AG. WATER PUMPING: A NEW PROGRAM TO EVALUATE AGRICULTURAL WATER USE IN GEORGIA

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ABSTRACT. This paper presents the concepts and preliminary approaches for a combined monitoring and modeling program to estimate agricultural water use across the entire state of Georgia. This program is called AG. WATER PUMPING (**A**gricultural **Water**: **P**otential **U**se and **M**anagement **P**rogram **in G**eorgia). Current conflicts on water allocation in the ACT (Alabama, Coosa, and Talapoosa) and ACF (Apalachicola, Flint, and Chattahoochee) river basins, saltwater intrusion effects in the 24 county area of southeast Georgia and other potential impacts on water use are all limited by the lack of available information on agricultural water use. This 5-year project is designed to develop a system to provide essential data for current and future water issues.

INTRODUCTION

Water use and management in Georgia is the responsibility of the Georgia Department of Natural Resources (DNR) based on the state of Georgia's "ownership" of water's within state boundaries (Kundell and Tetens, 1998; Carriker, 1985). To meet competitive needs of industries, municipalities, recreation, transportation, agriculture, etc., an understanding of how much water is being used is essential. Unlike DNR permitted industrial and municipal withdrawals, permitted agricultural withdrawals are not required to report quantities of water used. Therefore, understanding the magnitude of agricultural withdrawals and planning for future water needs is difficult.

Water allocation formulas for the ACT and ACF river basins were scheduled to be completed by December of 1998. These formulas would be designed to meet the current and future needs of the states (Florida, Alabama and Georgia) associated with the basins in a comprehensive plan. The resulting allocation is anticipated to require an equivalent level of sacrifice for all users based on a logical system of priorities. Agriculture is one of the largest users of water in the ACF basin. The combination of surface and ground water withdrawals (especially in the Lower Flint basin where ground water impacts river flows) create a need for comprehensive information on irrigation water use. Unfortunately, agricultural water use is not well documented, therefore, determination of actual water use across the basins suffers from the lack of information. Crop irrigation is also a consumptive use since water is taken up by plants and transpired into the atmosphere. Water is not reintroduced to surface resources after use as it is with most municipal and many industrial withdrawals.

While equitable distribution of water in shared river basins is a challenge to western and northern Georgia, salt water intrusion threatens ground water along the southeastern Georgia coast. The increased ground water withdrawal in recent years has created concerns about cones of depression and salt water affecting ground water supplies. The current moratorium on new ground water permits, increased monitoring of the salt water/fresh water interface, and required water management plans from the 24 coastal counties have been instituted to better understand the intrusion problem. Unfortunately, the effect of agricultural irrigation on salt water intrusion is also poorly documented.

Other water management issues are expected to surface and be a concern in the near future. As populations increase, rainfall continues to be variable, and water quality concerns increase, the need for better management of this limited resource becomes more important.

This paper describes a five year program for agricultural irrigation water use determination for the entire state of Georgia. Effective understanding and estimation of agricultural water use requires a combination of monitoring and modeling. A monitoring program must provide reliable, representative agricultural water use values over the entire irrigated region. Representation will include the types of irrigation systems, commodities, soils, local climatic variations, and management. Irrigation manager participation and interaction during the monitoring program is critical to their water use patterns. The model component is crucial considering the lack of economic resources to directly measure water use from over 19,000 permitted agricultural water users (Figure 1). The model approach also allows the creation of alternative management and critical climatic scenarios in a

Decision Support System (DSS) format which can be used to predict future withdrawals. A GIS-based DSS can aid planners in visualizing, understanding, and explaining water use patterns in Georgia. The projected withdrawals are essential input for basin-wide ground and surface water models which are needed for statewide and regional water use planning.

While water is used by our important animal-based agricultural operations, the consumption is minor compared to irrigation use. A monitoring effort for animal uses is not warranted, at this time.

PROCEDURES

The level of anticipated effort and the climatic variations expected over time indicate at least a five year period to fully develop and implement this program.

Monitoring Program

A comprehensive monitoring program is proposed to obtain reliable agricultural water use values. From over 19,000 current agricultural permits, a representative sample (at least 2 % or 400) are to be monitored. These systems will be representative on a county-basis in a similar proportion to the surface and ground water permits and crop-type from that region. The statistical representation of the permits will be primarily on a county basis, but some flexibility in the actual systems monitored is anticipated to ensure representation of irrigation withdrawals across the region.

The primary considerations for the installed monitoring systems will be reliability, environmental resilience, and reasonable cost. The large number of center-pivot irrigation systems in Georgia (Harrison and Tyson, 1999) will allow timer systems to be directly installed on the pivot. Approximately 89% of the center pivots in operation are estimated to have reliable hour meters already installed. An estimated 25 systems will require a new hour meter. Appropriate hour meter systems will be installed on the estimated 70+ drip irrigation, well-to-pond, and other electrical and non-electrical (diesel, etc.) systems expected to be instrumented.

All irrigation withdrawals will be monitored based on field area and rate of withdrawal. Portable flowmeters (electronic doppler-type) will be used to determine rates of withdrawal by three to four different teams during the installation of sites. The combination of field area, time of system operation and flowrate will determine withdrawal amounts in depth units (inches/mm) and volume rate of flow (mgd).

Monitoring of each irrigation withdrawal will be performed on a monthly basis by personnel funded by this program. The potential to obtain reliable, consistent, water use data from an entirely volunteer program is not considered dependable. Monitored data will include hours of operation, commodity, irrigated area, and rainfall. The need to obtain reliable and consistent field data while having personnel capable of checking and fixing equipment on a timely basis is essential.

Automated monitoring sites will be installed at about ten very remote locations. Automated monitoring can reduce the long-term cost of personnel required in a monitoring program. Several micro-logger based data aquisition alternatives will be investigated which may include phone access (line or cell) or short haul modem with a radio link (depending on site conditions).

GIS Development and Application

A state-wide Geographic Information System (GIS) will be used for cataloging data and irrigation system locations within counties. The GIS will be used for coordination of inputs and reporting of the data on county, regional, aquifer, monthly, and annual bases.

In addition to the withdrawal permit information that will be collected, agricultural and environmental information pertinent to the water use study from other existing and new sources will be gathered and geographically referenced. The Georgia Environmental Monitoring Network (Hoogenboom, 1997) will provide regional values for rainfall, temperature, relative humidity, wind and solar radiation during the time of irrigation monitoring. This continuous data resource will allow linkage of weather conditions with water withdrawal. The Georgia Agricultural Statistics Service is anticipated to provide more detailed information on actual crops grown under irrigation for particular soil types, planting dates, and production information for the non-monitored areas of the counties. This information will be referenced by county, sub-basin, and aquifer so that irrigation use can be extrapolated.

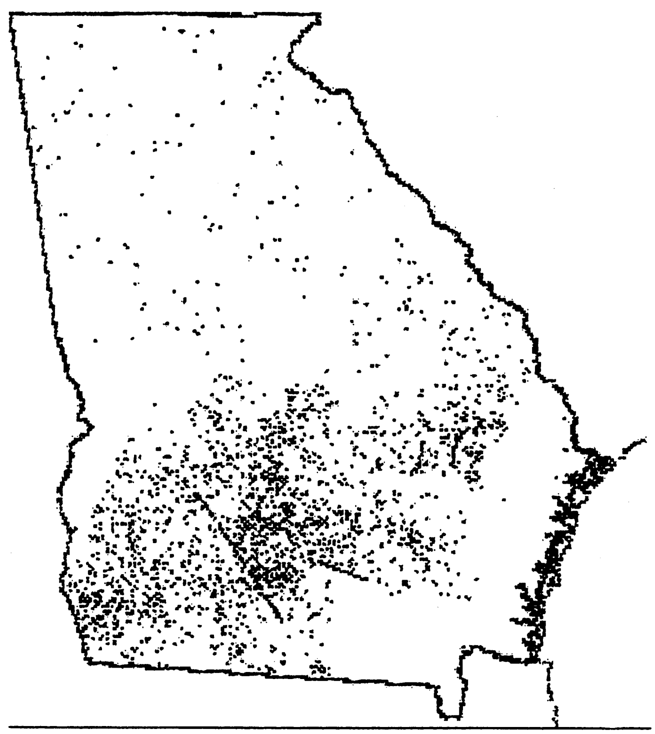

Figure 1. Representative locations of agricultural withdrawal permits in Georgia through 1993.

Model Development

Model use is essential for interpolating between monitored sites and to enable projections of future conditions. Since only about 2% of the permits are anticipated for the monitoring program, extrapolation must be used over the remaining 98% to provide statewide coverage of irrigation water use. Models will be linked to the GIS data bases and maps to fill in the gaps.

Because each monitored growing season is unique in water demand and because selected sites reflect management preferences of individuals, modeling projections alone are not representative of actual water use. They also are less flexible in anticipating changes in crop management improvements due to site or market conditions. The values from measured sites will be used to verify performance of the existing crop water use models. Models of many of the irrigated commodities, including corn, soybean, and peanut have already been adapted and tested for Georgia conditions. Additional models will be adapted and tested for cotton, vegetables, orchard crops and turf to include these irrigated commodities into accurate predictions of water use and economic impacts.

In addition to extrapolation over current and earlier years for water use, models will be used to probe the future. Scenarios will be presented for predicting water withdrawals under the severe but realistic drought conditions that have occurred in Georgia in past years, with limitations defined by the maximum permitted withdrawals. Growth in irrigated crop acreage will next be anticipated in projections. Potential benefits and/or reductions in water use by improved irrigation scheduling alternatives or other water conservation methods (Thomas et al., 1998) will also be evaluated. A primary output value will be the economic impacts of water use. The additional revenue from higher yielding crops as a result of irrigation will be estimated.

CONCLUSIONS

The system developed to calculate and determine agricultural water use is expected to require five years for complete implementation of monitoring sites and development of the models and GIS components. Once developed, this system is anticipated to be available for continued operation beyond the original development period and beyond the boundaries of the state. The ability to provide an accurate estimate of agricultural water use both now and into the future will be essential to optimum management of available water resources.

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