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Will Biomass Markets affect Arkansas Crop and Livestock Agriculture? Some Preliminary Numbers

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Introduction

Biofuel production from non-edible biomass is becoming an increasing reality. It is likely that a percentage of traditional farmland will shift to the production of biomass in the form of dedicated energy crops. In Arkansas, switchgrass, a low-input-intensive perennial crop, and annually planted forage sorghum, a more input-intensive but higher-yielding crop, offers two biofuel feedstock choices with different implications for farmers and processors. This analysis used an optimization model to predict the statewide supply and location of biomass crops by county.

Data and Methods

The model took into account historical practices related to traditional crops (cotton, corn, rice, grain sorghum, soybeans and wheat) and cost of production information based on county-specific technologies and cropping practices. Cooperative Extension estimated cost of production budgets for 2007 and 2008 provided input prices for traditional crops. Costs of production were estimated for biomass crops using expert opinion (Table 1). Crop prices were based on July futures prices as of December or September of the previous year, depending on crop. In addition, the model accounted for details such as available Conservation Reserve Program acreage and maintaining cattle inventories. The baseline model optimized net returns for each crop and each county while meeting minimum historical irrigation and planted acreage constraints for the traditional crops, pasture, hay and CRP land.

Additional model runs introduced the alternative crops using a wide range of switchgrass prices (P_s) -- $25 to $65/dmt. This price reflects switchgrass stored in round bales at road-accessible sites. Forage sorghum was assumed to be sold standing in-field at a $5 discount to switchgrass.

Results

Table 2 shows changes in switchgrass and forage sorghum profitability with changes in P_s. When P_s is relatively low, switchgrass is more profitable than forage sorghum. At $40/dmt, however, irrigated forage sorghum's

Table 1. Estimated Total Specified Expenses for Switchgrass and Forage Sorghum by Production Practice using Nov. 2007 Input Costs, Arkansas.

		Switchgrass[1]			Forage Sorghum	
Description	**Units**	**Crop**	**Hay land**	**Pasture**	**Irr.**	**Non-Irr.**
Fertilizer (N-P-K-S)						
Urea (46-0-0)	lb	--	--	--	300	220
Ammonium Nitrate (34-0-0)[2]	lb	198	193	193	--	--
Phosphate (0-45-0)[3]	lb	24	26	26	110	110
Potash (0-0-60)[4]	lb	16	17	17	235	235
Lime[5]	ton	0.10	0.13	0.13	--	--
Irrigation	inch	0	0	0	6	0
Labor						
Operator	hrs	0.92	0.84	0.77	0.55	0.45
Hired	hrs	0.02	0.02	0.02	0.25	0.10
Fuel (incl. custom hire)	gal	5.08	4.68	4.33	12.81	5.80
Cost of Production						
Seed (incl. seed treatment)	$	8.40	10.50	10.50	22.53	15.17
Chemicals[6]	$	4.29	3.80	3.80	25.71	25.71
Custom Hire (excl. fuel)	$	3.97	8.06	8.01	17.89	17.89
Bale Wrap	$	10.68	9.89	8.93	--	--
Repair & Maintenance	$	6.83	6.44	5.91	7.24	4.67
Ownership Charges[7]	$	18.49	17.40	15.89	51.49	21.77
Operating Interest (7%)[8]	$	2.87	3.09	2.99	8.33	6.41
Total Specified Expenses[9]	$	103.41	108.63	104.39	297.69	211.28
Yield	dmt	5.2	4.6	4.1	6.5	9.8

Notes:

1 Useful life for switchgrass is 10 and 8 years, respectively, on crop vs. hay or pastureland. All costs and quantities are averaged and discounted over the useful life. 8 lbs of pure live seed are applied per acre and cost of harvest is yield-dependent. Note that chemical costs for establishment on hay or pastureland are based on the use of Atrazine which is currently not licensed. Using alternatives would add an additional $3.99 prorated cost per acre.

2 For switchgrass, assumes 0 pounds per acre in the establishment year and 220 pounds per acre thereafter. The amounts differ between crop and hayland due to the difference in useful life.

3 For switchgrass, assumes 75 pounds per acre in the fall prior to the establishment year. For subsequent years, assumes a similar amount averaged over 4 years (18.75) but applied only once every 4 years.

4 For switchgrass, assumes 50 pounds per acre in the fall prior to the establishment year. For subsequent years, assumes a similar amount averaged over 4 years (12.5) but applied only once every 4 years.

5 Assumes 1 ton per acre in the establishment year only.

6 Chemicals include herbicides, insecticides, fungicides, surfactants, adjuvants, harvest aides and growth regulators. Chemicals are applied only in year 1 for switchgrass; thus, numbers represent prorated amounts.

7 Ownership charges include depreciation and capital costs but not housing, insurance and taxes.

8 Operating interest (7%) is based on half of total specified expenses less ownership charges.

9 Opportunity costs per acre for the establishment year are not included in total specified expenses and amount to $25 and $35 per acre for pasture and hayland prorated over 8 years and $52.21 per acre and $98.71 per acre for 2007 and 2008, respectively, on cropland prorated over 10 years.

yield advantage results in relatively higher profits. 2007 and 2008 supply responses across traditional and biomass crop categories were also estimated. At P_s of $45/dmt, for example, combined forage sorghum and switchgrass acreage surpassed rice acreage with significant acreage reductions in cotton, corn, wheat, hay and pasture acres. Some added 120 to 160 thousand acres are cropped as a result of the introduction of these crop alternatives as well.

Increases in biomass acreage also lower statewide water usage since these crops require little to no irrigation. Results show that a $5/dmt increase in the price of biomass would lead to an average 1.5% decrease in water usage per acre statewide. These findings are deemed significant to maintaining profitable crop production in light of expected irrigation restrictions in the Arkansas Delta.

Figure 1 shows the potential locations of biorefineries, assuming a range of P_s. Biorefineries are assumed to process 30MM gal/yr and source from only one county. Predictions of exact acreage and location will remain a challenge, however, as supply response is quite variable at P_s > $35/dmt. With a scenario of increased input prices compared to 2007 levels, for example, biorefineries interested in a given level of supply would need to pay an average of $10/dmt more to get the same supplies. Regardless of year or input cost, significant changes in supply level in the $35 to $60 price range for P_s occur (~ 50,000 acres / $1 change in P_s).

In conclusion, model results suggest that significant acreage of both switchgrass, at low biomass prices, and forage sorghum, at higher biomass prices, will enter land use allocations. These findings held true even under scenarios of heightened input costs as experienced in 2008.

Table 2. Profit per Acre of Switchgrass and Forage Sorghum under Different Pricing Levels and Production Methods.

		Switchgrass Price[1]								
Year	Land Use	$25	$30	$35	$40	$45	$50	$55	$60	$65
		Profit Per Acre[2]								
2007	Switchgrass on Cropland	-$5	$15	$34	$54	$73	$93	$112	$132	$151
	Switchgrass on Hayland	-$16	$2	$20	$38	$56	$74	$92	$110	$128
	Switchgrass on Pastureland	-$19	-$3	$13	$30	$46	$62	$78	$95	$111
	Non-irrigated Forage Sorghum	-$63	-$31	$2	$34	$67	$99	$132	$164	$197
	Irrigated Forage Sorghum	-$82	-$33	$16	$64	$113	$162	$211	$259	$308
2008	Switchgrass on Cropland	-$16	$3	$23	$42	$62	$81	$101	$120	$139
	Switchgrass on Hayland	-$23	-$5	$13	$31	$49	$67	$85	$103	$121
	Switchgrass on Pastureland	-$27	-$10	$6	$22	$39	$55	$71	$87	$104
	Non-irrigated Forage Sorghum	-$82	-$49	-$17	$16	$48	$81	$113	$146	$178
	Irrigated Forage Sorghum	-$104	-$55	-$6	$43	$91	$140	$189	$238	$286

Notes:

[1] Note that forage sorghum was priced at a constant $5 per dmt less than switchgrass for all switchgrass price levels and that average yields for switchgrass on crop, hay and pastureland, and for non-irrigated and irrigated forage sorghum were 5.2, 4.56, 4.125, 6.5 and 9.75 dry tons per acre, respectively.

[2] Profit per acre figures include opportunity cost for the year of establishment for switchgrass. Forage sorghum is not expected to be grown on pastureland. Non-irrigated forage sorghum as well as other non-irrigated crops of grain sorghum, soybean, wheat and cotton can be established on hayland with the cost of preparing a seedbed allocated to the haying enterprise.

Figure 1. 2008 Estimated Biomass Supply and Biorefinery Locations with Varying P_s.

Outlook for 2009 Wheat Production

Scott Stiles, Extension Economist, University of Arkansas Cooperative Extension Service

Largely due to higher commodity prices, Arkansas wheat growers planted 970,000 acres in 2008 (+18% over prior year). In contrast, Arkansas' wheat acreage will decline dramatically in 2009. Early estimates indicate that wheat acreage could be down as much as 50% to 485,000 acres—the lowest acreage since 2006 (365,000). Reduced acreage can be attributed to both weak basis levels and higher production costs.

Many Arkansas wheat growers produced a profitable crop in 2008. In spite of excessively wet conditions earlier this year, Arkansas managed a state average yield of 58 bushels per acre. Futures prices also provided favorable marketing opportunities with July '08 futures spending much of the 2007/08 growing season between $8 and $12 per bushel.

July 2009 wheat futures are currently trading near $7.50 per bushel—a high price level by historic standards. But, growers looking to forward price 2009 wheat are faced with a historically wide basis. Why? One key factor is an improvement in the global wheat supply and demand balance. Due to increased acreage and a lack of production problems in the European Union, Russia, and Ukraine, global wheat production will be up 11% this year; to a record high of 676 million metric tons. Global wheat demand is strong, but for present time European nations, Russia and the Ukraine are capturing the majority of global wheat sales.

New crop wheat basis in eastern Arkansas ranges from $2.00 to $2.40 under July '09 futures. Thus, growers are currently offered a forward price of $5.10 to $5.50 per bushel depending on delivery location. For many growers these prices will not cover variable production costs.

Using University of Arkansas estimated production costs, break-even yields on sand/silt loam soils to cover variable costs are as follows:

- 61 to 66 bushels per acre on owned land (assumes $5.30 net price for production)
- 83 to 89 bushels per acre on 75/25 rented land (assumes $5.30 net price for production)

The 2009 University of Arkansas wheat production budgets are available at the following Internet address:

http://www.aragriculture.org/crops/wheat/budgets/2009/default.htm

2009 wheat production costs will increase dramatically from the previous year. Preliminary budgets indicate wheat variable costs will average $352 per acre. This represents a $160 per acre or 83% increase over 2008. Fertilizer accounts for the majority of the variable cost increase. Combined DAP and urea costs are estimated to be $237.90 per acre—accounting for 68% of total variable costs. For 2009 budgets, urea was projected to be $1,050 per ton

and di-ammonium phosphate or DAP was projected to be $1,200 per ton.

Urea and DAP prices have increased substantially over the previous twelve (12) months. Since September 2007, U.S. Gulf DAP prices have increased 168% or $727 per ton. U.S. Gulf urea prices have increased 119% or $411 per ton over the same time period. Increases in fertilizer prices correlate well with rising grain and energy prices. U.S. dollar weakness during much of 2008 has also contributed to higher imported fertilizer costs. With strong global interest in feed grain production and intense competition for world fertilizer supplies, nitrogen and other nutrient prices are expected to remain firm in 2009.

Growers can download an Excel crop budgeting tool that will assist in determining production costs and returns at this website: http://www.uaex.edu/depts/ag_economics/default.htm The spreadsheet link is shown as *"crop planning budgets (MS Excel)."*

Trends in Arkansas Farmland Values: The 2008 Update

Terry Griffin, Assistant Professor and Extension Economist, Bruce Ahrendsen, Professor, Brad Watkins, Associate Professor and Extension Economist, and Jeffery Hignight, Program Associate, U of A Division of Agriculture, Agricultural Economics and Agribusiness Department

Farmland values have generally trended upward over time. This long-term trend in Arkansas and U.S. farmland values is shown in Figure 1. Farmland values in many other states followed similar trends of increased values during the 1970s followed by similar decreased values in the 1980s, with a steady to accelerated increase since the mid to late 1980s

Arkansas farmland values increased again last year, although at a slightly lower rate than in the previous year. Figure 2 helps to illustrate these events by graphing the percent change in farmland value from year to year; when the line or dot falls below zero, then the farmland value has decreased from the previous year. This year was the first time in the last five years that farmland values have not increased at or above 10%.

Although Arkansas farmland values continued a brisk rate of increase of 9% last year, farmland values in states such as Illinois, Iowa, North Dakota, Nebraska, and South Dakota increased at rates from 16% to 21%. Strong prices for corn, soybeans, and wheat certainly had an impact.

Types of Arkansas farmland can be compared over the last twelve years including 1) farm real estate, which is defined as the value of all land and buildings in the farm; 2) cropland; 3) irrigated cropland; 4) non-irrigated cropland; and 5) pasture land. All the measured types of farmland have been on the rise since 1997; however, the most notable increase has been in pasture land relative to cropland whether irrigated or non-irrigated (Figure 3). Pasture land values have been increasing at a faster rate than other types of farmland, surpassing the value of irrigated cropland in 2006. This trend in pasture land values has also been documented in surrounding states.

The annual increase in pasture values has averaged 13.6% from 2004 to 2008, compared with 8% to 9% for the other farmland types. However, during 2007, the increases in all farmland types were between 4% and 9%, much less than the previous three years.

Bottom-line Considerations

It is widely accepted that farmland values have been influenced by non-agricultural uses. What once was reserved for the production of crops and livestock are now being used for residential and recreational purposes as well. However, with the current slow-down in the economy, people may not have as much disposable income to spend on new residences and recreation. Yet, some investors may consider farmland to be a better investment than other investments. It is uncertain if farmland values will continue to increase in value, remain steady, or begin to decline. For more information contact your local University of Arkansas Cooperative Extension Service county Agent or Extension economist.

Figure 1. U.S. and Arkansas nominal farmland values, January 1.

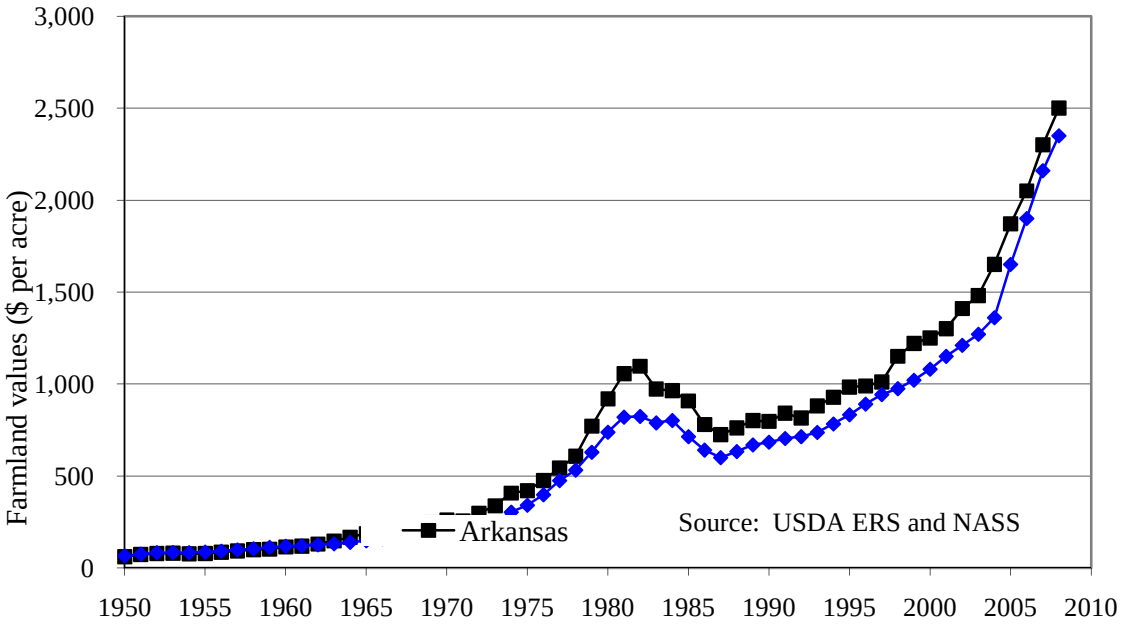


Figure 2. Percent change in Arkansas farmland values.

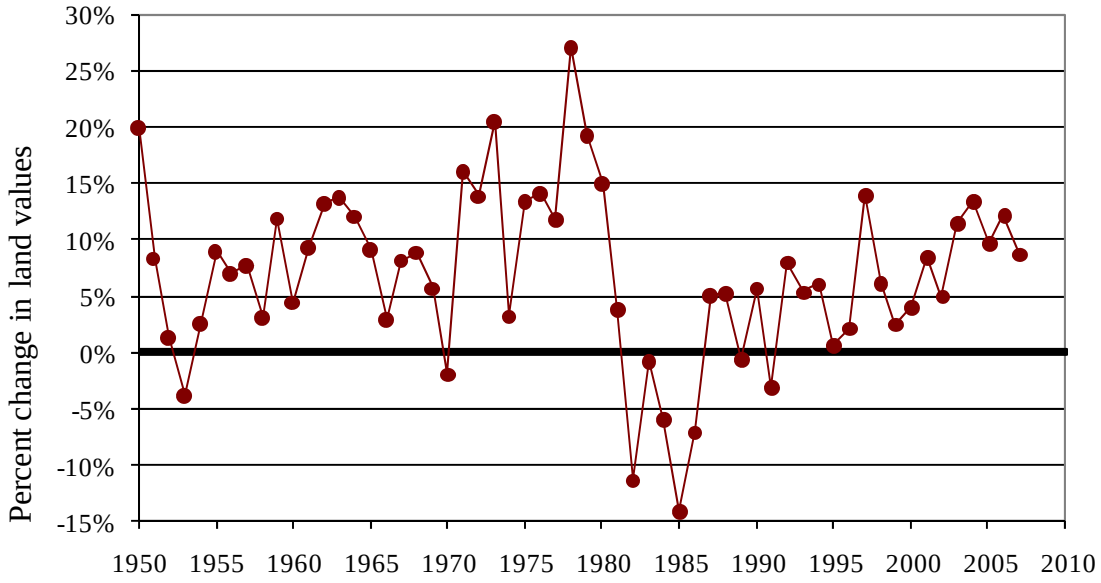
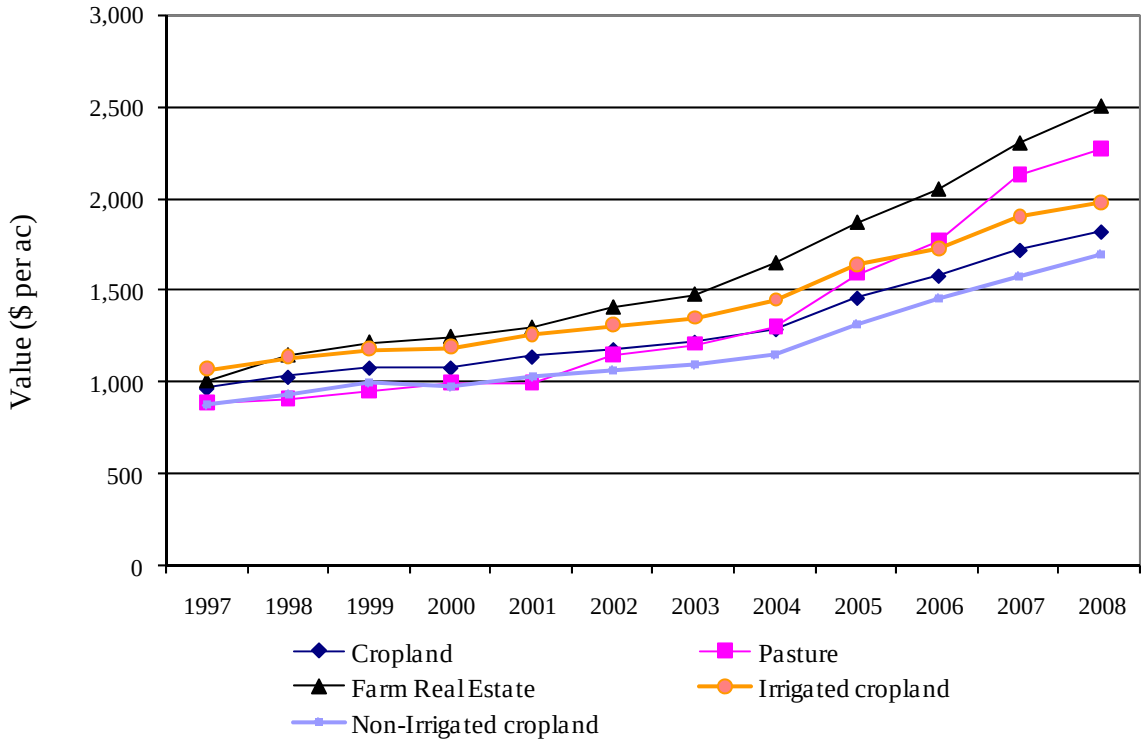


Figure 3. Arkansas farmland values by type, January 1



Resources

Arkansas farmland value information has been compiled from USDA sources and is available on-line at http://www.uaex.edu/depts/ag_economics/default.htm

USDA-ERS Value of Land & Buildings Per Acre. Stock Number 87012. January 1995 Available on-line at: http://www.ers.usda.gov/data/archive/87012/

USDA-NASS Arkansas Field Office. Arkansas Land Values and Cash Rents. Available on-line at: http://www.nass.usda.gov/ar/

The Impact of Agriculture on the Arkansas Economy in 2006

Jennie Popp, Associate Professor, Nathan Kemper, Program Associate, and Wayne Miller, Extension Economist, U of A Division of Agriculture, Agricultural Economics and Agribusiness Department

Arkansas' agricultural production, processing and retail sectors, expressed as a percentage of total Gross Domestic Product (GDP) by State, has exceeded those of surrounding states since at least 1969 when the Bureau of Economic Analysis (BEA) began publishing regional GSP information. For example, in 2006 the agriculture sector accounted for nearly 12% of Arkansas' GDP by State (Table 1). Arkansas' agriculture sector as a percentage of its GDP by State was about double that of most other Southern region states. It was more than double that of the United States' (US) agricultural production, processing and retail sectors as a percentage of its Gross Domestic Product (the national equivalent to a state's GDP) in 2006.

Agriculture has historically been one of Arkansas' primary economic sectors. While agriculture contributes to the economy through direct agricultural production and value-added processing, it also plays an important role through its interactions with other sectors. The use of non-agricultural goods and services as inputs for agricultural production and the purchase of goods and services by agricultural sector workers promotes diversified growth in

Arkansas' economy, thereby allowing agriculture to remain a vital part of the Arkansas state economy. A study was recently undertaken to analyze the impact of agricultural *production and processing* in the state for the year 2006.

Methods

To measure agriculture's total economic impact, direct production and processing impacts as well as the indirect and induced impacts of agriculture must be taken into consideration. Indirect impacts occur when the agriculture sector purchases goods and services from local businesses. The existence of certain banking services is an indirect impact of agricultural production. Agriculture's induced impacts are measured by increases in economic activity to satisfy the personal consumption by employees of the agriculture sector or by employees of firms that provide inputs to the agriculture sector. The sum of direct, indirect, and induced agricultural effects provides a measure of the total economic impact of agriculture.

Table 1. Agricultural Production, Processing and Retail as a Percentage of Gross Domestic Product by State, 2006[a]

State/Region	Percent of GDP by State
Arkansas	11.62
Mississippi	9.09
Tennessee	6.87
Missouri	6.58
Oklahoma	5.14
Louisiana	4.27
Texas	4.07
Southeast[b]	6.94
U.S.	5.22[c]

Source: USDC, BEA, Regional Accounts Data (2008).
[a] Current 2006 dollars
[b] In 2006, the BEA data for the Southeast region includes Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia.
[c] Agriculture is measured as a percent of GDP for the U.S. GDP by State is the equivalent measure of GDP used for the nation.

The economic impacts of Arkansas' agricultural sector were modeled using the Impact Analysis for Planning (or IMPLAN) System. IMPLAN is an input-output model which uses a computerized database to create regional economic multipliers. There are 509 sectors in IMPLAN - 109 agricultural sectors and 400 non-agricultural sectors. The agricultural sectors are categorized by three broader industries, agricultural production, agricultural processing and agricultural-related. Once the impact analysis is complete, impact results for the 509 IMPLAN sectors are aggregated into 20 2-digit NAICS industries. Arkansas data for 2006 from the Minnesota IMPLAN Group, Inc., the most recent data available, were used to calculate all impacts. Total employment, wages and value added impacts were calculated for all of the IMPLAN sectors; then results were summarized into the 20 NAICS industries. All labor income and value added figures are reported in 2006 dollars unless otherwise noted.

Results

Direct, Indirect and Induced Impacts

Table 2 shows the direct, indirect and induced impacts of agriculture on employment, value added and wages in the Arkansas economy. In 2006, the agricultural sector made large contributions to the economy in terms of employment, wages and value added. The agriculture production and processing sector provided 274,150 jobs, or 17.6%, of state employment. That is, one in six Arkansas jobs can be attributed to agriculture. Agriculture, either directly or indirectly, paid $9.1B or 16.0% of total state labor income and contributed $15.9B or 17.8% of state value-added. That is, about $1 out of every $6 in value added can be attributed to agriculture.

The agricultural sector's direct impact on the state economy is measured by the sum of the impacts of farm production and processing of farm products. There were 149,313 workers employed by the agricultural production and processing sectors. The livestock industry employed more than one out of every three (or 41%), whereas crop industries employed nearly 35% and forestry nearly 24% of these production and processing workers. These workers, and owners of these farms and businesses, received over $4.6B in labor income. Almost 77% of the labor income went to workers in processing industries. Crop, livestock and forestry industries directly added value of $8.3B to

Table 2. The Aggregate Agriculture Sector's Impact on Arkansas' Economy, 2006

	Employment [a]			Labor Income [b]			Value-Added [c]		
	Number of Jobs	% Total Impact	% Total Arkansas Jobs	Million $ [d]	% Total Impact	% Total Arkansas Labor Income	Million $	% Total Impact	% Total Arkansas Value Added
Production	63,077	23.0	4.0	1,076	11.8	1.9	2,759	17.3	3.1
Processing	86,236	31.5	5.5	3,581	39.3	6.3	5,527	34.7	6.2
Ag-Related	11,143	4.1	0.7	284	3.1	0.5	255	1.6	0.3
Direct Impact	**160,456**	**58.5**	**10.3**	**4,941**	**54.2**	**8.7**	**8,541**	**53.6**	**9.5**
Indirect Effects	59,777	21.8	3.8	2,608	28.6	4.6	4,363	27.4	4.9
Direct + Indirect Impact	**220,233**	**80.3**	**14.1**	**7,549**	**82.9**	**13.3**	**12,903**	**81.0**	**14.4**
Induced Effects	53,917	19.7	3.5	1,560	17.1	2.7	3,031	19.0	3.4
Total Impact	**274,150**	**100.0**	**17.6**	**9,109**	**100.0**	**16.0**	**15,934**	**100.0**	**17.8**

Source: Computed using the 2006 Arkansas database from MIG (2007)

[a] Equivalent to full- and part-time jobs (MIG, 2002)

[b] Labor income represents all forms of employment income; it is the sum of employee compensation and proprietor income (MIG, 2000)

[c] Value-added is the sum of employee compensation, proprietary income, and indirect business taxes

[d] Current dollars

[e] Appendix A, Table 3 lists sectors of direct agricultural production in terms of IMPLAN sectors

[f] Appendix A, Table 3 lists sectors of direct agricultural processing in terms of IMPLAN sectors

[g] Ag-related sectors include agricultural sectors not categorized as agricultural production or processing. These sectors are: Fishing, Hunting and Trapping, Agriculture and Forestry Support Activities, and New Farm Housing Units and Additions and Alterations

the Arkansas economy, two thirds of which came from processing industries. Ag-related industries added 11,143 jobs, $0.3B in labor income and $1.6B in value added.

Indirect impacts result when agricultural firms purchase raw materials and services from other Arkansas businesses to produce their products. In 2006, there were 59,777 workers employed by industries supplying goods and services to the farm production and processing industries. These workers and the owners of those establishments received $2.6B in labor income and these industries added value of $4.4B to the state economy.

Induced impacts result when employees of agricultural firms and employees of the raw material and service firms make local purchases. There were 52,917 workers employed by businesses providing goods and services to the employees in agriculture and its supplying industries. These employees and the proprietors of these businesses received over $1.6B in labor income and added value of over $3.0B to the Arkansas economy.

Where Jobs, Labor Income and Value Added are Generated

The impacts of agriculture are far reaching throughout the economy. Agriculture generates employment, wages and value added in all 20 sectors. However, three sectors (*Manufacturing, Agriculture*

Table 3. Industries Where Jobs are Generated by Arkansas Agriculture

Sectors	Total	Percent Jobs Ag Generated	Percent Jobs All AR
Manufacturing	90,145	33	45
Ag, Forestry, Fish & Hunting	74,220	27	100
Retail Trade	14,030	5	8
Health & Social Services	13,313	5	8
Transportation & Warehousing	12,813	5	25
Top Five Total	**204,521**	**75**	**31**

Forestry, Fishing and Hunting consistently rank in the top five of the 20 industries when ranked by total jobs (Table 3), labor income and value added (Table 4) generated by agriculture. Together these three sectors contribute at least 60% of the generated job, labor income and value added benefits. The top five sectors contribute 65% of jobs, 63% of labor income and 61% of value added.

Both agricultural and non-agricultural sectors benefit from the existence of agriculture in the state. The presence of agriculture leads to the creation of 113,694 jobs, generates $4.2B in labor income and $7.4B in value added in non-agricultural sectors. This represents roughly 7% of all jobs, 7% of all labor income and 8% of all value added generated by the presence of agriculture in Arkansas.

Table 4. Industries Where Value is Generated by Arkansas Agriculture

Top Five TVA	Total ($M)	Percent Value Added Ag Generated	Percent Value Added % of AR Base
Manufacturing	5,871	37	40
Ag, Forestry, Fish & Hunting	3,014	19	100
Wholesale Trade	1,266	8	24
Transportation & Warehousing	793	5	16
Government & non NAICs	781	5	4
Top Five Total	**11,725**	**74**	**25%**

Discussion and Conclusions

This research suggests that agriculture is very important to the economy of Arkansas. Almost 18% of all jobs and added value and 16% of all labor in the state exist because of agriculture. Agriculture generates benefits in all of the 20 2-digit NAICS industries, which include agricultural and non-agricultural sectors, as defined for this study.

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We hope you find our newsletter useful. If you have any comments or questions regarding these articles, or would like to make suggestions for future articles, contact the editor.

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