AN ECONOMIC ANALYSIS OF ALTERNATIVE AGRICULTURAL WATER USE REDUCTION PROGRAMS IN THE FLINT RIVER BASIN

Brigid A. Doherty[1] and John C. McKissick[2]

AUTHORS: [1]Research Coordinator and [2]Coordinator and Extension Economist, Center for Agribusiness and Economic Development, 303 Lumpkin House, the University of Georgia, Athens, GA 30602.
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Abstract. This paper investigates the costs (both direct and indirect) to agricultural producers, the State of Georgia, and local economies of reducing agricultural irrigation in the Flint River Basin of southwest Georgia. A policy of paying producers to reduce their irrigated acreage is compared to a policy of implementing higher efficiency water conservation technologies in irrigation systems. The cost of reducing water usage per gallon is examined under both policies. The potential amount of water conserved for a fixed dollar amount is also calculated for both policies. This research finds that implementing irrigation efficiencies carries a lower cost for the State of Georgia and provides benefits to agricultural producers.

INTRODUCTION

Water usage in the Apalachicola- Chattahoochee-Flint (ACF) River Basin is an issue of concern for many in the southeast. The ACF basin is largely located in Georgia, but includes parts of Florida and Alabama. In recent years, these neighboring states have made efforts to work together in managing the flow and quality of water in the basin. In an effort to increase flows in the Flint River, the state of Georgia has examined alternatives to manage water consumption in the basin. One industry targeted for water reduction efforts is agriculture. Currently, proposals are being implemented to decrease the amount of water utilized for irrigation during years of drought in the eighteen counties which make up the Flint River Basin.

In the 1999-2000 session, the Georgia State Legislature enabled the Flint River Drought Protection Act allowing the state in years of low flows in the Flint River to use a bid system to "buy" agricultural producer's rights to irrigate.

An alternative method to reduce the amount of irrigation water drawn from the Flint River Basin exists. In this proposal, irrigation efficiency and conservation technologies would be incorporated into existing systems. This allows for the amount of land under irrigation to remain relatively stable while simultaneously decreasing the amount of water used for irrigation.

This paper compares the economic costs of both programs. It explores the costs to the State as well as those to producers and local economies. Both the total cost per gallon of water conserved and the amount of water saved for a fixed dollar amount are calculated.

AGRICULTURE AND IRRIGATION IN THE FLINT RIVER BASIN OF GEORGIA

Agricultural production in the Flint River Basin (FRB) counties represents roughly eighteen percent of the state's total value (Rickett, Doherty and Dorfman, 1999) and thirty-six percent of total harvested crop acres in Georgia (Census of Agriculture, 1997). Further, the FRB counties produce more than forty percent of the state's corn, cotton, peanut and vegetable value. The production of agricultural commodities in the FRB created $1.4 billion dollars in revenue to producers in 1998 (Rickett, Doherty, Dorfman, 1999). Their activities, in turn, generated an additional $700 million of economic output. Thus, a total of $2.1 billion in economic output would be lost in the FRB if agricultural production ceased (Doherty and McKissick, 2000).

Producers in the FRB rely on irrigation as an integral input into the production of row crops. The region represents thirty-six percent of the state's total harvested crop acres, but has fifty-four percent of the total irrigated acreage in the state. Roughly thirty percent of total harvested crop land in the counties is irrigated and in some counties this figure exceeds fifty percent (Census of Agriculture, 1997).

Irrigation does have a measurable impact on recorded yields. According the 1997 Census of Agriculture, corn yields on acres grown under irrigation averaged 141 bushels/acre while dryland yields were 85.3 bushels/acre, a difference of 55.7 bushels/acre. Soybean yields were 12.9 bushels/acre lower on dryland (19 bu/acre) than on irrigated (31.9 bu/acre) land. Peanuts averaged 1.75 tons/acre under irrigation and 1.25 tons/acre on dryland or 0.5 tons/acre less on dryland. Cotton yielded 0.4 bales/acre fewer under dryland (1.2 bales/acre) than under irrigation (1.6 bales/acre). While these yield differentials may at first appear to be minor, when multiplied by acreage in the FRB counties, they become significant.

THE ECONOMICS OF A SYSTEM TO PAY PRODUCERS TO LIMIT IRRIGATION

The Flint River Drought Protection Act essentially created a "buyout" program for agricultural producers in the FRB. In years of low flows, producers can bid to not irrigate and receive a payment for forgoing this right. This program affects two groups. The State has to pay a bid price to the producer. The Act essentially allocated $10 million a year for the bid program. The producer and local community also will pay a cost in lost revenue. If, as expected, the bought out acres are taken out of agricultural production, $385 an acre would be lost in output to the producer and to the local community in the Flint River Basin. The gross value of lost agricultural production is approximately $260 an acre. The remaining cost of $125 an acre is the estimated value of output lost to the local economy. It includes the local output that is based on agricultural production in the area, thus it accounts for decreased sales of seed, fertilizer, labor, and so forth. It does not include the effect on industries beyond the farm gate, such as processing of agricultural commodities. An input-output model, IMPLAN, based on the eighteen counties in the FRB was used to estimate the effect on the local economy. The cost to the producer and the community is often overlooked in analyses of the Act.

Cost per Gallon

Assuming an average bid price of $150 an acre and adding the cost to the local region, the total annual cost per acre of the Act would be $535 an acre. In an average year, 7 inches of irrigation water are used on an acre. This equates to approximately 190,000 gallons being consumed per acre. Thus, 190,000 gallons per acre can be saved for $535 an acre, equating out to a cost $0.0028 per gallon.

Gallons Conserved

The amount of water saved under the buyout program can be calculated in a similar manner. With $10 million in funds and an average bid value of $150/acre, 66,667 acres can be removed from irrigation. Calculating this through, one finds that 12 billion gallons can be saved for the $10 million allocated. However, this 12 billion gallons for $10 million only accounts for the direct cost to the State. The local economies in the Flint River Basin will be impacted by an additional loss of $26 million in economic output, raising the true cost of the buyout program to $36 million a year.

THE ECONOMICS OF IMPLEMENTING IRRIGATION CONSERVATION TECHNOLOGY

Opportunities exist in Georgia to increase water conservation and efficiency in irrigation systems. A 1998 paper, Irrigation Conservation Practices Appropriate for the Southeastern United States (Evans, et al, 1998), explored water savings that could be achieved in Georgia by implementing improvements to irrigation systems.

Cost per Gallon

The above mentioned paper also provided cost estimates and water savings (in an average year) associated with these improvements. The four most cost efficient improvements to center pivot systems are: adding end gun shut off ($351/million gallon cost and 2851 million gallons saved), replacing the sprinkler package with a new package ($526/million gallon cost with 4181 million gallons conserved), reducing the angle impacts and using medium pressure ($631/million gallon cost with 1616 million gallon saved), and putting low pressure sprinklers on drops ($421/million gallons and 570 million gallons conserved). These individual costs were weighted by the amount of water conserved to arrive at a weighted estimated cost of $0.000485 per gallon. However, one strong restriction occurs here. These four improvements, if fully implemented, can only conserve a maximum of 9 billion gallons of water in Georgia. To generate water savings over 9 billion gallons, other new irrigation efficiencies would have to be implemented and the cost of $0.000485/gallon would not hold.

The three most cost-efficient improvements to traveling gun systems are: repairing the water delivery system ($2,166/million gallons with savings of 2585 million gallons), using speed compensation ($3,095/ million gallons conserving 2100 million gallons), and changing angle and trajectory ($1,857/million gallons saving 969 million gallons). The weighted cost of implementing improvements to traveling guns totals $0.002454 per gallon with a restriction of 5.7 billion gallons of total water savings possible.

Weighting the costs of each type of system, it is possible to arrive at a cost of $0.001234 per gallon to conserve a maximum of 15 billion gallons of water in Georgia. Since the FRB irrigates fifty-four percent of the state's total irrigated acreage, one can assume that roughly half the irrigation systems in Georgia are in this region. Applying that assumption, a maximum of 7.5 billion gallons of irrigation water can be conserved in the Flint River Basin by improving irrigation efficiency.

Gallons Conserved

Assuming the state would fund this project at the same level it currently intends to fund the Drought Protection Act, $10 million would be enough to save the available 7.5 billion gallons of water. Actually, saving 7.5 billion gallons of water in the FRB via this policy would cost $9.3 million dollars.

COMPARING THE PROGRAMS

Clearly, the second alternative (7.5 billion gallons) saves less irrigation water on a yearly basis than does the first solution (12 billion gallons). However, several other factors must be considered. Table 1 lists the breakdown of costs for each policy. The table shows that many of the irrigation efficiency improvements are actually less costly per gallon of water conserved than the buyout program.

There are other issues involved in the comparison of these policies. First, improving irrigation efficiency allows the producer to continue irrigating the same amount of land but with fewer total gallons of water. This, in turn, does not decrease revenue to the producer or decrease economic output in the community. Under the buyout program, another $26 million dollars of economic output was lost in the region for this reason. Second, improving irrigation efficiency has a long lasting effect. The amount of irrigation water conserved may initially be lower, but once the improvements have been installed, water is conserved every year for the one time price of improvements. Thus, $10 million in funds in a single year will generate water conservation for many following years. Within two years of the fully implemented irrigation efficiencies, the State can conserve more water than in a single year of the "buyout" program. Further, water is conserved irregardless of the rainfall level for the season. Finally, improving irrigation efficiency benefits producers by decreasing overall costs and increasing their competitiveness.

Table 1: Cost Comparison of Policies

Policy	Direct Cost	Indirect Cost	Total Cost
Bid Policy	$150/ acre	$385/ acre	$535/acre or $2800/ mill gallons
End Gun	$351/ million gallons	$0	$351/million gallons
New Sprinkler Package	$526/ million gallons	$0	$526/million gallons
Reduce angle impacts, medium pressure	$631/ million gallons	$0	$631/million gallons
Low pressure sprinklers on drops	$421/ million gallons	$0	$421/million gallons
Repair water delivery system	$2166/ million gallons	$0	$2166/million gallons
Speed Compen-sation	$3095/ million gallons	$0	$3095/million gallons
Low angle gun, 18 degree trajectory	$1857/ million gallons	$0	$1857/million gallons

SENSITIVITY ANALYSIS

Thus far, this paper has included several assumptions which are subject to alteration. These include a bid price of $150 an acre and an average year in terms of rainfall. Should either of these assumptions be altered, the results of this analysis would concurrently change.

A change in the bid price singularly affects the cost and water savings of the buyout program. Dropping the bid price to $100 an acre decreases the overall cost of the program to $485 an acre and $0.0026 per gallon. It further allows for more acreage to be removed from irrigation (100,000 acres) and more water to be conserved (19 billion gallons). Thus, it would take 3 years after the implementation of the irrigation efficiencies to save a comparable amount as in one year of the buyout program.

A change in the amount of rainfall affects the amount of inches per acre used in irrigation. To this point, this paper has considered an average year of 7 inches per acre. In a dry year, 12 inches per acre is used by irrigation systems. Increasing the amount of water utilized in irrigation will affect both the buyout program and the efficiency program. In the buyout program, the cost per gallon actually decreases in a dry year. This is because the bid price is assumed to remain stable and more water (22 billion gallons) can be conserved through non-irrigation. The uncertainty involved with this analysis is whether or not the bid price in a dry year would rise to entice producers to cease irrigation. For the irrigation efficiency program, the cost remains constant since the cost to improve efficiency is not affected by the amount of water conserved. However, the total amount of irrigation water that can be saved now reaches 25 billion gallons in the state and 12.5 billion gallons in the FRB.

CONCLUSIONS

Realistically, there are drawbacks to both policies. The current Act relies on agricultural producers to be willing to take several actions. First, the producer has to accept the bid price. According to estimates made in an earlier paper (Doherty and McKissick, 2000), the authors find that the majority of producers for the majority of crops, can expect a return over variable cost in excess of $150/acre. It is questionable whether producers would have enough incentive to participate in the bid program. Second, incentive would need to exist to prohibit the producer from breaking the contract and irrigating regardless. The cost of monitoring may be substantial.

A policy of implementing irrigation efficiencies has problems as well. The numbers provided here are estimates, thus some adjustments may be obvious once actual changes are made. It is uncertain whether all these improvements can be implemented.

Despite these limitations, the improved irrigation efficiency program emerges as a viable alternative to the buyout program. Although it will not reduce irrigation water consumption as quickly, improving irrigation systems has many attractive side benefits. The outlay has to occur only once, yet the benefits of reduced irrigation water consumption are evident annually, regardless of the amount of rainfall in the year. Finally, agriculture in the FRB can remain competitive and retain its position as a major source of economic activity in the region.

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