Irrigated Acreage Projections in Georgia

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Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Orlando, FL, February 6-9, 2010

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Abstract

Irrigated acreage is an important indicator for agricultural water demand which is a major category of water use. Three methodologies were applied in this study to project irrigated acreage of major crops in Georgia from 2010 to 2050. These three methodologies show consistent results. Total irrigated acreage of major crops in Georgia is projected to increase for the next 40 years. The acreage projection results provide useful information for Georgia agricultural policy makers and farmers. However, the methodologies used in the study have some limitations. They can only be used under certain assumptions. Thus, better methodologies are needed for future related research.

Key Words: Irrigated acreage projection, acreage response elasticities.

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Introduction

Water demands are increasing with the rapidly growing population of the southeastern U.S. Agricultural water demand is a major category of water use. Water use in the agricultural industry is mostly for the purpose of irrigation. Crops are irrigated by Georgia farmers for several reasons: increasing overall profitability, stabilizing income over dry as well as wet years, and insuring they can meet contractual obligations including marketing agreements, operating loan and other farm indebtedness. Irrigation allows farmers to enter new enterprises such as vegetables or other produce for fresh and processing markets. Thus, irrigated acreage is an important indicator for water supply and demand. The following question is of great interests to farmers and agricultural decision makers: How much water will be needed to sustain viability of Georgia's irrigated agriculture through 2050? This study projects irrigated acreage for major crops in Georgia for the next 40 years. Like all forecasting, in this study we use past trends to analyze what might happen in the future.

One of the forecasting approaches we used in this research was to follow trends of the United States Department of Agriculture (USDA) ten-year harvested acreage projections and use these trends to project future irrigated acreage in Georgia. However, it is assumed that harvested acreage and irrigated acreage are changing by the same growth rate. Another popular approach to projecting irrigated acreage changes is to use measures of irrigated acreage elasticity with respect to output price. Two studies have examined irrigated acreage responses to prices in Georgia (Tareen, 2001; Mullen et al., 2009). The Tareen (2001) study generated irrigated acreage elasticities with respect to expected profits and was exclusive to the Flint River Basin. The Mullen et al. (2009) study generated irrigated acreage elasticities with respect to output prices, under a fixed land constraint, for the whole state. Both of these studies focused on corn, cotton, peanuts, and soybeans. The major drawbacks of applying the Tareen (2001) estimates to the study at hand include their focus on the Flint River Basin and the counter-factual sign on the corn acreage elasticity – the estimate predicts irrigated corn acreage will fall when expected profits increase. The major drawback of applying the Mullen et al. (2009) estimates is the fixed land constraint.

USDA (1996) has also generated acreage response elasticities with respect to output prices. Estimates were produced at national and regional levels. In the Southeast Region, estimates were made for corn, cotton, and soybeans, but not peanuts. These estimates, however, are for total harvested acreage rather than irrigated acreage.

Data and Methods

USDA Acreage and Price Projections through 2018 were obtained from USDA report: "USDA Agricultural Projections to 2018". National level harvested acres for peanut were obtained from the Food and Agricultural Policy Research Institute (FAPRI). Mapped irrigated acreage which is treated as "baseline" acreage was obtained from the Georgia Environmental Protection Division (EPD) acreage mapping. "Baseline" irrigated areas were measured on 2007 -2008 aerial imagery using fields that had been identified as irrigated by farmers, the Georgia EPD's Agriculture Water Permitting Unit, the Georgia Soil and Water Conservation Commission's Agriculture Meter Program, and University of Georgia Agricultural Water Demand GIS efforts.

We used three projection methodologies to generate forecast of Georgia agricultural water demand:

1. Apply USDA national acreage projections to GA counties to simulate irrigated acreage variation in the future.
2. Apply empirical measures of acreage response to price changes with Southeast Region elasticity of harvested acreage with respect to price (USDA, 1996). Price changes are USDA ten-year commodity price projections.
3. Apply empirical measures of acreage response to price changes with Georgia elasticity of irrigated acreage with respect to price (Mullen et al., 2009). Price changes are USDA ten-year commodity price projections.

The above three methodologies are all applied to "baseline" irrigated acreage which relies on EPD acreage mapping results.

Irrigated acreage projections are based on long-run projections conducted by the USDA. Especially, the first methodology uses USDA ten-year national harvested acreage projections, while the second and third methodologies use USDA ten-year national commodity price projections. The USDA makes ten-year, national acreage projections for the following major field crops: corn, sorghum, barley, oats, wheat, rice, upland cotton, and soybeans (USDA, 2009). Broad categories of horticultural crops are also projected, namely, fruits and nuts, vegetables, and nursery and greenhouse products. Fruits and nuts are further divided into three categories: citrus, non-citrus, and tree nuts. Vegetables are divided into fresh, processed, and potatoes. Nursery and greenhouse products are not further divided. The reason for the highly aggregated projection is a lack of sufficient data. USDA does not project peanut acreage. Data from the Food and Agricultural Policy Research Institute (FAPRI) were used to address peanuts (FAPRI, 2008). Estimates for 2008 irrigated acres were generated from the mapped acreage. These estimates serve as the baseline for irrigated acreage projections for each crop. The particular challenge to the acreage projections is the uncertainty surrounding state-level and county-level historic irrigated acreage. Ideally, these projections would be based on empirical evidence regarding how farmers in Georgia expand and adjust irrigated acreage across crops in response to price changes.

None of the aforementioned studies estimate irrigated acreage responses for tree nuts, or fresh or processed vegetables. Furthermore, the USDA national projections for these crops are in millions of pounds rather than harvested acres. To address these crops, several assumptions were made:

> *Assumption 1*: the growth rate of irrigated acres of tree nuts, fresh vegetables, and processed vegetables in Georgia will be equal to the respective projected growth rate of national production (in millions of pounds) for each crop, through 2018.
>
> *Assumption 2*: the county-level growth rate of irrigated acres for each crop will be equal to the state-level growth rate.
>
> *Assumption 3*: the growth rate of irrigated acres for each crop beyond 2018 will be equal to the average projected growth rate from 2016 through 2018.

In this way, water demand for vegetable and specialty crops could be included with major crops for total water withdrawal computations. In the interest of methodological consistency, projections for corn, cotton, peanuts, and soybeans are also made by applying similar assumptions. The only modification is in Assumption 1 – namely, the growth rate of irrigated acres of corn, cotton, peanuts and soybeans will be equal to the projected growth rate of national harvested acres for each crop, through 2018.

Projections were also made for corn, cotton, and soybeans using the acreage response elasticities for the Southeast Region (USDA, 1996). In addition, the elasticity estimates from Mullen et al. (2009) were used to generate projections for corn, cotton, peanuts, and soybeans. In both of these cases, projected prices from USDA through 2018 were applied to the acreage response elasticities (the peanut price projections were from FAPRI). Assumption 2 and Assumption 3 were employed, as above. Specifically, acreage response elasticities were used to generate acreage based on USDA price projections. Then acreage growth rate from 2009 to 2018 were calculated and applied to each county.

Furthermore, in order to support the methodologies used, several macroeconomic assumptions were followed including (USDA, 2009):

1. U.S. and world economic growth reflect near-term effects of the current economic crisis followed by a transition back to steady economic gains;
2. Global economy assumed to slow to 1.7-percent growth in 2009 while the U.S. economy declines by 0.5 percent;
3. The financial crisis and global economic slowdown will constrain U.S. exports in the short to intermediate term;
4. Global economic growth assumed to rebound to a 3.4-percent average growth rate for 2010-18;
5. The U.S. economy resumes growth in 2010 at 2.5 percent, followed by average rates near 3 percent over the remainder of the projection period.

Results and Discussion

In the short run – to 2010 – there is considerable consensus in future irrigation acreage projections across the three methodologies for each crop. At the state level, the soybean projections differ by less than 2%. The peanut, corn and cotton projections differ by less than 6%, 9%, and 7%, respectively. In the medium run – to 2020 – the consensus continues across methodologies continues for cotton, peanuts, and soybeans. The largest projected differences for these crops are 4%, 4%, and 3%, respectively. The maximum difference in projected corn acreage, however, has grown to 17%. In the long-run – to 2050 – the difference in projected soybean acreage remains steady, at 4%. The difference in projected peanut acreage grows to a modest 10%. The difference in projected cotton and corn acreage grows to 24% and 30%, respectively. The divergence of projected irrigated acreage for these two crops is fueled by compounding small differences in projected growth rates over more than 30 years. Projections using the Tareen elasticity estimates have not been done to date. However, preliminary calculations indicate they are extremely likely to fall within the current range of estimates. One should keep in mind the uncertainty associated with any projection increases exponentially as we move out in time.

Through 2020, the three methodologies provide remarkably similar projections of irrigated acres. Given this, we only report here irrigated acreage projections based on the USDA growth rate of national harvested acres since using the USDA projections allows us to apply a consistent methodology across all crops (e.g., acreage response elasticity measures were not available for all crops).

According to table 1 and figure 5, we can observe that Georgia irrigated acreage projections gradually increase for the next 40 years. Projected irrigated acreage in 2010 is 1,336,291 acres, and it increases to 1,686,408 acres in 2050. The projections suggest that over time irrigation acreage for corn, cotton, fresh vegetable and tree nuts will increase, and irrigation acreage for soybeans, peanuts, and processed vegetable will decrease.

Conclusions

Georgia irrigated acreage projections for next 40 years were obtained by three methodologies. It is demonstrated that three methodologies have similar output. Based on the first methodology, overall Georgia irrigated acreage increase gradually from 2010 to 2050. However, not all crops have increasing irrigated acreage. Forecasting models diverge after 2018, but closely simulate existing application depths. Vegetable and tree nuts make up much less of Georgia's water demand than the major crops. Nonetheless, the water demand created by these valuable crops is significant in many areas of Georgia.

Because of persistent drought in the Southeastern U.S. (which has abated some only recently) and continued population growth in this region, water supplies in many areas of Georgia are being stretched to their physical limits. Thus, there is a need for long-term planning to deal with possible water demand and supply “gaps” or shortages in the state. The irrigation acreage projections reported in this paper can be used by the agricultural industry and public officials to assess future agricultural water demands, and plan for how to balance agricultural water demands with water demands from other industries, businesses and homeowners.

References

Food and Agricultural Policy Research Institute, U.S. and World Agricultural Outlook, FAPRI Staff Report 08-FSR 1, January 2008.

Mullen, Jeffrey D., Yingzhou Yu, and Gerrit Hoogenboom, "Estimating the Demand for Irrigation Water in a Humid Climate: A Case Study from the Southeastern United States," *Agricultural Water Management*, in press.

United States Department of Agriculture, USDA Agricultural Projections to 2018, Long-term Projections Report OCE-2009-1, February 2009.

Tareen, Irfan, "Forecasting Irrigation Water Demand: An Application to the Flint River Basin," Department of Agricultural and Applied Economics, University of Georgia, PhD. Dissertation, 2001.

Table 1. Georgia irrigated acreage projections

Georgia irrigated Acres Projection (acres)					
	2010	2020	2030	2040	2050
Corn	252124.963	257782.9	263019.1	268361.5	273812.5
Soybeans	95911.7348	93251.22	93251.22	93251.22	93251.22
Cotton	458870.139	552127.4	615896.1	687029.8	766379.2
Peanuts	343681.619	325668.6	319257.3	312972.3	306810.9
Vegetables, Processed	3901.63775	3824.454	3748.936	3674.908	3602.343
Vegetables, Fresh	98818.0556	111107.3	124960.7	140541.3	158064.7
Tree nuts	82983.2995	83196.51	83624.59	84054.87	84487.36
Total	1336291.45	1426958	1503758	1589886	1686408

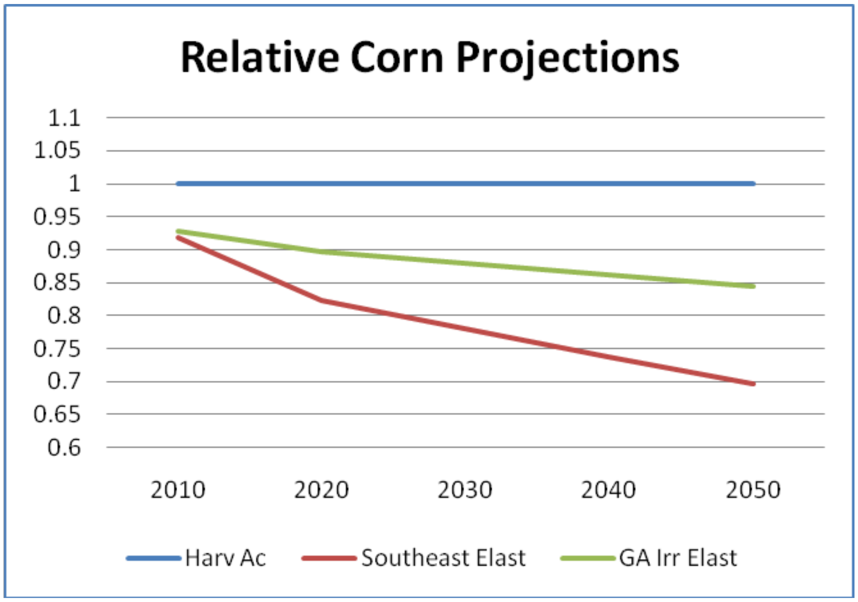

Figure 1. Relative corn projections for three methodologies

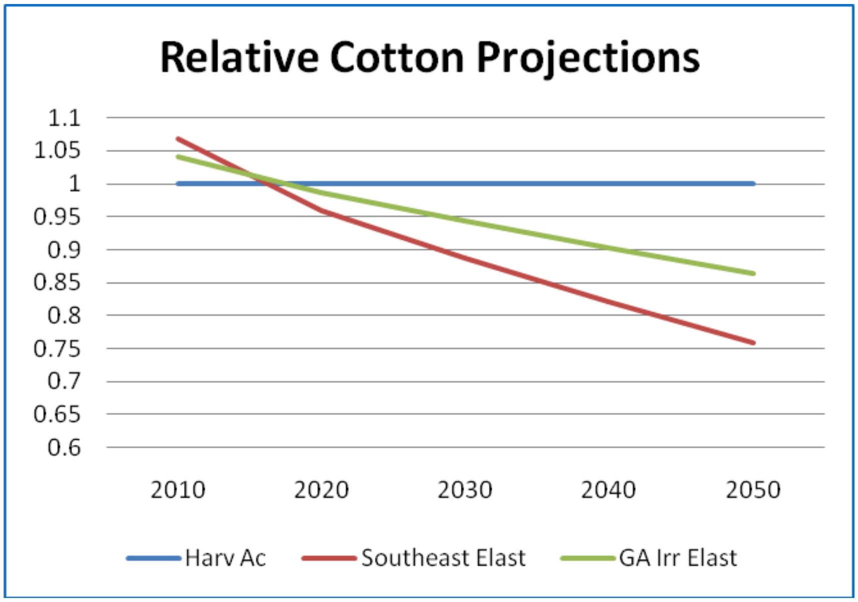

Figure 2. Relative cotton projections for three methodologies

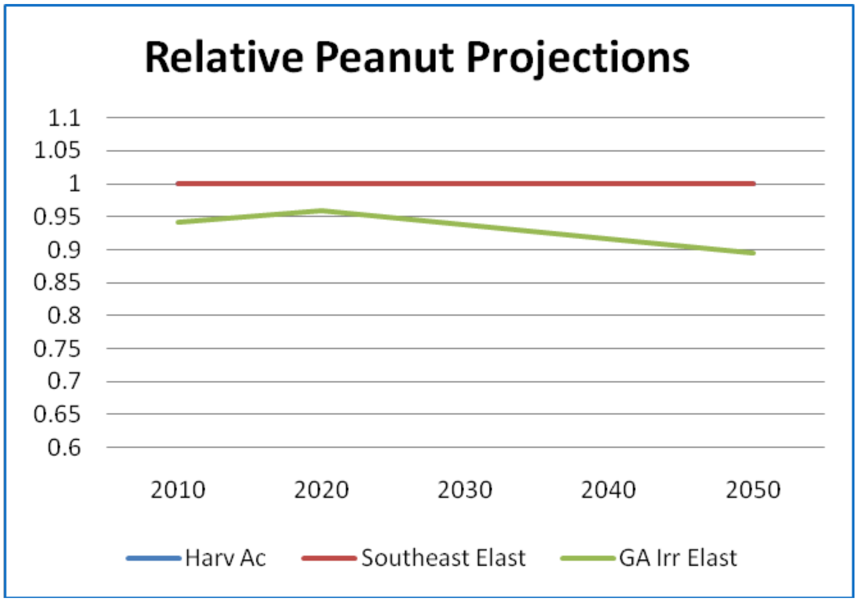

Figure 3. Relative peanut projections for three methodologies

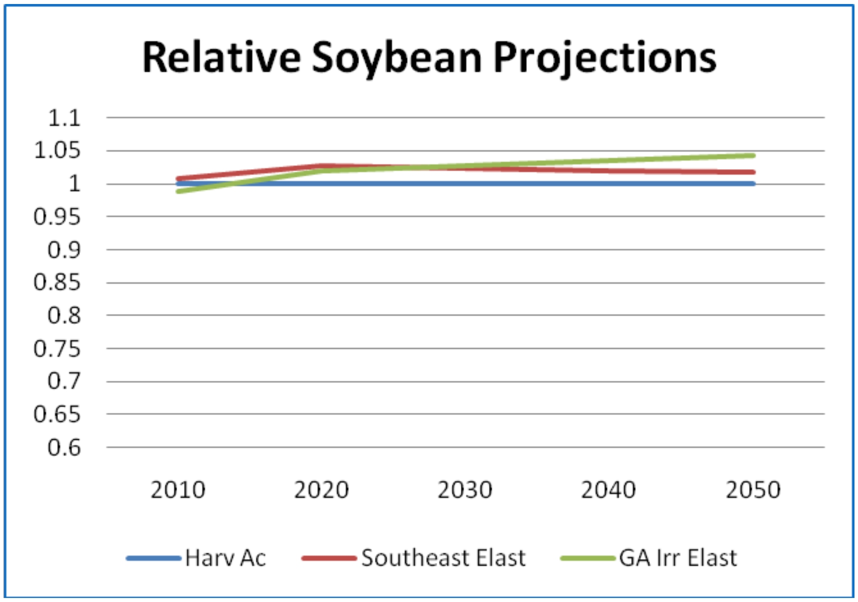

Figure 4. Relative soybean projections for three methodologies

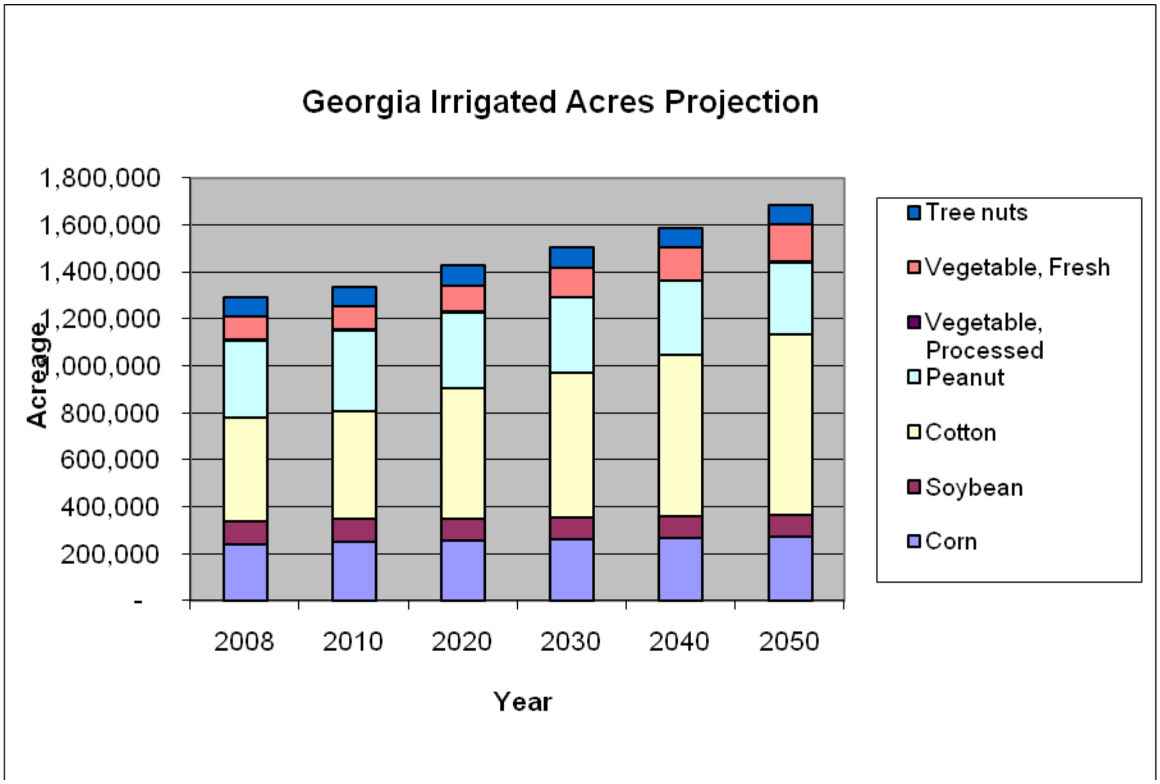

Figure 5. Georgia irrigated acreage projection