Economic Impact of Agriculture in the Southern Albuquerque, New Mexico Metropolitan Area

Research Report 785

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SUMMARY

The economic impact of agricultural production in the southern Albuquerque, NM, metropolitan area was estimated using the IMpact Analysis for PLANning (IMPLAN) model, with a geographic focus on Bernalillo and Valencia Counties. Hay and dairy production dominate agricultural economic activity in the two counties, while the formal economic contribution of high-value fruit and vegetable crop production is very low. Many of the small irrigated farms in the region are not engaged in commercial-scale or income-oriented agriculture and are not included in databases used for economic impact analysis. Relative to the larger regional economy, agricultural output and employment in the study region are small, although estimated multipliers indicate that increased agricultural production would positively contribute to overall economic activity.

INTRODUCTION

New Mexico's Middle Rio Grande (MRG) is undergoing rapid urbanization, population increase, and economic growth. Traditional agricultural use of land and water in the region is facing competition from new users of these resources. The growing urban area requires water, while housing for new residents and commercial development are removing land from crop production. An expanding road network requires land, and there are demands on the region's water resources for environmental restoration and endangered species.

Like many rapidly growing urban areas in the western United States, the MRG is an irrigated river valley, where the future of agricultural land is closely linked to the future of water resources (and vice versa). Approximately 90% of water consumed in the arid regions of the western United States is used by irrigated agriculture (Western Water Policy Review Advisory Commission, 1998). Agricultural water users throughout the West are frequently confronted by demands for agricultural water use accountability by non-agricultural interests. Emerging concerns about water use accountability are also leading to increased monitoring, regulation, and scrutiny of agriculture's traditional claim on scarce water resources. The future of traditional irrigated agriculture in rapidly urbanizing communities is thus quite tenuous at a time when interest in preserving local agriculture and local food production is growing.

Some South Valley MRG residents have become very vocal and active in their efforts to increase local food production, reduce their region's dependence on imported food supplies, and preserve their agricultural heritage and traditions (Wang, 2007). Wang (2007) concluded that a segment of citizens of the MRG's South Valley believe that agriculture is not a temporary land use activity but one that has both tangible and intangible values. They believe that agriculture not only serves as a source of income but also provides the region with environmental benefits, such as open space, oasis-like microclimate effects, and wildlife habitat (including for locally important threatened and endangered species) (Wang, 2007). These residents believe that small-scale irrigated agriculture is an essential component of their culture and heritage, is the foundation of their identity as land-based people, results in health benefits, and is something to which they are deeply connected.

Many of the non-market values identified by Wang (2007) as being associated with local agriculture cannot be measured using traditional methods or data. However, states and counties routinely use input–output models to assess the economic contributions of agricultural production and related industries by quantifying the value of output, employment, and multiplier impacts. The economic effects of increased or reduced agricultural production can be estimated and then compared with the impacts of other types of economic activity or industries. In arid areas where crop production is not possible without irrigation, the economic effects of water transfers out of agriculture to other uses can

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be projected. Communities can examine the potential economic impacts of increased high-value crop production and value-added processing of agricultural products, including upstream and downstream economic ripple effects. While the models used to estimate agriculture's contribution to the larger economy are not without shortcomings, they are an important piece of information for understanding a region's agricultural sector.

The objective of this paper is to document and describe the contribution of southern Middle Rio Grande agriculture and related industries to the region's economy. The study focuses on the portion of the MRG Basin located south of the Albuquerque metropolitan area, specifically Bernalillo and Valencia Counties. Estimates of the current economic position of southern MRG agriculture will provide a baseline against which future land and water use changes in the region, as well as levels of agricultural output and value-added processing, can be evaluated. This paper reports estimates of the economic contributions of local agriculture in the southern MRG through the use of the IMpact Analysis for PLANning (IMPLAN) model. IMPLAN utilizes a conventional input–output model to estimate the employment, total output, and value-added impacts an economic sector has on a defined geographic area. The nature of the data used in the IMPLAN model (discussed later) means that the model is unable to capture the economic contribution of much of MRG irrigated agriculture. The information presented in this report gives insight into how the southern MRG's economy is affected by the agricultural sector and what would happen if the size of the region's agricultural and related sectors increases or decreases.

AGRICULTURE IN NEW MEXICO'S MIDDLE RIO GRANDE BASIN

The southern MRG has a rich history of agricultural land use. This area has been farmed for more than one thousand years, dating back to the early Native Americans who inhabited the Rio Grande Valley (Clark, 1987). Many current residents live in this area today because of the numerous benefits associated with the rural, agrarian environment. The nonfood values or outputs of agriculture in the region are many, including landscape amenities and open space, recreation, rural culture and lifestyle opportunities, local food production, and ecosystem services such as the cooling effect of irrigated agriculture in a hot desert climate. The southern MRG is currently home to residents whose families have lived in the area for many generations, as well as many newcomers.

The Albuquerque metropolitan statistical area (MSA) is centered in the City of Albuquerque and includes Bernalillo, Sandoval, Torrance, and Valencia Counties. An MSA is defined by the federal government as a geographic area with a large population nucleus and adjacent communities that are highly integrated both economically and socially with the city center or population nucleus (U.S. Bureau of Economic Analysis, 2011). The population of the Albuquerque MSA was estimated to be 857,903 in 2009, an increase of 17.6% since 2000 (U.S. Bureau of Economic Analysis, 2011). The heart of the City of Albuquerque is located in Bernalillo County, with Valencia to the south and Sandoval to the north. These three counties are located along the Rio Grande and include both present and former croplands, as well as desert mesa lands to the east and west. Torrance County is a historically rural area located southeast of the city center, not in the Rio Grande Basin, but within Albuquerque's shadow and commuting zone. The South Valley is an unincorporated census-designated place located in Bernalillo County, and is bordered on the south by Isleta Pueblo (also located within Bernalillo County), which was originally settled in the 1300s. Valencia County is directly south of Bernalillo County. Socioeconomic data for Bernalillo and Valencia Counties are presented in Table 1, with data for New Mexico overall presented for comparison.

Bernalillo County is the most populous county in the state, and also has one of the highest median household incomes. The poverty rate in Bernalillo County is one of the state's lowest, and given the diversity of the county's economy, the percentage of employment in the private sector is higher than the state overall. Valencia County has a higher poverty rate and a higher unemployment rate than the state, with a lower percentage of the workforce employed in the private sector. Total covered employment in the primary product sectors of agriculture, forestry, fishing, and hunting in the two counties is very small, and represents 3.27% of the state's employment in those sectors. The majority of New Mexico's employment in these primary product sectors is located in Doña Ana, Chavez, and Roosevelt Counties.

Bernalillo and Valencia Counties account for 7.35% of all farms in New Mexico (USDA–National Agricultural Statistics Service, 2009). A "farm" is defined by the U.S. Census of Agriculture as any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, in a given

Table 1. Socioeconomic Indicators for Bernalillo and Valencia Counties and New Mexico, 2009

	Bernalillo County	Valencia County	New Mexico
Population	642,527	72,913	2,009,671
Median Household Income	$45,550	$41,494	$42,830
Persons Below Poverty Level	15.6%	20.2%	18.2%
Average Annual Unemployment Rate	7.1%	8.1%	7.2%
Total Covered Employment*	318,223	15,020	791,509
Private %	80%	71%	76%
Government %	20%	29%	24%
Total Agriculture, Forestry, Fishing, and Hunting** Employment	158	192	10,692

* Employment is for workers covered by New Mexico unemployment insurance.
** North American Industry Classification System (NAICS) Major Sector.
Source of data: University of New Mexico Bureau of Business and Economic Research, http://bber.unm.edu/.

year.[2] All agricultural products, whether they are crops or livestock, are included in the Census farm definition. In New Mexico, this means that small, irrigated acreages as well as large rangeland grazing operations are all counted as "farms." Thus, Census data for "farms with irrigated land" provide a better assessment of local food production resources and capacity in New Mexico.

U.S. Census of Agriculture data indicate that in 2007 there were 403 and 741 farms with irrigated land in Bernalillo County and Valencia County, respectively (USDA–National Agricultural Statistics Service, 2009). Distribution data from the Census of Agriculture for farms with irrigated land show that 67% of Bernalillo irrigated farms and 50% of Valencia irrigated farms consist of less than 10 acres of irrigated land. Of farms with irrigated land in the two counties, 82% annually sell less than $10,000 in agricultural products. Two-thirds (68%) of farms with irrigated land in Bernalillo County are classified as retirement or residential-lifestyle farms and account for 14% of that county's agricultural product sales, while 58% of Valencia County farms with irrigated land are retirement or residential-lifestyle oriented and account for 8% of county agricultural sales (Table 2). Farms classified as such are operated by people whose primary sources of income are non-farm (Hoppe et al., 2000).

In 1982, the Census of Agriculture enumerated 253 farms with irrigated land in Bernalillo County and 500 irrigated farms in Valencia County. The number of irrigated farms in both counties increased from 1982 to 2007, while total irrigated acreage decreased from 10,927 to 7,757 acres in Bernalillo County and increased from 14,286 to 20,951 acres in Valencia County. Land fragmentation in Bernalillo County has not been accompanied by increasing irrigated acreage as it has in Valencia County, but the counties both show rapid growth in small irrigated farms (~160% increase between 1982 and 2007).

The profile of agricultural production in Bernalillo and Valencia Counties shown in Table 3 indicates that agricultural sales are dominated by milk and other dairy products from cows (approximately 12,000 dairy cows were enumerated in the two counties in 2007). Nursery, greenhouse, floriculture, and sod have the highest level of crop-related sales in Bernalillo, while other crops (primarily hay) dominate crop sales in Valencia County. These two categories of crop sales account for the majority of all crop-related agricultural sales in the two counties. Sales of fruits, tree nuts, and berries are small, while sales of all other crops not shown in Table 3 are included in "all other crops" because the values are not disclosed by the Census of Agriculture due to the small number of producers and the risk of identifying data for individuals. Approximately $1.5 million worth of products sold directly to individuals for human consumption (both crop and livestock) were identified in the 2007 Census of Agriculture for the two counties. These profiles indicate very low levels of high-value crop production. In Bernalillo and Valencia Counties, the dominant position of the large-scale, commercial dairy industry in generating economic value is evident.

ECONOMIC CONTRIBUTION OF AGRICULTURE IN BERNALILLO AND VALENCIA COUNTIES

Many communities, counties, regions, and states have tried to assess the economic contribution of their

[2] U.S. Census of Agriculture data reported here are for the 2007 Census year (with data published in 2009). Data for the 2012 Census of Agriculture will likely be available in 2014.

Table 2. Farms with Irrigated Land by Type of Farm*, Numbers of Farms, and Agricultural Sales, Bernalillo and Valencia Counties, New Mexico, 2007 Census of Agriculture

	Bernalillo County				Valencia County			
	# farms	% farms	$ sales (1,000)	% sales	# farms	% farms	$ sales (1,000)	% sales
Limited-Resource Farms	74	18.4	360	3.0	149	20.1	609	2.2
Retirement Farms	130	32.3	524	4.4	178	24.0	1,188	4.3
Residential-Lifestyle Farms	142	35.2	1,097	9.3	255	34.3	988	3.6
Farming Occupation – Lower Sales	33	8.2	593	5.0	110	14.9	1,376	5.0
Farming Occupation – Higher Sales	1	0.3	160	1.4	14	1.9	2,251	8.2
Large Family Farms	0	0	0	0	3	0.4	774	2.8
Very Large Family Farms	3	0.7	6,398	53.9	5	0.7	18,002	65.8
Non-Family Farms	20	5.0	2,729	23.0	27	3.6	2,183	8.0
Total Farms	**403**				**741**			
Total Agricultural Sales	**11,861**				**27,371**			

* This typology was developed by the USDA Economic Research Service. Criteria for the typology can be found at http://www.ers.usda.gov/media/480803/aib759_1_.pdf

Source of data: USDA, Census of Agriculture, National Agricultural Statistics Service, New Mexico Office, Las Cruces, NM.

Table 3. Agricultural Production Profiles, Bernalillo and Valencia Counties, New Mexico, 2007 Census of Agriculture

	Bernalillo County	Valencia County	Total Two Counties
	All figures in US $		
Total sales of agricultural products	17,883,000	36,322,000	54,205,000
Crops, including nursery and greenhouse	5,886,000	439,000	12,325,000
Fruits, tree nuts, and berries	564,000	29,000	593,000
Nursery, greenhouse, floriculture, and sod	2,922,000	774,000	3,696,000
Other crops and hay	1,864,000	5,233,000	7,097,000
Corn	—	224,000	224,000
Sorghum	—	112,000	112,000
Other grains, oilseeds, dry beans, and dry peas	1,000	2,000	3,000
Vegetables, melons, potatoes, and sweet potatoes	—	65,000	65,000
All other crops and undisclosed crops	535,000	—	535,000
Livestock, poultry, and their products	11,997,000	29,883,000	41,880,000
Cattle and calves	1,227,000	7,758,000	8,985,000
Milk and other dairy products from cows	9,891,000	21,633,000	31,524,000
Poultry and eggs	88,000	47,000	135,000
Hogs and pigs	13,000	10,000	23,000
Sheep, goats, and their products	22,000	57,000	79,000
Horses, ponies, mules, burros, and donkeys	561,000	371,000	932,000
Aquaculture	152,000	—	152,000
Other animals, other animal products, and undisclosed	43,000	7,000	50,000
Value of products sold directly to individuals for human consumption	1,393,000	273,000	1,666,000

Source of data: USDA, Census of Agriculture, National Agricultural Statistics Service. http://www.agcensus.usda.gov/Publications/2007/Full_Report/index.asp

agricultural sectors. The regional economic impacts of agriculture are of interest to communities where the size of the farm sector is shrinking (often relative to other economic sectors) and where land is being converted from agricultural to other uses, as well as to communities seeking to encourage agriculturally based rural development or maintain their agricultural character and heritage. Differences between various agricultural sub-sectors (e.g., different commodities and value-adding activities) are of interest to policymakers, planners, community activists, and citizens. Economic development objectives are assisted by information about the economic impact of existing sectors, as well as potential changes in economic activity if these sectors increase or decrease in size. Some regional economic impact studies focus on the production of primary products (e.g., at the farm level), while others include processing of raw agricultural products, and still others include all economic sectors from agricultural inputs, on-farm, processing, food wholesaling, retailing, and even restaurants.

As noted previously, the use of input–output models, and IMPLAN in particular, is commonly used to assess the economic contribution of agriculture and related industries. IMPLAN is an off-the-shelf model that is capable of being applied to any industry or economic sector since the database contains county-level economic data reported by the federal government in standardized formats for all U.S. counties. Sources of IMPLAN agricultural data include the USDA's National Agricultural Statistics Service (NASS) and the U.S. Census of Agriculture. Agricultural activity not disclosed by NASS or the Census of Agriculture because of privacy concerns is aggregated into broader categories and reduces the ability of IMPLAN to accurately assess economic relationships for specific agricultural sub-sectors. Furthermore, data for farms not meeting the federal definition of a "farm" are not reported by NASS or the Census of Agriculture and thus not included in IMPLAN-generated estimates of total agricultural economic activity. Informal economic transactions, legal or illegal, are also not included in IMPLAN estimates of economic activity.

In a region such as Bernalillo and Valencia Counties, IMPLAN captures economic relationships and activity from the larger, commercial agricultural production profiled in Table 3 (e.g., dairy, nursery and greenhouse, hay, etc.). Because of their small size, non-commercial operator motivations, and reliance on non-farm income sources, IMPLAN does not capture economic relationships and activity from the >80% of farms that are classified as limited-resource, retirement, or residential-lifestyle farms. The dual–structure nature[3] of southern MRG agriculture means that while IMPLAN analysis is valuable, it is an incomplete picture of a region's agricultural sector. The remainder of this report focuses on IMPLAN model results for Bernalillo and Valencia Counties, with complete awareness of the shortcomings of the model results for these two counties.

PREVIOUS IMPLAN STUDIES

IMPLAN has been used to assess the economic impact of several New Mexico industries or agricultural subsectors. Lillywhite et al. (2007a) estimated the economic impact of the state's dairy industry, and found that the total output of the industry (direct, indirect, and induced effects) was valued at $1.32 billion and that the industry accounted for 3,423 employees within the state. The output multiplier was estimated at 1.55 and the employment multiplier at 3.34. Lillywhite et al.'s (2007b) study of the economic impact of New Mexico's pecan industry determined that pecans account for 821 employees in the state and the total output value of the industry (direct, indirect, and induced) was $126 million. The employment multiplier for pecans was 2.28 and the economic output multiplier was 1.80.

Also using IMPLAN, Lillywhite and Wise (2009) concluded that the New Mexico racehorse industry accounts for 5,236 jobs in the state and has a total economic output value of $327 million (direct, indirect, and induced effects). The racehorse industry economic output multiplier was estimated to be 1.79. The economic impacts of the green industry (defined as golf, golf tourism, and institutional-scale landscape services in both public and private spaces) were examined by Diemer, who found that the total economic impact of the sector in 2004–2005 was $985 million, and that it accounted for 20,800 employees (Diemer, n.d.). Diemer noted that golf is the economic engine for New Mexico's green industry.

Hall and Skaggs (2003) analyzed the economic impact of high-value vegetable production and processing in southern New Mexico, more specifically Doña Ana, Luna, and Hidalgo Counties, in 2003. The employment multiplier for high-value vegetables in these counties was found to be 3.54, while the output multiplier was 1.61. Total economic output attributed to high-value vegetable production and processing in the three counties was $418 million, and total employment impact was 5,320 jobs. Again, these values account for direct, indirect, and induced effects. Since the Hall and Skaggs (2003) publication was released, acreage

[3]A dual–structure agriculture is one where large numbers of farms contribute very little to total agricultural output or sales, while small numbers of larger farms contribute the majority of total agricultural output of sales.

devoted to high-value vegetable production in the three study-area counties has decreased, and thus the economic impact of the industry has also decreased.

IMPLAN is widely used throughout the United States in economic analyses of food and agricultural system activities, including emerging and alternative food production and delivery systems (e.g., local food, direct marketing, etc.). For example, in a recent economic impact study of farmers' markets in Oklahoma, Henneberry et al. (2008) applied IMPLAN and concluded that farmers' markets in the study area have a total employment impact of 1,940 jobs and a total economic output impact of $7.8 million.

A study of the economic impacts of local food systems in central Illinois by Schrader and Lauchlan (2009) concluded that increased local food production has positive output effects on an economy. The analysis investigated the impacts of replacing acreage used for grain production with fruit and vegetable production and found that there were net gains from the increased fruit and vegetable production relative to when the land was used for producing grain. In the authors' most optimistic scenarios, 11.4% of current vegetable consumption and 2.07% of current fruit consumption would be supplied by local producers, creating $4,870,761 in new regional output, $1,568,957 in combined earnings (proprietors' and employees'), and more than 19 new jobs, while displacing 3,952 acres of grain production (Schrader and Lauchlan, 2009).

Otto and Varner (2005) evaluated the economic impact of Iowa farmers markets' and found that the markets generated $12.2 million in direct, indirect, and induced output, and had an economic output multiplier of 1.58 and employment multiplier of 1.47. The net economic impact of farmers' markets in West Virginia was estimated to be $1.1 million and 82 jobs after adjustments for revenue losses by grocery stores (Hughes et al., 2008). Hughes et al. (2008) used an opportunity cost framework with the assumption that increases in farmers' market sales would be offset by reduced grocery store sales of similar products.

INPUT–OUTPUT MODELING METHODOLOGY

An input–output model is used to analyze the relationship and impact a particular industry has on a local economy. A local economy can be defined in this model as a country, state, county, city, region, etc. Input–output analysis was developed in the 1930s as a tool for quantifying economic relationships within a defined geographic area, and is a means to derive estimates of economic output and employment multipliers. The models are frequently used to examine the impacts of policy changes and economic trends on an economy. The flows of dollars within an economy are estimated, and the results can be applied to economic development planning. In many cases, input–output modeling addresses questions of what is the economic impact of a particular industry, what would be the impact if a particular industry were to shrink, or what would be the impact if a particular industry were to grow.

An input–output model is specified as a system of linear equations that represents all consumption and production, and describes the circular flow of all income and products between sectors within an economy (Holland and Yeo, 2001). The A matrix in an input–output model is called the matrix of technical coefficients and represents the production functions of all the industries in the model (net of imported inputs) (Holland and Yeo, 2001). The input–output model is derived from algebraic manipulation of the A matrix. The following describes the derivation of the input–output model (Holland and Yeo, 2001).

$$(1) \quad X = AX + Y$$
$$(2) \quad (I - A)X = Y$$
$$(3) \quad X = (I - A)^{-1}Y$$

where,

X = total industry output
I = identity matrix
A = A matrix
Y = final demand

This equation can also be interpreted as:

$$(4) \quad \Delta X = (I - A)^{-1}\Delta Y$$

where,

ΔX = change in total industry output
ΔY = change in final demand
$(I - A)^{-1}$ = Leontief inverse

IMPLAN is a combination of a software program (i.e., the input–output model) and databases. The program was developed in the 1970s by the U.S. Forest Service in cooperation with the Federal Emergency Management Agency and the U.S. Department of Interior's Bureau of Land Management (BLM), and was originally used for land and natural resource management and planning (Mulkey and Hodges, 2003). The program and its associated databases were privatized in 1993. The databases used by IMPLAN come from different federal agencies, including the Bureau of Labor Statistics,

Bureau of Economic Analysis, County Business Patterns, and, as noted previously, NASS and the Census of Agriculture. Today, the program and its associated databases are under the control of the Minnesota IMPLAN Group, Inc., located in Stillwater, MN.

IMPLAN estimates three different types of economic impacts for a particular industry: direct, indirect, and induced effects. For example, a particular industry produces goods or services, or results in money brought into an economy, which is then spent within the economy. That initial spending forms a sort of chain reaction as economic activity continues to be created and money continues to be spent in the local or regional economy until it leaks out of that economy into another (Mulkey and Hodges, 2003). Direct effects are those directly resulting from an industry that produces and sells goods or services. As economic impacts spread from firm to firm throughout the local economy, indirect effects occur, which are inter-industry transactions that occur as other industries produce and sell more goods and services to the directly affected industries (Mulkey and Hodges, 2003). Induced effects reflect changes in local spending that result from income changes in the directly and indirectly affected industry sectors (Mulkey and Hodges, 2003).

IMPLAN captures the direct, indirect, and induced effects, and summarizes them in estimated economic multipliers. The IMPLAN model also provides users with options of different types of economic and employment multipliers. Type SAM (Social Accounting Matrix) is the recommended, most comprehensive, and default multiplier for IMPLAN input–output models. Type SAM multipliers are calculated as (direct effects + indirect effects + induced effects) / direct effects. The IMPLAN model results provide estimates of both economic output and employment Type SAM multipliers. The output and employment multipliers relate the changes in sales to final demand by one industry to total changes in output by all industries within the local area (Mulkey and Hodges, 2003). For example, the output multiplier for New Mexico's pecan industry of 1.80 suggests that increased output of $100 in the pecan production sector will lead to an additional output of $80 within the state's economy ((1.80 x 100) – 100), while the pecan employment multiplier of 2.28 indicates that the addition of 100 new jobs in pecan production would result in an additional 128 jobs ((2.28 x 100) – 100) in related industries in the state (Lillywhite et al., 2007b). From Lillywhite et al.'s (2007a) results for the New Mexico dairy industry, the employment multiplier of 3.34 indicates that the addition of 100 new jobs in the dairy production sector would result in 234 additional jobs ((3.34 x 100) – 100) in related industries in the state, and the output multiplier of 1.55 predicts that increased output of $100 in dairy production will lead to an additional $55 of output within the state's economy ((1.55 x 100) – 100).

IMPLAN RESULTS AND DISCUSSION FOR BERNALILLO AND VALENCIA COUNTIES

The study area or "local economy" for this economic impact study consists of Bernalillo and Valencia Counties. This application of the IMPLAN model focuses on crop and animal production sectors that have a significant (measurable) presence in the local economy. "Measurable" means that the agricultural sector economic activity analyzed here is derived from data reported in the federal data sources noted earlier. The year of analysis is 2007 and all dollar amounts are in nominal terms. IMPLAN uses an industry sectoring scheme based on the North American Industry Classification System (NAICS).

Table 4 shows the IMPLAN-estimated multipliers for the different agricultural production sectors in Bernalillo and Valencia Counties. These multipliers quantify the "ripple effect" relationships between a specific sector and the rest of the local economy. For example, the 2.45 employment multiplier for vegetable and melon farming in the region indicates that there are an additional 1.45 jobs in the economy for every one person that is directly employed in producing vegetables/melons, while the employment multiplier for cattle shows a 1:1 relationship and the dairy sector shows a 0.5:1 relationship. The low employment multipliers for dairy production and grain farming reflect the nature of low labor input and technology-intensive production.

The output multipliers are clustered around 2.0 and do not show notable differences between them, indicating that $1.00 output from these sectors results in approximately another $1.00 output elsewhere in the economy. Industry multipliers for agriculture are typically a ratio close to 2 (Paggi 2011), and these results for Bernalillo and Valencia County output multipliers are consistent with results from other regions.

Multiplier effects vary between the different agricultural production sectors included in Table 4 because different products require different types of inputs, which are obtained from a variety of locations (both local and distant) and have different types of economic relationships with other local and distant sectors or industries. The production sectors included in the analysis interact in diverse ways with other industries located elsewhere in the state and outside the state. Economic relationships, transactions, and multiplier effects with industries outside of the two-county region in New Mexico and outside of the state of New Mexico are not included in the IMPLAN analysis or results.

Table 4. Employment and Output Multipliers for Agricultural Production in Bernalillo and Valencia Counties (Estimated Using IMPLAN, 2007 Data)

IMPLAN Economic Sector #	Economic Sector Title	Employment Multiplier	Output Multiplier
2	Grain farming	1.40	1.91
3	Vegetable and melon farming	2.45	1.95
4	Fruit farming	1.90	1.85
5	Tree nut farming	1.83	2.00
6	Greenhouse production	2.18	1.91
10	All other crop production	2.29	1.89
11	Cattle ranching and farming	2.00	2.08
12	Dairy cattle and milk production	1.50	1.87
14	All other animal production	1.66	2.05
19	Support activities for agriculture	1.25	2.11

Table 5. Economic Impact of Agricultural Production in Bernalillo and Valencia Counties (from IMPLAN, 2007 Data, Nominal Dollars)

	Direct Effects[a]		Indirect Effects[d]		Induced Effects[e]		Total Effects[f]	
Economic Sector Title	Industry Output[b] ($ sales)	Employment[c] (jobs)	Industry Output ($ sales)	Employment (jobs)	Industry Output ($ sales)	Employment (jobs)	Industry Output ($ sales)	Employment (jobs)
Agricultural Production Sector								
Fruit, vegetable, nut, and melon farming	1,305,235	9	4,149	0	8,121	0	1,317,505	9
All other crop production, including greenhouse and nursery	29,709,897	204	2,438,833	17	18,704	0	32,167,433	221
Cattle ranching and farming	11,454,916	118	2,477,708	26	7,124	0	13,939,748	144
Dairy cattle and milk production	24,751,164	419	86,526	2	31,184	1	24,868,874	422
All other animal production	15,847,560	28	812,322	2	12,806	0	16,672,689	30
Support activities for agricultural production	552,207	24	407,683	18	629	0	960,519	42
Total Agricultural Production Sectors	83,620,980	802	6,227,221	65	78,568	1	89,926,768	868
All Other Economic Sectors	--	--	21,533,123	177	49,285,546	507	70,818,669	684
TOTAL	83,620,980	802	27,760,344	242	49,364,114	508	160,745,437	1552

[a] Direct effects are the direct result of a particular industry (e.g., sales of agricultural commodities or sales of services in the case of the "support activities for agricultural production" sector).

[b] Industry output is the value of the sales of agricultural commodities or services from the agricultural production sectors.

[c] Employment is the number of full-time-equivalent jobs.

[d] Indirect effects are secondary economic impacts. An agricultural commodity producer's purchases of agricultural inputs (such as fertilizer and seeds) are indirect effects.

[e] Induced effects are the result of the change in total economic activity and household consumption because of overall increased employment and incomes. For example, a fertilizer vendor's employees shopping at local grocery stores is an induced effect.

[f] Total effects include direct, indirect, and induced effects.

Table 5 shows the IMPLAN-generated total economic impacts of agricultural production in Bernalillo and Valencia Counties. Direct, indirect, induced, and total effects are shown for aggregated commodity sectors as well as for IMPLAN Sector #19 (Support activities for agriculture). Sector #19 includes custom farming operations, agricultural consulting, and other services directly related to farm-level agricultural production. Based on the IMPLAN results, there are approximately 800 jobs in the two counties that are directly related to agricultural production. These sectors of the economy generate $83 million in industry output. The economic impact of these sectors is dominated by economic activity in field crop production, greenhouse production, and the dairy cattle sector. Field crop production in the two counties is primarily hay destined for consumption by local livestock. Sixty-five percent of the direct industry output from the sectors included in the analysis is attributed to field crop production, greenhouse production, and the dairy industry.

Indirect effects of the economic sectors analyzed are dominated by field crop and greenhouse production and beef cattle. There are virtually no indirect effects from high-value crop production (i.e., fruits, vegetables, nuts, etc). With respect to induced economic effects, the agricultural sector's contribution to the local economy is dominated by the dairy industry. As noted previously, locally produced alfalfa hay is a key input into the local dairy industry. Thus, the IMPLAN results presented here include some degree of double counting of the regional economic impact of the combined hay–dairy industry complex.

As shown in Table 5, the IMPLAN model estimates there are approximately 1,500 jobs in Bernalillo and Valencia Counties that are related directly or indirectly to production agriculture. Agriculture (as defined by the economic sectors listed in Table 5) also generates $160 million of local economic output. From Tables 4 and 5, it can be noted that the high-value fruit and vegetable production—viewed by many in the community as a potential engine of local economic development and local food production—is extremely small in the two-county study region and currently has minimal economic impact. Even if production of high-value fruits and vegetables grows at a rapid rate, the base from which the growth would take place is very small.

According to data from the Bureau of Economic Analysis (BEA, a federal agency), the Albuquerque metropolitan area had a total gross domestic product (GDP) of $34.5 billion in 2007 (U.S. Bureau of Economic Analysis, 2011). Metropolitan area GDP is the sub-state counterpart of the nation's GDP and is the most comprehensive measure of economic activity in the United States (U.S. Bureau of Economic Analysis, 2011). The $34.5 billion Albuquerque metropolitan area GDP includes Bernalillo and Valencia Counties as well as Sandoval and Torrance Counties. The BEA also estimates that the Albuquerque MSA had total employment of 506,901 jobs in 2007 (U.S. Bureau of Economic Analysis, 2010). Comparing BEA estimates of total economic activity and employment for the Albuquerque MSA to IMPLAN estimates of the economic impact of agricultural production in Bernalillo and Valencia Counties shows that the economic footprint of the study area's agriculture is extremely small. Bernalillo and Valencia County agricultural economic activity accounts for approximately 0.5% of total economic activity and 0.3% of employment in the MSA.

DISCUSSION

The information and data presented in this paper indicate that measured economic activity attributed to production agriculture in Bernalillo and Valencia Counties is very small relative to overall economic activity in the Albuquerque MSA. The application of IMPLAN in the study region can be criticized because the model uses national-level coefficients to describe economic transactions throughout the entire country, and the model thus does not perfectly represent the study region. The nationally standardized production function relationships embedded within the IMPLAN model are likely responsible for the differences in primary product sector employment presented in Table 1 and the IMPLAN results for Bernalillo and Valencia Counties presented in Table 5. However, regardless of the shortcomings of IMPLAN methodology and data, the relative and absolute magnitudes of measured and reported agriculturally related economic activity in the study area are small.

IMPLAN captures reported economic activity and is widely used in applications that attempt to assess the economic impact of agricultural production. IMPLAN data and methods do not capture informal economic activity in any state or for any economic sector. Informal economic activity includes household production and consumption of goods and services, inter-household bartering, sharing, volunteer work, subsistence production, unpaid labor and labor exchanges, unreported business transactions, and illegal economic activity (Ratner, 2000). These types of agricultural economic transactions have not been quantified in New Mexico, although there is a high level of such activity throughout the state. Many of New Mexico's irrigated, pastoral communities have long traditions of non-market agricultural activity, including community work sharing (e.g., maintenance of community irrigation ditches) and bartering. While some of these traditions are relatively new, others can be traced to the colonial period or to pre-European times. Currently, very little information or documentation is available on the magnitude of non-market agricultural

activity in New Mexico. Knowledge of informal economic activity attributed to agriculture would provide additional insight into the economic contributions of production agriculture, as well as the economic value of the land and water resources currently dedicated to production agriculture in the state.

As noted previously, IMPLAN does not capture informal economic activities that occur in a community, namely the informal dealings between local residents. For example, if residents trade pasture grazing for meat, or sell alfalfa hay for cash, the direct, indirect, and induced economic effects of the transaction cannot be estimated. The results of the IMPLAN model support the conclusion that agriculture in the two counties does not have a large economic footprint (either absolutely or relative to all other economic activity). The economic impact of formal, reported agriculture in the area is primarily derived from a few large hay growers, local dairies, and a few larger beef cattle producers. While there are larger numbers of small-scale hay and pasture producers, gardeners, and small-scale livestock producers who sell their products to neighbors or keep them for personal consumption, the cumulative value of their agricultural sales is still small. This is the nature of dual–structure agriculture as it currently exists throughout the United States (Browne et al., 1992). However, the informal economic transactions that occur between small growers and their neighbors do have both social and economic impacts in the community. As Wang (2007) concluded, South Valley Middle Rio Grande community members don't want to lose the traditions associated with a rural–residential, agricultural setting. They also do not want to lose their claim on the water resources used on their small farms.

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