**Title:** Horizontal Wells for Irrigation Supply for Blueberries

**Progress Report**

**Grant Code:** SRSFC Project # 2006-13

**Research Proposal**

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**Objectives**

The objectives of this research project are:

1. Research the potential use of horizontal wells as a water supply system for irrigating blueberries in the Coastal Region of Georgia, and
2. Research the potential of using horizontal wells as an alternative water supply system for blueberries that does not contribute to salt water intrusion.

**Justification**

The problem to be addressed in this project is the limited irrigation water availability resulting from the limited number of deep well permits being issued in the 24 county coastal region of Georgia. This research project will work with farmers and others on a technology for collecting irrigation water for use in the production of crops, specifically blueberries, in the coastal regions of Georgia. Additionally a part of the project will be to research and educate farmers and interested parties on the potential of recycling valuable nutrients used in fruit production. In the coastal region of Georgia and other states, production of agricultural products is limited in some part by the availability of water resources. The Coastal Region of Georgia and neighboring states set on the Upper Floridian Aquifer System, which is a deep and productive aquifer system. However, due to over pumping, salt water has begun to intrude into potable regions of the Upper Floridian Aquifer System being used by citizens along the coast. This intrusion of salt water has forced the Georgia Environmental Protection Division (EPD) of the Department of Natural Resources (DNR) to cap the amount of water removed from the Upper Floridian Aquifer System in the 24 county area of coastal Georgia; thereby, limiting the number of vertical wells that can be drilled. If the amount of water that can be removed from the aquifer is restricted, then the potential for agricultural growth and sustainability is also restricted. With the restriction of groundwater wells, there needs to be alternative technologies by which farmers in the coastal region of Georgia can get water for sustainable production of blueberries and other food and fiber crops. There is the potential to build ponds in this region of Georgia; however, the geology of the region limits the locations and use of ponds due to the underlying sands and required need for sealing materials to be imported.

Horizontal wells were originally developed as far back as the late 1920's to 1930's for the removal of water from landslide prone areas in California and the extraction of oil from selected strata (Society of Petroleum Engineers, 2004; Welchert and Freeman, 1973). Typical applications for the use of horizontal wells includes exploitation of thin oil-rim reservoirs, avoidance of drawdown-related problems such as water/gas coning in the oil industry (Society of Petroleum Engineers, 2004), environmental remediation, water management (Park and Zhan, 2003) and the tapping of water bearing strata in rangeland areas of the arid west (Welchert and Freeman, 1973). This research and education project will adapt and use the advantages of horizontal wells to collect surficial aquifer water for the use in irrigating blueberries in two of the coastal counties in Georgia.

Horizontal wells would be an alternative water supply method in the 24 county Coastal Region of Georgia where the permitting of vertical well and the geological uncertainty of constructing irrigation ponds is restrictive. The horizontal well would

also be an alternative water supply that would tap the surficial aquifer system that would not contribute to the salt water intrusion problems associated with over pumping the Upper Floridian Aquifer System. Additionally the use of horizontal wells would allow the farmer to potentially recycle nutrients in blueberry production systems.

This research and education project will use the horizontal well on blueberry farms in Brantley and Ware counties Georgia. With the restriction on vertical well development this project is proposing to research the potential of using horizontal wells to supply required and needed irrigation water to blueberry operations.

The use of horizontal wells has a couple of advantages that apply to this region of Georgia and the United States. These include: 1) horizontal wells are priced comparably with vertical wells, 2) irrigation water can be obtained from surficial aquifers that will not contribute to salt water intrusion, 3) They should not fall under the restriction of well permitting, 4) they allow recycling of nutrients, 5) surficial water would be better for blueberry production, and 6) energy costs are reduced.

Typical costs of horizontal wells are $25-30 per linear foot as compared to $ 20-25 per linear foot for vertical wells (Middleton Drilling Company, personal contact, 2005)Even at a seemingly more expensive well system, the horizontal wells can be useful and should pay for themselves in increased production. This is especially true if the farming operation is restricted on irrigation water or is not allowed to drill a well for irrigation water. The restriction of vertical well permits in the 24 county coastal region of Georgia could prevent the development of a water supply wells for crop production, thereby making the wells affordable. The ability to get irrigation water from a surficial aquifer in the Coastal Region of Georgia would allow a permit to be issued, if required, also it would allow a farmer to produce a crop in a region suitable for the production of blueberries and like crops. The collection of irrigation water from surficial aquifers will also prevent the farming operation from contributing to the problem of salt water intrusion in to the Upper Floridian Aquifer System.

The horizontal well will also allow the farming operation to capture and recycle nutrients thereby reducing the costs associated with the purchase of nutrients to replace ones that have leached past the root zone. The use of horizontal wells will also reduce energy costs of operating the water supply system though a reduced horsepower pump. Horizontal wells are placed typically at 20-30 feet below ground surface verses hundreds of feet below ground surface for deep-vertical wells. This water available in surficial aquifer systems, especially under current blueberry operations will have a pH that is closer to that required for improved production of blueberries. Water collected from deep wells may have high bicarbonate concentrations which has adverse affects on blueberry production. These are increased pH reduces the availability of iron (Fe) and zinc (Zn) for plant uptake, it increases the pH of the soil thereby reducing the health of the plant since blueberries like an acidic soil. The presence of bicarbonates in the irrigation water also affects the root system of the plant and leaves a residue on the leaves. All of these effects of high bicarbonate in irrigation water reduces the productivity of the plant and likewise the sustainability of the farming operation. The last benefit of the horizontal well is

that the distance from the surface to the well is small so a smaller horsepower pump is required and an associated smaller requirement for energy.

The benefits listed and described above have substantial relevance to making a farm using a horizontal well system sustainable. The benefits associated with the horizontal well itself contribute to sustainability, but the ability to get water for production will add to sustainability. Additionally, the use of such a water supply system will not adversely affect other aspects of making the farming operation sustainable. Matter fact, it may make the farming operation more sustainable by reducing nutrient costs associated with production of a crop.

**Methodologies**

Horizontal wells will be used in this research project to meet the conditions of the first objective listed above, by adapting the technology of the oil industry to provide a reliable water supply. The length of the horizontal well is practically unlimited and is only limited by the property lines of the farm. This however can be increased by installing multiple and lateral lines if required. The installation of horizontal wells will draw water from a geological layer that is typically homogenous and has similar flow patterns thereby reducing the drawdown problems associated with vertical wells. The installation of horizontal wells under farming operations will also allow the recycling and reuse of otherwise loss nutrients. This recovery of nutrients has a two-fold benefit, first the cost of purchasing nutrients will be reduced and the potential of polluting nearby streams will be reduced.

The second objective will be met by the use of horizontal wells by not contributing to the drawdown effects of vertical wells in deep aquifer systems. This system of wells for water supply uses surficial aquifer systems and never comes in contact with the aquifer systems connected to the areas of the Floridian Aquifer System directly impacted by the salt water intrusion issues. To demonstrate this aspect of the horizontal well, potentiometers may be installed to demonstrate that the drawdown of the aquifer system is not a problem as is with the vertical well systems.

**Results**

To Date the following activities have been completed on the project:

1. There has been 1 paper written on the idea of using horizontal wells for in irrigation source for blueberries. This was presented at the 2006 North American Blueberry and Extension Workers Conference.
2. A visit was made to the University of Florida Cooperative Extension Service to discuss and visit with farmers to inquire about their experiences with horizontal wells and potential installers.
3. Poster presented at the 2006 Annual Meeting of the Georgia County Agricultural Agents (GACAA)
4. There was a poster presented at the 2007 Southeast Fruit and Vegetable Conference
5. Five pieziometers have been installed to monitor the level of the groundwater during a “wet” and “dry” period. The lowest level of the water was found to be at an average level of 120 inches (305 cm) below the surface and a high water table of an average of 31 inches (80 cm)

below the ground surface. The lowest level was measured in the last quarter of 2006 and the highest level was measured in the first quarter of 2008.

6. Based on the information in #2 and 4 listed above, a horizontal well installer was contacted (after determining the high water table level) to provide use with an estimate and feasibility of installing a horizontal well for use in blueberry production. Even though the water table elevation was approximately 31 inches (80 cm) below the ground surface, the soil structure at 12-15 feet (3.5 – 4.6 meters) (as determined by the horizontal well installer) was unfit for using a horizontal well system. The installer said he could install the system, but would estimate that the well would be clogged within one growing season.
7. Bob Boland and Gary Hawkins then decided not to install the well and will work to find another and better suited site for installing such a system. This decision was made for the main purpose of trying to find a possible site and mainly not wasting the money received from the Small Fruit Consortium on a project that maybe only good for one year.

**Conclusions**

The conclusions derived from the piezieometer data is that the water table in the selected field is ample to provide the water needed to conduct the research. The high water table of approximately 31 inches (80 cm) below ground surface would provide in wet times a good driving head to fill the well and allow for pumping onto a blueberry crop. The low water table elevations (10 feet, 3.05 meters) would also provide ample water (typical trenching depth is 18 feet (5.5 meters) for the irrigation of blueberries, but would not have the driving head as available at a higher water table elevation.

Based on the information from the pieiometers there was a good water table elevation that would allow the installation of a horizontal well to be used for pumping irrigation water to blueberries. A few test pits were dug with a backhoe down to 14 feet (4.3 meters). Water was present at this level, but the soil structure at the lowest point of the trench was of a consistency that, in the opinion of the installer, would clog the horizontal well within the first year of usage. The decision was made by the investigators to not spend the grant funds on a project that would provide only a very short term solution for irrigation water.

**Impact Statement**

No impact statement has been drafted since no well has been installed to date.

**Citation(s) for any publications arising from the project**

1. Hawkins, G.L., B. Boland, J. Jacobs, G. Krewer. 2006. Horizontal wells: What are they, How do they work and How would they benefit us? Proceedings of the 10th annual North American Blueberry Research and Extension Workers Conference held at the University of Georgia Conference Center, Tifton Ga, June 4-8, 2006, D. S. NeSmith, ed.

2. Jacobs, J.L.; Hawkins, G.L.; Krewer, G.W.; Boland, R.T. Horizontal Wells: What are they, How do they work and How would they benefit us?. Poster displayed at the 2006 GACAA Annual Meeting. Held Nov 14-16, 2006 in Albany, GA.
3. Horizontal Wells: What are they, How do they work and How would they benefit us? Poster and Abstract at the 2007 Southeast Regional Fruit and Vegetable conference, Savannah, GA 6 Jan 2007