Final Report

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"Utilizing Solar Power as a Supplemental Power Source for Small Irrigation Needs"

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NRCS CIG Agreement Number 68-3A75-5-155
Final Report Submitted to USDA NRCS CIG Program on Behalf of The University of Georgia

The following materials are submitted as the final report for the original grant agreement number NRCS 68-3A75-5-155 which was granted to The University of Georgia.

Summary:

Photovoltaics (solar panels) are becoming of more interest to persons recently. Solar panels have been used to produce electricity for many years, but recently the interest has begun to climb. Systems installed are still small (kilowatt size), but occasionally you can find large systems (megawatt size). This idea of using small solar systems was further explored in this project to demonstrate that small solar systems (1-2 kW0) could be used in the commercial production of pecans. The system installed had a rated output of 1.5 kW. As installed the irrigation system had a few problems when the pump was operated only from solar panels. The problems were the amperage spikes caused by the occasional cloud cover. However, a battery bank was installed in the second year of project and had no problems once the spikes were buffered out via the batteries. The cost of the solar system was $11,537 with a payback period of 15 years. Overall, the system works great for small irrigation needs and should be cost effective in locations where power lines are limited.

Introduction:

The use of alternative energy sources has been of increasing importance over the past 5-10 years and specifically the past 3 years. One of these minor alternative energy sources is the use of solar photovoltaics for the production of electricity. Generally solar is considered to only provide 0.1 percent of the BTUs of energy in 2008 (Figure 1) and is the same as the 2005 year (beginning of project) as reported by the Department of Energy.

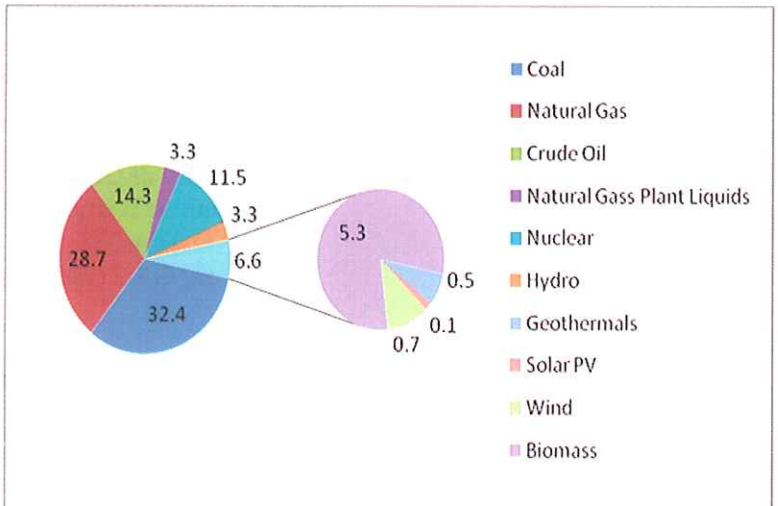


Figure 1. Energy produced in 2008 by type. Graph produced from data reported by Dept of Energy.

However, solar has potential in various operations and the use of solar is increasing for residential and agricultural uses. One use of solar is in the transfer of water for irrigation in small settings where electric lines are a distance from the location of needed power.

Reason for Project and Objectives:
Solar as mentioned has a place in small applications where power is not readily available. Some farmers have small acres of planted crops that would benefit from irrigation, but the availability of power is limited or at a distance that is not economical. Therefore this project was designed to use solar power as the main source to provide power for a drip irrigation system on pecan trees. To demonstrate how solar can be used to provide power for irrigating pecan trees, the following objectives were used to guide the project:

1. Demonstrate that solar power can be a large supplemental and feasible energy source for irrigation in rural areas, and
2. Demonstrate how soil moisture sensors can be used to conserve water through proper and timely irrigation.

Project Location and Size:
The farm used for this project is the Lamar Lane Pecan Farm. This is a 150 tree pecan orchard located on 70 acres in Pierce County, Georgia. The solar cells will be located directly adjacent to a 20 million gallon irrigation pond constructed on a dirt road approximately 100 yards off of a paved state road. The major soil type of this farm is Tifton Loamy Sand.

What was done to meet project:
Design of system:
The system was designed to provide water to a small portion of the orchard (45 mature pecan trees daily) for demonstration and to remove these trees from his house well. The rate we were designing for was 1 gallon per minute per tree through the system. To design the power delivery system, we worked with a solar design company/distributor. The system was designed to have a 70-80 foot dynamic head and a flow of 40 gpm. From these specifications a SunCentric Pump (mention of trade names or specific items does in no way provide endorsement of this specific product by The University of Georgia or the USDA-NRCS) 7000 series. This pump was a DC pump that operated on 36 volts and 24 amps.

The source of water for the irrigation system was a pond as described above. The pond was used for multiple reasons: 1) it was an available source of water that had a good watershed feeding the pond even during dry summers and 2) we were looking to reduce the need to use groundwater resources. To insure the suction head on the inlet of the pump did not vary, the pump was mounted to a floating dock (Figure 2).

Since the water was coming from a pond, the water was pumped through a small media filter (Yardney Corporation) to remove sediment and algae. After the filter, the water was pumped to the drip irrigation system through 2 inch PVC pipe. In the orchard, two driplines was placed on either side of the pecan trees approximately six feet off of the base of the tree. Drip emitters (Bowsmith 2.0 GPH) were placed on the lateral lines around each tree. Each tree had six emitters.

Figure 2. Pump location on floating

The power was supplied to the pump by twelve Kyocera KC130TM photovoltaic modules. These panels are capable of producing a maximum of 130 watts, 17.6 volts, 7.39 amps and an output of 1500 watts. The panels were installed in series and parallel to produce 36 volts and 24 amps needed for the pump. The irrigation system was installed in August 2006 and the solar system was installed in November 2006. The total system was tested in December 2006 and started in the spring 2007 (Figure 3). Also as part of the building and installation, a sign was installed to provide some information on the project and source of funding (Appendix A).

Figure 3. Completed solar irrigation system. Mr. and Mrs. Lamar Smith and Gary L. Hawkins.

Operation of the Solar System:

The system as stated above was started in the spring 2007. The system in the 2007 growing season (April – October) was operated with a straight connection of the solar panels to the pump. This direct connection was controlled by a typical irrigation control system from the hours of 8 AM to 7 PM on a two hour on two hour off setting. This arrangement worked very well when the sun was not blocked by the clouds; however, when the clouds came between the solar panels and the sun the pump flow rates was greatly reduced. Through the continual movement of clouds between the sun and the panels, the pump had some increases in the amperage and therefore small arcs between the brushes and shaft.

During the second season, to alleviate the problems with the cloud cover, a set of batteries was installed to control the voltage and amperage. Along with this an Outback MX60 PV MPPT charge controller was also installed. The operation of the pump during the second and third season was then not interrupted by the occasional cloud cover. At the beginning of the third season, it was noticed that the pump was not performing correctly, so the shaft was retooled to remove the barbs caused by the arcing and the pump is operating as expected and stated in the literature.

In the winter of 2008, to try and get a little better water quality for the system, a horizontal well system was installed between the pond and control building. The well was installed to allow the soil between the pond and the well to filter the water prior to the irrigation system. The well was also installed to help the filter system work better. A horizontal well is installed below the watertable and stretches approximately 80 feet. The pipe was standard leachate pipe and the well was covered by gravel to provide a better filter.

To monitor the soil moisture, watermark sensors were installed around three trees to monitor soil moisture over time. The results indicated that the system was providing ample water to the trees. The data indicated that the soil potential during the growing season was maintained below 20 centibars. This did increase during the winter months, but the irrigation system was not operational and the soil moisture was solely due to winter rains.

Education and Outreach:

The Conservation Innovation Grant (CIG) Program is designed to demonstrate innovative use of technology on farm. Part of the CIG is also designed to disseminate information to other farmers. To accomplish the dissemination of information one Field Day was formally arranged and multiple additional field days and visits were arranged for various groups. To further disseminate information, various presentations have been conducted at local, state, national and international workshops and conferences.

Formal Field Day:

The formal field day was conducted on 29 May 2007. The field day was conducted from 9:30 to 12 noon. Topics covered during the field day consisted of system design, power source and specifications, use of solar on small farms, cost of system and benefits of such a system. The field day had 70 persons present. Associated with the field day, two newspaper articles were written in the regional newspapers. A copy of the flyer, agenda and newspaper articles are provided in Appendix A.

Various Field Days, visits and conversations:

In addition to the 29 May field day, multiple other field days and visits have been arranged. These have included:

1. A visit by the members of the Seven Rivers RC&D Council after a presentation by Gary Hawkins,
2. Visit by Representative Jack Kingston,
3. Visit by other CIG recipients in the initial stages of their projects,
4. Impromptu visits by persons driving by and seeing someone at the site, and
5. Various conversations on the phone by the project director and co-directors to discuss the project, operation and results of the project.

Presentations:

Presentations were presented at the following locations to disseminate information on the solar powered irrigation system:

1. 2007 American Society Agricultural and Biological Engineers International Meeting. Paper number 078025, "Demonstration of Solar Energy to Power Pecan Irrigation Systems" (40 persons). Minneapolis, MN
2. 2007 Georgia Chapter of Association of Natural Resources Extension Professionals, Poster "Demonstration of Solar Energy to Power Pecan Irrigation Systems" (30 persons)
3. 2007 Soil and Water Conservation Society International Meeting, Presentation "Utilizing Solar power as a Supplemental power Source for Small Irrigation Needs" (50 people), Tampa, Florida.
4. 2008 National Association of Natural Resources Extension Professionals, Poster "Solar Energy as an Alternative for Irrigating a Pecan Orchard"
5. 2008 SE Regional Fruit and Vegetable Conference, Presentation "Demonstration of Solar Energy to Power Pecan Irrigation System", (55 persons), Savannah, GA.

6. Presented at the Seven rivers RC&D Quarterly Meeting " demonstration of Solar Energy to Power Pecan Irrigation System" (45 persons)
7. Presentation at the 2008 Sunbelt Expo on the use of solar power for Irrigating Pecans.
8. 2009 Presentation to the Georgia State NRCS Technical Committee on Solar Irrigation CIG Project.
9. 2009 Presentation to the NRCS North Technology Workshop, Avalon, NJ. Invited October 2009

Copies of the first slide of presentations and posters can be seen in Appendix B.

Cost of System:

The cost analysis of the system as installed is shown below. The price of the system when installed in 2006 was $11,537. The prices have dropped a little since that time, but have only dropped 4% in 3 years. The irrigation system cost $5,647 and the building and dock to mount solar system and pump cost $4,855. Total cost of system was $22,039. The cost is specific to this location and will change depending on where you purchase the components of the system. A basic analysis of the system indicates a payback of 15 years or less. This is based on the cost of the initial system, initial electricity rates are constant for 30 years, line charges are constant for 30 years. These are basic assumptions and the price of electricity would be expected to change over time, but was not noted here. With these basic assumptions, the payback period of the system would be less than 15 years. The expected life of the system is 25-30 years. Therefore, the savings realized after the payback period would help pay for a replacement system after useful life of current system.

Benefits and Drawbacks:

The system as installed has both benefits and drawbacks as you would expect. For this installed system these include:

Benefits:

1. Uses an available water supply (pond). The installation of the horizontal well uses the water from the pond, but the soil between the pond and the horizontal well helps filter the water prior to introduction to the system,
2. The system installed here is small enough to place in remote areas, but still provides enough power to supply 35-40 gpm for an irrigation system, and
3. The use of a similar solar system will provide "free' electricity for 20-30 years.

Drawbacks:

1. A system, as installed, if placed within close proximity of an AC power source will not pay for itself within the useful life of the system unless you can get greater than 50% of the system paid,
2. There is a limit of the DC pumps available currently,

3. If the system is used without a battery bank, the potential of intermediate cloud cover can cause problems with the pump and pumping volumes,

Lessons Learned:

Some of the lessons learned from the installation of the solar system for irrigating an orchard are:

1. REMEMBER – Solar Panels are ACTIVE as soon as the sun hits the panel!!!!!!!!!!!,
2. The weight and size of solar panels should be accounted for when designing the support structure,
3. If a building is being used, then the roof line, if possible, should be designed to capture maximum solar radiation,
4. If using water from a pond system, the turbidity should be accounted for when designing filtration system,
5. As with any irrigation system, the head has to be accounted for when picking a pump and then a solar system,
6. When buying solar panels, it is best to keep the same size panels if at all possible. By doing this, voltages and amperage outputs will match and cause less problems,
7. To insure proper voltage and amperage for the pump, the panels need to be installed in proper series and parallel configuration to get desired output,
8. Have a battery system for small systems to buffer the amperage spikes from occasional cloud cover,
9. The maximum power from the solar panels will occur in the middle to early afternoon. The sun will be shinning in the early morning and late afternoon, but the maximum solar radiation will occur around noon, and
10. Check with insurance company to determine if system will be covered in case there is a lighting strike or other reasons that the system may get damaged..

I expect there are others, but these are the main lessons that we learned from the installation and operation of the system.

Other Locations and Conditions of Technology Application:

This technology should have very few places where it would not be appropriate to use. By that I mean, if there is a clear area from early morning to late afternoon then the solar system will produce power. However, some of the things that needs to be accounted for in such a system is the angle of the panels to the sun, the potential of shadows crossing the panels and the amount of radiation in the area of interest for installation. In areas where the solar radiation is low, then the panels will produce power, but they may not provide the rated power. On that same line, the number of solar day light hours is important in the amount of power that can be produced. The lower the number of solar daylight hours the lower the daily output of power.

In terms of limits on the irrigation system as described here, the only limits would be the head and flow rates from the pump. The solar panel array can be designed to provide the need watts. The pump however has a limit on the pressure head it can produce and the flow at various pressure heads. Therefore, the only limit with crops that can be watered, soils to be irrigated and number of different areas is again the number of solar daylight hours, the pressure head and the flow rate required.

Letter from Lamar:

The farmer involved in the project was Mr. Lamar Smith of Pierce County Georgia. His thoughts on the Solar Irrigation CIG project and his feelings on its usefulness are presented in Appendix D.

Conclusions:

Overall the installation of the solar system for pumping water to a pecan orchard for irrigation purposes was a success. The project participates initially set out to show that small scale solar systems could be used to pump water for irrigating a small pecan orchard. The system as installed (solar portion only) was $11,537. This cost is expected to drop a little, but not very fast. Other than the cloud cover causing an interruption and amperage spikes in the first year of operation (no battery bank) there has been no problem with operating the solar system. A few slight problems with the filters has occurred, mainly due to suspended solids, but the solar system has had no problems. Thoughts for future installations, make sure that when designing a system you account for the solar day light hours for your specific location, the amount output possible for your location and the requirements for the load. On the irrigation side of the system, use standard irrigation design practices and make sure you design for the needed pressure and volume. The cost of the system is a little high, but depending on the location and distance from power lines, the cost maybe less than expected and the system typically will have a 25-30 year life so account for that in deciding on the purchase of a system.

Appendix A

Materials for Field Days and Articles

THE UNIVERSITY OF GEORGIA
COOPERATIVE EXTENSION
Colleges of Agricultural and Environmental Sciences & Family and Consumer Sciences

NRCS Natural Resources Conservation Service

Utilizing Solar Power as a Supplemental Power Source for Small Irrigation Needs

A Conservation Innovation Project funded by
USDA- Natural Resource Conservation Service: CIG Program

Project Director: Dr. Gary L. Hawkins
Biological and Agricultural Engineering, University of Georgia

Cooperating Farmer: Mr. Lamar Smith

Cooperators:

- Agricultural Pollution Prevention Group at UGA
- Seven Rivers RC&D
- DNR – Pollution Prevention Assistance Division
- Satilla Rural Electric Membership Cooperative
- GA Soil and Water Conservation Commission
- Satilla Soil and Water Conservation District

Solar Powered Irrigation System

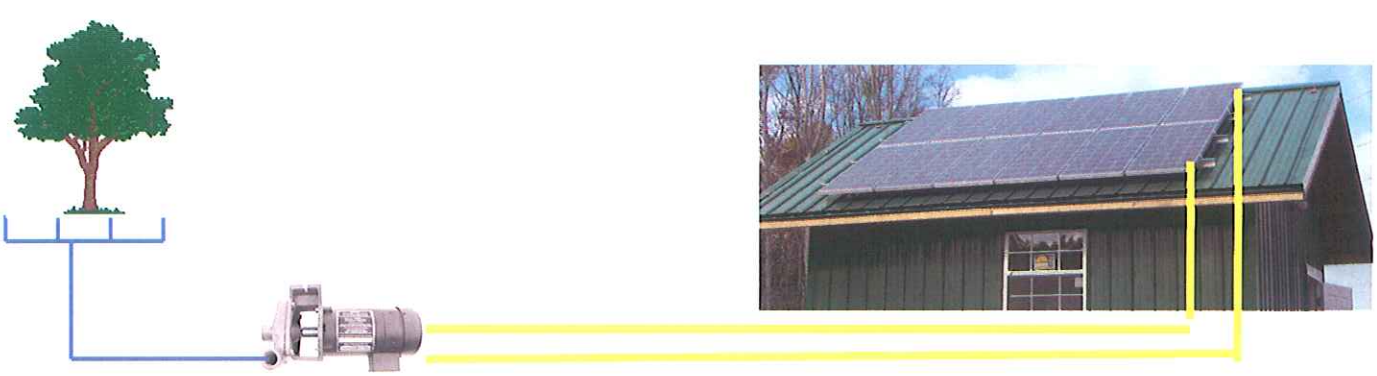
Field Day

29 May 2007

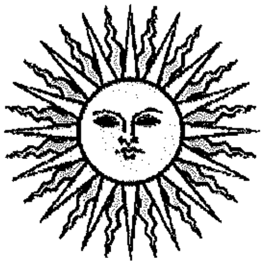
9:30-12:00

Agenda

9:00 – 9:45 AM	**Registration**	
9:45 – 9:55	**Welcome –**	**James Jacobs, Pierce County Extension Agent** **"Wink" Strickland, 7 Rivers RC&D Council** **Kenneth Bennett, Satilla River SWCD**
9:55 – 10:10	**CIG Program – What is it?**	**Dot Harris**
10:10 – 10:45	**System Components**	**Gary L. Hawkins**
10:45 – 11:00	**System Costs**	**John Ed Smith**
11:00 - 11:15	**What's Next?**	**Gary L. Hawkins**
11:15 – 11:25	**How can this system be used in other settings?**	**Kevin Peacock, Satilla REMC**
11:25 – 11:35	**Owners Viewpoints**	**Lamar Smith**
11:35 – 11:45	**Legislators/ Legislative Aides**	
12:00	**Lunch**	



Field Day flyer distributed prior to the May 29, 2007 field day.



Join us for a field day to debut a

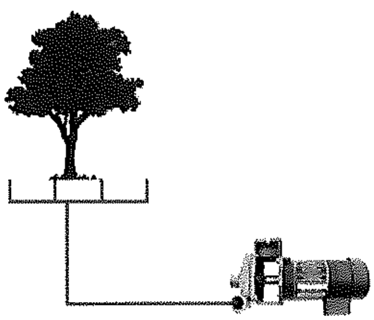
Solar Powered Irrigation System

for small farms.

Place: Lamar Smith Farm
Blackshear, GA
Time: 9:30 AM – 12:00
Date: 29 May 2007
Lunch: Pierce Co. Ag Center

Directions to Farm:
Hwy 203N (Blackshear Hwy)
Approx. 2 miles
Lamar Lane on Right
(Signs will be posted)

Please let
Pierce County Extension Agent (912-449-2034)
or NRCS office (912-449-5303)
know if you plan to attend.



Article written prior to Field Day of May 29, 2007

New solar technology to debut at local farm

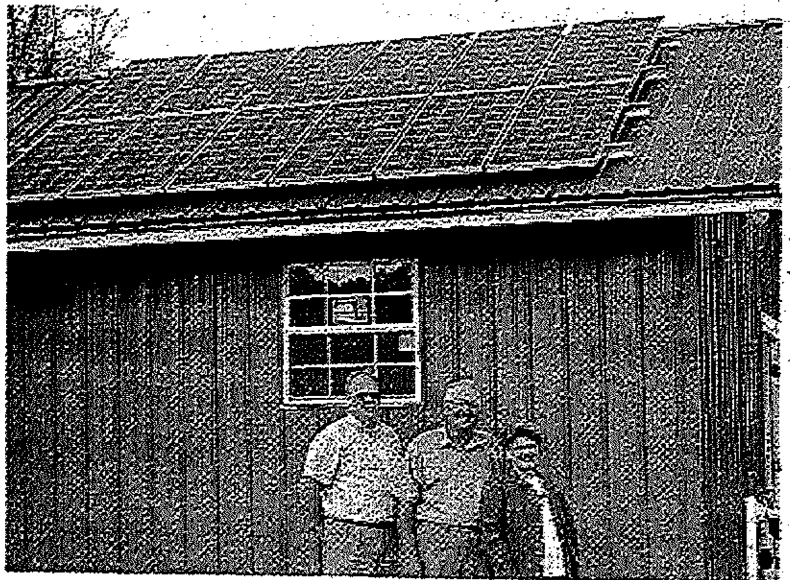
Pierce County will get the first look at a new wave of farming technology next Tuesday.

The first public presentation of a solar-powered irrigation system will be held here May 29 at the Lamar Smith farm.

"The purpose of the event is to debut the system, explain the cost of operating it, discuss its components and talk about how we see it being used now for small farms," says Dr. Gary Hawkins of the University of Georgia.

The system is expected to allow irrigation systems to be placed where no electrical outlets are available, according to Hawkins. He notes solar panels are becoming less costly as their production increases and could become more cost effective than running cords long distances to power sources.

The irrigation system uses 1,230-watt solar panels to power a small direct-current (DC) irrigation pump. The project is part of the Conservation Irrigation Grant (CIG) Program, Hawkins says.



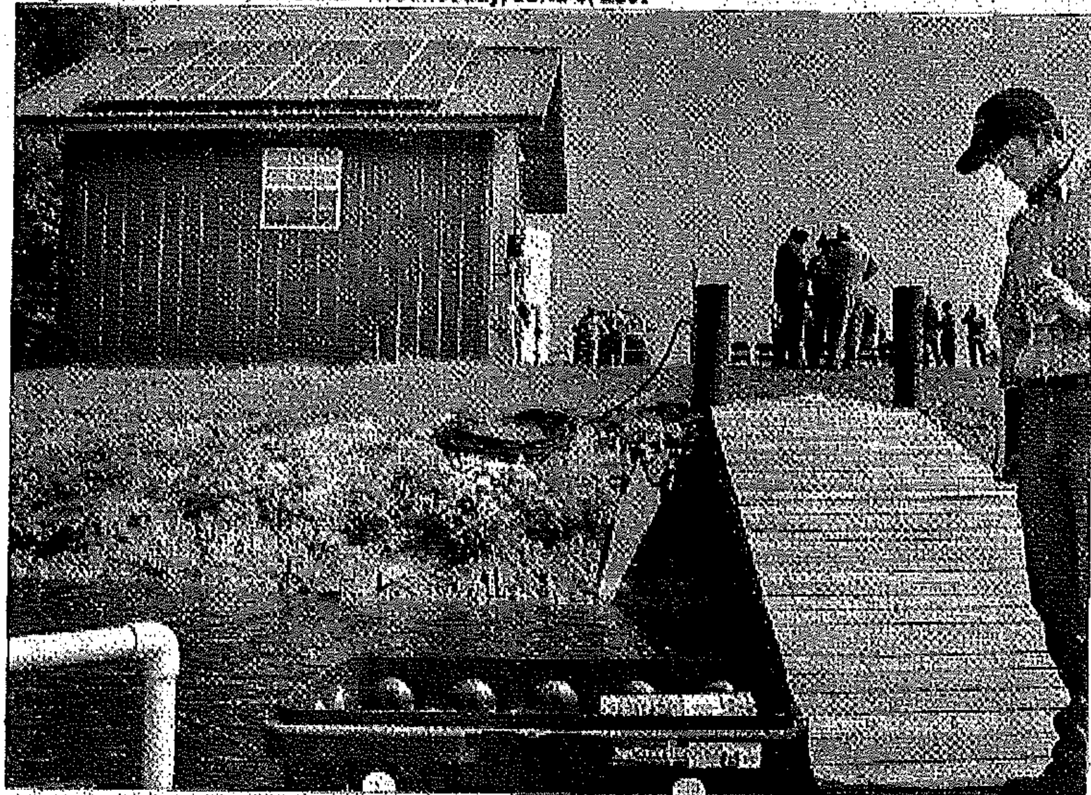
A new wave of agricultural technology will be on display in Blackshear next Tuesday. Dr. Gary Hawkins of the University of Georgia (left) stands with farm family Larry and JoAnne Smith in front of a solar-powered irrigation system.

Hawkins, from UGA's Department of Biological and Agricultural Engineering, will be among the presenters, which include Kevin Peacock of the Satilla REMC and Smith.

The event site is located off Highway 203 North. From Blackshear, take a right on Lamar Lane and go approximately two miles. The presentation is expected to last from 9:30-noon.

Lunch will be provided at the Pierce County Ag Center after the presentation. Anyone interested in attending should contact the county extension office at 449-2034.

Article written after the May 29, 2007 field day. 70 persons were on hand for field day.



Montgomery County extension agent Shane Curry examines an irrigation pump mounted to a floating dock. The pump is powered by solar panels on the building beside the pond. Curry was one of several dozen guests who got an early look at the new technology at a Pierce County farm.

Solar power potential for farms previewed by UGA researchers

Solar power potential for farms previewed by UGA researchers

By Wayne Hardy
Staff Writer

Farmers and ag officials from around the state got a glimpse into the future of irrigation technology last week in Blackshear.

A crowd of over 60 people gathered at a pond near the home of Lamar Smith, who has partnered with University of Georgia researchers to implement a solar-powered irrigation pump on his farm.

"We're in one of the best spots on the planet to do this," said Smith about our global position with the sun. "We're a nine on a scale of 1-10."

Researchers believe solar power could eventually provide a more efficient way of powering water pumps for crops and livestock. The system can also allow irrigation in areas once considered too far away to run electrical cords to a power source.

The research project is being funded by Smith and a Conservation Innovation Grant (CIG) from the USDA Natural Resources Conservation Service.

Smith says he wanted to use the solar-powered pump to irrigate about five acres without pulling power off an electrical grid.

"We've almost accomplished that," the farmer said. "They (solar panels) have far surpassed our expectations of producing energy."

The pump sits on a floating dock, which rises and falls with the water level for consistency. Pipelines connect the pump to irrigation valves located just over the nearby bank.

Valves are next to a shed-like unit housing power controls in its interior, and solar panels mounted on its roof at a 31-degree angle. The panels could also be mounted to a pole, as well.

Total costs for the project is $22,030. Solar components comprise half of that amount at $11,537. The price of irrigation parts is $5,647. Construction costs for the housing unit and dock are $4,855.

John Ed Smith, former county extension agent and current area agent for commercial blueberry production, said the solar-powered system is likely cost-prohibitive for most farmers today. There is a ray of sunshine, however, when it comes to solar panel prices.

"Even in the little time since these panels have been installed (here), the cost has come down," Smith said. "That's what we expect to happen over time."

The solar panels are made of polysilicon, which is also used to make semiconductors found in computer chips.

Smith added not all systems had to include a shelter like the one on display. He said a filtration unit will be necessary for drip irrigation systems, which apply water slowly to the roots of plants instead of spraying water from above.

The price to build the system on Lamar Smith's farm did not include establishing a water source, since it was placed next to an existing pond. Presenters noted drilling a well could increase the final total.

The solar-powered pump on the Blackshear farm generates 45 gallons of water per minute per suction head. The extension agent said even at 30 gallons per minute, one could water three acres of crops.

"These pumps will get bigger and better as technology improves," Smith said.

The up-and-coming technology has some catching up to do with more established power sources, however.

Smith said solar power costs anywhere from 30-60 cent per kilowatt hour, compared to the 8-12 cent rate of electricity generated from fossil fuels. Wind power, he said, costs about 18 cents per kilowatt hour.

"Is it feasible today? No. And it probably won't be feasible tomorrow, next week or maybe next year, but that's not why we're here," Smith said. "It certainly has potential to be and that's why they're doing the research now."

Studying the use and efficiency of solar-powered irrigation is the main purpose of the system's presence on the Smith farm.

Dr. Gary Hawkins, of UGA's Department of Biological and Agricultural Engineering, said the irrigation unit would be observed using two sources of power.

The system will initially run on traditional electrical power. After a designated period, it will be switched to a battery charged by solar energy. Researchers will be able to compare consumption and cost.

Also of interest to the group is the system's payback period: The time required for the system to repay for its initial cost.

Other than giving economists new figures to crunch, Hawkins notes the rest of the state, and federal agencies, will benefit from the research conducted here.

"After today's field day, we get down to research and look at the cost and payback period," Hawkins says. "We'll share this info with extension agents in other counties and also pass it along to Washington (D.C.)"

Article in Gulf Coast Cattleman Magazine October 2007

Sun, Wind Help Pump Water to Cattle

by Brad Haire

Cattle sometimes go to streams and rivers to drink because there is no other place they can get water. But they can pollute that water downstream. A University of Georgia (UGA) expert is setting up sites near Georgia's coast to show cattlemen how to use wind and sun to take the water to the cattle.

Using solar panels and wind turbines to produce electrical power is nothing new, said Gary Hawkins, a water specialist with the UGA College of Agricultural and Environmental Sciences. But using them to power water pumps in Georgia is. They are more common in the Midwest and western United States.

"The goal of this project is to provide cattlemen who are already involved with other conservation and grazing management programs a sustainable alternative for getting their cattle the water they need," Hawkins said.

Five farms will be picked this fall to participate in the three-year project. The Natural Resources Conservation Service Conservation Innovation Grants Program will pay for it.

The project is a collaboration with the Seven Rivers and the Coastal Georgia Resource Conservation and Development Inc. The systems will be installed and running by spring.

The water pumps will be powered by a hybrid system, one that uses both wind and solar energy, said Hawkins, the project's coordinator.

Georgia isn't considered a windy state. But the wind blows consistently along the coast during cooler months when days are shorter. The wind dies off in the summer when the days are longer.

The hybrid system will use wind turbines for power in cooler months and the solar panels in summer. Both sources are enough to provide power to pump as much as 3,000 gallons a day. This is enough water to easily sustain a herd of up to 150 head of cattle.

The cattlemen get the power systems free but must agree to take data and open their farms for field days so others can learn about the technology, too, he said.

Traditionally, cattlemen have used electricity or diesel to fuel pumps. Diesel prices have more than doubled in the past five years to more than $2 a gallon. In some remote pastures, electricity is not available. It costs between $2.50 per foot and $3 per foot to install electrical line, depending on the location and company.

But the biggest limiting factor for the hybrid system technology is the price, he said. It varies depending on the configuration needed. The systems in this project cost about $12,000. But solar panels and wind turbine prices are coming down.

Hawkins will study the economic benefit of the hybrid system, too. Considering current prices for electricity and diesel, a hybrid system may pay for itself in a decade. Instructional publications will be created for other cattlemen to use to build similar systems on their farms.

Hawkins set up a solar powered irrigation system on a farm in Pierce County two years ago to see if it could pump water adequately from a holding pond to a five-acre pecan orchard. It worked. The farmer was pleased, he said. Seventy people came to a field day on the farm to learn more about that system earlier this year.

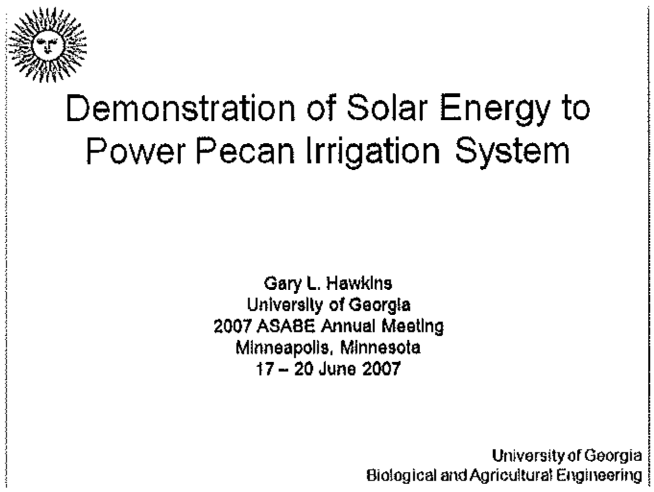
STAMPEDE By Jerry Palen

"And then I thought, what would be more romantic than a jug of perfume for your birthday?"

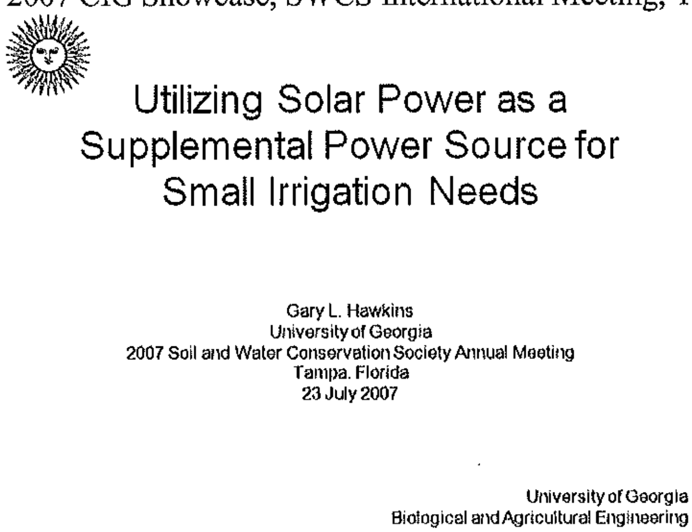
Appendix B

Posters and First Slides of Presentations

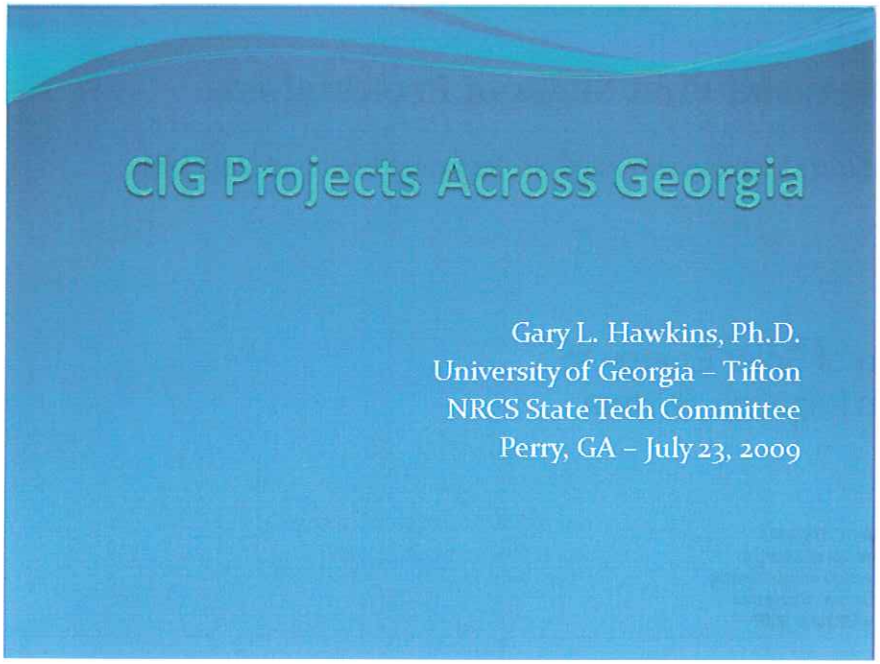
2007 ASABE International Meeting and 2008 SE Regional Fruit and Vegetable Conference



2007 CIG Showcase, SWCS International Meeting, Tampa FL



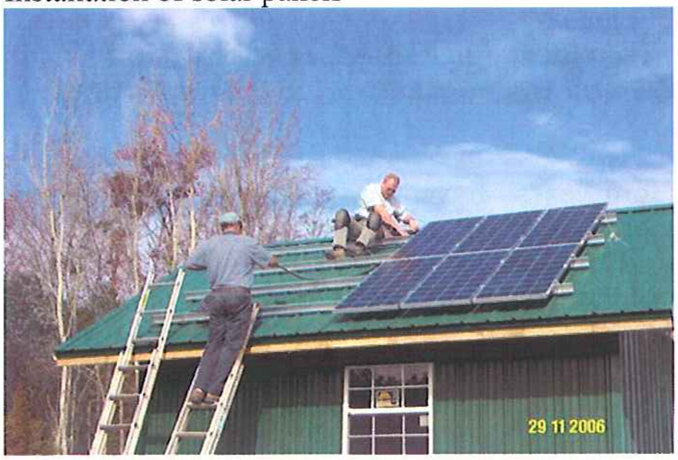
2009 Georgia NRCS State Technical Meeting



Appendix C

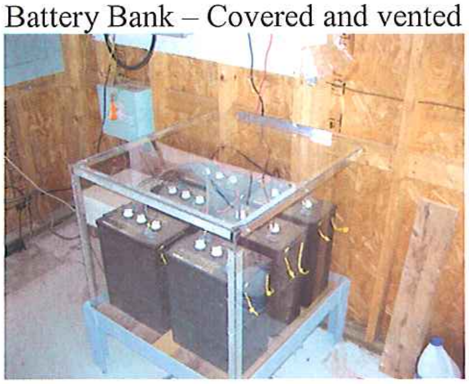
Candid Shots of Different Aspects of Solar Irrigation Project

Installation of solar panels



Field Day conducted 29 May 2007

Battery Bank – Covered and vented



Appendix D

Letter from Mr. Lamar Smith

September 15, 2009

To all interested parties concerning the scope and effect of the solar powered irrigation system installed on my Pecan Farm in Pierce County Georgia.

Over the course of almost the last four years I have been privileged to be able to work with primarily the University of Georgia's Biological Agricultural Engineering Department. Dr. Gary Hawkins (Project director) has worked long and hard to bring my primarily dry land pecan farming into a well irrigated orchard. The numerous UGA staff that worked on the project were as I would say "the cream of the crop" as far as a group of people applying new irrigation technology to a real life situation.

As we near the end of the project I now watch the pecan trees blossom and grow due to the solar power pumping system giving 24000 gallons of pond water a day. During the construction of the project I watched partnerships blossom and grow. UGA, Federal Agencies, State Agencies, Resource Conservation and Development Councils as well as private companies all came together with the help of a good mediator like Dr. Hawkins. Everyone had good and sometimes not so good ideas. I valued both ideas because both types of ideas were showing us what would and eventually did work best.

Reality for me was the fact that I planned to have irrigation water. Most likely I would have just dug a deep well and irrigated from there like most farmers are doing now a days. The Conservation Incentive Grant made it possible to show how we could irrigate with surface water with no negative impact to the environment.

Over the last six months of the growing season I would be willing to say I have spent maybe an hour doing routine maintenance. It starts in the morning by itself, cleans the lines itself and it quits running by itself at night. I can visually see if the water is pumping without even slowing down the truck or getting out to check the system. Best of all there are no power bills in the mailbox at the end of every month for the electricity usage. We kept trouble shooting glitches early in the project to make it run as reliable as it does. I hope this work helps other farmers reach their irrigating needs.

The project has been a total success.

From the Smith family
and Myself, Lamar Smith
THANKS TO ALL.