The Economic Impact of Agriculture in Sedgwick County, KS

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Introduction

The size and structure of agriculture has changed dramatically over the past century. The application of new cultural practices and technology has increased agricultural productivity and output. Structural changes continue as the scale of productive activity and vertical integration of production systems increase. Many of these changes have raised important policy questions related to agricultural support, the welfare of rural communities, and the nature of farming systems. To put these issues in perspective, it may be helpful to get a clearer picture of what agriculture actually contributes to the county's economy.

Determining the economic impact of an industry is not a simple matter. We know, for example, that industries are connected directly and indirectly in important ways. Tracking these connections can be a challenge. Similarly, the relative strength of the linkages between industries is another important consideration. If one industry is dependent on another to the extent it may not exist in the absence of the first, where is the line between the two? Measuring the impacts of agriculture, in particular, is doubly difficult because of the lack of information related to very basic measures such as employment.

Certain accounting techniques using information available from published economic reports can be used to estimate the scale and strength of economic linkages between industry sectors. The Micro-IMPLAN input-output modeling system combines national, state, and local economic data to create accounts that can be used to describe economic relationships and estimate economic impacts. This system was used to estimate the economic contributions of agriculture to the Sedgwick County economy. The information is current to 2003, the most recent year for which needed information was available. All dollar figures are presented in 2003 dollars.

This paper proceeds with a brief discussion of the modeling system used for this project. The next section presents various measures of direct economic impact for several sectors known to be important to county agriculture. Finally, the definition of agriculture used in this research and estimates of direct and indirect economic impacts are presented, identifying the value of agriculture to the county's economy.

Input-Output Analysis

Input-output (I-O) analysis is a system of accounting for the economic transactions occurring in an economy at a point in time. An I-O model traces the flow of dollars between business sectors,

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households, government, and other non-local consumers of locally-produced goods and services. I-O analysis enables estimates of how spending in one area of the economy "ripples" through the economy to other sectors as businesses buy and sell to one another and generate income for local labor and proprietors. The I-O system used in this research is the IMPLAN (IMpact analysis for PLANning) system developed by the U.S. Forest Service. The system uses data published in government economic reports as the basis for constructing economic accounts for every county and state in the U.S. It uses national average production relationships to estimate economic linkages between sectors.

The data related to agriculture comes from various sources. The primary information resources used to construct agriculture accounts come from the National Agricultural Statistical Service (NASS), the Census of Agriculture, and the Bureau of Economic Analysis. A variety of techniques are used to estimate non-disclosed information and distribute the activity geographically. All of the information is allocated against known benchmarks to ensure consistency of the system.

Estimates of Economic Impact

Economic impacts can be reported in several ways. The most general measure of impact would be economic output, the overall value of production. For most sectors, output can be interpreted as the value of sales. It represents the increment of additional value to a product created by a given producer. In this modeling system, only that increment of new value is attributed to a given sector to avoid double counting the value of economic activity. For example, in the trade sectors, only the retailer's margin is counted and attributed to trade. The cost of the good sold and the cost to transport the good is allocated to the manufacturing and the trucking sectors.

Another common measure of impact would be changes to local income. Employee compensation (wages, salaries and certain fringe benefits), proprietary income, other property income (rents, royalties and corporate dividends) and value added (the sum of the three types of income plus indirect business taxes) are shown. Value added is the broadest measure of total income associated with productive activities and, as such, is the preferable measure with which to evaluate overall household welfare. Employment impacts are also reported. Employment is reported in number of jobs without regard to whether the job is full-time or part-time. Finally, the value of imports and exports are included.

Economic impacts arise in several ways. The employment, payroll and sales of a given firm or sector are considered the direct economic impacts and are readily observed directly at a firm. Indirect impacts arise from the inter-industry trading relationships that exist in the county as businesses buy the output from one firm as an input into their production. In the IMPLAN modeling system, the inter-industry trading relationships are based on a national "production recipe" for up to 528 economic sectors.

The spending of household income derived from labor and investment generates a third type of impact called the induced effect. Household spending has the effect of spreading economic impacts broadly throughout the economy.

An Overview of the Sedgwick County Economy

A 311-sector model of the Sedgwick County economy was built. The standard way to represent the economic sectors is by use of the North American Industry Classification System (NAICS). Using the most general aggregation of industries, we can get an initial view of overall economic activity in the county. Several measures of economic activity by sector are shown in Table 1.

Table 1. Sedgwick County Economic Activity by Economic Sector, 2003, (2003$)

Industry	Industry Output*	Employment	Total Value Added*
Ag, Forestry, Fish & Hunting	128.717	2,251	57.382
Mining	1,137.149	4,636	520.237
Utilities	281.655	587	191.394
Construction	1,800.571	17,851	770.166
Manufacturing	19,041.911	53,478	4,425.778
Wholesale Trade	1,431.946	11,693	1,089.121
Transportation & Warehousing	1,125.707	12,639	600.386
Retail trade	1,633.262	32,025	1,238.764
Information	1,321.150	6,376	597.513
Finance & insurance	1,480.345	10,853	949.034
Real estate & rental	1,228.610	10,400	825.358
Professional- scientific & tech services	1,128.482	12,748	634.686
Management of companies	461.557	3,384	254.893
Administrative & waste services	1,018.624	17,688	534.798
Educational services	216.460	5,041	121.302
Health & social services	2,408.238	33,068	1,480.680
Arts- entertainment & recreation	141.483	5,108	71.751
Accommodation & food services	1,025.082	23,390	476.512
Other services	934.026	16,423	457.520
Government & non NAICs	2,944.456	32,866	2,535.296
Totals	**40,889.429**	**312,506**	**17,832.571**

*Millions of dollars

Source: Minnesota IMPLAN Group, 2006

As measured by total value of production, manufacturing is the largest economic sector by far in Sedgwick County with nearly $20 billion in output (sales). The largest sector within manufacturing, of course, is aircraft-related. The picture changes when considering other measures of economic activity. The combined service sectors provide the largest source of employment and income (value added) in the county. In addition to manufacturing, government and combined wholesale and retail trade are other major sources of jobs and income.

A somewhat closer look at income generation is shown in Table 2 as value added is broken into its component parts. Employee compensation and proprietor's income together make up the income earned by labor in the county. Other property income is investment income such as dividends, interest, rents and corporate profits. Indirect business taxes are certain taxes paid by local employers.

Table 2. Sedgwick County Value Added by Type and Economic Sector, 2003 (2003$)

Industry	Employee Compensation*	Proprietor Income*	Other Property Income*	Indirect Business Tax*
Ag, Forestry, Fish & Hunting	20.128	10.427	23.850	2.978
Mining	45.189	136.982	279.572	58.494
Utilities	46.286	10.996	105.430	28.683
Construction	556.898	99.223	104.573	9.472
Manufacturing	3,582.061	195.214	548.409	100.093
Wholesale Trade	557.069	52.534	243.736	235.782
Transportation & Warehousing	374.517	97.157	101.646	27.067
Retail trade	725.300	55.572	227.727	230.165
Information	245.768	39.468	245.725	66.552
Finance & insurance	417.499	40.921	461.914	28.699
Real estate & rental	109.253	103.096	481.024	131.985
Professional- scientific & tech services	406.035	128.737	89.788	10.126
Management of companies	194.114	1.763	54.804	4.213
Administrative & waste services	390.758	34.351	96.912	12.777
Educational services	114.154	3.177	1.276	2.694
Health & social services	1,189.257	114.631	161.632	15.160
Arts- entertainment & recreation	41.467	13.194	10.027	7.063
Accommodation & food services	289.146	41.724	94.725	50.917
Other services	283.584	64.396	67.877	41.663
Government & non NAICs	1,455.255	0.000	908.382	171.659
Totals	**11,043.736**	**1,243.564**	**4,309.029**	**1,236.242**

*Millions of dollars

Source: Minnesota IMPLAN Group, 2006

Sedgwick County Agricultural Production

In total, agricultural production sectors in Sedgwick County produced about $128 million worth of commodities in 2003 as shown in Table 3. Agriculture is one of the important exceptions to the accounting rule that output only include the increment of value generated within the sector. Given the available data, the direct output estimate for agriculture involves a considerable amount of "double counting" the value of production inputs. A better indicator of the increment of value produced within a commodity production sector is the value added estimate. Production sectors also accounted for about 2,250 jobs and $57 million in all types of income (Table 3). Additional detail regarding the contents of each of the commodity sectors is provided in an attached appendix.

Table 3. Sedgwick County Commodity Production and Food Processing, 2003, (2003$)

Industry	Industry Output*	Employment	Total Value Added*
Oilseed farming	8.369	90	4.657
Grain farming	43.260	977	22.470
Fruit farming	0.335	2	0.218
Greenhouse and nursery production	5.697	35	5.485
Cotton farming	0.715	6	0.384
All other crop farming	6.602	39	4.172
Cattle ranching and farming	40.750	430	4.320
Poultry and egg production	4.716	10	2.170
Animal production, except cattle and poultry	1.956	55	0.327
Agriculture and forestry support activities	16.317	606	13.179
Commodity Totals	128.717	2,250	57.382
Dog and cat food manufacturing	51.861	56	7.221
Other animal food manufacturing	19.661	33	2.847
Flour milling	147.648	220	19.981
Fruit and vegetable canning and drying	2.163	7	0.301
Fluid milk manufacturing	103.015	193	11.270
Animal, except poultry, slaughtering	160.288	415	30.379
Meat processed from carcasses	452.529	1,305	63.583
Rendering and meat byproduct processing	9.796	15	4.042
Poultry processing	19.369	90	7.238
Processing Totals	966.330	2,334	146.862
Total Ag. and Processing	1,095.047	4,584	204.244
Total Sedgwick County	40,889.429	312,506	17,832.571

*Millions of dollars

Source: Minnesota IMPLAN Group, 2006

Sedgwick County is a major producer of grains in Kansas. Its importance is seen across all impact measures. It generated about $43 million in output, nearly 1,000 jobs and $22 million in all types of income. The value of beef production in the county is the other major commodity production sector. Recall, the value added measure is probably the best estimate of the new wealth created by the sector.[2]

[2] In this case, the value added totals for cattle ranching and farming are probably under-estimates. It's known that 2003 was a very good year in the cattle industry. Yet, the economic accounts used to construct the income estimates would make it appear cattle production was not especially profitable in the year. This is because the benchmark income estimates produced by the U.S. Bureau of Economic Analysis and used to calibrate the model only report an aggregate farm income number. When generating the agricultural sector detail, the income is distributed across the sectors using an average level of profitability for the whole of agriculture. Given that 2003 was not a great year for overall farm profitability, it depresses the estimate for the cattle sector. Unfortunately, there is not alternative information available with which to estimate detailed income in the cattle industry.

Commodity production is only part of the economic activity associated with agriculture. Food processing, too, contributes significantly. While classified as nondurable goods manufacturing, it can be broken out of the broader sector and highlighted. Table 3 also contains information about the Sedgwick County food processing sectors known to have a strong connection to commodity production. The combined food processing sectors accounted for nearly $1 billion in total industry output in 2003. Further, they generated about 2,300 jobs and nearly $150 million in county income.

Table 4 breaks total valued added into its component parts. Once again, grain production is a major source of income in the commodity-production group. Livestock slaughtering and processing are major income generators in the food processing group.

Table 4. Sedgwick County Value Added by Type for Commodity and Processing Sectors, 2003 (2003$)

Industry	Employee Compensation*	Proprietor Income*	Other Property Income*	Indirect Business Tax*
Oilseed farming	0.044	1.382	2.983	0.247
Grain farming	0.755	5.448	15.210	1.057
Fruit farming	0.066	0.036	0.107	0.010
Greenhouse and nursery production	1.309	0.852	3.246	0.078
Cotton farming	0.053	0.031	0.291	0.009
All other crop farming	0.391	0.646	2.962	0.173
Cattle ranching and farming	1.492	0.112	1.552	1.163
Poultry and egg production	0.384	0.245	1.520	0.022
Animal production, except cattle and poultry	0.165	-0.017	0.139	0.041
Agriculture and forestry support activities	15.470	1.692	-4.161	0.178
Commodity Totals	**20.129**	**10.427**	**23.849**	**2.978**
Dog and cat food manufacturing	3.175	0.270	3.453	0.323
Other animal food manufacturing	2.081	0.074	0.539	0.153
Flour milling	10.553	0.242	8.291	0.895
Fruit and vegetable canning and drying	0.138	0.005	0.151	0.008
Fluid milk manufacturing	9.105	0.065	1.498	0.603
Animal, except poultry, slaughtering	24.888	2.155	1.681	1.655
Meat processed from carcasses	49.042	1.015	10.440	3.086
Rendering and meat byproduct processing	1.583	0.016	2.340	0.102
Poultry processing	4.257	0.043	2.771	0.166
Processing Totals	**104.822**	**3.885**	**31.164**	**6.991**
Total Commodity and Processing	**124.951**	**14.312**	**55.013**	**9.969**
Total Sedgwick County	**11,043.736**	**1,243.564**	**4,309.029**	**1,236.242**

*Millions of dollars
Source: Minnesota IMPLAN Group, 2006

Exporting Kansas Agricultural Output

County agriculture supplies food to other areas of the state, country and world. Exporting commodities and processed foods attracts income to the county to support not only agriculture

but other sectors as well through indirect linkages. Table 5 shows the estimated value of imports and exports for selected agricultural production and processing sectors.

Table 5. Value of Commodity Exports by Destination and Industry Imports by Source, 2003 (2003$)

Commodity/Industry	Foreign Commodity Exports*	Domestic Commodity Exports*	Total Commodity Exports*	Foreign Export Proportion	Total Industry Imports*	Total Industry Foreign Imports*
Oilseed farming	3.07	5.16	8.23	0.37	2.30	0.11
Grain farming	8.08	29.02	37.09	0.22	14.11	0.92
Fruit farming	0.06	0.26	0.32	0.18	0.08	0.00
Greenhouse and nursery production	0.23	4.72	4.95	0.05	0.14	0.01
Cotton farming	0.40	0.30	0.70	0.57	0.23	0.01
All other crop farming	0.40	4.69	5.09	0.08	1.64	0.15
Cattle ranching and farming	0.07	0.00	0.07	1.00	24.63	0.72
Poultry and egg production	0.05	2.62	2.67	0.02	2.06	0.06
Animal production- except cattle and poultry	0.13	0.00	0.13	1.00	1.22	0.05
Agriculture and forestry support activities	0.03	15.85	15.88	0.00	2.45	0.30
Dog and cat food manufacturing	3.42	48.16	51.58	0.07	33.06	1.18
Other animal food manufacturing	0.65	20.82	21.47	0.03	13.04	0.69
Flour milling	3.84	129.91	133.75	0.03	82.09	2.16
Fruit and vegetable canning and drying	0.14	5.37	5.51	0.03	1.26	0.12
Fluid milk manufacturing	0.24	55.45	55.69	0.00	57.27	2.15
Animal- except poultry- slaughtering	20.08	0.00	20.08	1.00	90.99	5.70
Meat processed from carcasses	12.83	345.44	358.28	0.04	178.09	10.58
Rendering and meat byproduct processing	1.54	2.41	3.94	0.39	2.15	0.35
Poultry processing	0.77	0.00	0.77	1.00	8.56	0.06

*Millions of Dollars
Source: Minnesota IMPLAN Group, 2006

By far, the major export items are grain, flour and processed meats. Most of the exports are to domestic sources of demand (somewhere outside the county but in the U.S.).

Imports are the other side of the coin in trade relations. They represent an economic leakage from the region by sending money out of the county to bring goods in. High levels of imports, however, are not necessarily bad. If raw products are brought into region for further processing, they can represent a significant source of income generation.

Ethanol Production

Sedgwick County also hosts and ethanol production plant, Abengoa Bioenergy, in Colwich, about 20 miles northwest of Wichita. This activity, too, would not exist if not for the production of agricultural commodity inputs and therefore is appropriately considered along with agricultural production.

Unfortunately, the available information related to Abegoa Bioenergy was somewhat limited for purposes of this analysis. While specific quantities of fuel alcohol and intermediate grain products production were known, no sales or payroll information was available. However, total employment at the facility, 43 workers, was known. This value was applied to the broader sector

in which ethanol production is classified, other basic organic chemical manufacturing, to estimate values for output and value added. Applying the county-level coefficients, it was estimated that these 43 workers produced $34.2 million worth of output and generated $4.9 million in value added.[3]

Direct and Indirect Impacts of Sedgwick County Agriculture

There are several ways to estimate the indirect economic effects of an industry sector. The method chosen partially depends on the assumptions made regarding what constitutes an "economic impact." For many, economic impact arises from a business or industry's ability to attract dollars from outside the economy. Thus, only businesses that export goods or services outside the local economy (thereby importing new income) would be considered to generate an economic impact. Following this conception, the economic activity associated with meeting purely local demand would not be counted as generating economic impact. This might be considered the more "conservative" approach to estimating economic impacts. Indeed, given the accounting system used in I-O analysis, this approach requires that all industries' cumulative direct and indirect economic impacts must sum to no more than the amount directly observed.

The second and perhaps more common approach to impact analysis is to use economic multipliers. Economic multipliers are numeric estimates of the combined overall impact of an activity or an event. As such, they capture the economic activity necessary to satisfy both local and non-local demand for goods and services. Many believe this is the preferred method of estimating economic impact because even if a business exists to meet purely local demand, it is nonetheless in business providing jobs and paying taxes. The problem with this approach, however, is that economic multipliers inherently contain some amount of "double counting." While there are methods to reduce the double counting problems, some inherently remains. If one were to calculate economic multipliers for every industry sector and add up all of the associated impacts, the sum is typically more than the total value of the economy.

For purposes of this paper, both methods are used to estimate the economic impact of agriculture. Together, the more conservative estimate and the more generous estimate might be considered a confidence interval (low- and high-end estimates) within which something close to the actual impact would be found.

Table 6 reports all sources of demand for the county production of agricultural commodities and locally-processed food. Intermediate regional purchases are sales to other industry sectors in the county to use as inputs for further production. Regional household is household demand by county residents. Government, investment (inventory) and trade are sales outside the county. Trade is both foreign and domestic. Together, households, government, investment and trade are termed final demand because they consume the product in its final form. Intermediate purchases plus final demand equals the total production of the industry sector.

[3] This method of estimating values for ethanol production probably underestimates the output value. Using modern production technologies, a relatively few number of workers are able to generate a very large amount of output in the ethanol and biodiesel sectors. The estimates of value added credited to the sector probably are not that far off, but the output values will be low. This will have implications for estimating the indirect impacts later.

Table 6. Intermediate and Final Demand for Sedgwick County Agricultural Commodity and Processing Output, 2003 (2003$)

		Final Demand				
			External Source			
Industry Sector	Intermediate Regional Purchases*	Regional Households*	Govt*	Invest-ment*	Trade*	Total Output*
Oilseed farming	0.068	0.047	0.006	0.014	8.233	8.369
Grain farming	6.022	0.359	0.045	0.084	36.750	43.260
Fruit farming	0.036	0.011	0.000	0.000	0.286	0.335
Greenhouse and nursery production	0.447	0.401	0.035	0.001	4.814	5.697
Cotton farming	0.056	0.008	0.000	0.000	0.651	0.715
All other crop farming	2.171	0.052	0.011	0.003	4.365	6.602
Cattle ranching and farming	40.056	0.315	0.015	0.000	0.364	40.750
Poultry and egg production	2.047	0.493	0.045	0.001	2.129	4.716
Animal production	1.711	0.115	0.001	0.001	0.127	1.956
Agriculture and forestry support activities	1.368	0.333	0.693	0.009	13.914	16.317
Dog and cat food manufacturing	0.011	0.397	0.001	0.000	51.452	51.861
Other animal food manufacturing	0.083	0.016	0.001	0.000	19.561	19.661
Flour milling	4.553	0.930	0.698	1.985	139.483	147.648
Fluid milk manufacturing	18.489	26.310	2.293	0.817	55.105	103.015
Animal- except poultry- slaughtering	101.896	18.355	2.598	0.269	37.170	160.288
Meat processed from carcasses	46.718	56.750	4.849	1.956	342.255	452.528
Rendering and meat byproduct processing	8.554	0.018	0.010	0.040	1.175	9.796
Poultry processing	7.622	10.813	0.365	0.013	0.556	19.369
Other basic organic chemical manufacturing	1.862	0.435	0.344	0.958	30.601	34.201

*Millions of Dollars

Source: Minnesota IMPLAN Group, 2006

Considering the notion that economic impact arises from new infusions of dollars into the economy, the demand from intermediate purchasers and regional households represents internal transfers of dollars. It is the last three sources of final demand (government, investment and trade) that represent new annual infusions into the economy that sustain and grow the economic base. Across the entire economy, these sources of final demand are the cumulative economic impact of productive activity in a given year. Applying the appropriate math, it is possible to distribute this final demand across all sectors in proportion to that which they generated. This is shown in Table 7.

Of note in Table 7 is the fact that households have been brought into the accounts and treated as any other economic sector. This is appropriate insofar as households act as exporters in that they attract considerable income resources into the county through various income transfers. In excess of 30 percent of all household income typically is associated with various types of passive income transfers such as pensions, Social Security and Medicare, investment, farm payments, etc. These transfers represent significant new infusions into the economy on an annual basis.

Three types of impact are reported in Table 7: output (value of sales); value added (income associated with regional production); and household income (income from all sources, including transfers) – the broadest measure of household welfare. Agriculture and related sectors accounted for nearly $1.5 billion in economic activity in 2003. This represented about 3.5 percent of all external final demand attracted to the county that year. These sectors also accounted for about 2.5 percent of total value added and 2 percent of all household income in the county.

Table 7. Estimates of Value and Share of Economic Activity Associated with Meeting Sedgwick County Export Demand, 2003 (2003$)

	Output		Value Added		Household Income	
Industry/Institution	**millions**	**Percent**	**millions**	**Percent**	**millions**	**Percent**
Agricultural Commodities	134.1	0.33%	76.3	0.43%	45.6	0.31%
Food Processing	1,236.6	3.06%	354.9	2.00%	221.3	1.49%
Ethanol Production	66.7	0.17%	20.3	0.11%	12.9	0.09%
Mining	866.8	2.15%	420.2	2.37%	217.7	1.47%
Utilities	30.2	0.07%	18.7	0.11%	8.6	0.06%
Construction	3,455.3	8.56%	1,611.7	9.08%	1,092.5	7.38%
Other Manufacturing	22,441.2	55.60%	8,117.5	45.71%	5,353.2	36.14%
Wholesale Trade	225.0	0.56%	150.8	0.85%	83.6	0.56%
Transportation & Warehousing	452.2	1.12%	240.1	1.35%	159.8	1.08%
Retail trade	213.3	0.53%	142.8	0.80%	83.4	0.56%
Information	1,192.3	2.95%	577.1	3.25%	319.5	2.16%
Finance & insurance	247.5	0.61%	151.5	0.85%	83.2	0.56%
Real estate & rental	156.2	0.39%	97.9	0.55%	44.1	0.30%
Professional- scientific & tech services	139.0	0.34%	77.0	0.43%	52.8	0.36%
Management of companies	71.2	0.18%	39.1	0.22%	25.4	0.17%
Administrative & waste services	1,076.0	2.67%	574.0	3.23%	378.9	2.56%
Educational services	67.3	0.17%	37.5	0.21%	26.1	0.18%
Health & social services	1,173.6	2.91%	675.6	3.80%	466.3	3.15%
Arts- entertainment & recreation	1.2	0.00%	0.6	0.00%	0.4	0.00%
Accommodation & food services	476.7	1.18%	231.8	1.31%	143.2	0.97%
Other services	59.7	0.15%	30.1	0.17%	19.3	0.13%
Government & non NAICs	2,445.1	6.06%	1,783.7	10.04%	1,026.2	6.93%
Households	4,135.8	10.25%	2,327.7	13.11%	4,948.8	33.41%
Totals	40,363.0	100.00%	17,757.0	100.00%	14,813.0	100.00%

Source: Minnesota IMPLAN Group, Inc., 2006 and Author's calculations

Tables 8-10 show information from the second analysis technique employed to estimate the economic impact of agriculture, the multiplier analysis. A separate multiplier was calculated for each commodity producing and food processing sector. Only the output multiplier is calculated for ethanol production.[4]

[4] Given assumptions inherent in input-output analysis, certain types of economic activities are extremely difficult to model accurately. Ethanol and biodiesel are two such sectors. Given the capital-intensive production technologies employed, these sectors tend to produce very large quantities of output per worker. The result is that the economic

To reduce the double-counting problem, all trade between the sectors was restricted to zero. Without this restriction, estimates of employment and income impacts would be grossly exaggerated. Still, not all double counting can be eliminated in a multiplier analysis. That becomes apparent in observing certain of the estimates for employment and value added. Yet, many industry advocates argue the impact analysis should consider the impacts associated with both final demand and local demand. Additional discussion of multipliers and their interpretation is attached as an appendix to this report.

The multipliers estimate the impacts associated with a change in demand for the output of the aggregate sectors. The total value added and output multipliers are associated with a $1 change in demand, while the employment multipliers are per $1 million change in demand.

Table 8. Sedgwick County Agricultural Output Multipliers and Value of Economic Contributions, 2003, (2003$)

Industry	Direct Output*	Output Multiplier	Total Output*
Oilseed farming	8.369	1.6603	13.895
Grain farming	43.260	1.6301	70.520
Fruit farming	0.335	1.6182	0.542
Greenhouse and nursery production	5.697	1.3962	7.954
Cotton farming	0.715	1.4977	1.071
All other crop farming	6.602	1.5492	10.228
Cattle ranching and farming	40.750	1.4504	59.105
Poultry and egg production	4.716	1.3306	6.275
Animal production, except cattle and poultry	1.956	1.4354	2.808
Agriculture and forestry support activities	16.317	2.1538	35.144
Commodity Totals	128.717		207.542
Dog and cat food manufacturing	51.861	1.5147	78.551
Other animal food manufacturing	19.661	1.4974	29.441
Flour milling	147.648	1.6052	237.005
Fluid milk manufacturing	103.015	1.4906	153.552
Animal, except poultry, slaughtering	160.288	1.3543	217.071
Meat processed from carcasses	452.529	1.5563	704.269
Rendering and meat byproduct processing	9.796	1.4505	14.209
Poultry processing	19.369	1.4201	27.506
Processing Totals	964.167		1,461.604
Other basic organic chemical manufacturing	34.201	2.0347	69.589
Total Ag. and Processing	1,127.085		1,738.735
Total Sedgwick County	40,889.429	**Share**	4.25%

*Millions of dollars

multipliers become unreliable and present a distorted picture of their true economic contribution. For ethanol, no employment or value added multipliers are reported. A more reasonable approximation might be something close to the value of the output multiplier.

In Table 8, the direct output shows the value of production estimated for the sector in 2003 (2003$). The multiplier shows the changes occurring within the industry sectors experiencing the increased demand. Thus, as total sales in oilseed faring increase by $1, sales across all sectors in the economy will increase by an additional 66 cents. If the total output impacts are added across all commodity production sectors, the initial estimate of $128 million in value of production translates to $207 million across the entire economy. Similarly, the $964 million in processing activity is closely related to about $1.4 billion in total economic activity across the county. In total, the estimated $1.7 billion in total economic activity associated with agriculture represents about four percent of total economic activity in the county.

A similar analysis was completed for employment impacts, reported in Table 9. Again, the interpretation is the change in employment associated with a $1 million change in demand for the associated industry. The inherent double counting of multiplier analysis can be observed in the food processing employment multipliers. In general, a multiplier much above about 2.0 is suspect. Multipliers in the range of 3-5 are probably not very reliable and should be used with caution and the appropriate caveats.

Table 9. Sedgwick County Agricultural Employment Multipliers and Value of Economic Contributions, 2003, (2003$)

Industry	Direct Employment	Employment Multiplier	Total Employment
Oilseed farming	90	1.5196	137
Grain farming	977	1.2257	1,197
Fruit farming	2	1.8580	4
Greenhouse and nursery production	35	1.7139	60
Cotton farming	6	1.4477	9
All other crop farming	39	1.7654	69
Cattle ranching and farming	430	1.3754	591
Poultry and egg production	10	2.5405	25
Animal production, except cattle and poultry	55	1.1399	63
Agriculture and forestry support activities	606	1.3347	809
Commodity Totals	2,250		2,964
Dog and cat food manufacturing	56	5.0333	282
Other animal food manufacturing	33	3.6399	120
Flour milling	220	5.0286	1,106
Fluid milk manufacturing	193	3.2774	633
Animal, except poultry, slaughtering	415	2.3926	993
Meat processed from carcasses	1,305	2.7921	3,644
Rendering and meat byproduct processing	15	3.8865	58
Poultry processing	90	1.9223	173
Processing Totals	2,327		7,009
Other basic organic chemical manufacturing	43		43
Total Ag. and Processing	4,620		10,016
Total Sedgwick County	312,506	**Share**	3.20%

In total, the original 4,577 jobs in agriculture-related activities are closely tied to about 9,973 jobs across the county. This represents about three percent of total employment.

A final multiplier analysis was completed for value added in the county. Table 10 reports the results. The direct $204 million in total income is closely tied to about $514 million across the entire economy. This represents about three percent of total value added in Sedgwick County in 2003.

Table 10. Sedgwick County Agricultural Value Added Multipliers and Value of Economic Contributions, 2003, (2003$)

Industry	Direct Value Added*	Value Added Multiplier	Total Value Added*
Oilseed farming	4.657	1.5946	7.426
Grain farming	22.470	1.5857	35.631
Fruit farming	0.218	1.4727	0.321
Greenhouse and nursery production	5.485	1.2312	6.753
Cotton farming	0.384	1.4432	0.554
All other crop farming	4.172	1.4205	5.926
Cattle ranching and farming	4.320	3.2524	14.050
Poultry and egg production	2.170	1.3839	3.003
Animal production, except cattle and poultry	0.327	2.3775	0.777
Agriculture and forestry support activities	13.179	1.7806	23.467
Commodity Totals	57.382		97.909
Dog and cat food manufacturing	7.221	2.7979	20.204
Other animal food manufacturing	2.847	2.7601	7.858
Flour milling	19.981	3.6231	72.393
Fluid milk manufacturing	11.270	3.2268	36.366
Animal, except poultry, slaughtering	30.379	2.0265	61.563
Meat processed from carcasses	63.583	3.0691	195.145
Rendering and meat byproduct processing	4.042	1.5906	6.429
Poultry processing	7.238	1.6147	11.687
Processing Totals	146.561		411.645
Other basic organic chemical manufacturing	4.910		4.910
Total Ag. and Processing	208.853		514.465
Total Sedgwick County	17,832.571	**Share**	2.88%

*Millions of dollars

Conclusion

Estimates of the economic impacts of Sedgwick County agriculture were presented in this report. In addition to commodity production, the impacts of linked food processing and ethanol production sectors were considered. Estimates of the direct and indirect contributions agriculture makes to the Sedgwick County economy were offered. Generally, it might be said agriculture makes a gross contribution of between three and four percent of the county's economic activity, about three percent of value added income, and about two percent of employment.

Agricultural Commodity Industry Definitions by NAICS Code

Oilseed Farming
111110 Soybean Farming
111120 Oilseed (except Soybean) Farming
111191 Part Oilseed and Grain Combination Farming

Grain Farming
111130 Dry Pea and Bean Farming
111140 Wheat Farming
111150 Corn Farming
111160 Rice Farming
111191 Part Oilseed and Grain Combination Farming
111199 All Other Grain Farming

Fruit Farming
111310 Orange Groves
111320 Citrus (except Orange) Groves
111331 Apple Orchards
111332 Grape Vineyards
111333 Strawberry Farming
111334 Berry (except Strawberry) Farming
111336 Part Fruit and Tree Nut Combination Farming
111339 Other Noncitrus Fruit Farming

Greenhouse and Nursery Production
111411 Mushroom Production
111419 Other Food Crops Grown Under Cover
111421 Nursery and Tree Production
111422 Floriculture Production

Cotton Farming
111920 Cotton Farming

All Other Crop Farming
111940 Hay Farming
111992 Peanut Farming
111998 All Other Miscellaneous Crop Farming

Cattle Ranching and Farming
112111 Beef Cattle Ranching and Farming
112112 Cattle Feedlots
112120 Dairy Cattle and Milk Production
112130 Dual-Purpose Cattle Ranching and Farming

Poultry and Egg Production
112310 Chicken Egg Production
112320 Broilers and Other Meat Type Chicken Production
112330 Turkey Production
112340 Poultry Hatcheries
112390 Other Poultry Production

Animal Production except Cattle and Poultry and Egg
112210 Hog and Pig Farming
112410 Sheep Farming
112420 Goat Farming
112511 Finfish Farming and Fish Hatcheries
112512 Shellfish Farming
112519 Other Animal Aquaculture
112910 Apiculture
112920 Horses and Other Equine Production
112930 Fur-Bearing Animal and Rabbit Production
112990 All Other Animal Production

Agriculture and Forestry Support Activities
115111 Cotton Ginning
115112 Soil Preparation, Planting, and Cultivating
115113 Crop Harvesting, Primarily by Machine
115114 Post-harvest Crop Activities (except Cotton Ginning)
115115 Farm Labor Contractors and Crew Leaders
115116 Farm Management Services
115210 Support Activities for Animal Production
115310 Support Activities for Forestry

Understanding Economic Multipliers[5]

John Leatherman
Aaron Lusby[6]

A simple non-technical discussion of the formulation of economic multipliers is presented in this paper. While there are several ways to calculate a multiplier, the methods discussed here are based on input-output (I-O) modeling.

Economic multiplies are built on the notion that an economy has both “basic” and “non-basic” industries. Basic industries produce goods for export that, in turn, attracts new income to the region. This income then becomes available to support non-basic sectors that exist to satisfy local demand. Thus, any change in demand for the output of a basic industry leads to some multiple total effect on the economy. The initial change to the basic industry is the direct economic effect and the “spillover” to other economic sectors is the indirect effect. The total change can be summarized by a single number, the economic multiplier.

An input-output model is a method for representing the economy as a series of accounting transactions within and between the producing and consuming sectors. The producing sectors supply commodities while the consuming sectors are sources of demand for those commodities. Given these interpretations, the I-O model may be used to assess the impacts of alternative scenarios on the region's economy.

A central concept of I-O modeling is the interrelationship between the producing sectors of the region (e.g., manufacturing firms), the consuming sectors (e.g., households) and the rest of the world (i.e., regional imports and exports).[7] The simplest way to express this interaction is a regional transactions table (Table 1). The transactions table shows the flow of all goods and services produced (or purchased) by sectors in the region. The key to understanding this table is realizing that one firm's purchases are another firm's sales and that producing more of one output requires the production or purchase of more of the inputs needed to produce that product.

In the simplified transactions table, three production sectors are represented: agriculture, manufacturing, and services. Households are represented both as a source of demand (consumers of locally-produced goods and services), and as the labor input into the production of local goods and services. The other source of demand is exports and the other input into production is imports.

The table is a complete representation of all of the economic relationships that exist in the economy showing the buying and selling of every sector to every other. More detailed tables

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[5] This paper draws from Steven Deller. 2004. “Basics of Input-Output Modeling.” Department of Applied and Agricultural Economics, University of Wisconsin-Madison, by permission of the author.

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[7] A “region” is defined here as a functioning economic area. This could be as large as multiple states such as the Great Plains states or as small as a specific county.

account for more transactions. But, for illustration purposes, this simplified representation will suffice.

The transactions table is important because it provides a comprehensive picture of the region's economy. Not only does it show the total output of each sector, but it also shows the interdependencies between sectors. It also indicates the sectors from which the region's residents earn income as well as the degree of openness of the region through imports and exports. More open economies will have a larger percentage of total expenditures devoted to imports. The “openness” of the economy has a direct and important impact on the size of economic multipliers. Specifically, in more open economies, as new dollars are introduced (injected from exports) into the economy they leave the economy more rapidly through leakages (imports).

Table 1. Illustrative Transactions Table

	Purchasing Sectors (Demand)			Final Demand		
Processing Sectors (Sellers)	Agr	Mfg	Serv	HH	Exports	Output
Agr	10	6	2	20	12	50
Mfg	4	4	3	24	14	49
Serv	6	2	1	34	10	53
HH	16	25	38	1	52	132
Imports	14	12	9	53	0	88
Inputs	50	49	53	132	88	372

Once having the economic relationships charted, we can begin using the information for further analysis and the calculation of various economic multipliers. Economic multipliers are based on the notion that as economic transactions occur, they will have a “ripple effect” on the economy. For example, if an order is placed for some manufactured good, that manufacturer must increase production. This means it will purchase more inputs from suppliers and hire labor to produce the good. All of the backward-linked business, in turn, must then increase their production and hire labor. For its part, labor represents the local households who use their income to purchase household goods and services from a wide variety of local businesses. In this way, a single increase in demand sends a “shock” to the economy that ripples out to a wide variety of businesses and many households.

A single shock (say, $1) reverberates outward through the economy until the impact finally returns to the original source. By that time, however, some of it has “leaked” out of the economy due to the purchase of imported goods and services, non-local taxes, and non-local investments. Thus, the original shock returns as some diminished amount (say, 40¢) that is available for re-spending. This continues round after round, each time diminishing a little until the impact is finally exhausted. This process is illustrated in Figure 1.

Graphically, the direct effect of change is shown in the far left-hand side of the figure (the first bar (a)). The direct effect of a $1.00 change in the level of exports leads to indirect effects spilling over into other sectors and create an additional 66 cents of activity. In this example, the simple spending (output) multiplier is 1.66. Using mathematical techniques, we are able to track the shock through multiple rounds of spending and re-spending. A variety of multipliers can be calculated using input-output analysis.

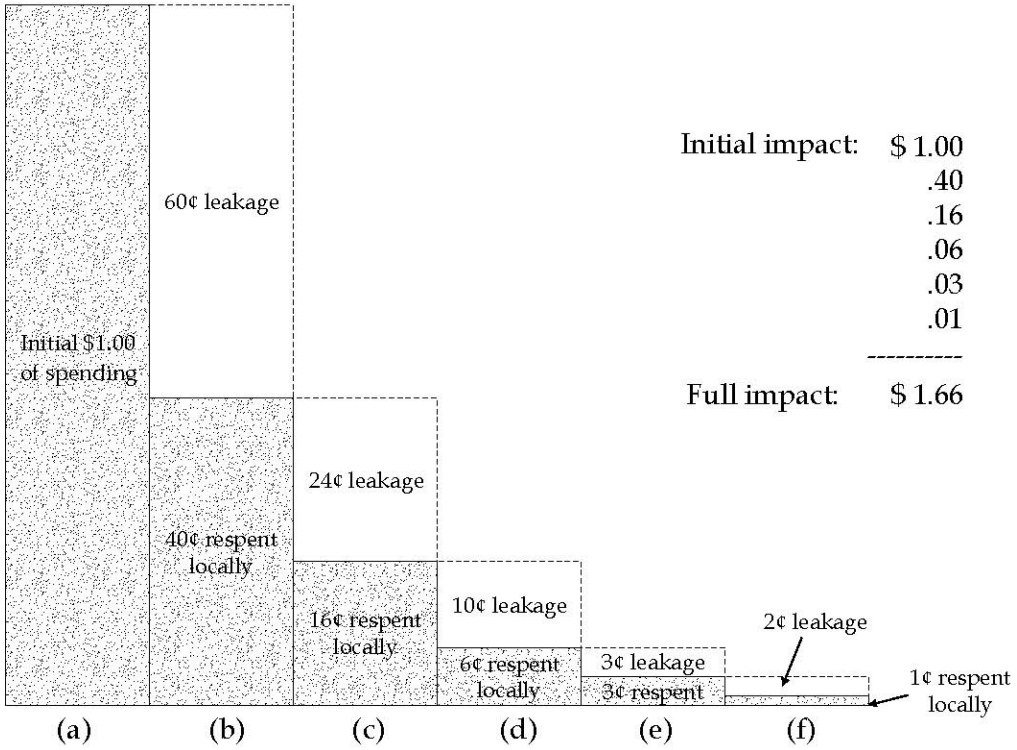

Figure 1. Multipliers and the round-by-round impacts estimated using input-output analysis

Typically, the result of measuring all of the direct and indirect effects is presented as a total requirements table (Table 2). Each cell in Table 2 indicates the dollar value of output from the sector named at the left that will be required in total (i.e., direct plus indirect) for a one dollar increase in final demand for the output from the sector named at the top of the column. For example, the element in the first row of the first column indicates the total dollar increase in output of agricultural production that results from a $1 increase in final demand for all agricultural products is $1.28. Here the agricultural multiplier is 1.28: for every dollar of direct agricultural sales there will be an additional 28 cents of economic activity within the agriculture sector as measured by industry sales.

An additional, useful interpretation of the transactions table, as well as the total requirements table, is the measure of economic linkages within the economy. For example, the element in the second row of the first column indicates the total increase in manufacturing output due to a dollar increase in the demand for agricultural products is 12 cents. This allows the analyst to not only estimate the total economic impact but also provide insights into which sectors will be impacted and to what level.

Highly linked regional economies tend to be more self-sufficient in production and rely less on outside sources for inputs. More open economies, however, are often faced with the requirement of importing production inputs into the region. It follows then that the values making up the total requirements table, or the multipliers, will be smaller. In other words, more open economies have smaller multipliers due to larger imports.

Table 2. Illustrative Total Requirements Table			
	Purchasing Sectors (Demand)		
Processing Sectors (Sellers)	Agr	Mfg	Serv
Agr	1.28	0.17	0.06
Mfg	0.12	1.11	0.07
Serv	0.16	0.07	1.03
Total	1.56	1.35	1.16

Input-Output Multipliers

Through the discussion of the total requirements table, the notion of external changes in demand rippling throughout the economy was introduced.[8] The total requirements table can be used to compute the total impact a change in demand for one sector will have on the entire economy. Specifically, the sum of each column shows the total increase in regional output (value of sales) resulting from a $1 increase in final demand for the sector heading the column. Considering agriculture, an increase of $1 in the demand for agricultural output will yield a total increase in regional output equal to $1.56 (Table 2). This figure represents the initial dollar increase plus 56 cents in indirect effects. The column totals are often referred to as output multipliers.

The use of these multipliers for policy analysis can prove insightful. These multipliers can be used in preliminary policy analysis to estimate the economic impact of alternative policies or changes in the local economy. In addition, the multipliers can be used to identify the degree of structural interdependence between each sector and the rest of the economy. For example, in the illustrative region, a change in the agriculture sector would influence the local economy to the greatest extent, while changes in the service sector would produce the smallest change.

The output multiplier described here is perhaps the simplest input-output multiplier available. The construction of the transactions table and its associated total requirements table creates a set of multipliers ranging from output to employment multipliers.

The complete set includes:

Type	Definition

1. Output Multiplier. The output multiplier for an industry measures the sum of direct and indirect requirements from all sectors needed to deliver one additional dollar unit of output of the industry to final demand.

[8] Economic impact analysis is an attempt to model the impacts that an economic change has on regions. Input-output analysis specifies this economic change, most commonly, as a change in final demand (sales) for some product. Simply stated, this is the manner in which we attempt to introduce an economic change.

2. Income Multiplier. The income multiplier measures the total change in income throughout the economy from a dollar unit change in final demand for any given sector.

3. Employment Multiplier. The employment multiplier measures the total change in employment due to a one unit change in the employed labor force of a particular sector.

The income multiplier represents a change in total income (employee compensation plus proprietary income plus other property income plus indirect business taxes) for every dollar change in income for any given sector. The employment multiplier represents the total change in employment resulting from the change in employment in any given sector. Thus, we have three ways that we can describe the change in final demand.

Misuse of Multipliers[9]

(1) Interchanging Multipliers. Multipliers can be estimated for changes in business output (sales), household income, and employment. These different multipliers are sometimes mistakenly used interchangeably. This should not be done, as the sizes of the multipliers are different—and they measure totally different types of activity. Similarly, multipliers calculated for one place and time should not be "borrowed" for another place or time. The economies of different places will be structured differently and, therefore, the multipliers will be different.

(2) Double Counting. Unless otherwise specified, the direct effect or initial change is included in all multiplier calculations. Consider, for example, a mining business multiplier of 2.20. The 2.20 represents 1.00 for the direct effect, and 1.20 for the indirect effects. The direct effect is thus accounted for by the multiplier and should not be added into the computation (double counted). A $440,000 total impact resulting from an increase of $200,000 in outside income (using the above 2.20 multiplier) includes $200,000 direct spending, plus $240,000 for the indirect effects. The multiplier effect is sometimes thought to refer only to the indirect effect. In this case, if the initial impact is added to the multiplier effect, it is thereby counted twice—yielding an inflated estimate of change.

(3) Pyramiding. A more complicated error in using multipliers is pyramiding. This occurs when a multiplier for one sector is added to the multiplier of a backward-linked sector. For example, assume a food processing plant were to close. Local farmers may have been supplying raw inputs into the processing plant. They subsequently lost their local market and instead have to export their raw materials. To understand the overall impact, the multiplier for the food processing plant already accounted for any change in backward-linked farming. It would be incorrect to add the food processing multiplier to the agricultural multiplier and represent that as the total impact.

Similarly, adding individual industries to estimate a larger sector's impact would be incorrect. For example, if the hospital sector had a multiplier of 1.50 and the nursing home sector had a multiplier of 1.35, it would be incorrect to then say that the "health care" sector has a multiplier

[9] This material is based on a report prepared by Eugene Lewis, Russ Youmans, George Goldman, and Garnet Premer, "Economic Multipliers: Can A Rural Community Use Them?" Western Rural Development Center, Oregon State University, Corvallis, OR. WREP 24, October, 1979.

of 2.85. A separate multiplier can be calculated for overall healthcare that will be much closer to the individual sectors.

(4) Turnover and Value Added. Economic measurements incorrectly used for multipliers also result in misleading analysis. Two such examples are turnover and value added. Turnover refers to the number of times money changes hands within the community. In Figure 1, for example, the initial dollar "turns over" five times; however, only part of the initial dollar is re-spent each time it changes hands. Someone confusing turnover with multiplier might say the multiplier is 5, when the multiplier is actually only 1.66.

Value added reflects the portion of a product's total value or price that was provided within the local community. The value added would consider the value of a local raw product—like wheat delivered to the mill—and subtract that from the total wholesale value of the flour, then figure the ratio between the two. With cleaning losses, labor, bagging, milling, etc., the wholesale value may represent several times the value of the raw product and may be a fairly large number. The proportion of value added to the raw product is not the same as an economic multiplier.