cotton farmers to demonstrate advanced irrigation scheduling tools – soil moisture sensing systems and the SmartIrrigation Cotton App – in 34 cotton fields across 9 counties within the UF and LFO regions (18 fields in 2019 and 16 fields in 2020). The Lower Flint – Ochlocknee Regional Water Council (LFO) and the Upper Flint Regional Water Council (UF) (Appendix 1), in their respective Regional Water Plans, specify several demand management (DM) practices, for both surface water and groundwater, to address potential gaps in water resources in their respective regions of Georgia. The DM1 and DM4 demand management practices in the LFO along with the DM4 and DM5 demand management practices in the UF demonstrate the need for continuous improvements in agricultural water use efficiency (more crop per drop) and water conservation in the two regions. The data resulting from two years of cotton irrigation scheduling research studies at Stripling Park (Appendix 4) clearly show the potential for increasing water use efficiency, water conservation and/or increases in yield. The deployment of the technologies in real-world, on-farm implementations in this project provided vital insights into how certain approaches to incentivizing the use of and implementing advanced tools for irrigation scheduling may have varying levels of success.

2.3 SUPPLEMENT INFORMATION

All additional information, including maps, photos etc., are included in the Appendices of this report.

3.0 LONG TERM RESULTS IN TERMS OF BEHAVIOR MODIFICATION, STREAM/LAKE QUALITY, GROUND WATER, AND/OR WATERSHED PROTECTION CHANGES

Historically, research has shown that properly scheduling agricultural irrigation applications can lead to increased water use efficiency and can often lead to water conservation and/or increases in yield. Numerous studies conducted by UGA, including many at SIRP, have shown that advanced irrigation scheduling tools such as soil moisture sensors and evapotranspiration (ET) –based models will significantly improve efficiencies under all types of weather conditions. Yet, experience and research has noted that many farmers are hesitant to adopt such technologies. Based on results from other projects, it has been observed that farmers are very busy individuals and are more inclined to try a technology if their local UGA Extension county agent is familiar with and recommends the technology. However, a “top-down” approach, as in the case of this project, where the project PI’s dictated all the parameters of the project, did not work as well as hoped with Extension agents. Perhaps a more organic, “bottom-up” approach may have worked better as the agents would have had more buy-in with the project.

In late 2018 and early 2019, as part of a MARS Wrigley Confectionery funded project, a team of UGA social science collaborators, including an agricultural economist and agricultural communication specialists, interviewed 10 farmers and surveyed 86 additional “irrigators” in southern Georgia. From these interviews and surveys, the social science team uncovered several major barriers to adoption of advanced irrigation scheduling tools. This barriers included, but were not limited to: a) Limited cell phone/broadband connectivity; b) Stress from time and money commitment; c) Installation/operation/maintenance costs; d) Sufficiency with current scheduling methods; e) Lack of knowledge about new methods; and f) See potential in technology, but are uncertain of dollars saved.

The MARS Wrigley funded social science activities with the farmers and irrigators determined that a) there is a significant financial return on the investment in soil moisture sensors, however, barriers to adoption still exist; b) there is a need to continue to document reproducibility in results across crops, production methods, and external pressures; and c) education and Extension outreach efforts need to continue to illustrate profitability and water use efficiency while also bridging the learning curve to adopting advanced methods.

From surveys of farmers and UGA Extension agents participating in this project (Appendix 5), it appears that the farmers did increase their knowledge level of various aspects of irrigation and irrigation scheduling as related to the project by participating in the project and working with their local extension agent. Agents, on the other hand, indicated by their responses that they still have much to learn about the various topics this project involves.

Anecdotal feedback from agents and survey results indicate the project had an impact on the views and knowledge level of both agents and farmers of using tools to enhance efficiency of irrigation applications and led to an increase of interest in and/or awareness of advanced, innovative irrigation scheduling tools such as SMSS and the SI App. These results gave research and extension specialists valuable insights into farmer knowledge, opinions and adoption barriers.

4.0 BEST MANAGEMENT PRACTICES (BMPS) DEVELOPED AND/OR IMPLEMENTED

Irrigation Water Management (USDA-NRCS Conservation Practice Standard 449)

5.0 MONITORING RESULTS (IF APPLICABLE)

The only “monitoring” results applicable to this project were from the two years of irrigation scheduling research at the Stripling Park. Results from 2019 and 2020 are provided in Appendix 4.

6.0 PUBLIC INVOLVEMENT AND COORDINATION

6.1. STATE AGENCIES

1. University of Georgia, College of Agricultural & Environmental Sciences – Grant execution, implementation, management, and reporting.
2. UGA Extension – Implementation of many grant objectives by working directly with participating farmers.
3. Georgia EPD – Grant funding, administration, advising.

6.2. FEDERAL AGENCIES

N/A

6.3 LOCAL GOVERNMENTS, INDUSTRY, ENVIRONMENTAL, AND OTHER GROUPS, PUBLIC AT LARGE

N/A

6.4. OTHER SOURCES OF FUNDS

All match has been reported through quarterly reports. Match was received generally from these items:

Unrecovered indirect costs

Cotton Incorporated
Mars Wrigley Confectionery company

7.0 ASPECTS OF THE PROJECT THAT DID NOT WORK WELL

Most large, ambitious projects will have numerous aspects that do not go well. This project was no exception:

• A “top-down” approach where the project PI’s dictated all the parameters of the project did not work well with agents. A more organic, “bottom-up” approach may have worked better as the agents would have had more buy-in with the project.

• Turn-over within the agent group over the two years of the project was also a critical issue. The project lost 2 agents but added 1 from 2019 to 2020.

• The perceived complexity of the scheduling tools and reduced or loss of interest among agents (and farmers) were detrimental to the project’s success.

• As noted in Task 1.3, the departure of the lead social science collaborator (ag economist) from the University of Georgia early in the project meant that this project was unable to complete the proposed formal social science reports. However, despite the lack of such formal reports, the information and results provided in Section 3.0 and Appendix 5 provide insights into the knowledge levels of the agents and farmers involved in the project.

• After conferring with agents, the use of a “producer agreement” was determined to be a hindrance to gaining farmer participation in the project.

• Conversations with participating agents and farmers seemed to indicate they preferred a soil moisture sensor system collecting data from a field versus the SmartIrrigation App which uses weather data from a station some distance away and rainfall data from a rain gauge in-field (which often had performance issues).

• Agents were very busy and could not devote the time required to make the project work as planned. Surveys, farmer yields and irrigation info, etc. were difficult to obtain. The project team communicated the need for data gathering to participating county agents on numerous occasions in both 2019 and 2020 crop seasons. Agents were able to obtain only a limited amount of data from the fields involved in the project.

• Agents were not able to get any farmers to participate in the wrap-up meetings held after each crop season, despite repeated encouragement.

• Yield monitors (on cotton pickers) were not as widely available on farmer harvesters as we had expected when the grant proposal was developed. So getting yields from the farmer fields proved to be a challenge.

• COVID-19 played a MAJOR role in how the project proceeded in 2020.

• Farmers are VERY busy and could not devote the time required to make the project work as planned. Some agents chose to work with large growers. Unfortunately, these growers are very busy, very spread out, etc. This presented a challenge to get them to try/adopt/get comfortable

with new technologies like SMSS and SI App. But often these are the farmers that can afford to try new technologies and become early adopters and influencers.

• Farmers did not attend postseason workshops despite personal invitations from their county's UGA Extension agents. As described above, these farmers are quite busy and could not set aside the time to attend.

• The Trellis soil moisture sensing systems and rain gauge gear, while more affordable, was riddled with performance issues.

• Low cost SMSS (like Trellis) allowed more growers to be equipped with gear during the project versus using more expensive hardware systems. But, using low cost gear proved to present challenges as we had many issues that more expensive gear might have reduced or eliminated – reliability, connectivity, accuracy, performance, etc. It also confirmed the old adage – "you get what you pay for" – as related to low-cost SMSS gear and associated performance issues.

• The App had some functional/programming issues during the project but were addressed quickly. Interruptions of linkage to Trellis soil moisture data proved more detrimental and affected the performance of the App in several instances.

8.0 FUTURE ACTIVITY RECOMMENDATIONS

• In order for farmers to adopt and implement advanced irrigation scheduling tools that are expensive, such as the SMSS, a means of incentivizing such tools beyond the limited opportunities available through Seed Grants or USDA-NRCS EQIP cost-share funding is needed.
• A more organic, "bottom-up" approach (instead of top-down) may have worked better as the UGA Extension agents would have had more buy-in with the project.
• Similarly, including the social science collaboration (ag economist) faculty member as a co-PI on the project may have led to him staying involved in the project even after he left UGA.
• To increase the likelihood of farmers utilizing the provided tool(s), providing needed data, survey results, etc., an approach that involves some tangible commitment from the farmers is needed in projects like this one. This could come in the form of cost-share instead of providing the technology at no cost.

8.1 INFORMATION AND EDUCATION OUTPUTS

See Appendices for additional information and outputs.

See the project results website for a project summary:

https://striplingpark.caes.uga.edu/research/sfy2018-regional-water-plan-seed-grant.html

9.0 BUDGET

BUDGETED EXPENDITURES

Item	Object Class Category	State Grant Funds	Matching Funds	Cash	Total
A	Personnel	16,022.00	0	0	16,022.00
B	Fringe Benefits	7,528.00	0	0	7,528.00
C	Travel	0	0	0	0
D	Equipment	0	0	0	0
E	Supplies	44,450.00	19,260.00	0	63,710.00
F	Contractual	5,000.00	0	10,000.00	15,000.00
G	Construction	NA	NA	N/A	NA
H	Other	1,000.00	0	12,000.00	13,000.00
I	Total Direct Charges (Sum of A-H)	74,000 00	19,260.00	22,000.00	115,260.00
J	Indirect Charges	0	29,600.00	0	0
K	Total (Sum of I and J)	74,000.00	48,860.00	22,000.00	144,860.00

FINAL EXPENDITURES

Item	Object Class Category	State Grant Funds	Matching Funds	Cash	Total
A	Personnel	16,610.00	0	0	16,610.00
B	Fringe Benefits	5,852.52	0	0	5,852.52
C	Travel	0	0	0	0
D	Equipment	0	0	0	0
E	Supplies	46,435.79	19,260.00	0	65,695.79
F	Contractual	5,000.00	0	11,150.00	16,150.00
G	Construction	NA	NA	N/A	NA
H	Other	50.00		11,482.34	11,532.34
I	Total Direct Charges (Sum of A-H)	73,948.31	19,260.00	22,632.34	115,840.65
J	Indirect Charges	0	29,579.32	0	29,579.32
K	Total (Sum of I and J)	73,948.31	48,839.32	22,632.34	145,419.97

9.1 BUDGET JUSTIFICATION

There are no discrepancies in budget line items between the Budgeted Expenditures and Final Expenditures.

Georgia EPD approved using extra Fringe funds toward Supplies.

Minority Business Enterprise (MBE) and Women Business Enterprises (WBE) Utilization

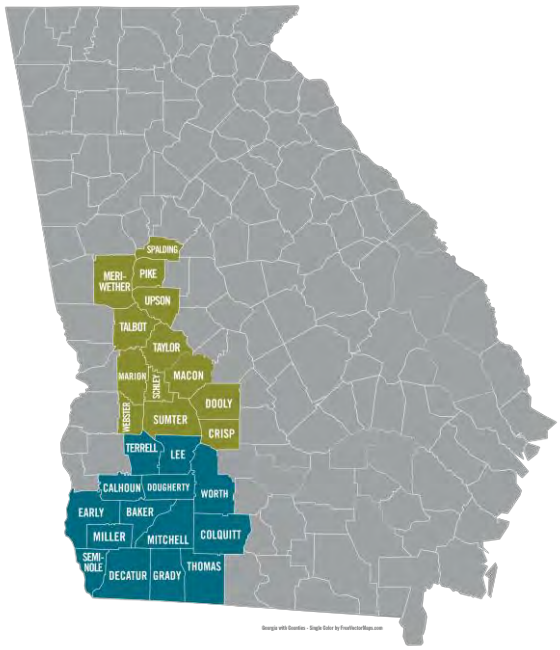
(For additional information regarding this topic, please refer to your Contract.)

MBE – Cumulative reporting period 07/18 – 06/21 Total: $ 00
WBE – Cumulative reporting period 07/18 – 06/21 Total: $ 00

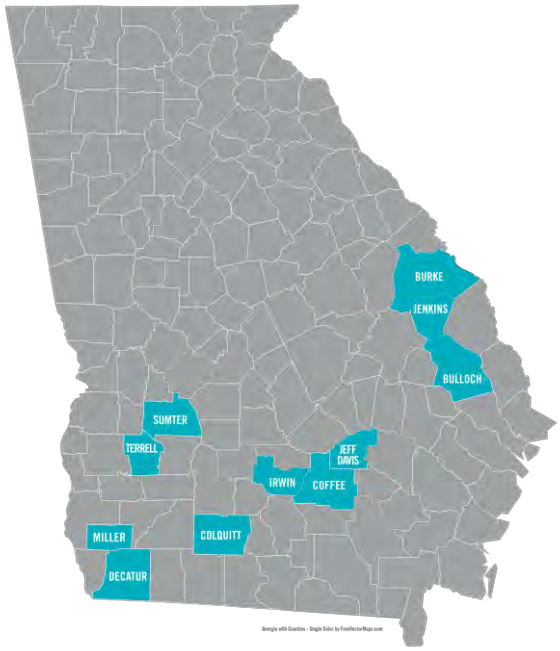
List of Appendices

Appendix 1

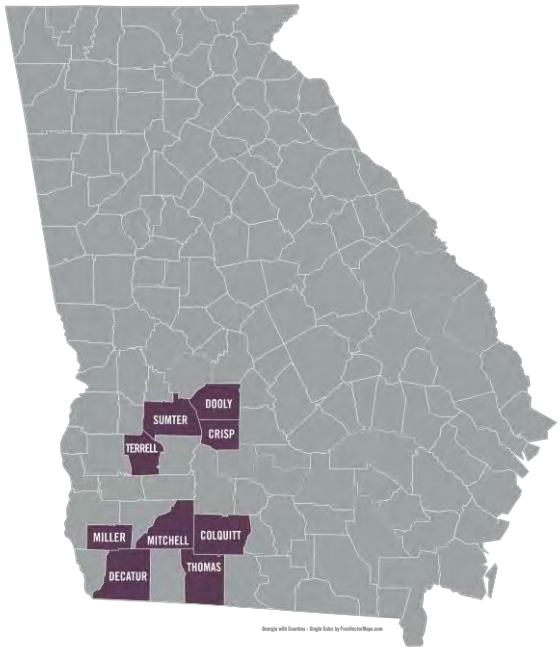
Maps of Georgia Counties Involved in the Project



Counties in the Lower Flint - Ochlocknee (blue) and Upper Flint (green) Regional Water Council regions.



2017 Phase 1 - Pilot Project counties.



2019-2021 Phase 2 - Pilot Project (this project) counties.

Appendix 2

Photos of Project Activities

Installing SMSS in Terrell County.

Installing SMSS in Mitchell County.

Installing SMSS in Crisp County.

Installed SMSS in Colquitt County.

SmartIrrigation Cotton App installed on grower's smartphone.

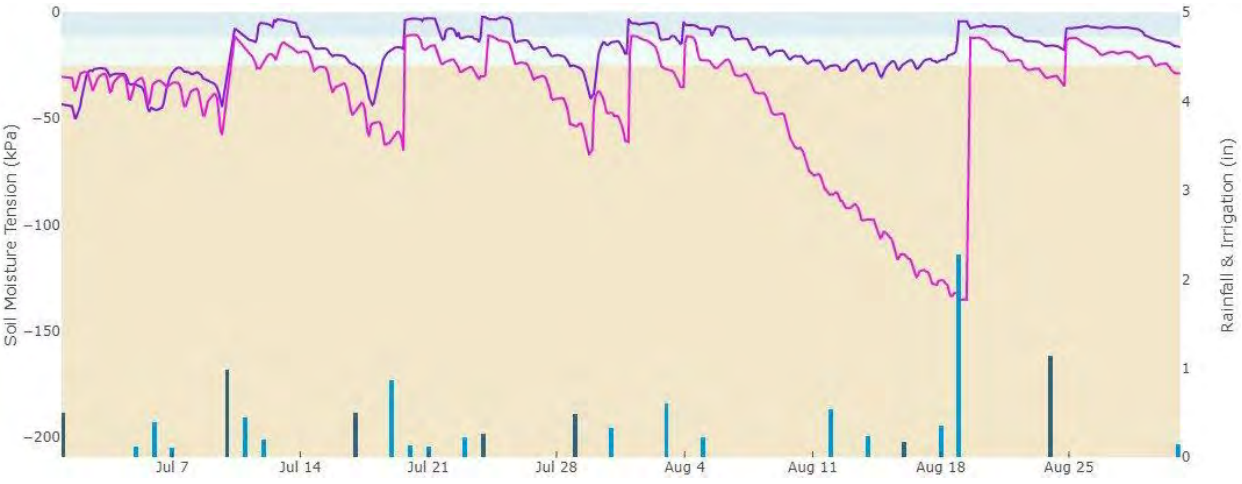
Irrigating cotton research plots at Stripling Park.

Removing SMSS probe in defoliated cotton in Mitchell County.

Appendix 3

SMSS Graphs of Soil Moisture and Rainfall+Irrigation

Graph of data from SMSS installed in Miller County cotton field in 2019. Shallow sensor shown in dark blue, deep sensor shown in purple.



Graph of data from SMSS installed in Thomas County cotton field in 2019. Shallow sensor shown in purple, deep sensor shown in dark blue.

Graph of data from SMSS installed in Mitchell County cotton field in 2020. Shallow sensor shown in dark blue, deep sensor shown in purple.

Graph of data from SMSS installed in Thomas County cotton field in 2020. Shallow sensor shown in dark blue, deep sensor shown in purple.

Appendix 4

Results from Irrigation Scheduling Research at Stripling Park

Treatments	Yield (lb/ac)	Yield (ba/ac)	Irrigation (in)	IWUE (lb/ac-in)
App	1054	2.2	8.3	127.8
Checkbook	1060	2.2	11.2	94.3
UGA SSA	1276	2.7	5.5	231.9

Results from research at Stripling Park in 2019. Variety was typical of what many farmers planted that year. IWUE = Irrigation Water Use Efficiency. SSA = Smart Sensor Array (an SMSS).

Treatments	Yield (lb/ac)	Yield (ba/ac)	Irrigation (in)	IWUE (lb lint/in irrig)
App	865	1.8	8.8	98.1
Checkbook	813	1.7	10.5	77.5
UGA SSA	946	2.0	4.8	197.5

Results from research at Stripling Park in 2020. Variety was typical of what many farmers planted that year. IWUE = Irrigation Water Use Efficiency. SSA = Smart Sensor Array (an SMSS).

Appendix 5

Agent and Farmer Survey Results

Farmer survey results from 2019 and 2020.

FARMER Survey Results[1]		Averaged Responses	
		2019	2020
Farmer Age[2]		3.5	3.1
Farmer Irrigated Acres		864.3	1838.4
How Much Do You Know About:[3]			
Irrigation Management in General	Yr Ago	4.0	3.8
	Now	4.0	3.9
Dif Ways of Making Irrig Decisions	Yr Ago	3.5	3.5
	Now	3.8	3.9
Effects of Dif Irrig Mgmt Systems on WUE	Yr Ago	3.5	3.3
	Now	3.5	3.7
Effects of Dif Irrig Mgmt Systems on Yield	Yr Ago	3.5	3.1
	Now	3.5	3.6
Soil Moisture Sensors	Yr Ago	2.5	3.2
	Now	3.0	3.9
Irrig Scheduling App on Phone / Tablet	Yr Ago	2.3	3.1
	Now	3.0	3.6

Notes:
1 – 2019 and 2020 farmer surveys were conducted at end of season.
2 – Age categories (years): [1] 18 to 24, [2] 25 to 34, [3] 35 to 44, [4] 45 to 54, [5] 55 to 64, [6] 65 to 74, [7] 75 to 84, [8] 85 to older.
3 – Response categories: [1] None, [2] Little, [3] Moderate amount, [4] A lot, [5] Great deal.

Extension agent survey results from 2019 and 2020.

AGENT Survey Results[1]		Averaged Responses	
		2019	2020
Agent Experience (Years)		7.0	7.7
How Much Do You Know About:[2]			
Irrigation Management in General	Now	3.2	3.1
Dif Ways of Making Irrig Decisions	Now	3.4	3.2
Effects of Dif Irrig Mgmt Systems on WUE	Now	3.2	3.1
Effects of Dif Irrig Mgmt Systems on Yield	Now	3.0	2.9
Soil Moisture Sensors	Now	3.1	3.1
Irrig Scheduling App on Phone / Tablet	Now	2.8	2.8

Notes:
1 – 2019 agent surveys were conducted preseason. 2020 agent surveys were conducted at end of season.
2 – Response categories: [1] None, [2] Little, [3] Moderate amount, [4] A lot, [5] Great deal.

Appendix 6

Main Page of Project Website