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The Effect of Ethanol Production on Agricultural Production in the State of Alabama

By

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Abstract

This research assessed the economic effect of corn-based fuel ethanol production on agriculture and the state economy in Alabama. The results showed that in the short run a 15 million gallon per year plant will be profitable. This will have farm income and a multiplier affect in the rest of the state economy.

Keywords: ethanol, corn producers, farm income, price elasticity, economic impact

Introduction

The current US fuel ethanol production is corn based, and the bulk of the production and consumption is located in the Mid-West in the major corn producing areas and California (Renewable Fuels Association 2003). By the year 2000 approximately 12 percent of all gasoline sold in the US was ethanol blended (Northeast Regional Biomass Group 2000). Growth in the production of fuel ethanol leads to the development of renewable energy businesses and value-added agricultural processing (Tiffany and Eidman 2003, Paulson et al. 2004).

An increase in fuel ethanol production would increase the demand for corn above baseline by 28 million bushels in 2000 to over 500 million bushels per year beginning in 2004 (USDA 2000). Ethanol production is increasingly a major factor contributing to the recent growth in the Midwest (Swenson 2005). Reduction in smoke and particulate matter emissions and a 13 to 30 percent emission reduction of carbon monoxide are the major environmental benefits of ethanol (Goldemberg 2000; Merritt and Ulmet 2004).

There is no commercial production of ethanol in Alabama but there are some non-attainment areas where oxygenated gasoline can be used. In addition, ethanol production could

improve the well being of depressed rural economies. The local production of fuel ethanol will introduce new cash crops, increase farm income, provide new processing, distribution, and service industries in the rural economies and reduce the import of octane enhancer and petroleum based gasoline at the state level. The objective of this study is to investigate the feasibility and potential economic impact of an ethanol plant in Alabama, with a focus on farm income and the volume of production of corn and sorghum. In addition, we will assess the direct impact of the plant on value added agricultural produce and employment.

Ethanol Technologies and Blends

Two methods are currently used to produce fuel ethanol from corn, wet milling and dry milling. Wet milling produces ethanol, corn syrup, high fructose corn syrup, corn starch and corn oil as well as other products. Dry mills produce only fuel ethanol distillers dried grains (DDGS) and liquid carbon dioxide (Kim and Dale 2002). DDGS is sold as an animal feed, mainly for ruminant animal diets, due to its high fiber content, and its low price. However, the advantage of dry mills is that they are simple, less expensive to build and have reduced operating costs. Dry mill ethanol plants represent the vast majority of growth in ethanol production capacity in the U.S. (Tiffany and Eidman 2003). Advances in enzymes, yeasts, and process controls have improved ethanol plant efficiencies. New technologies are being developed to recover multiple high valued co products such as germ and coarse fiber in the beginning of the dry grind process, prior to fermentation (Murthy et al. 2004).

There are different blends of ethanol and gasoline. E10 is 10 percent ethanol with 90 percent gasoline referred also as gasohol, and is widely used. A blend of ethanol under 10 percent can be used without vehicle modification and can be distributed through the existing

infrastructure. E85 and E95 are ethanol and gasoline blend of 85 percent and 15 percent, and 95 percent and percent, respectively, which could be used in vehicles with slightly adapted internal combustion engine (Hamelinck et al. 2003). General Motors is currently the largest producer of E85 flexible fuel vehicles in the United States and every major car producer approves the use of E10 (E10 Unleaded, 2006). The use of ethanol will decrease the amount of petroleum based gasoline by a significant amount and will result in cost saving for the users.

Average consumption of gasoline in the state of Alabama between 2000 and 2004 was 167,400 gallons per day (Energy Information Administration, 2006). Some Alabama counties (e.g. Jackson, Jefferson, Shelby, and Walker counties) are in EPA's non-attainment areas list mainly for ozone and particulate matters and should use reformulate gasoline (RFG), additional oxygenated gasoline, to reduce harmful ground level ozone (smog). The rest of the state does not have an air quality problem but the use of an ethanol blend can assist to maintain air quality and reduce the use of gasoline by 10 percent, which may benefit corn and sorghum producers and increase farm income of growers in Alabama.

Corn and grain sorghum are two cereals widely grown in Alabama. Between 1992 and 2003, the acreage of corn declined from 281,053 to 176,122 acres and acreage of sorghum declined from 24,343 to 6,000 (USDA/NASS 2005). Corn is produced in most counties in Alabama, except in the central part of the state where some counties grow very small amounts. Yield per acre ranges from 70 -124 bushels per acre (USDA/NASS 2003). Sorghum is mainly produced for animal feed and the yield per acre for the state is about 45 bushels per acre. The decline in acreage parallels the decline in the volume of corn produced in the state.

Methodology and Data

It is hoped that new uses for field crops in Alabama may enhance competitiveness of the state for growing those crops. The determination of competitiveness can only be done when the total impact of growing the crop is evaluated. Input/output analysis is one of the widely used economic impact assessment methods for evaluating new enterprises or the expansion of industrial production. It allows capturing interdependencies of the different sectors in the economy. Sporleder et al. (2001) used an input-output model to estimate the impact of a 40 million gallon per year dry milling ethanol processing plant on the Ohio economy and showed that the ripple effect would be an estimated \$89.9 million per year. Because of the increase in the demand of ethanol as additive and octane booster, most Midwest states are increasing ethanol production. Iowa is one of the ethanol exporting states. Swenson (2005) used an input-output model to assess the economic impact of a 41 million gallon per year wet milling processing plant in Iowa and showed that it would increase corn production by 15.2 million bushels and will bring about \$47.05 million sales from ethanol, 35 jobs, and tax to the local and state governments. Tiffany and Eidman (2003) assessed the factors that affect the success of ethanol production and found that smaller plants, with less than 15 million gallons per year, are highly reliant on government subsidies because average cost per gallon is higher.

Alabama grows corn and sorghum. The volume of corn production in Alabama has been on the decline in the last 15 years. However, an increase in corn demand for fuel ethanol production would be likely to increase corn price and therefore result in increased production. In our empirical analysis we used three methodologies; regression analysis, linear programming and input-output analysis.

Regression analysis was used to test the acreage response of corn and sorghum to price

changes. Data on Alabama acreage and price for corn and sorghum from 1980 to 2004 were obtained from USDA/NASS website. A seemingly unrelated regression was used to estimate double-log form acreage price-response equations. State wide corn and sorghum planted acreage and price were used in the estimation. The regression models were supplemented by a simple farm-level linear programming model for the Wiregrass region where peanuts are an important crop and typically produced in rotation with cotton. Corn has similar rotation effects to cotton for peanuts. Experimental data in Alabama show about a 16 percent increase in peanut yields following one year of a rotation crop, and 36 percent following two years of a rotation crop. Finally, input-output methodology was used to assess the economic impact of fuel ethanol on farm and state income. The input-output model was used to estimate the direct, indirect, and induced employment and income effect of the plant (Miller and Blair 1985).

Results and Discussion

Overall, results of the regression models show that corn supply, both at the state-level and in the two regions, is sensitive to price changes. Hence, for each 1 percent increase in price of corn, corn acreage would increase by at least $\frac{1}{2}$ percent in the short run. The estimates in all the regression models showed that in the long run corn acreage is price elastic. The long-run price elasticity of corn acreage was 1.05 for North Alabama, 1.85 for the wiregrass counties and 2.62 for the state-level. Thus, a one percent increase in the price of corn will create a 1.05 percent and 1.85 percent increase in acreage of corn production in North Alabama and the Wiregrass, respectively (Table 1). An increase in production implies an increase in income in the rural economies. Results of the linear programming analysis show that, at current prices, corn is competitive with cotton as a rotation crop for peanuts in the Wiregrass, especially for producers

who do not have high ownership costs associated with cotton harvesting equipment. (Detail of the linear programming model is available upon request).

Two fuel ethanol plant sizes, 15 and 30 million gallons per year (MGY), corn based dry milling fuel ethanol plants were compared to identify the most profitable size. The major costs include corn, power and chemicals followed by labor (Table 1). The cost per gallon declines with the size of the plant due to economies of scale. Two scenarios of the two plants were estimated. Scenario one used only corn as feedstock. Scenario two assumed the use of 95 percent corn and 5 percent sorghum as feedstock. Sorghum is one of the cereals so far that has been tried with corn the feedstock.

For scenario one the corn requirements are 5,455,000 and 10,909,000 bushels of corn for the 15MGY and 30MGY, respectively. The average yield per acre for Alabama is 123 bushels for corn in 2003 (USDA/NASS 2005). The equivalent acreage of land required to produce the corn is approximately 44,000 and 89,000 acres for 15 MGY and 30 MGY, respectively.

Scenario two sorghum requirements were based on average sorghum yield per acre of 45 bushels in the state of Alabama (USDA/NASS 2005). The total area of land required for the different plants was approximately 42,129 and 84,257 acres of corn and 4,702 for 9,404 acres of sorghum for the 15 and 30 MGY plants, respectively. The combined acreage for both crops would thus be 46,831 acres for 15MGY and from 93,662 for 30MGY which is higher than scenario one. Since the price of sorghum per bushel is lower than corn it makes the cost per gallon cheaper than the plants using only corn. However, based on current acreages, it appears that sorghum may not be as attractive to growers as corn.

The total harvested acres for corn and sorghum in 2004 in the State of Alabama was 190,000 and 6,000 acres, respectively (USDA/NASS 2005). In the case of scenario one, without

additional acres of land the 15 and 30 MGY ethanol plants will use 24 and 47 percent of the land in corn in Alabama, respectively. In the case of scenario two, the 15 MGY ethanol plants will use 22 percent of acres under corn, and 100 percent of the sorghum. And the 30 MGY ethanol plants will use 44 percent of acres under corn and additional 3,000 acres of sorghum produced in Alabama.

The cost per gallon for the 30 million gallon plant is lower but the area of land required is larger and will be a constraint. In the short run, it is more feasible to set up a 15 MGY plant, scenario one. In the long run the increase in acreage may be feasible and larger size plants could be economical. DDGS and liquid CO₂ are the two by-products of fuel ethanol production. Based on the assumption made about 18 pounds of DDGS and 18 pounds of liquid CO₂ per bushel, there will be 98.2 million pounds of DDGS, and 98.2 million pounds of liquid CO₂ will be locally available for animal feed and industrial use.

Farm Income and Economic Effect of 15 MGY

The corn requirement for the 15MGY ethanol fuel plant is about 5,455,000 bushels of corn ((Table 2). The equivalent acreage of land required to produce the corn is approximately 44,000 acres which will have a direct impact on farm income and employment. The input-output result shows the total effect in the state economy in a given year. The standard input-output model was used to assess the economic impact of 15 MGY plant. A state level input-output model was developed using the 2002 IMPLAN data and structural matrix. The revenue from the 15 million gallon of fuel ethanol and the operation cost was applied into an input-output model to estimate the direct, indirect and induced output, employment and value added generated in the economy. The result showed that the plant will generate a total amount of \$30 million worth of

output, \$23 million of value added composed of income and indirect business taxes in the economy. The indirect business taxes of about \$12 million will be the revenue for the government. Corn production has a multiplier of 1.57 and accounts for about \$12.8 million which generates about \$423,059 of indirect output which are mainly power, maintenance, fertilizer, pesticides, machinery, transportation, wholesale trade, real estate, insurance, and other professional service (details available upon request).

Conclusion

The analysis showed that the state of Alabama has the potential to produce fuel ethanol. Feedstock could be obtained by increasing the acreage of corn as well as by the introduction of GM corn, which can reduce losses and increase yields. Increase in yields will reduce the amount of land required to grow the energy crop. The introduction of GMOs in Alabama, and the development of varieties which can provide higher yields will be essential for Alabama to be competitive with other states. Most of the farming is rainfed and the introduction of irrigation can secure production for the plant. Sorghum was introduced as a feedstock to supplement corn which has a wider demand than sorghum.

The analysis showed that sorghum could reduce the per gallon cost of ethanol, however, with the current state of production and yield per acre it may not be feasible to be used as feedstock. DDGS will be a good source of local animal feed for the many livestock producers in the state. The number of producers, income and employment will increase, which will generate economic benefit to the rural economies.

The location of the plant is not discussed in this study which will have an effect on the feasibility of the plant. Access to highway and other means of transportation, power lines and

natural gas supplies will be factor to be taken into consideration. The results are limited by the assumptions made and the accuracy of the data, but the model will assist in the evaluation of a bioenergy plant coming into rural communities.

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Table 1. Regression results for Acreage Response Models.

	Alabama	Alabama	North Alabama	Wiregrass
Variables	Corn	Sorghum	Corn	Corn
Intercept	0.831 (0.18)	2.61 (1.74)	0.345 (0.33)	0.048 (0.04)
Lagged dependent variable	0.800 (1.18)	0.499** (2.46)	0.522** (3.60)	0.616** (4.46)
Lagged real price	0.530** (2.95)	0.421** (2.88)	0.501** (3.19)	0.709** (3.55)
Trend	-0.010 (-0.03)	0.2328** (-2.88)	-0.332** (-2.23)	0.233** (1.15)
Dum	0.152 (-1.39)	-0.177 (-0.55)	0.060 (0.72)	-0.179** (-2.30)
R square	0.79	0.93	0.55	0.91

** 5% and *10% significant level. Figures in parenthesis are t-values.

Equations estimated in double-log form, with correction for autocorrelation. Alabama corn and sorghum equations estimated in SUR system.

Table 2. Corn requirements for 15 and 30 MGY dry milling fuel ethanol plants

Items	15 MGY	30MGY
Total Operating Cost	\$6,930,000	\$12,540,000
Corn	\$12,872,727	\$25,745,455
Total Cost*	\$19,802,727	\$38,285,455
Total cost per gallon	\$1.320	\$1.276
Bushels of corn	5,454,545	10,909,091
Acre of corn	44,346	88,692

* Sparks Company and Kansas State University, 2002 adjusted using Alabama price.