STATUS OF AG. WATER PUMPING: A PROGRAM TO DETERMINE AGRICULTURAL WATER USE IN GEORGIA

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Abstract. This paper presents the current status of a combined monitoring and modeling program to estimate agricultural water use across the entire state of Georgia. This program is called AG. WATER PUMPING (Agricultural Water: Potential Use and Management Program in Georgia). 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 at the mid-point in its development and is expected to provide comprehensive data starting in 2001. Preliminary results are presented for the partial monitoring installation in calendar year 2000.

INTRODUCTION

Water use and management in Georgia is one of the most critical issues being faced in present times. Allocation formulas for distribution of waters within the ACT and ACF basins between Alabama, Florida and Georgia that have not been finalized, salt water intrusion along the coast, and water quality concerns throughout the state (TMDL’s) are all exacerbated by three years of continuous drought conditions. All of these issues are under close scrutiny, but cannot be covered with close finality because water use by agriculture remains a “determination”. Since agricultural water users are not required to report their water use, programs such as Ag. Water Pumping must be employed to provide a “best estimate” of agricultural water use.

The Ag. Water Pumping program is currently at the mid-point in its original five year reign. Basically, the program was designed to determine agricultural water use from irrigation for the entire state. A combination of monitoring and modeling is being used to determine the water use. This paper is designed to illustrate the distribution and preliminary results of the monitoring program. The first full year of monitoring from all sites will be during the 2001 calendar year. The modeling program is still in development stages. Details about how the modeling approach will seek to integrate the monitored data over the entire region are still not finalized.

The primary concern associated with monitoring is to represent “what the farmers are actually doing”. The monitoring program used a random selection of all permits and was designed to provide an “average” indication of how much water is being withdrawn for crop production. The monitoring program also includes responses due to localized weather, especially rainfall. If farmer A benefitted from a localized shower and did not irrigate, farmer B just down the road may not have received that rainfall and thus irrigated.

It is important to remember that the monitored irrigation results may not directly relate to how much water the crop actually “needs”. The wide variety of irrigation scheduling approaches being used (all the way to “none”), water resource availability (especially surface ponds), and economic decisions (will it pay for me to actually irrigate more considering the price of current commodities?) all affect the amount of water used by an individual farmer.

PROCEDURES

Monitoring Program

A monitoring program was implemented in 1998 to provide at least a 2% sample of the 19,000+ agricultural withdrawal permits across the state of Georgia (Fig. 1). At this time, over 20,000 permitted withdrawals are present in the state, and the sampling program was enhanced to ensure the 2% goal. The statistical-based selection process included representation of ground and surface water withdrawals and crop type. All selections were oriented toward a county being the smallest unit of sampling. Under that scenario, if a county had less than 50 agricultural withdrawal permits, none would be selected for monitoring. To allow all permits access to potential monitoring, all counties with less than 50 permits were lumped into a single group. Two percent of that group was then selected for monitoring. This process
provides equal opportunity for monitoring, but does not address "regional representation". In some cases, additional site selection was used to ensure that at least one monitoring site was included in the North Georgia regions.

In selecting sites for potential monitoring, an ordered statistical sample representing at least 6% of the total permits was developed. This procedure was used since the overall program was voluntary, and designated participants had the right to refuse to participate. In some cases, monitoring sites were not used due to other circumstances including: the permit was no longer being used, the complex nature of the irrigation water delivery did not allow for monitoring of actual water use on a particular area, or the irrigation system literally could not be monitored with any degree of accuracy.

For example, a farmer has a cable tow irrigation system that he uses in more than one field. Each of the fields are different in size. There is no good location to mount monitoring instrumentation (such as a timer), and the farmer can provide water to the cable tow unit from a pond or a well. The difficulty in assigning water use to a particular source and a particular area while having immense problems in monitoring would likely deny this site for the program.

In the final statistical analysis, over 67% of the permit holders that were contacted agreed to participate. This high percentage of participation is an indication that voluntary programs can be very effective. In only six counties was there a modification made to the original list of selected permits. In one county, the statistical randomization was regenerated. In most cases, the small number of available withdrawal permits for that county did not produce a volunteer from the original list.

One characteristic of interest in the overall selection process is the potentially large percentage of permits within the agricultural withdrawal permit database that are no longer being used. In some cases, wells have been drilled to supplement surface resources, and gradually those surface resources have been eliminated due to convenience or lack of reliability. Since most agricultural withdrawal permits were issued "in perpetuity", there is no consistent procedure in place to allow permits to be "given back" if they are no longer being used. Therefore, that water continues to be accounted for when future permit requests are received.

Representation by crop has been a concern throughout the monitoring program installation. Most field crops such as cotton, peanut, corn, soybean are relatively well represented. However, crops such as sod production, pecan, onion, and watermelon are being more closely scrutinized. Some additional sites are being implemented to ensure at least a 2% sample for these major crops. It was determined during the installation that representation of all crops would be difficult (if not impossible). For most field crops, a rotation system is used which places different crops in a field in different years (or seasons). The small land areas associated with many vegetables and a monitoring program tied to an irrigation system (not a crop) would logically miss selected crops in some areas each year. The modeling program is anticipated to help overcome the inadequacies of the small sample size in the monitoring program. However, in many cases, the representation of a particular vegetable/truck crop may not be obtained in any one year. It was decided by the team that most vegetable/truck crop results would be lumped into a category called "mixed" vegetables (truck crops). Only those truck crops with significant land areas (such as watermelon and onion) would be represented individually.

One change which has occurred in the monitoring program since its original development, is the use of state-change data loggers which were not available when this project began. HOBO1 state loggers are being installed on many of the irrigation monitoring sites to provide more accurate information on water use. These state loggers are being used in combination with a pressure switch to allow logging of on- and off-times based on system water pressure. This type monitoring is expected to greatly reduce the problems associated with "dry walking" of center pivots and will help

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1The use of tradenames, etc. in this publication does not imply endorsement of the product named, nor criticism of similar products not mentioned.
in monitoring traveler-type irrigation systems. In normal field operations, center pivots may be moved to allow for field operations without pumping water. A basic timer tied to the electrical operating system assumes water is being pumped. Without a distinct record of when the irrigation system was moved, assumptions must be made to account for potential dry-walking of the system.

The current monitoring program has 407 permitted irrigation withdrawals that are being monitored. The county-based representation of the monitoring is indicated in figure 2. Actual monitoring is being done on 580 individual field sites and 44 other sites where water is being pumped from a well or other source into a pond (called a well-to-pond). The reason for the larger number of actual monitoring sites is that more than one irrigation system may be associated with a particular withdrawal. The total land area being monitored is at least 15,500 ha (38,330 ac). This represents about a 2.0% sample of the agricultural irrigation land based on an assumed 770,000 ha (1.9 million ac) of total agricultural irrigation in the state (from the agricultural withdrawal permit database).

The monitoring installation was completed during the 2000 calendar year, so the first complete monitoring year will be 2001. The data is being collected on a monthly basis using personnel hired within the program. For additional information about procedures, refer to Thomas et al. (1999) and the web address: www.agwaterpumping.net.

PRELIMINARY RESULTS

Preliminary results have been compiled for the 2000 calendar year. These results reflect relatively complete records in the Lower Flint River basin and the 24 county region in Southeast Georgia where salt water intrusion is a concern. The central and northern portions of the state were the last areas instrumented (some as recently as November, 2000). As a result, these preliminary irrigation results must be kept in perspective.

Rainfall during the 2000 calendar year (and the growing season) was below normal in most locations. However, all areas did not experience the same level of "drought" conditions. Using an average growing season period from April through September, Figure 3 illustrates the total monthly rainfall by region within the state. Each monthly value represents at least six different rainfall monitoring sites within that area (from the Georgia Agricultural Environmental Monitoring Network, Hoogenboom, 1997; and web address: www.georgiaweather.net). The last bar is the long-term average rainfall (NOAA) that has occurred during these same months for the state of Georgia.
2000 was quite a bit higher than the long-term average. Rainfall during June was relatively close to normal values. Most spring/summer row crops in Georgia are irrigated in June, so all crops would have benefitted by the rainfall present at that time.

It is essential to understand that these rainfall figures cannot represent every single field in the regions indicated. In some cases, convective rainfall showers may hit one field while missing another. These are average values and should be interpreted as such. Many areas would have more rainfall than is indicated while others would have less.

Preliminary results from the Ag. Water Pumping monitoring program for selected crops are presented in Table 1. The figures on acres and million gallons are directly associated with those monitored sites, not the entire cropping area in Georgia. As was indicated by the rainfall patterns in Figure 3, corn was irrigated to a greater extent than other crops with an average 13.6 inches applied over the sites that were monitored. Cotton, peanut, and soybean would have benefitted from the rainfall in June, July and August.

The “Upper quartile” figures represent the monitoring locations (top 25%) where more water was required for irrigation than normal. These figures are based on full cropping season records. Whether some rainfall occurred at those monitoring sites, water supplies were limited, the farmer made a decision to not irrigate due to economic factors, or irrigation amounts were as indicated due to some other unknown reason cannot be determined with these results.

The important result is that “on the average”, irrigation water use was indicative of the average rainfall over the regions and irrigation recommendations and results from past studies (Harrison and Tyson, 1999; Thomas et al., 1998).

CONCLUSIONS

The Ag. Water Pumping program is achieving its expected role of providing reliable estimates of agricultural water use for the state of Georgia. The continued development of the modeling system to allow improved “extrapolation” of the monitored results over the state are essential to a comprehensive system. Initial results from the 2000 monitoring season indicate reasonable irrigation amounts were applied “on the average”. Since some rainfall did occur during the cropping season, irrigation amounts were not as high as might be expected considering the state-wide drought.

LITERATURE CITED


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