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Aggregate Economic Effects of Corn Ethanol and Soy-Based Biodiesel Production

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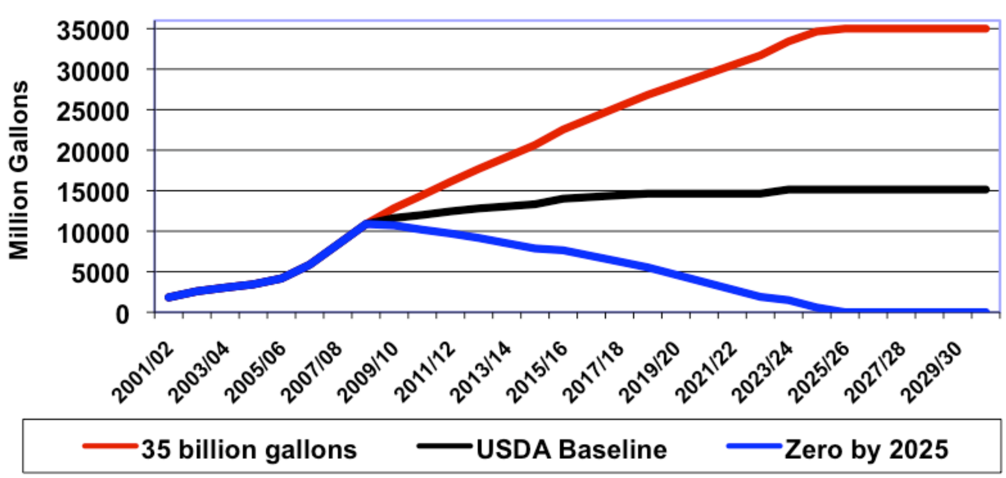
The National Biofuels Action Plan, drawing on mandates and funding in the Energy Independence and Security Act (EISA) of 2007, the Food, Conservation, and Energy Act (FCEA) of 2008, and other Federal legislation, lays out an ambitious plan for replacing imported oil with biofuels derived from plant matter. Biofuel production from first-generation technology, primarily ethanol from corn and biodiesel from vegetable oils, has increased dramatically in the last few years, now accounting for over 10 billion gallons annually and projected by U.S. Department of Agriclutre to grow to about 15 billion gallons over the next several years.

This briefing paper presents estimated aggregate economic effects of expanding production of first generation biofuels to a total of 35 billion gallons by 2025. AGSIM, a large-scale dynamic econometric-simulation model of demand and supply of the major field crops in the United States is used for the analysis. Effects are measured in two ways: (1) relative to the USDA baseline of about 15 billion gallons, which is the middle line in the Figure 1 below and (2) relative to zero production of first generation biofuels. The first comparison shows the effects of an increase of about 20 billion gallons above economic impacts caused by production of about 15 billion gallons. The second comparison shows the full economic effects of producing 35 billion gallons annually. In all scenarios, it is assumed that about 95% of the gross biofuel production is from corn ethanol and the remaining amount from soy-based biodiesel.

Figure 1. Corn Ethanol plus Biodiesel Production Baseline and Alternative Scenarios Evaluated



AGSIM simulates the time path of the agricultural economy. For brevity, however, only the average effects for 2026-2030 are generally presented here. All economic variables for future time periods are expressed in constant, 2009 dollars.

Research reported in this Briefing Paper was based in part on USDA CSREES grant #2008-34620-19065, titled "Policy Analysis for a National Secure & Sustainable Food, Fiber, Forestry, and Energy Program." Views expressed herein do not necessarily reflect those of Auburn University, Texas A&M University or USDA. These results are based on application of the econometric agricultural sector model AGSIM. A brief description of AGSIM is available at https://sites.auburn.edu/academic/ag/group/bioenergy/_layouts/viewlsts.aspx?BaseType=1

Crop and Fertilizer Price Impacts

Estimated effects of expanded biofuel production on major crop prices are shown in Table 1.[1] USDA's projection of about 15 billion gallons of biofuel is estimated to increase corn price by $0.88/bu, most of which is reflected in current corn price. Increasing production to 35 billion gallons from the projected 15 billion gallons is estimated to increase corn price by an additional $1.55/bu. The total impact in going from zero to 35 billion gallons by 2025 is thus an increase of $2.43/bu in the price of corn. Soybean price also increased, in part to increased demand for soybean oil for biodiesel production and in part from competition with corn for available cropland.

Table 1. Major Crop Price Increases under Alternative Biofuel Scenarios Assuming CRP Land Does Not Return to Crop Production

Change in:	Zero to 15 billion gallon increase	15 to 35 billion gallon increase	Zero to 35 billion gallon increase
Corn Price ($/bu)	$0.88/bu	$1.55/bu	$2.43/bu
Soybean Price ($/bu)	$0.74/bu	$1.15/bu	$1.89/bu
Wheat Price ($/bu)	$0.25/bu	$0.57/bu	$0.82/bu
Cotton Lint Price ($/cwt)	$0.52/cwt	$0.84/cst	$1.36/cwt
Hay Price ($/Ton)	$2.46/T	$3.97/T	$6.43/t

Corn is an intensive user of nitrogen fertilizer, which is made primarily from natural gas. Expanded crop acreage due to biofuel production increases fertilizer consumption, which increases prices of the primary plant nutrients. Estimated domestic consumption and price effects for crop fertilizers are shown in Table 2.

Table 2. Effects of Alternative Biofuel Scenarios on Fertilizer Prices and Domestic Consumption

Change in:	Zero to 15 billion gallon increase	15 to 35 billion gallon increase	Zero to 35 billion gallon increase
Nitrogen Fertilizer Consumption	3.8%	8.4%	12.2%
Phosphorus Fertilizer Consumption	3.0%	6.9%	9.9%
Potassium Fertilizer Consumption	3.9%	8.6%	12.5%
Nitrogen Fertilizer Price	2.9%	6.6%	9.5%
Phosphorus Fertilizer Price	2.5%	5.8%	8.4%
Potassium Fertilizer Price	2.5%	5.6%	8.1%

In recent years the U.S. has imported about 50% of nitrogen (N), essentially no phosphorus (P), and 85% of potassium (K) fertilizer. Expanded biofuel production would thus increase imports of N and K fertilizers, partly offsetting any reduced reliance on imports of oil. World sources of P are being progressively depleted and

[1] Economic impacts are based on the assumption that 2.8 gallons of ethanol, and 17.4 lbs of DDGS by-product are obtained from a bushel of corn. DDGS obtained from a bushel of corn used for ethanol production is assumed to substitute for .275 bushels of corn and .039 bushels of soybean equivalent in livestock feed, primarily for pork production. Economic impacts assume continuation of current subsidies for corn ethanol and biodiesel production.

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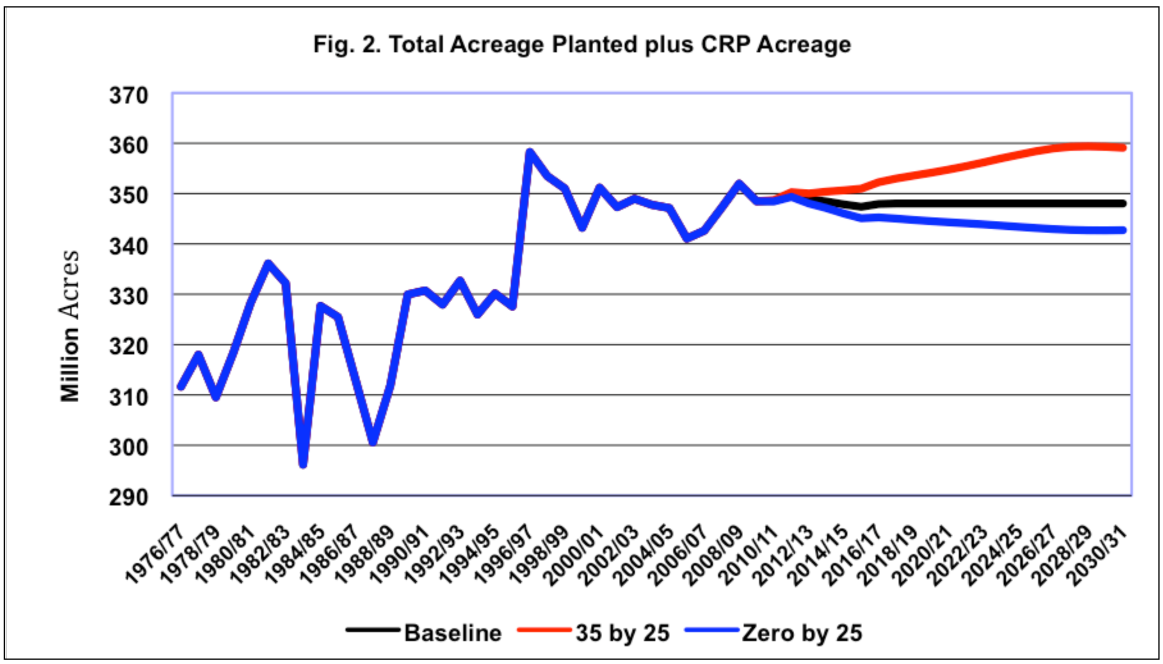
production costs are increasing. Most commercially viable reserves of P are found in only two locations, Morocco/Western Sahara and China. Predictions are that commercially viable reserves of phosphate rock in the United States will be depleted in only 25-30 years at present use rates. Depletion of U.S. supplies could occur much sooner with substantial use of plant material for biofuel production. Further discussion of the critical nature of P availability is discussed in another Briefing Paper.[2]

Cropped Acres

Effects of the biofuel scenarios on the total acreage planted to the 10 major field crops or in the conservation reserve program (CRP) are shown in Figure 2. For historical reference, this figure also shows actual acreage back to 1976. For the biofuel scenarios reported here, it is assumed that approximately 36 million acres of land in the CRP do not return to crop production.

Producing 35 billion gallons of first generation biofuel requires a net addition of 16.4 million cropped acres compared to acreage required without any biofuel produced (red line compared to blue line in Fig. 2). As can be seen from Figure 2, producing 35 billion gallons of first generation biofuel along with meeting demand for food would require more land than used for food production in previous decades and exceed the historic high for the past several decades.



[2] https://sites.auburn.edu/academic/ag/group/bioenergy/Phosphorus%20Policy%20Brief/Forms/Summary.aspx

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Aggregate Economic Impacts

Aggregate economic impacts of first generation biofuel production are shown in Table 3. The economic effects shown in this Table are the net impacts on farm income, taxpayer expense, and food consumers' surplus (consumer well-being), of the biofuel subsidies. Food consumers' well being is reduced through higher food prices and somewhat reduced consumption attributable to expanded biofuel production.

Table 3. Economic Effects of Alternative Biofuel Scenarios (billions of current dollars annually)

Item	Zero to 15 billion gallon increase	15 to 35 billion Gallon increase	Zero to 35 billion gallon increase
Change in Food Consumers' Well-Being	-$20.5 billion	-$46.2 billion	-$66.7 billion
Change in Net Farm Income for Major Field Crops	$17.8 billion	$36.9 billion	$54.7 billion
Change in Federal Taxpayer Expense for Biofuel Subsidy	$8.2 billion	$10.6 billion	$18.8 billion
Change in Net Economic Surplus (well-being) of Food Sector	**-$10.9 billion**	**-$19.9 billion**	**-$30.8 billion**

The baseline level of biofuel production (15 billion gallsons) reduces food consumer well being by $20.5 billion annually (Table 3). Federal biofuel subsidies are estimated at $8.2 billion annually for the baseline scenario. Thus citizens, in their dual role as food consumers and taxpayers have economic surplus losses totaling $28.7 billion annually for about 15 billion gallons of biofuel per year. Net farm income increases $17.8 billion annually. Net economic well being in the domestic food sector is estimated to decrease by $10.9 billion annually in the baseline scenario. This net negative impact on the domestic food sector must be weighed against presumably positive impacts on the non-agricultural economy.

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