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NEBRASKA'S ANIMAL AGRICULTURE:

ECONOMIC IMPACTS OF CATTLE, HOG, DAIRY, AND POULTRY INDUSTRY CHANGES

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Chapter 1: Introduction

Nebraska is a major agricultural state. In 2012, its total value of agricultural production exceeded $25 billion, ranking it fourth highest among states, surpassed only by the levels of California, Iowa, and Minnesota. The net value-added of that production in 2012 was $8.8 billion, which represented nearly 10 percent of Nebraska's total gross state product, the third highest percentage of the 50 states.

When considering the total agricultural production complex, including the closely related industries providing inputs as well as processing and other important services, the impact on the Nebraska economy becomes even more profound. In 2010, that complex represented 27 percent of the state's gross state product, 24 percent of the total work force, and 25 percent of the state labor income (Thompson, et al., 2012). Moreover, in several of the sub-state regions, the agricultural production complex in that year accounted for essentially half or more of those regions' value-added activity.

The state's agricultural production complex is particularly important economically because it represents a rich combination of both crop and livestock sectors with associated processing.

The state's agricultural production complex is particularly important economically because it represents a rich combination of both crop and livestock sectors with associated processing. In what could be called the *Nebraska Advantage,* there is in place an interrelated system of crop, livestock, and biofuel production capacity that is basically unmatched anywhere else in the nation. Besides being ranked No. 1 in irrigated acres with more than 9 million acres, commercial red meat production, and tied for first place with Texas for cattle-on-feed numbers; the state ranks No. 2 in corn-based ethanol production; No. 3 in corn for grain production; No. 4 in soybean production; No. 5 in all hay production; No. 6 in all hogs and pigs; and No. 7 in commercial hog slaughtering.

Industry officials have branded this the Golden Triangle (*Figure 1.1*). It represents a symbiotic relationship of the major enterprises of corn, soybeans, and biofuels production; with livestock production creating a critical interactive role. It is a system in which the components are closely linked with one another through various feedback loops and flows leading to synergistic opportunities and outcomes. Because of this system, there is much greater value-added economic activity playing out, particularly in the non-metropolitan economies of the state. (By value-added, we mean any activity or process that increases the market value or utility of a product or service to consumers.)

In earlier generations, production agriculture at the farm level was predominantly organized around a diverse enterprise system of both crops and livestock. Crops were grown as feed input for the animal enterprises, which in turn supplied organic fertilizer and even the horsepower energy for crop production. Farms typically sold both crops and livestock. Over time, however, as agriculture industrialized and farms expanded to capture economies of size, on-farm production became much more specialized, with increased reliance on purchased inputs. Today, across the United States heartland the predominant pattern is one of larger cash-grain farming operations specializing in just one or two crops, interspersed with some mega-sized animal enterprise units producing a single species. While specialization provides greater production efficiency to these operations, some economic adaptability and resiliency is lost because of lack of economic diversity.

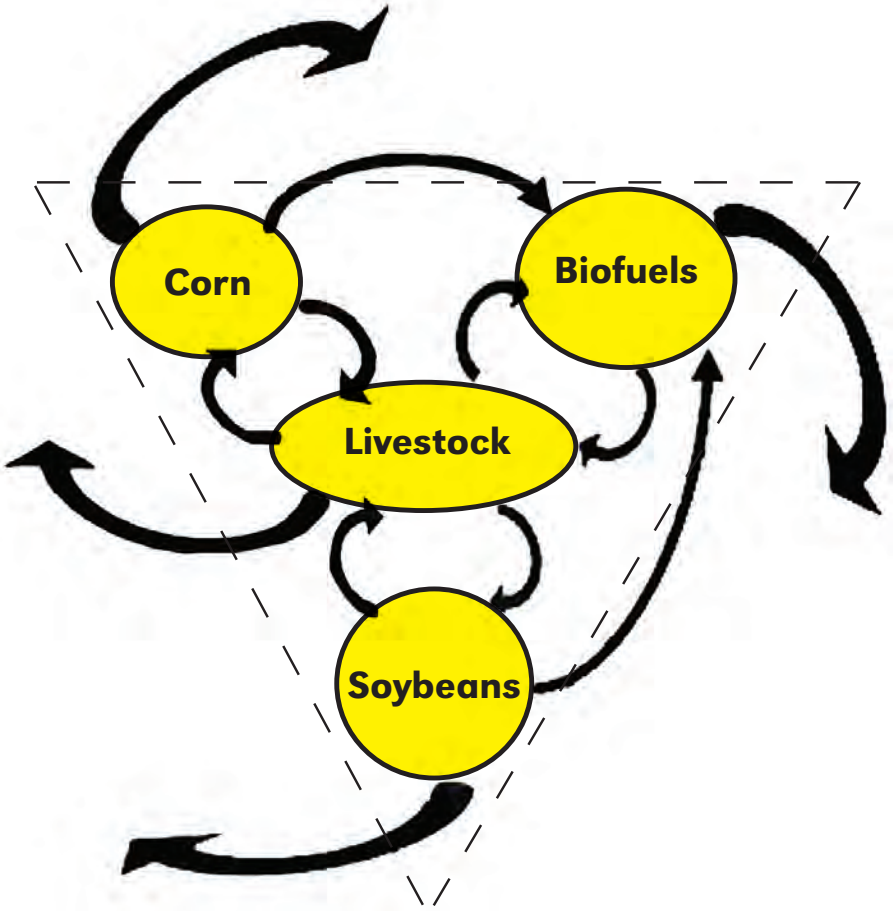

Figure 1.1 Nebraska's Golden Triangle

But while individual agricultural production units today are predominately specialized operations, in Nebraska the interactive crop/livestock system has essentially moved to a higher plane in terms of regional agricultural economies. The clearest example of this is the rapid development over the past decade of corn-based ethanol production, which not only produces ethanol fuel but also distillers grains (DGs).

Once considered a rather marginal "waste product" of the process, DGs are now regarded as a valuable co-product of the biofuels industry and used as high quality livestock feed, particularly for ruminant animals. The fact that Nebraska's cattle industry has ready access to DGs has clearly provided a competitive economic advantage over other major cattle producing states more distant from DGs. At the same time, the ongoing economic viability of the biofuels industry is significantly strengthened by the steady returns associated with this co-product.

Similarly, soybean meal, a co-product of soybean processing, is produced in abundance in the area and is, therefore, a very cost-efficient ration ingredient for a number of animal species. In short, the livestock industry of the state plays a pivotal role in utilizing the major crops produced in the state, as well as the co-products of further value-added processing of those crops.

There is also a feedback loop occurring across agricultural areas that is growing in economic importance — the substitution of animal manure for commercial fertilizer.

Proper management of livestock manure can provide a consistent, high quality organic fertilizer substitute for cash-grain producers located near larger livestock operations. The nitrogen and phosphorous content of manure can provide critical nutrients to crops. Also, manure application can enhance the organic matter content of the soil, which, in turn, increases water-holding capacity. As livestock manure is effectively returned to the soil, the environmental concerns associated with large concentrations of manure are essentially negated. Moreover, emerging technology is on the horizon that may soon make the application of methane digesters to mega-livestock operations cost efficient (see Appendix B). This would represent an additional feedback loop added to the current Golden Triangle that would capture methane emissions known to damage the atmosphere and convert those to usable biofuels or electricity.

Finally, in scaling up the Golden Triangle to an area agricultural economy, the crop sector may well see increasing opportunities for supplying crop residue and late season forage to the neighboring livestock sector. The cattle industry could support larger livestock numbers with the greater availability of forage, while the crop sector essentially can enhance cropland returns by this form of "double cropping." Nebraska's ability to essentially retain its cattle numbers during the devastating drought of 2012 is a reflection of this emerging forage connection.

The Golden Triangle production cluster relies on the strength of all the component industries to survive and thrive.

But as true of any system, the Golden Triangle production cluster relies on the strength of *all* the component industries to survive and thrive, and there are concerns that this state's current situation is not operating to its full potential, and may even be slipping in rigor in recent years.

One concern is that Nebraska still exports out of state a high proportion of its crop output as commodities. Currently, more than one-third of its annual corn crop, and more than half of the in-state production of DGs is shipped out of state. Industry officials estimate that more than 80 percent of the state's soybean meal output is exported out of Nebraska annually. This comes at a time when expanding irrigation development (an estimated 9.1 million acres under irrigation in 2013) has contributed to the state expanding its annual corn and soybean production dramatically over the past decade. This means even greater volumes being shipped out of state as commodities, rather than flowing into in-state, value-added livestock production/processing and subsequent economic activity in the state's non-metro economies. Crop sector trends are discussed in greater detail in Chapter 2.

A second concern is that while nearby states experienced significant percentage growth in livestock production over the past decade, Nebraska has not kept pace. Particularly, in the case of hog and dairy production, it has fallen behind at a time when those sectors are seeing increasing movement from coastal regions towards the central part of the U.S. The dynamics of these livestock industries suggest there may be fairly short windows of opportunity for Nebraska to participate in these geographic and structural shifts, if it chooses to embrace expansion. And in fact, Nebraska may well be facing the challenge of just retaining the livestock production/processing activity it currently has. Analysis and implications of trends in the livestock sector are presented in Chapter 3.

In light of the above, this report analyzes various livestock expansion scenarios that industry leaders consider quite possible under current conditions. The intent is

to provide a reliable set of economic performance measures to sub-state regions and county-level economies. In so doing, the various industry stakeholder groups involved will be able to effectively incorporate economic considerations into their decision-making process.

In consultation with industry officials, the following livestock expansion scenarios were designed:

- A 25 percent expansion of hog finishing volume in Nebraska, scattered across three regions of the state and 15 counties. Some 270 on-farm units, each with a 2,400 head capacity and a twice-per-year turnover rate added.
- More than a doubling of the state's current dairy herd numbers (60,000 additional head), divided across three regions of the state and 18 counties. A total of 24 new dairy operations, each with a 2,500 head capacity and two new milk processing facilities added.
- A 10 percent increase in fed cattle production in the state, with expansion distributed geographically in similar proportion to current patterns of production.
- A tripling of poultry (egg-laying) production in the state.

Also, one contraction scenario was designed reflecting the closing of one of the state's three hog processing facilities. This reflects some concern that the state's current levels of market hog production may not be sufficient to maintain this processing volume indefinitely.

The basic analysis framework was the IMPLAN model of the Nebraska economy. It is a widely used input-output analysis software package and database that can provide a detailed picture of the economy for any state and sub-state region in the nation. For this analysis, IMPLAN data for the year 2010 was used (2010 was deemed a fairly representative year for Nebraska's agricultural production complex). Results can then be compared with those of the recent report, *The 2010 Economic Impact of the Nebraska Agricultural Production Complex* (Thompson, et al., 2012). Key economic measures are estimated in the analysis, including job numbers, earnings, and value-added economic activity. Additionally, other components are also part of the impact assessment including local tax revenue impacts, assessment of feed input availability with livestock production changes, and the fertilizer economics associated with the manure co-product.

While the scenarios are generic in nature, without specific counties designated, the analytical procedure has been completed so as to provide timely response to actual proposed livestock expansion or contraction plans, with detailed economic impact metrics described above. The analysis allows both the direct and indirect effects to be estimated down to county-level detail. Each of these scenarios is addressed separately in detail in Chapters 4 through 8 of this report.

Finally, in the concluding chapter, the state's livestock industry and the future of Nebraska's economy is addressed in a broader context and conclusions/implications drawn regarding the potential for building on Nebraska's Golden Triangle.

Chapter 2: Crop Production Trends

By virtually any measure, the growth of Nebraska's crop sector in recent times has been phenomenal. The total value of the state's crop production rose from $2.79 billion in 2000 to $11.42 billion in 2012, a 309 percent increase. This totally eclipsed the U.S. crop sector increase of just 128 percent over the same time period.

Aside from the more universal factors of increasing yields (of about 1 percent per year for most major crops) and higher crop commodity prices, there are two additional elements that have influenced Nebraska's crop production growth. One was the rapid development of the corn-based ethanol industry during this time period. The industry brought a new demand dynamic into the Midwestern states, and corn producers responded accordingly. Iowa, the No. 1 ethanol-producing state, saw its crop sector production grow by about 235 percent from 2000 to 2012. With Nebraska being the No. 2 state in ethanol production, much of its crop sector output growth also can be attributed to this industry.

The second factor, unique to Nebraska, has been rapid irrigation development. In 2000, less than 7.4 million acres were under irrigation. By 2013, irrigated cropland in Nebraska had grown to 9.1 million acres — a 23 percent increase. Not only has this represented conversion of dryland cropland to irrigated cropland with significant yield increases, but also new cropland development as grassland was brought into production (Jansen and Johnson, 2013). In most instances, newly-irrigated cropland has been allocated primarily to corn production.

The above factors have had the most profound effect on the production of the state's two primary crops — corn and soybeans. Since 2000, total corn production has risen 50 percent (*Figure 2.1*). That is quite a contrast relative to a rather modest 16 percent increase over the previous 15-year period (Peterson and Frederick, 2002). As the major feed grain and biofuel input, this growth of corn production carries significant economic implications for the state. Coming off what appears to be a historic peak in corn prices in 2012, the supply response in 2013 has dramatically cut corn prices. Wide profit margins enjoyed by corn producers over the past few years have largely dissipated and are not projected to return anytime soon. Meanwhile, the ethanol industry has essentially matured with no further expansion expected for the foreseeable future. That leaves Nebraska's agricultural economy particularly vulnerable to a global oversupply of corn that may take some time to work through. So, the most reasonable option may be to actively expand in-state utilization via the livestock industry.

From its expanded and more productive cropland base, Nebraska has also experienced an expansion of soybean production of about 25 percent since 2000 (*Figure 2.2*). As an oil seed crop, the global market demand/supply situation has remained relatively favorable for producers up to the present time. However, for cash-grain producers to merely reduce corn acres and expand soybean acres in order to recoup more desirable profit margins is not the total answer. So here again, expanded livestock production and the greater utilization of soybean meal within the state seems to be a critical component of adjusting to the economic forces that are playing out. In short, livestock becomes the critical dynamic of Nebraska's Golden Triangle.

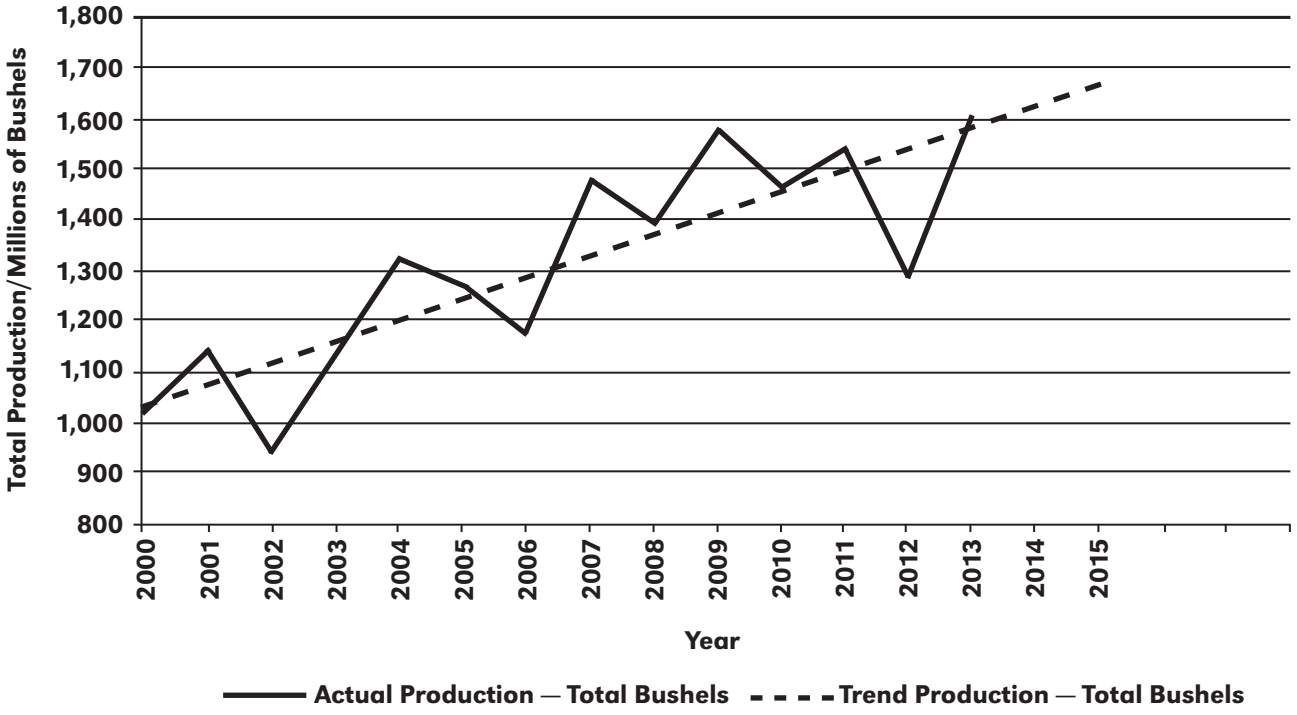

Figure 2.1 Nebraska Annual Corn Production: Actual and Trend from 2000 to 2015

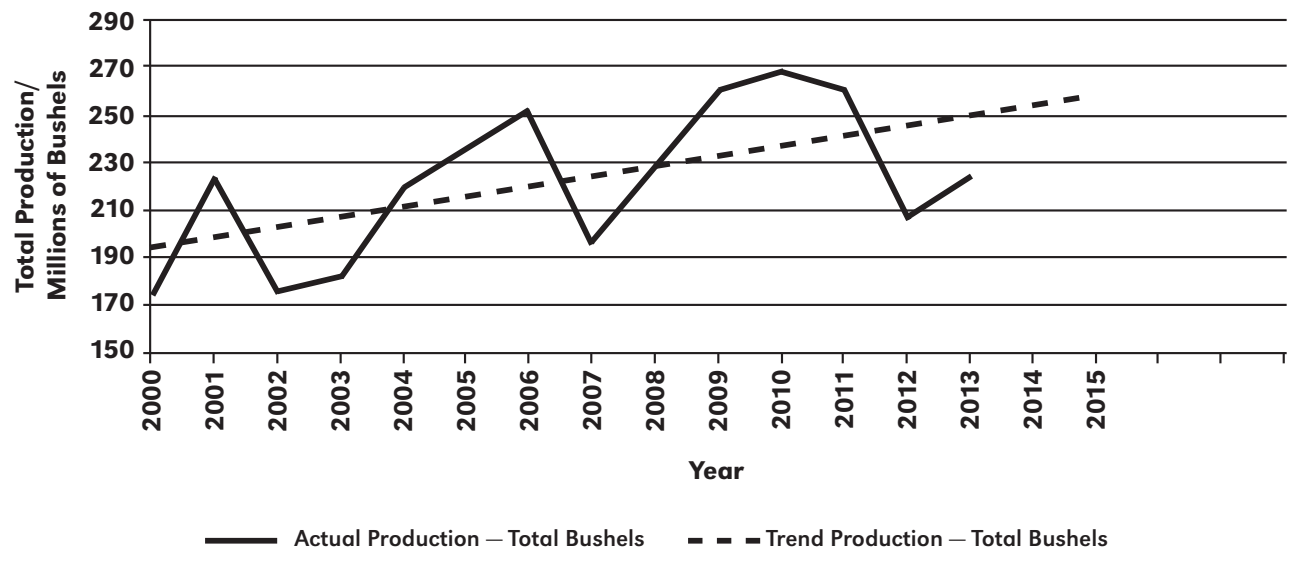

Figure 2.2 Nebraska Annual Soybean Production: Actual and Trend from 2000 to 2015

Chapter 3: Animal Production Trends

While Nebraska's crop sector production has grown rapidly since 2000, the state's livestock sector experienced relatively modest growth. Total value of livestock (including poultry) production in 2012 was $11.6 billion, representing a 96 percent growth in nominal dollars over the 2000 level — less than a third of the growth rate registered by the crop sector. Whereas the value of Nebraska livestock production was more than twice the value of the state's crop output in 2000, the two sectors are now essentially even in annual value of production output (Economic Research Service, USDA, Nov. 26, 2013).

Compared with several of the major livestock producing states, Nebraska's livestock sector has not grown as fast over the past decade (*Table 3.1*). Since 2003, the annual value of the state's production grew 67 percent, slightly above the national average. However, over the recent decade neighboring Iowa saw its total livestock production value more than double, primarily due to major hog expansion. Likewise, Minnesota recorded strong gains in livestock output — primarily hogs — as did Idaho, with a rapidly developing dairy industry. In contrast, states to the south of Nebraska, which are primarily cattle producing states, lagged behind in decade growth of their livestock industries, due in part to multiyear drought conditions and industry restructuring.

Table 3.1. Dollar Value of Livestock Production for the U.S., Nebraska, and the Other Top 10 Producing States, 2003-2012

Area	Value of Livestock Production		— 2003-2012 Change —	
	2003	2012	Dollar Amount	Percent Increase
	Million Dollars			%
U.S.	104,995	170,425	65,430	62
Nebraska	**6,909**	**11,572**	**4,663**	**67**
Texas	10,276	14,479	4,203	41
Iowa	6,026	13,141	7,115	118
California	6,942	12,113	5,171	74
Kansas	6,429	8,856	2,427	38
North Carolina	4,195	7,377	3,182	76
Minnesota	4,090	7,442	3,352	82
Oklahoma	3,316	5,215	1,899	57
Colorado	3,256	4,550	1,294	40
Idaho	2,185	4,184	1,999	91
Missouri	2,585	4,167	1,582	61
Rest of States	48,786	77,329	28,543	59

Source: Economic Research Service, USDA, U.S. Net Farm Income and Wealth Statistics, Updated Nov. 26, 2013

When the above livestock expansion metric is compared against changes in net farm income in the respective states between 2003 and 2012, an interesting pattern emerges (*Figure 3.1*). For Iowa and Minnesota, their 2012 net farm income was more than 350 percent higher than that of 2003. Likewise, Idaho saw its net farm income level rise more than 170 percent. (Note: The expanding ethanol industry was a significant contributor to farm earnings in Iowa and Minnesota over this time period, but was essentially absent in Idaho.) Meanwhile, those major livestock producing states located in the Southern Plains — Texas, Oklahoma, and Kansas — experienced low to even negative growth in total annual net farm income between 2003 and 2012. This would seem to suggest there has been some correlation of farm income trends with livestock expansion in recent years, even though it was a period when profit margins of livestock producers were often diminished by record-level feed input costs.

For Nebraska, the period 2003 to 2012 saw the state move into the No. 2 ranking of ethanol production, as well as into the No. 1 ranking in irrigated crop acres. So the fact that the state's 2012 net farm income was 120 percent higher than 10 years previous comes as no surprise. What is remarkable is that livestock expansion that was basically par with the U.S. average could have been far greater than it was, given the resources available. And in turn, recent farm income levels may well have been significantly higher than they were.

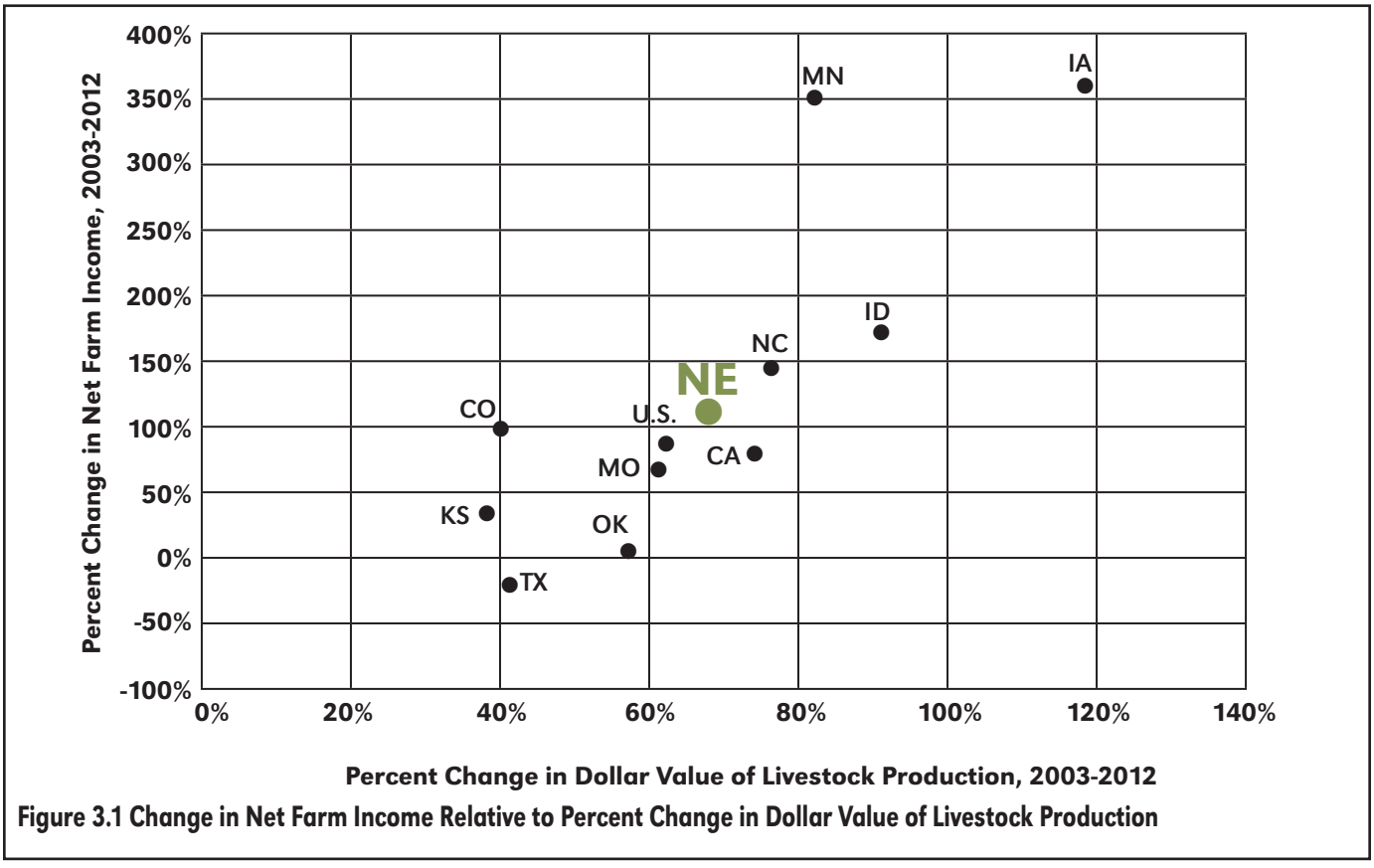

Figure 3.1 Change in Net Farm Income Relative to Percent Change in Dollar Value of Livestock Production

Fed Cattle

Nebraska's fed cattle production, which constitutes about 80 percent of its livestock sector production value, has tended to remain relatively strong in recent years, even showing a greater prominence compared with the major cattle producing states of Texas, Kansas, and Oklahoma (Brooks, et al., December 2013). While several factors have contributed to this, better access to corn and the greater availability of DGs in cattle rations have certainly given Nebraska a competitive advantage. That, in combination with extensive in-state processing and expanded use of crop residue-based forage, gives particular resiliency to this state's cattle industry. In fact, for the period 2010 through 2012, annual cattle and calves receipts rose 44 percent in Nebraska, compared with the U.S. increases of 32 percent. Nebraska's percentage increase was the highest of any of the major cattle producing states. Moreover, there seems to be opportunity to expand it even more, as the U.S. cattle industry continues to restructure and relocate in the years ahead. If recent trends continue for the next five to seven years, Nebraska will become the solid leader for U.S. cattle on feed numbers.

Hogs

In contrast to the fed-cattle sector, trends of the state's hog sector are much more problematic. Nebraska's annual pig crop over the most recent decade grew 14 percent, which was the national average (Jansen, et al., 2013). During the same time period in neighboring states, pig crop numbers grew by more than 53 percent in South Dakota, 30 percent in Iowa, 25 percent in Minnesota and 22 percent in Missouri. In fact, Iowa has recently claimed the No. 1 ranking from North Carolina as the leading state in pig crop numbers. It is clear that recent development of the hog industry has moved to the central part of the U.S., which industry leaders believe is largely due to better proximity to feed inputs.

Even more striking than pig numbers is the annual market hog inventory numbers, where Nebraska recorded a decade growth of 3 percent, compared with the U.S. growth of 11 percent (*Table 3.2*). By comparison, Iowa grew by 32 percent, Minnesota 20 percent, and Kansas 17 percent. In short, the hog industry, which has scaled up produc-

Table 3.2. Market Hog Annual Inventory, Nebraska, U.S., and Selected States, 2003-2012

U.S./State	2003	2012	Change, 2003 – 2012		Percent of U.S. 2012 Inventory in:	
			Number	Percent	2003	2012
	(1,000 head)	(1,000 head)	(1,000 head)	(%)	(%)	(%)
U.S.	54,434	60,538	6,104	11.2	100.0	100.0
Iowa	14,850	19,570	4,720	31.8	27.3	32.3
North Carolina	8,980	8,140	-840	-9.4	16.5	13.4
Minnesota	5,900	7,090	1,190	20.2	10.8	11.7
Illinois	3,590	4,110	520	14.5	6.6	6.8
Indiana	2,800	3,520	720	25.7	5.1	5.8
Nebraska	2,535	2,620	85	3.4	4.7	4.3
Kansas	1,490	1,740	250	16.8	2.7	2.9

Source: NASS, USDA

tion units to capture size economies and greater efficiency, has progressed very slowly in Nebraska, even though it shares many of the same economic advantages of its neighboring states.

Ironically, Nebraska does not even "feed out" all of its annual pig crop to market-weight levels. Presently, about one-third of its pig crop is shipped out of state to be fed out, only to then be shipped back to Nebraska for processing — a situation which may eventually jeopardize maintaining the state's current level of pork processing. In fact, in 2012 Nebraska accounted for 8.6 percent of the U.S. butcher hog slaughtering capacity, while at the same time accounting for only 4.3 percent of the nation's annual market hog inventory (Jansen, et al., 2013).

Dairy

The nation's dairy industry is undergoing both structural changes and significant geographic shifts. These changes are reflecting larger, more efficient production systems (mega-dairies), and an associated processing industry gradually transforming from fluid milk to more milk-based products for both domestic and international demand. But while these changes are swiftly occurring, Nebraska's dairy sector in the aggregate seems to be moving directly counter to what is happening nearby. Dairy cow numbers in Nebraska have declined nearly 17 percent over the past decade, to a Jan. 1, 2013, inventory of 55,000 head. This reflects a continuing trend of phasing out of smaller dairies, and very limited entry of larger dairy operations into the state (Jansen, et al., 2013). Over the same time period, several of the states surrounding Nebraska have seen expanded dairy cow numbers — Colorado growing by 37,000 head to 135,000, Kansas by 20,000 head to 132,000, and South Dakota by 8,000 head to 92,000. Iowa, which already had more than 200,000 head of dairy cows, maintained that level over the decade.

In sum, Nebraska currently accounts for less than 1 percent of the nation's milk production value, showing little sign of reversing the multiyear phasing out of its dairy sector — even though both domestic and global demand for dairy-based protein products is on the rise. In fact, unless there is some reversal in milk production, the state's remaining processers also may soon depart, as evidenced by the most recent closing of the dairy processing plant in Ravenna, Nebraska, due to insufficient milk supplies (Lincoln Journal Star, Nov. 11, 2013).

Poultry

While a relatively small contributor to Nebraska's animal industry, poultry production in the state has historically had a presence. In recent times, that has shifted primarily to larger egg-laying operations, with reduced broiler and turkey production — a pattern fairly characteristic of poultry trends across the central part of the U.S. Therefore, the focus here is on egg expansion.

From 2000 to 2012, Nebraska's annual value of egg production rose 93 percent ($94 million to $181 million), while the U.S. growth rate was 82 percent (Economic Research Service, USDA, Nov. 26, 2013). Meanwhile, over the same time period, some nearby states experienced more robust growth rates: Iowa, 311 percent ($241 million to $990 million); Missouri, 144 percent ($70 million to $171 million); and South Dakota, 159 percent ($17 million to $44 million). The point is that egg production has expanded in the region.

Summarizing Nebraska's Animal Production Trends

While the state's cattle industry has remained strong in the face of dynamic industry demand and supply shifts and is in a position to even expand, the recent trends of Nebraska's other livestock sectors are not nearly as favorable. As the U.S. hog, dairy and poultry industries have experienced a scaling up of production units for greater size economies as well as significant geographic shifts, Nebraska has lagged in the adjustment process. While nearby states have seen a dramatic growth over the past decade, one could conclude that Nebraska has experienced a "failure to thrive."

In the context of Nebraska's Golden Triangle, this is particularly troublesome. Without more progressive development of the state's livestock sector, Nebraska's total agricultural economy will not progress to its full potential in the years ahead. And as findings of the various livestock expansion scenarios in the following chapters reveal, the economic implications for our non-metro economies across the state are significant.

Chapter 4: Economic Impact of a 25 Percent Increase of Hog Finishing Production in Nebraska

Nebraska has substantial potential for growth in hog finishing activity to supply existing processing capacity in the state. Such an expansion would grasp a significant opportunity to expand family farm operations in many parts of Nebraska, which is consistent with both economic and demographic growth objectives in rural areas. Expansion of local supply also may be critical in helping Nebraska maintain its existing pork processing plants, which are major employers. In 2012, the Nebraska pig crop was estimated at 7.4 million head; and feeder hog inventory in the state for the same year was 2.6 million head. With an assumed annual production turnover rate of two, this suggests 5.2 million head of Nebraska-raised pigs were fed to slaughter weight in the state in 2012. This implies that essentially 30 percent of the state's pig crop is exported as feeder pigs out of the state annually. Moreover, given Nebraska's annual in-state hog slaughter volume of nearly 7.5 million, the state is providing only 70 percent of its born-in-Nebraska hogs for in-state processing.

In the long run, Nebraska's hog processing plants may wish to be located closer to an abundant supply of finished (market-weight) hogs. Expansion of hog finishing facilities in Nebraska would appear essential for increasing the likelihood of existing processing facilities remaining in the state. This is critical for the state's economic development future. Should just one of three pork processing plants choose to relocate closer to hog production areas, Nebraska could well lose more than 2,000 direct pork processing jobs to one of its neighboring states. This, combined with the associated economic multipliers is why hog expansion, particularly hog finishing in Nebraska, is deemed a critical aspect of Nebraska's economic future — and particularly across its non-metropolitan regions.

The Expansion Scenario

In consultation with hog industry experts, we have developed a hog-finishing expansion scenario example that would essentially mean *half* of the state's annual pig crop currently being shipped to other states for finishing would remain in Nebraska to be fed out to slaughter weight. It is believed this level of in-state expansion would be sufficient to assure continuation of current pork processing volume in the state, as well as provide a significant economic boost to rural economies.

Specifically, the scenario example would accommodate hog-finishing production expansion of 1.3 million head per year (25 percent increase over 2012 market hog volume). This would require a 648,000 head expansion of facilities, given a facility production turnover rate of twice per year (typical turnover rate of a wean-to-finish operation). As previously noted, it would account for expanded hog finishing of essentially half the pig numbers now leaving the state for finishing. Fortunately, Nebraska has a sufficient supply of feed inputs and family farms to accommodate this level of facility expansion in the near future, much like what has occurred in recent years in nearby states.

The scenario of a 648,000-head facility space expansion is assumed to occur across three multicounty Nebraska regions. Each of these regions would experience a 216,000-

head increase of facility spaces, for the production of 432,000 head of market-weight hogs annually. The expansion in each region would be done with 90 units of hog finishing of 2,400 head capacity, evenly distributed across five counties (18 finishing units per county). In total, the summation of the three regions would be some 270 on-farm units added to the state's production capacity.

In this scenario we assume there also would be an expansion of Nebraska hogs at existing Nebraska processing facilities of 650,000 head per year. In other words, there would be a net increase in pork processing in Nebraska equivalent to 50 percent of the additional market hog expansion increase occurring in hog finishing within the state. This is a conservative assumption, since discussions with industry experts suggest 50 percent is on the lower end of the range of probable outcomes, the result of lower transportation costs of market hog supply being closer to the plants. We assume that the additional hog processing would occur in regions where additional pig finishing would occur.

Using the IMPLAN model[1] with Nebraska data for 2010, this study calculates the economic impact down to county and sub-state regional economies, as well as the overall state impact under this expansion scenario for hog finishing and hog processing. The study also calculates local tax revenue impacts.

Economic impacts resulting from this scenario are designed to show the potential economic growth from an expansion of hog finishing facilities and associated processing, somewhere within Nebraska.

Economic impacts resulting from this scenario are designed to show the potential economic growth from an expansion of hog finishing facilities and associated processing, somewhere within Nebraska. This is not an attempt to show the economic impact of any particular project; therefore, results are presented in a generic manner rather than for a specific named set of counties within a region. Results are based on specific Nebraska counties, but the names of those counties are not reported here. Until such time that local stakeholders would desire to have a more definitive economic analysis of a specific expansion proposal, these scenarios will serve to be fairly representative of the general nature of county-level economic impacts.

The annual economic impact includes the direct economic activity at the hog finishing facilities and the expanded production at the hog processing plants. The total annual economic impact also includes a multiplier impact that occurs at businesses throughout the economy as the finishing facilities and processing plants purchase supplies, and as the owners and employees at these facilities spend their earnings in local and regional economies. The total economic impact is the sum of the direct impact and the multiplier impacts.

In this analysis, we arrive at economic impact in terms of four economic concepts*: output, value-added, proprietor and labor income, and employment numbers. Output* is equivalent to an increase of business receipts of finishing facilities, the expanded processing plants, and other Nebraska businesses that are part of the multiplier impact. *Value-added* is analogous to gross domestic product and reflects the increase in labor income, proprietor profits, business taxes paid, and capital consumption in the economy. In this analysis, also included in the value-added measure is increased profitability in the agricultural crop sector due to use of the manure co-product as a substitute for commercial fertilizer. The *proprietor and labor income* metric corresponds closely with personal income estimates maintained annually for state and local units of government by the U.S. Department of Commerce, Bureau of Economic Analysis. Finally, the total estimate of *employment numbers* (both direct and multiplier) generated is a critical measure to

[1]See *www.implan.com.*

consider, particularly in rural areas where population decline due to limited employment opportunity is problematic.

Economic impact estimates are presented for the 15 counties with increased hog finishing, the two counties with increased hog finishing and enhanced pork processing activity, the remainder of the three regions, and the rest of Nebraska.

In addition to the economic impact analysis, the tax implications for area governments are estimated. Also, key agricultural measures relating to availability of inputs relative to existing use in the region, the utilization and value of manure generated from the hog operations as soil nutrients, etc., are analyzed and discussed in some detail. These, we believe, are also critical economic metrics to consider when evaluating the economic impacts on local and area economies.

The Findings

The analysis begins with the direct economic impact of the hog finishing operations and the subsequent expanded pork processing. The hog finishing facilities are assumed to be spread evenly among the five counties within each of the three production regions (a total of 15 counties). Two of those counties also have a pork processing facility.

Estimates of direct annual wage and value-added in each hog finishing facility are based on a report by Lemke (2013), and discussions with industry representatives. That report considered the cost for a hog finishing facility of 4,400 head — generally considered in the industry to be the optimum size for greatest efficiency. But, in light of potentially greater ease of adapting to current farming operations and local community preferences, our model examined hog finishing facilities of 2,400 head capacity — essentially half the size of what is deemed quite efficient by the industry. In turn, we therefore assume that construction costs would fall at the midpoint of the cost per hog capacity range ($275 per head), leading to a total cost of $660,000 per finishing facility. Labor to operate the facility, whether it is the facility owner or hired labor, is assumed to be a one-fifth job (.2 FTE or 365 hours per year). At $20 per hour, the annual wage is $7,300.

Following the current pattern of the larger hog finishing units being built across the country, this analysis assumes that the facility's owner would contract with an integrator for finishing the hogs owned by the integrator, and be paid an annual fee per head of capacity. Currently, this rate for a wean-to-finish operation runs about $38 per head of capacity. This is to cover the labor provided and ownership costs of utilities, building upkeep and property taxes, as well as a return on owner's investment. Annual utility costs were assumed to average $12,000, building upkeep of 1 percent of new cost or $6,600 and property taxes of $6,685 per year. When these are subtracted from the 2,400 head integrator fee of $91,200, the dollar net to the facility owner is $65,915 (an annual amount that would cover the mortgage payments for the full amount of the facility in 14 years at a 4 percent interest rate).

In addition to the above, the facility owner would have the manure co-product which substitutes for commercial crop fertilizer. Using the industry rule of thumb of 80 acres of cropland nutrients per 1,000 head capacity, the 2,400 head unit would serve to fertilize 192 acres of corn annually. At current budgeted costs of commercial fertilizer of $125 per acre, this represents a value of $24,000 annually. With an assumed cost of application of 10 percent, the net to the facility owner — either sold or used — is valued at $21,600 annually.

So the combined net return from the contract, plus the value of the manure co-product leaves the facility owner with a total annual net return of $87,515 (an annual amount that would pay off a 100 percent mortgage of the facility in 10 years, at a 5 percent rate of interest). It is assumed the facility would continue to be contracted for the remaining 15 years of its useful life. In terms of dollar output from the hog finishing expansion, the annual sales from each finishing facility would average $842,400. This assumes 4,800 head of 270 pound market hogs, sold for $65/cwt.

Hog processing facilities would expand production by the equivalent of 50 percent of the additional hogs finished in Nebraska (most likely existing plants adding additional production shifts rather than expanding facilities). The value of the direct output (business receipts) for the expanded hog processing facility was calculated based on an estimate that approximately 41 percent of the revenue of a processing plant would be spent on purchasing hogs. That estimate came from the IMPLAN model, which provides information on the spending patterns of industries. The IMPLAN model also is utilized to calculate multiplier impacts.

Direct economic effects are presented in *Table 4.1* and *Appendix Table 4.1*. In each of 15 counties, there would be 18 finishing units, while two counties also would see additional processing of the market hogs. The average finishing county would experience the addition of: three direct jobs (full-time equivalent), $132,700 in labor income, $1.55 million in proprietor's income, $1.70 million in value-added, and $15.47 million in output. The average county with both finishing facilities and a processing facility would have 296 jobs, $11.56 million in labor income, $1.55 million in proprietor's income, $15.26 million in value-added, and $143.37 million in output.

There are two finishing counties in this scenario, which also have a processing facility. There are 13 counties with only finishing facilities. *Table 4.2* shows the total direct economic impact of the pig finishing facilities and expanded hog processing facilities across the 15 counties. The direct economic impact is $487.9 million. The direct economic impact in terms of value-added is $52.7 million. The employee compensation impact is $24.8 million in labor income and $23.2 million in proprietor's income.

Table 4.1. Direct Economic Impact of the Hog Industry Expansion by Type of County

Average Direct Impact	Jobs	Labor Income	Proprietor Income	Value-Added	Output
Finishing County (13)	3	$ 132,727	$1,547,491	$ 1,701,818	$ 15,473,455
Finishing and Processing County (2)	296	$11,559,727	$1,547,491	$15,263,374	$143,368,428

Source: Authors' calculations using IMPLAN model

Table 4.2. Total Direct Economic Impact of the Hog Industry Expansion

Total Direct Impact	Jobs	Labor Income	Proprietor Income	Value-Added	Output
Statewide	635	$24,844,905	$23,212,364	$52,650,381	$487,891,765

Source: Authors' calculations using IMPLAN model

The multiplier impact is calculated utilizing the IMPLAN model. The IMPLAN model can be used to calculate economic multipliers for every county, state, or combination of counties and states in the U.S. in over 400 industries. Economic multipliers show the additional dollars of impact and jobs for each direct dollar of output, value-added or employee compensation, or direct job. These economic multipliers represent the additional economic activity in each county as the hog finishing facilities or the expanded hog processing facilities purchase supplies, or as their employees spend their paychecks.[1]

Summary *Table 4.3* shows the average multiplier impact in a county with finishing facilities, and counties with both finishing facilities and a processing facility. Appendix *Table 4.2* shows the multiplier impact for each of the 15 counties. *Table 4.3* also shows the multiplier impact on the rest of each region and the rest of the state of Nebraska. The county, rest of region and rest of state impacts can be summed to estimate the total direct economic impact on the state of Nebraska.

The total multiplier impact is shown in *Table 4.4*. The total multiplier impact is $312.4 million in output and over 2,040 new jobs. These economic multiplier impacts reflect the additional robustness which value-added activity brings to an economy. As can be seen here in the comparison of entries in *Table 4.1* with those in *Table 4.3*, the jobs, wages, and incomes expand by some multiple of the more direct effects. And the greater the economic activity of moving raw materials and commodities to more complex final products in a local economy, the greater that economic multiple will be.

The total economic outcome is the sum of the direct economic impact and the multiplier impact (*Table 4.5* and *Appendix Table 4.3*). *Table 4.5* shows the average total economic impact for finishing counties and counties with finishing and processing facilities.

The total economic impact of the new hog finishing facilities and the expanded hog processing facilities on the state of Nebraska is $800.2 million (*Table 4.6*). The total economic impact in terms of value-added is $184.6 million. The total proprietor and labor income impact is $115.6 million, spread over 2,676 jobs added to the state's employment role.

[1]To avoid double counting, purchases of hogs are excluded from the multiplier impact of the processing facilities.

Table 4.3. Multiplier Economic Impact of the Hog Industry Expansion

Average Multiplier Impact	Jobs	Proprietor and Labor Income	Value-Added	Output
Finishing County (13)	41	$ 1,081,062	$ 2,367,673	$ 5,073,619
Finishing and Processing County (2)	398	$11,954,459	$24,852,772	$ 60,455,730
Rest of Region	45	$ 1,345,157	$ 3,145,402	$ 7,727,159
Rest of State	583	$25,551,642	$41,999,580	$102,301,642

Source: Authors' calculations using IMPLAN model

Table 4.4. Total Multiplier Economic Impact of the Hog Industry Expansion

Total Multiplier Impact	Jobs	Proprietor and Labor Income	Value-Added	Output
Statewide	2,041	$67,549,834	$131,921,080	$312,351,628

Source: Authors' calculations using IMPLAN model

Table 4.5. Total Economic Impact of the Hog Industry Expansion by County Type

Average Economic Impact	Jobs	Proprietor and Labor Income	Value-Added	Output
Finishing County (13)	44	$ 2,761,280	$ 4,069,491	$ 20,547,074
Finishing and Processing County (2)	694	$25,061,677	$40,116,145	$203,824,158
Rest of Region	45	$ 1,345,157	$ 3,145,402	$ 7,727,159
Rest of State	583	$25,551,642	$41,999,580	$102,301,642

Source: Authors' calculations using IMPLAN model

Table 4.6. Total Economic Impact of the Hog Industry Expansion by County Type

Total Economic Impact	Jobs	Proprietor and Labor Income	Value-Added	Output
Statewide	2,676	$115,607,102	$184,571,461	$800,243,393

Source: Authors' calculations using IMPLAN model

While total statewide impact is noteworthy, it is no less important to recognize local economic impacts, and to put those impacts into proper context. In any of the above counties where the new finishing units are located, an average of 44 additional employment positions would occur, with diversity across the full spectrum of the local economy and at wage rates typically above current county averages.

Moreover, this type of economic development may actually allow farm expansion to support a son or daughter returning to join a family farm operation that would otherwise be too small to do so — thus sustaining, and even increasing, rural population. In short, not only does that represent positive and sustainable economic growth, but it is enhanced by the fact that economic benefits from this type of development are effectively distributed across the geographic area. Rather than centered in one location or community, the economic activity of this livestock-based expansion is evident across the countryside and local main streets — an attribute afforded by few other economic development strategies.

Local Tax Revenue Impacts

In addition to the above income and employment considerations and associated demographics, there is also a local tax revenue impact associated with this total economic impact. The local tax revenue impact results from the increase in annual property taxes and sales taxes.

Property tax revenue grows in part due to the construction of pig finishing facilities in each county. Based on a building estimate of $275 per hog unit, this analysis would place a cost of each finishing facility at $660,000. *Table 4.7* shows the estimated average annual property tax revenue associated with the hog finishing facilities in each of the finishing 15 counties. Likewise, average additional property tax revenues are identified for two processing counties. This revenue was estimated by multiplying the value of each facility by the number of facilities in each county, by the tax rate for agricultural facilities in each county. Given the multiplier impact, there also is an economic impact on

non-agricultural property. In particular, the number and size of homes may expand as the local income expands, and the number and size of commercial properties also may increase. Statewide in Nebraska there was $1.64 in taxable real and personal property (excluding agricultural property), for each $1 in income. This ratio was used to estimate the increase in taxable property due to the increase in income resulting from the multiplier impact. The property value was then multiplied by the county property tax rate for residential and commercial property.

The sales tax revenue impact was the last component of the local tax impact. Local taxable sales were estimated based on income. A comparison of statewide taxable sales and income indicates that there is $0.396 in taxable sales in Nebraska for each $1 in personal income. We utilize this ratio to estimate the taxable spending impact for each county. This taxable spending, however, can occur anywhere in Nebraska, including the metropolitan areas. To estimate the share of spending that occurs in each county we utilized retail sales pull factor estimates (developed by the University of Nebraska–Lincoln Department of Agricultural Economics) for each Nebraska county. The pull factors for counties in this analysis range from 0.19 to 1.0. The estimated spending in each county is then multiplied by the relevant local option sales taxes to yield the estimated sales tax revenue impact in each county. Results are shown in *Appendix Table 4.4*.

In *Table 4.8*, the estimated annual local tax revenue impact from the hog industry expansion is $6.1 million, with nearly 94 percent of that being local property tax revenues. In rural counties, the bulk of the property tax revenues (60 percent or more) are usually directed at funding K-12 school districts; thus, the hog expansion activity generating countywide property tax revenues of $200,000 or more annually is a significant aspect for local stakeholders to consider in their deliberations of this kind of development. Obviously, the majority of the local property tax revenue impact occurs within the local economy, while the far smaller local option sales tax collections tend to be more dispersed beyond the respective county and region of development.

Table 4.7. Local Tax Revenue Impact of the Hog Industry Expansion by County

Average Economic Impact	Property Tax Hog Finishing Facility	Other Local Property Tax	Local Sales Tax	Total Local Tax Revenue
Finishing County (13)	$130,183	$ 88,105	$ 7,821	$ 226,109
Finishing and Processing County (2)	$118,795	$834,307	$ 71,310	$1,024,412
Rest of Region	$0	$ 42,905	$ 2,830	$ 45,736
Rest of State	$0	$838,094	$151,777	$ 989,871

Source: Authors' calculations

Table 4.8. Total Local Tax Revenue Impact of the Hog Industry Expansion

Total Economic Impact	Property Tax Hog Finishing Facility	Other Local Property Tax	Local Sales Tax	Total Local Tax Revenue
Statewide	$1,929,963	$3,780,787	$404,564	$6,115,313

Source: Authors' calculations

The additional dollars of local property and sales tax revenue generated is not necessarily a total "windfall" for the public sectors in rural area economies. Expanded hog production and processing would imply some expanded population and area business activity, which would obviously require some increase of government services. However, the additional costs of such services associated with this type of economic development (value-added activity associated with the primary economic sector), would most likely be a relatively modest portion of the tax revenue gains.

Feed Input Metrics of Expansion

The value-added activity of expanding hog finishing in the state is the key underlying concept behind the economic increases stated above. In short, it represents a shift from Nebraska's production of *commodities* (corn, soybeans, distillers grains, and feeder pigs) exported out of state, to *agricultural products* (finished market-weight hogs processed into meat, hides, and other products) for export out of state.

But in so doing, the question must be asked, are the critical feed inputs of sufficient supply in the regions to accommodate this additional feed demand without significantly altering the price of such inputs? If supplies are already tight under existing conditions, then additional demand could trigger higher feed input prices for all competing livestock producers and, in turn, reduce profit margins for the local livestock industry. To address the above we used a three-step process:

- First, we calculated the associated feed input needs of the expansion based on typical feed rations for finishing hogs, from weaning to market weight.
- Second, we assessed corn production volume down to county levels relative to county-level usage by the existing livestock industry in the respective counties — in short, we determined if counties are currently corn surplus or deficit, and if surplus, by how much.
- Third, we assessed existing surplus to see if it would be sufficient to accommodate new feed input needs.

As for feed consumption requirements for finishing an additional 1,300,000 hogs annually, the amount of feed consumed (using a typical ration of 575 pounds per hog, consisting of 64 percent corn, 14 percent dried distillers grains, and 22 percent soybean meal) annually was estimated to be 8.6 million bushels of corn, 52,000 ton dried distillers grains or equivalent, and 81,250 ton of soybean meal. Accordingly, in each of the respective regions in the expansion scenario the usage would be one-third of this amount.

In assessing county-level corn production relative to current livestock needs within the county, the analysis indicated that, with the exception of Cuming County in eastern Nebraska and a handful of counties in north central and northwest Nebraska, there is a sizable annual corn production surplus of several million bushels in every other county. (Note: Due to extensive corn ethanol processing in Washington and Platte Counties in eastern Nebraska, these areas also can run minimal corn surpluses in some years.) Thus, in the regions being considered for hog finishing expansion, additional feed requirements represent some reduction of corn normally exported out of the county and region. (Note: Current estimates by UNL Agricultural Economist Dennis Conley suggest as much as one-third of the state's corn production is exported out of the state

as grain.) Likewise, distillers grains, a co-product from corn-based ethanol plants, are also in considerable surplus relative to current in-state feed usage; with more than half of Nebraska's production exported out of the state (Conley, 2013). Moreover, with more than 20 ethanol plants currently in operation and distributed fairly widely across the state, distillers grains are economically accessible for the hog expansion across much of the state. As for soybean meal, industry officials suggest that the state is currently feeding less than 25 percent of what is produced in Nebraska, so deficits in availability at competitive prices are not an issue. (In fact, while this expansion scenario implies an 11 percent increase in soybean meal usage in Nebraska from present levels, this feedstock would still remain in considerable abundance.)

In sum, we conclude there is considerable surplus of feed inputs in the state beyond the needs of the current livestock industry. It is highly unlikely that an expanded volume of market hog production reflected in this scenario would negatively disrupt the feed grain prices and availability for those livestock producers already present. Quite the contrary, the expansion would be utilizing some of the commodities currently exported to produce value-added agricultural products to the benefit of local area economies. In fact, in the case of corn production, Nebraska's annual production has risen from about 1 billion bushels 10 years ago to more than 1.5 billion bushels today, largely due to expanded irrigation development. There may well be developing such a serious glut of corn in some local areas that local basis prices could be seriously impacted in the foreseeable future. In those areas, it would stand to reason that cash-grain crop producers would welcome and support greater local livestock utilization.

Economics of Manure Co-Products

Increasingly, the utilization of livestock manure as a substitute for commercial crop fertilizer is coming into prominence, where the former is available. In neighboring Iowa, which currently produces more than seven times the volume of market-weight hogs as Nebraska, the use of manure on the state's cropland is the norm rather than the exception. For Iowa hog producers, the manure represents a valuable co-product.

As the cost of commercial fertilizer rises, the implied dollar value of soil nutrients in manure goes up as well. As crop producers come up on the learning curve and become more adept at effectively managing this nutrient source, the input substitution effect will only expand in the future.

In this analysis we rely on the industry metric that 80 acres could be fully fertilized annually per 1,000 head of hog capacity (of facility). This converts to the manure co-product of each facility in this scenario being sufficient for 192 cropland acres. At current budgeted fertilizer costs for corn production of at least $125 per acre for commercial fertilizer, this would put the value of the manure co-product at $24,000 per facility. Assuming a 10 percent cost adjustment for application, each facility still captures a soil nutrient value of $21,600 per year — either to sell or to use directly.

For each county which is home to 18 facilities, the total acres fertilized with the manure co-product would be 3,455 acres, replacing the commercial equivalent value of $432,000. In each of the three scenario regions, the manure co-product value (commercial fertilizer substitute) would be $2.16 million, sufficient to fertilize 17,300 acres of cropland. In total for the state, the manure co-product would be valued at $6.48 million and provide the soil nutrient requirements of nearly 52,000 acres of corn annually.

CHAPTER 4: APPENDIX

Appendix Table 4.1. Direct Economic Impact of the Hog Industry Expansion

	Jobs	Labor Income	Proprietor's Income	Value-Added	Output
Finishing County 1 and Processing County 1	192	$ 7,503,727	$1,547,491	$10,447,760	$100,736,771
Finishing County 2	3	$ 132,727	$1,547,491	$1,701,818	$ 15,473,455
Finishing County 3	3	$ 132,727	$1,547,491	$1,701,818	$ 15,473,455
Finishing County 4	3	$ 132,727	$1,547,491	$1,701,818	$ 15,473,455
Finishing County 5	3	$ 132,727	$1,547,491	$1,701,818	$ 15,473,455
Finishing County 6 and Processing County 2	400	$15,615,727	$1,547,491	$20,078,987	$186,000,086
Finishing County 7	3	$ 132,727	$1,547,491	$1,701,818	$ 15,473,455
Finishing County 8	3	$ 132,727	$1,547,491	$1,701,818	$ 15,473,455
Finishing County 9	3	$ 132,727	$1,547,491	$1,701,818	$ 15,473,455
Finishing County 10	3	$ 132,727	$1,547,491	$1,701,818	$ 15,473,455
Finishing County 11	3	$ 132,727	$1,547,491	$1,701,818	$ 15,473,455
Finishing County 12	3	$ 132,727	$1,547,491	$1,701,818	$ 15,473,455
Finishing County 13	3	$ 132,727	$1,547,491	$1,701,818	$ 15,473,455
Finishing County 14	3	$ 132,727	$1,547,491	$1,701,818	$ 15,473,455
Finishing County 15	3	$ 132,727	$1,547,491	$1,701,818	$ 15,473,455
Rest of Region 1	0	$0	$0	$0	$0
Rest of Region 2	0	$0	$0	$0	$0
Rest of Region 3	0	$0	$0	$0	$0
Region 1 Total	205	$ 8,034,635	$7,737,455	$17,255,032	$162,630,589
Region 2 Total	414	$16,146,635	$7,737,455	$26,886,259	$247,893,904
Region 3 Total	17	$ 663,635	$7,737,455	$8,509,090	$ 77,367,273
Rest of State	0	$0	$0	$0	$0
State Total	635	$24,844,905	$23,212,364	$52,650,381	$487,891,765

Source: Authors' calculations

Appendix Table 4.2. Multiplier Economic Impact of the Hog Industry Expansion

	Jobs	Proprietor & Labor Income	Value-Added	Output
Finishing County 1 and Processing County 1	100	$ 3,069,356	$ 5,528,890	$ 8,849,543
Finishing County 2	71	$ 1,462,179	$ 3,569,400	$ 8,104,268
Finishing County 3	49	$ 1,289,973	$ 2,607,843	$ 4,607,455
Finishing County 4	26	$ 825,841	$ 1,703,037	$ 3,248,952
Finishing County 5	35	$ 1,183,774	$ 2,437,539	$ 4,339,953
Finishing County 6 and Processing County 2	696	$20,839,563	$ 44,176,653	$112,061,916
Finishing County 7	25	$ 700,204	$ 1,432,350	$ 3,232,598
Finishing County 8	72	$ 1,980,629	$ 4,486,576	$ 10,513,014
Finishing County 9	60	$ 1,046,685	$ 3,130,534	$ 7,855,457
Finishing County 10	41	$ 1,002,298	$ 2,297,919	$ 4,674,695
Finishing County 11	27	$ 734,916	$ 1,638,812	$ 3,383,162
Finishing County 12	41	$ 1,365,331	$ 2,445,805	$ 4,989,117
Finishing County 13	37	$ 1,395,319	$ 2,558,480	$ 5,368,920
Finishing County 14	21	$ 488,798	$ 1,094,084	$ 2,382,412
Finishing County 15	25	$ 577,856	$ 1,377,372	$ 3,257,047
Rest of Region 1	23	$ 505,758	$ 957,353	$ 1,224,895
Rest of Region 2	104	$ 3,276,804	$ 7,881,368	$ 19,395,431
Rest of Region 3	7	$ 252,908	$ 597,485	$ 2,561,150
Region 1 Total	303	$ 8,336,882	$ 16,804,062	$ 30,375,066
Region 2 Total	998	$28,846,182	$ 63,405,400	$157,733,112
Region 3 Total	158	$ 4,815,128	$ 9,712,038	$ 21,941,808
Rest of State	583	$25,551,642	$ 41,999,580	$102,301,642
State Total	2,041	$67,549,834	$131,921,080	$312,351,628

Source: Authors' calculations using IMPLAN

Appendix Table 4.3. Total Economic Impact of the Hog Industry Expansion

	Jobs	Proprietor & Labor Income	Value-Added	Output
Finishing County 1 and Processing County 1	292	$ 12,120,574	$ 15,976,650	$109,586,313
Finishing County 2	74	$ 3,142,397	$ 5,271,218	$ 23,577,722
Finishing County 3	52	$ 2,970,191	$ 4,309,661	$ 20,080,910
Finishing County 4	29	$ 2,506,059	$ 3,404,855	$ 18,722,407
Finishing County 5	38	$ 2,863,992	$ 4,139,357	$ 19,813,408
Finishing County 6 and Processing County 2	1,096	$ 38,002,781	$ 64,255,640	$298,062,002
Finishing County 7	28	$ 2,380,422	$ 3,134,168	$ 18,706,053
Finishing County 8	75	$ 3,660,847	$ 6,188,394	$ 25,986,469
Finishing County 9	64	$ 2,726,903	$ 4,832,352	$ 23,328,912
Finishing County 10	44	$ 2,682,516	$ 3,999,737	$ 20,148,149
Finishing County 11	30	$ 2,415,134	$ 3,340,630	$ 18,856,617
Finishing County 12	45	$ 3,045,549	$ 4,147,623	$ 20,462,572
Finishing County 13	40	$ 3,075,537	$ 4,260,298	$ 20,842,375
Finishing County 14	24	$ 2,169,016	$ 2,795,902	$ 17,855,867
Finishing County 15	28	$ 2,258,074	$ 3,079,190	$ 18,730,502
Rest of Region 1	23	$ 505,758	$ 957,353	$ 1,224,895
Rest of Region 2	104	$ 3,276,804	$ 7,881,368	$ 19,395,431
Rest of Region 3	7	$ 252,908	$ 597,485	$ 2,561,150
Region 1 Total	508	$ 24,108,971	$ 34,059,094	$193,005,655
Region 2 Total	1,412	$ 52,730,272	$ 90,291,659	$405,627,016
Region 3 Total	174	$ 13,216,218	$ 18,221,128	$ 99,309,081
Rest of State	583	$ 25,551,642	$ 41,999,580	$102,301,642
State Total	2,676	$115,607,102	$184,571,461	$800,243,393

Source: Authors' calculations

Appendix Table 4.4. Local Tax Revenue Impact of the Hog Industry Expansion

	Property Tax Hog Finishing Facility	Other Local Property Tax	Local Sales Tax	Total Local Tax Revenue
Finishing County 1 and Processing County 1	$ 131,228	$ 397,038	$ 18,239	$ 546,505
Finishing County 2	$ 138,186	$ 102,215	$ 12,133	$ 252,534
Finishing County 3	$ 118,535	$ 91,080	$ 10,762	$ 220,378
Finishing County 4	$ 112,323	$ 69,713	$ 4,764	$ 186,799
Finishing County 5	$ 105,073	$ 77,652	$ 8,676	$ 191,402
Finishing County 6 and Processing County 2	$ 106,361	$1,271,577	$124,381	$1,502,319
Finishing County 7	$ 141,920	$ 78,203	$ 2,121	$ 222,244
Finishing County 8	$ 125,412	$ 110,866	$ 5,016	$ 241,294
Finishing County 9	$ 130,847	$ 85,089	$0	$ 215,936
Finishing County 10	$ 134,298	$ 86,203	$ 5,311	$ 225,812
Finishing County 11	$ 124,837	$ 78,175	$ 9,468	$ 212,480
Finishing County 12	$ 153,009	$ 107,056	$ 18,091	$ 278,156
Finishing County 13	$ 142,892	$ 109,316	$ 18,269	$ 270,477
Finishing County 14	$ 135,861	$ 76,065	$ 3,221	$ 215,147
Finishing County 15	$ 129,179	$ 73,730	$ 3,845	$ 206,754
Rest of Region 1	$0	$ 15,262	$ 1,302	$ 16,564
Rest of Region 2	$0	$ 104,815	$ 6,488	$ 111,303
Rest of Region 3	$0	$ 8,639	$ 701	$ 9,340
Region 1 Total	$ 605,345	$ 752,960	$ 55,876	$1,414,181
Region 2 Total	$ 638,839	$1,736,752	$143,317	$2,518,908
Region 3 Total	$ 685,778	$ 452,980	$ 53,595	$1,192,353
Rest of State	$0	$ 838,094	$151,777	$ 989,871
State Total	$1,929,963	$3,780,787	$404,564	$6,115,313

Source: Authors' calculations

Chapter 5: The Economic Impact of Dairy Expansion in Nebraska

There is substantial potential to expand dairy activity in Nebraska. This report considers the economic impact from the formation of a dairy cluster in three Nebraska regions. The cluster would consist of eight dairies, with capacity for 2,500 head apiece in each of the six regions. The dairies would be spread through five to seven counties for a total expansion of 20,000 dairy cows in each region, or 60,000 dairy cows overall. The milk is also expected to be processed within two of the three regions. One region will border the state of Iowa, and we anticipate milk from that region will be processed in Iowa.

This analysis examines the economic impact from essentially doubling Nebraska's current dairy herd numbers and dairy production output. Such an expansion is feasible going forward. The state's dairy herd numbers have been on a significant decline for the past two decades. Currently, the milking herd numbers are at 55,000 head, down nearly 17 percent since 2003. This decline has occurred at the same time that neighboring states have significantly expanded over the past decade — Colorado increasing 38 percent to 135,000 cows, Kansas up 18 percent to 132,000 cows, and South Dakota up 10 percent to 92,000 cows. Iowa has continued to maintain more than 200,000 cows over this time period.

For a variety of reasons, the dairy industry, along with other livestock sectors, is changing rapidly in both the structural configuration of production processes and geographic location. Scale efficiencies have transformed the bulk of dairy production to large dairies of several thousand head. Meanwhile, a growing share of the processing component of the industry has shifted from fluid milk to the manufacturing of a variety of dairy products for both domestic and foreign market demand. It is this aspect that has led to major geographic shifts of dairy away from the traditional *milk shed* regions of the country that historically clustered around larger metropolitan areas.

While Nebraska has not been actively present in the changing dairy industry it nevertheless represents a state with all the essential ingredients to grow a more robust industry — land, water, climate, abundant feedstock, reasonable utility rates, geographic location, etc. This type of expansion, particularly with accompanying processing, represents a powerful value-added effect on area economies and, therefore, is considered to be a viable option for future economic development in rural Nebraska. Ultimately, however, the future lies in the will of the state and its citizens as to whether or not to actively embrace it in the near future (a fairly limited window of opportunity of perhaps no more than three to five years). The economic analysis and findings to follow hopefully assist in that process of rational deliberation and decision-making.

The Expansion Scenario

We calculated the ongoing annual economic impact of dairy expansion occurring in three multicounty regions of Nebraska. Each regional cluster is comprised of contiguous counties, with a total of eight dairies in each region. In two of the regions a new milk processing facility is assumed to be added. We also calculated the property

value and tax implications, and assumed each dairy is milking 2,500 head. The annual economic impact identifies the direct economic activity at the eight dairy facilities in each region and the two milk processing plants. The total annual economic impact also includes a multiplier impact which occurs in businesses throughout the economy as dairies and processing plants purchase supplies, and as their employees spend their salaries in local economies. So, the total economic impact is the sum of the direct impact and the multiplier impact.

The analysis uses the IMPLAN model for the Nebraska economy for the year 2010. As with the other scenarios, the model used here calculates the economic impact down to county and sub-state regional economies in Nebraska, as well as the overall state impact.

The economic impacts resulting from this dairy expansion scenario are designed to show the potential economic impacts somewhere within the central, northeast and east Nebraska regions. Results, therefore, are presented in a generic manner rather than for a specific named set of counties within the region (the results are based on specific Nebraska counties, but the names are not reported here). Similarly, regional results are presented as Region 1, Region 2, and Region 3, without naming the specific region. Until such time that local stakeholders would desire to have a more definitive economic analysis of a specific expansion proposal, these scenarios will serve to be fairly representative of the general nature of both county and regional-level economic impacts.

In this analysis, economic impact is presented in terms of four economic concepts: *output, value-added, proprietor and labor income, and employment numbers*. *Output* is equivalent to an increase of business receipts of dairies, the milk processing plant, and other Nebraska businesses that are part of the multiplier impact. *Value-added* is analogous to gross domestic product and reflects the increase in labor income, profits, business taxes paid, and capital consumption in the economy. The *proprietor and labor income* metric corresponds closely with personal income estimates maintained annually for state and local units of government by the U. S. Department of Commerce, Bureau of Economic Analysis. Finally, the total estimate of *employment numbers* generated (full-time jobs both direct and multiplier) is a critical measure to consider, particularly in rural areas where population decline due to limited employment opportunity is problematic.

In addition to the economic impact analysis, the tax implications on area governments from the expansion are estimated. Also, key agricultural measures relating to availability of inputs relative to existing use in the region, the utilization and value of manure generated from the dairies as soil nutrients, etc., are analyzed and discussed in some detail. These, we believe, are additional important economic metrics to consider when evaluating the economic impacts on local and area economies.

The Findings

Table 5.1 shows the direct economic impact of the dairies in the three regions and the milk processing plant in two regions. The eight dairy facilities in each region are assumed to be spread geographically across the regions. Some counties in each region host two dairies, while most counties host one dairy. Results are also reported for two processing counties, where the milk processing facilities would be located. Each milk processing plant would be large enough to process the milk from 20,000 dairy cows.

Estimates of direct employment, annual wage, and value-added in each dairy are based on a recent study by Lemke (Lemke, 2012), as well as discussions with industry representatives. The Lemke report considered cost for a dairy near the maximum-efficient size of 6,000 head with 50 employees and compensation, including both wages and benefits of approximately $44,000 per worker. Since our scenario incorporated smaller dairies with 2,500 head of cattle, smaller than maximum efficiency size, we assume that the dairies in this analysis would require more worker input per dairy cow; specifically, 28 workers in a dairy with 2,500 cows. Total compensation per employee was assumed to average $42,000. The sales of each dairy are estimated based on approximately 180 cwt of milk per dairy cow per year, valued at $20 per cwt. There also was revenue from the sale of calves and dairy cows for meat each year as well as the agricultural value of manure, valued at $65 per cow per year. The estimated annual revenue of each dairy was $10.37 million.

The value of the direct output (business receipts) for the milk processing plant was calculated based on an estimate that approximately 29 percent of the revenue of a processing plant would be spent on milk. That estimate came from the IMPLAN model, which provides information on the spending patterns of industries. The IMPLAN model also is utilized to calculate multiplier impact, as described later. The output (business receipts) of the milk processing plant was estimated to be $244.20 million per year.

Direct economic effects are presented in *Table 5.1* and *Appendix Table 5.1*. In each of 18 counties there would be either one or two dairies, while two counties also would see additional milk processing with a dry milk facility. The average dairy county would experience the addition of 37 direct jobs, $1.56 million in labor and proprietor's income, $4.12 million in value-added, and $13.82 million in output. The average county with a dairy and a milk processing facility would have 252 jobs, $12.62 million in labor and proprietor's income, $37.23 million in value-added, and $254.57 million in output.

There are two dairy counties in this scenario which also have a milk processing facility. There are 16 counties with only dairy facilities. *Table 5.2* and *Appendix Table*

Table 5.1. Direct Economic Impact of the Dairy and Milk Processing Cluster by Type of County

Average Direct Impact	Jobs	Labor and Proprietor Income	Value-Added	Output
Dairy County (16)	37	$ 1,555,556	$ 4,118,889	$ 13,821,333
Dairy and Processing County (2)	252	$12,622,164	$37,230,092	$254,566,795

Source: Authors' calculations using IMPLAN model

Table 5.2. Total Direct Economic Impact of the Dairy Industry Expansion

Total Direct Impact	Jobs	Labor and Proprietor Income	Value-Added	Output
Statewide	1,116	$50,910,995	$142,421,851	$737,185,590

Source: Authors' calculations using IMPLAN model

5.1 show the aggregate direct economic impact of the dairies and milk processing facilities across the 18 counties. The direct economic impact is $737.19 million, the direct economic impact in terms of value-added is $142.42 million, and the labor and proprietor income impact is $50.91 million in labor income. The job impact is 1,116 new jobs and the average labor income per job is $45,600, which is a somewhat higher level than for employees of the dairies, reflecting the presence of some higher-skilled positions required in the processing plant.[2]

The multiplier impact is calculated utilizing the IMPLAN model. The IMPLAN model can be used to calculate economic multipliers for every county, state, or combination of counties and states in the U. S. in over 400 industries. Economic multipliers show the additional dollars of impact or jobs for each direct dollar of output, value-added labor income or direct job. These economic multipliers represent the additional economic activity in each county, as the dairies or the milk processing facilities purchase supplies, or as their employees spend their paychecks.

Summary *Table 5.3* shows the average multiplier impact in a county with a dairy and counties with both a dairy and a milk processing facility. *Appendix Table 5.2* shows the multiplier impact for each of the 18 counties. *Table 5.3* also shows the average multiplier impact on the rest of each region from the dairies located in that region. Finally, the table shows the impact on the rest of the state from the dairies in all three regions.

Average values for the 16 dairy counties, two dairy and processing counties, three remaining counties in each region (rest of region), and the rest of the state can be summed to yield the total multiplier impact statewide. The total multiplier impact statewide is shown in *Table 5.4* and *Appendix Table 5.3*. The total multiplier impact is $369.43 million in output and over 2,012 jobs. These economic multiplier impacts reflect the additional robustness which value-added activity brings to an economy. As can be seen in the comparison of entries in *Table 5.1* with those in *Table 5.2*, the jobs, wages, and

[2]To avoid double counting, purchases of milk are excluded from the multiplier impact of the milk processing facility.

Table 5.3. Average Multiplier Economic Impact of the Dairy and Milk Processing Cluster, by Type of County

Average Multiplier Impact	Jobs	Labor and Proprietor Income	Value-Added	Output
Dairy County (16)	36	$ 1,309,356	$ 2,711,020	$ 6,707,983
Dairy and Processing County (2)	395	$13,320,225	$29,964,167	$59,789,741
Rest of Region	74	$ 3,183,733	$ 7,183,368	$18,008,793
Rest of State	427	$21,381,187	$34,024,199	$88,495,456

Source: Authors' calculations using IMPLAN model

Table 5.4. Total Multiplier Economic Impact of the Dairy Industry Expansion

Total Multiplier Impact	Jobs	Labor and Proprietor Income	Value-Added	Output
Statewide	2,012	$78,522,532	$158,878,951	$369,429,037

Source: Authors' calculations using IMPLAN model

incomes expand by some multiple of the direct effects. The greater the economic activity of moving raw materials and commodities to more complex final products in a local economy, the greater that economic multiple will be.

The total economic outcome is the sum of the direct economic impact and the multiplier impact (*Table 5.5* and *Appendix Table 5.3*). *Table 5.5* shows the **average** total economic impact for dairy counties and counties with dairy and processing facilities.

The total economic impact of the dairy industry expansion on the state of Nebraska is $1,106.61 million (*Table 5.6*). The total economic impact in terms of value-added is $301.3 million, and the total proprietor and labor income impact is $129.4 million spread over 3,128 new jobs added to the state's employment role. This is an average annual compensation of $41,400 per job, including wages and benefits.

In addition to the total impact, it is also important to consider the distribution of economic effects across the multicounty region. As evidenced in *Appendix Table 5.3*, even the counties where just one of the eight dairies is located could expect to see from 37 to 59 additional jobs added to the county economy, with wage rates above the county averages. For the two counties also home to a milk processing plant, which would likely be a regional hub, the addition of up to 779 jobs and associated income flows would, no doubt, be regarded as a major economic boost. In short, dairy production expansion and the associated opportunity for milk processing can generate considerable economic growth, and distribute it widely across a multicounty region.

Tax Implications for Area Economics

There is a local tax revenue impact associated with this total economic impact. The annual local tax revenue impact results from the increase in property taxes and sales taxes. Property tax revenue grows in part due to the construction of new dairy facilities in each county. Analysis by Lemke (2013) found that each 6,000-head dairy would cost approximately $12 million to construct. Based on this figure, and adjusting for somewhat higher construction costs per cow for a dairy that is much less than the

Table 5.5. Average Total Economic Impact of the Dairy and Milk Processing Cluster, by Type of County

Average Multiplier Impact	Jobs	Labor and Proprietor Income	Value-Added	Output
Dairy County (16)	74	$ 2,913,523	$ 6,958,624	$ 20,961,233
Dairy and Processing County (2)	647	$25,942,388	$67,194,259	$314,356,536
Rest of Region	74	$ 3,183,733	$ 7,183,368	$ 18,008,793
Rest of State	427	$21,381,187	$34,024,199	$ 88,495,456

Source: Authors' calculations using IMPLAN model

Table 5.6. Total Multiplier Economic Impact of the Dairy Industry Expansion

Total Economic Impact	Jobs	Labor and Proprietor Income	Value-Added	Output
Statewide	3,128	$129,433,527	$301,300,802	$1,106,614,627

Source: Authors' calculations using IMPLAN model

maximum efficient size, will yield a property value of $6.7 million per dairy. We assume that in a typical year, given depreciation, the value of that property is just 75 percent of that amount. This revenue was estimated by multiplying the assessed value (90 percent of market value) of each facility by the number of facilities in each county by the tax rate for agricultural facilities in each county. Given the multiplier impact, there also is an economic impact on non-agricultural property. In particular, the number and size of homes may expand as local income expands, and the number and size of commercial properties also may increase. Statewide, in Nebraska there was $1.64 in taxable real and personal property (excluding agricultural property) for each $1 in income. This ratio was used to estimate the increase in taxable property due to the increase in income resulting from the multiplier impact. The property value was then multiplied by the county property tax rate for residential and commercial property. Results for individual counties are shown in *Appendix Table 5.4*.

The sales tax revenue impact was the last component of the local tax impact. Local taxable sales were estimated based on income. A comparison of statewide taxable sales and income indicates that there is $0.396 in taxable sales in Nebraska for each $1 in income. We utilize this ratio to estimate the taxable spending impact for each county. This taxable spending, however, can occur anywhere in Nebraska, including in the Omaha and Lincoln areas. To estimate the share of spending that occurs in each county, we utilized pull factor estimates for each Nebraska county (developed by the UNL Department of Agricultural Economics). The pull factor ranges from 0.19 (trade leakage) to greater than 1.00 (trade surplus), depending on the retail viability of the respective county. The estimated spending in each county is then multiplied by the relevant local option sales tax to yield the estimated sales tax revenue impact in each county. Results are shown in *Table 5.7*. The majority of the local tax revenue impact occurs within the three regions, with just $0.83 million in local tax revenue impact occurring in the rest of the state.

Table 5.8 and *Appendix Table 5.4* show that the total annual local tax revenue impact is $6.19 million. The largest source is other property tax revenue generated due to the

Table 5.7. Average Local Tax Revenue Impact of the Dairy and Milk Processing Cluster by County

Average Multiplier Impact	Property Tax Dairy Facility	Other Local Property Tax	Local Sales Tax	Total Local Tax Revenue
Dairy County (16)	$80,924	$130,625	$ 14,760	$ 226,309
Dairy and Processing County (2)	$75,607	$879,109	$ 99,452	$1,054,168
Rest of Region	$0	$101,171	$ 8,307	$ 109,478
Rest of State	$0	$701,303	$127,004	$ 828,307

Source: Authors' calculations

Table 5.8. Total Local Tax Revenue Impact of the Dairy Industry Expansion

Total Tax Impact	Property Tax Dairy Facility	Other Local Property Tax	Local Sales Tax	Total Local Tax Revenue
Statewide	$1,451,169	$4,233,271	$501,427	$6,185,867

Source: Authors' calculations

multiplier effect. The property tax revenue from the dairy facilities is the second largest revenue source. Sales taxes account for a fairly small share of local tax revenues.

Feed Input Metrics of Dairy Expansion

Whenever consideration is given to the potential entry of a larger livestock operation such as a 2,500-head dairy, it is important to consider the demand for livestock feed and its implications on availability and price. Can the region accommodate the additional feed demand from existing supply without triggering higher feed input prices for all competing livestock producers and, in turn, tighten profit margins? To address that issue, we used a three-step process:

- First, we calculated the associated corn input needs of the dairy expansion based on typical feed rations for dairy cattle (the corn bushel equivalent of grain and corn silage was estimated to be 120 bushels per head per year, or 300,000 bushels per 2,500-head dairy).
- Second, we assessed corn production volume down to county levels relative to county-level usage by the existing livestock industry in the respective counties — in short we determined if counties are currently corn surplus or deficit, and if surplus, by how much annually. All the northeast Nebraska counties, except Cuming County, were found to be corn surplus counties in recent years; even in 2012 with pervasive drought conditions, the corn surplus of production over usage was considerable.
- Third, the step involved a county-by-county determination to see if the typical corn surplus was sufficient to meet the needs of the dairy expansion. With the exception of Cuming County (a major cattle-feeding area in northeast Nebraska), our analysis indicated that the additional feed requirements, based on corn-based feed, would easily be met by each respective county should one or two dairies be added to the local demand.

Economics of Manure Co-Products from Dairy Expansion

The use of livestock manure as a substitute for commercial fertilizer is growing in prominence in cash-grain regions where this option exists. Partly due to the steady rise of commercial fertilizer prices and partly due to improved management of organic-based fertilizer, it is likely that the economics of this substitution will only expand in the future.

In consultation with industry officials, we are assuming the annual manure byproduct of a lactating dairy cow is valued at $65. In other words, this product would be substituted for commercial fertilizer by that amount. Given Nebraska Department of Environmental Quality guidelines of a minimum of one acre of cropland for spreading manure from three cattle, no less than 6,600 acres of cropland in the dairy cluster region would have access to this organic substitute. The total value of the manure byproduct would be $1.2 million annually. Moreover, within a most efficient transportation distance — zero to 10 miles — of each respective 2,500-head dairy, essentially 1,000 acres of cropland could receive an application each year, with a total substitution value of $150,000. (Note: While the per-acre cost of the manure would be $150, and higher than the typical annual cost of commercial fertilizer, the nutrient and organic matter enhancement of the manure application would actually be carried forward for more than a single crop year, thus justifying its substitution.)

CHAPTER 5: APPENDIX

Appendix Table 5.1. Direct Economic Impact of the Dairy and Milk Processing Cluster

	Jobs	Proprietor & Labor Income	Value-Added	Output
Dairy County 1	27.8	$ 1,166,667	$ 3,089,167	$ 10,366,000
Dairy County 2	55.6	$ 2,333,333	$ 6,178,333	$ 20,732,000
Dairy County 3 and Processing County 1	252	$12,948,122	$ 37,556,051	$254,566,795
Dairy County 4	28	$ 1,166,667	$ 3,089,167	$ 10,366,000
Dairy County 5	28	$ 1,166,667	$ 3,089,167	$ 10,366,000
Dairy County 6	28	$ 1,166,667	$ 3,089,167	$ 10,366,000
Dairy County 7	28	$ 1,166,667	$ 3,089,167	$ 10,366,000
Dairy County 8 and Processing County 2	252	$12,296,205	$ 36,904,133	$254,566,795
Dairy County 9	28	$ 1,166,667	$ 3,089,167	$ 10,366,000
Dairy County 10	28	$ 1,166,667	$ 3,089,167	$ 10,366,000
Dairy County 11	28	$ 1,166,667	$ 3,089,167	$ 10,366,000
Dairy County 12	56	$ 2,333,333	$ 6,178,333	$ 20,732,000
Dairy County 13	56	$ 2,333,333	$ 6,178,333	$ 20,732,000
Dairy County 14	56	$ 2,333,333	$ 6,178,333	$ 20,732,000
Dairy County 15	56	$ 2,333,333	$ 6,178,333	$ 20,732,000
Dairy County 16	56	$ 2,333,333	$ 6,178,333	$ 20,732,000
Dairy County 17	28	$ 1,166,667	$ 3,089,167	$ 10,366,000
Dairy County 18	28	$ 1,166,667	$ 3,089,167	$ 10,366,000
Rest of Region 1	0	$0	$0	$0
Rest of Region 2	0	$0	$0	$0
Rest of Region 3	0	$0	$0	$0
Region 1 Total	447	$21,114,790	$ 59,180,219	$327,128,795
Region 2 Total	447	$20,462,872	$ 58,528,300	$327,128,795
Region 3 Total	222	$ 9,333,333	$ 24,713,332	$ 82,928,000
Rest of State	0	$0	$0	$0
State Total	1,116	$50,910,995	$142,421,851	$737,185,590

Source: Authors' calculations using IMPLAN model

Appendix Table 5.2. Multiplier Economic Impact of the Dairy and Milk Processing Cluster

	Jobs	Proprietor & Labor Income	Value-Added	Output
Dairy County 1	68	$ 2,837,176	$ 4,660,313	$ 9,907,991
Dairy County 2	35	$ 1,036,846	$ 2,153,090	$ 4,336,714
Dairy County 3 and Processing County 1	263	$ 8,816,465	$ 16,364,925	$ 31,394,161
Dairy County 4	13	$ 443,044	$ 925,415	$ 1,898,580
Dairy County 5	9	$ 333,700	$ 777,779	$ 1,516,549
Dairy County 6	61	$ 2,583,318	$ 4,857,980	$ 9,680,898
Dairy County 7	24	$ 929,357	$ 1,784,134	$ 3,322,751
Dairy County 8 and Processing County 2	527	$17,823,984	$ 43,563,409	$ 88,185,321
Dairy County 9	15	$ 480,541	$ 930,604	$ 2,155,046
Dairy County 10	31	$ 1,032,932	$ 3,064,927	$ 7,302,785
Dairy County 11	23	$ 606,867	$ 1,944,675	$ 4,567,853
Dairy County 12	54	$ 1,477,280	$ 4,715,140	$ 10,866,272
Dairy County 13	50	$ 1,988,097	$ 3,885,141	$ 11,044,285
Dairy County 14	25	$ 799,349	$ 1,704,571	$ 4,890,850
Dairy County 15	30	$ 993,592	$ 2,095,641	$ 5,410,076
Dairy County 16	87	$ 3,683,406	$ 6,546,721	$ 19,782,121
Dairy County 17	11	$ 356,764	$ 736,929	$ 1,379,896
Dairy County 18	37	$ 1,367,427	$ 2,593,255	$ 9,265,054
Rest of Region 1	35	$ 1,467,376	$ 2,654,262	$ 7,108,037
Rest of Region 2	72	$ 2,642,680	$ 10,436,365	$ 30,031,055
Rest of Region 3	117	$ 5,441,144	$ 8,459,476	$ 16,887,286
Region 1 Total	507	$18,447,282	$ 34,177,898	$ 69,165,681
Region 2 Total	772	$26,052,381	$ 68,540,261	$154,152,617
Region 3 Total	306	$12,641,682	$ 22,136,593	$ 57,615,283
Rest of State	427	$21,381,187	$ 34,024,199	$ 88,495,456
State Total	2,012	$78,522,532	$158,878,951	$369,429,037

Source: Authors' calculations using IMPLAN model

Appendix Table 5.3. Total Economic Impact of the Dairy and Milk Processing Cluster

	Jobs	Proprietor & Labor Income	Value-Added	Output
Dairy County 1	96	$ 4,003,843	$ 7,749,480	$ 20,273,991
Dairy County 2	91	$ 3,370,179	$ 8,331,423	$ 25,068,714
Dairy County 3 and Processing County 1	515	$ 21,764,587	$ 53,920,976	$ 285,960,956
Dairy County 4	41	$ 1,609,711	$ 4,014,582	$ 12,264,580
Dairy County 5	37	$ 1,500,367	$ 3,866,946	$ 11,882,549
Dairy County 6	89	$ 3,749,985	$ 7,947,147	$ 20,046,898
Dairy County 7	52	$ 2,096,024	$ 4,873,301	$ 13,688,751
Dairy County 8 and Processing County 2	779	$ 30,120,189	$ 80,467,542	$ 342,752,116
Dairy County 9	43	$ 1,647,208	$ 4,019,771	$ 12,521,046
Dairy County 10	59	$ 2,199,599	$ 6,154,094	$ 17,668,785
Dairy County 11	51	$ 1,773,534	$ 5,033,842	$ 14,933,853
Dairy County 12	110	$ 3,810,613	$ 10,893,473	$ 31,598,272
Dairy County 13	106	$ 4,321,430	$ 10,063,474	$ 31,776,285
Dairy County 14	80	$ 3,132,682	$ 7,882,904	$ 25,622,850
Dairy County 15	85	$ 3,326,925	$ 8,273,974	$ 26,142,076
Dairy County 16	142	$ 6,016,739	$ 12,725,054	$ 40,514,121
Dairy County 17	39	$ 1,523,431	$ 3,826,096	$ 11,745,896
Dairy County 18	65	$ 2,534,094	$ 5,682,422	$ 19,631,054
Rest of Region 1	35	$ 1,467,376	$ 2,654,262	$ 7,108,037
Rest of Region 2	72	$ 2,642,680	$ 10,436,365	$ 30,031,055
Rest of Region 3	117	$ 5,441,144	$ 8,459,476	$ 16,887,286
Region 1 Total	954	$ 39,562,072	$ 93,358,117	$ 396,294,476
Region 2 Total	1,219	$ 46,515,253	$127,068,561	$ 481,281,412
Region 3 Total	529	$ 21,975,015	$ 46,849,925	$ 140,543,283
Rest of State	427	$ 21,381,187	$ 34,024,199	$ 88,495,456
State Total	3,128	$129,433,527	$301,300,802	$1,106,614,627

Source: Authors' calculations using IMPLAN model

Appendix Table 5.4. Local Tax Revenue Impact of the Dairy and Milk Processing Cluster

	Property Tax Dairy Facilities	Other Local Property Tax	Local Sales Tax	Total Local Tax Revenue
Dairy County 1	$ 85,005	$ 140,742	$ 23,783	$ 249,530
Dairy County 2	$ 69,354	$ 109,088	$ 12,652	$ 191,094
Dairy County 3 and Processing County 1	$ 75,744	$ 750,393	$100,323	$ 926,460
Dairy County 4	$ 70,470	$ 47,463	$ 1,887	$ 119,820
Dairy County 5	$ 73,508	$ 51,110	$0	$ 124,618
Dairy County 6	$ 70,317	$ 129,106	$ 22,275	$ 221,698
Dairy County 7	$ 73,769	$ 65,278	$ 8,728	$ 147,774
Dairy County 8 and Processing County 2	$ 75,470	$1,007,825	$ 98,582	$1,181,876
Dairy County 9	$ 78,845	$ 54,115	$ 1,468	$ 134,427
Dairy County 10	$ 69,674	$ 66,613	$ 3,014	$ 139,300
Dairy County 11	$ 72,693	$ 55,340	$0	$ 128,033
Dairy County 12	$149,220	$ 122,454	$ 7,545	$ 279,219
Dairy County 13	$118,179	$ 115,280	$ 8,556	$ 242,015
Dairy County 14	$ 69,912	$ 89,980	$ 6,029	$ 165,921
Dairy County 15	$ 75,227	$ 104,103	$ 7,707	$ 187,037
Dairy County 16	$ 68,058	$ 188,611	$ 34,667	$ 291,337
Dairy County 17	$ 77,661	$ 52,217	$ 4,054	$ 133,932
Dairy County 18	$ 78,066	$ 78,734	$ 8,234	$ 165,034
Rest of Region 1	$0	$ 48,449	$ 3,528	$ 51,977
Rest of Region 2	$0	$ 84,532	$ 5,233	$ 89,764
Rest of Region 3	$0	$ 170,534	$ 16,160	$ 186,694
Region 1 Total	$ 518,166	$1,341,630	$173,175	$2,032,971
Region 2 Total	$ 564,080	$1,506,158	$124,397	$2,194,634
Region 3 Total	$ 368,924	$ 684,180	$ 76,851	$1,129,954
Rest of State	$0	$ 701,303	$127,004	$ 828,307
State Total	$1,451,169	$4,233,271	$501,427	$6,185,867

Source: Authors' calculations

Chapter 6: Economic Impact of Cattle Expansion in Nebraska

Cattle production dominates the livestock industry in Nebraska. The industry has evolved due to the ingenuity and work of the state's livestock producers, and the abundance of feed and rangeland in the state. Despite this success, there is room for further expansion in the cattle industry for some of the same reasons that exist for other livestock sectors. There has been a substantial expansion of grain production in Nebraska over the last few decades, while feed processing through livestock and other means has yet to develop to fully utilize the full extent of that feed stock. There is also now an abundant supply of distiller's grain in Nebraska for use by both ranches and feedlots. However, the cattle feeding industry, along with the hog, dairy, and poultry industries have faced a variety of obstacles, including permit and regulatory barriers that have previously limited their development in Nebraska. This implies there is potential for expansion of feedlot activity if these regulatory processes are reformed and rationalized.

Climatic trends also may be advantageous for the livestock industry in Nebraska and throughout the Northern Plains. Persistent drought, falling aquifer levels, and declining processing capacity have limited potential for ranching and feedlots in Texas and neighboring states in recent years. Some of the production, which may have remained in the Southern Plains under past conditions is now migrating to the north, including to Nebraska.

These factors suggest potential for growth in the cattle industry in Nebraska. However, given the current size of the industry, there is a limit to how much the industry can expand on a percentage basis. This scenario, developed in collaboration with industry leaders, calls for a 10 percent increase in annual fed-cattle production in Nebraska — approximately a 560,000-head increase. The 10 percent increase would be proportionally spread across Nebraska's eight agricultural regions. In other words, there is a 10 percent increase in production in each of the regions. Given the advantages of clustering, that growth is assumed to occur in the three largest cattle production counties in each region. All of the new production is assumed to be processed at one of three existing beef processing plants in South Sioux City, Lexington, and Schuyler, Nebraska. (Note: The prominence of Nebraska in red meat processing suggests that processing additional cattle will be done entirely within the state's facilities. Also, as plant closings are occurring in other states, it is reasonable to assume that the net increase of Nebraska cattle processing will expand 10 percent along with the in-state production increase.)

The Expansion Scenario

We calculated the ongoing annual economic impact of the 10 percent increase in fed-cattle production and processing throughout Nebraska. We assumed that both production and processing can be accommodated in existing feedlots and the three major existing processing facilities in the state. Roughly one-third of new processing is projected to occur at each of the three plants. The annual economic impact identifies the direct economic activity of the increased cattle production and processing in all

eight agricultural regions of the state. The total annual economic impact also includes a multiplier impact which occurs in businesses throughout the economy such as feedlots and processing plants purchase supplies, and their employees spend their salaries in local economies. So, the total economic impact is the sum of the direct impact and the multiplier impact.

The Findings

Using the IMPLAN model for the Nebraska economy, the analysis suggests the multiplier impacts are substantial and occur throughout the state. *Table 6.1* shows the average multiplier effect for $1 million in cattle production and one job at a feedlot: 1) within the same county, 2) within the rest of the region, and 3) within the rest of the state. The right-hand side of *Table 6.1* shows the same concepts for $1 million in meat production at a beef processing plant. Each $1 million of direct sales at a ranch or feedlot yields another $742,000 in output around the state economy, due to multiplier impacts. Much of that impact is within the same county due to the presence of suppliers, and given that workers and proprietors would spend some of their income locally. However, each $1 million in sales would lead to $57,000 in sales for businesses in other counties in the same region, and $124,000 at businesses located in other parts of the state. These results demonstrate how businesses throughout the state benefit from ranching and feedlot activity in rural regions, with workers also benefitting. For each 10 ranch or feedlot jobs created, there are 13 additional jobs created within the same county, two jobs created at a business in another county in the same region, and four jobs created in another part of the state. There are similar spillover benefits at beef processing plants.

The economic impacts resulting from this cattle production and beef processing expansion scenario are designed to show the potential economic impacts somewhere within the state. Therefore, results are presented in a generic manner rather than for a specific named set of counties within the region. The results are based on specific Nebraska counties, but the names are not reported here. Similarly, regional results are presented for Region 1 through Region 8 without naming the specific region. Until such time that local stakeholders would desire to have a more definitive economic analysis of a specific expansion proposal, these scenarios will serve to be fairly representative of the general nature of both county and regional-level economic impacts.

Table 6.2 shows the direct economic impact from the expansion of the livestock industry. A 10 percent expansion is assumed for all eight regions, with that expansion occurring in the three largest cattle production counties within each region. Beef

Table 6.1. Multiplier Impacts of Fed Cattle Expansion

Direct Impact and Multiplier Impacts	Output	Jobs	Output	Jobs
Direct Impact	$1,000,000	1.0	$1,000,000	1.0
Multiplier Impact:				
Same County	$ 561,662	1.3	$ 255,618	0.8
Rest of Region	$ 56,691	0.2	$ 102,252	0.3
Rest of State	$ 123,545	0.4	$ 129,118	0.4
Total Multiplier Impact	$ 741,898	1.9	$ 486,987	1.5

Source: Authors' calculations using IMPLAN model

processing is assumed to be evenly divided between the three large, existing plants in Lexington, Schuyler, and South Sioux City, Nebraska. Results are presented separately for the three counties with beef processing plants. Two of those three also were leading cattle production counties within their region. Results are presented separately for the 22 counties which only have cattle production.

Estimates of the increase in direct output, employment, annual wage and value-added in each county are based on a 10 percent increase in the values for each cattle production industry according to the IMPLAN model. The value of the direct output (business receipts) for the beef processing plants were calculated based on an estimate that approximately 46 percent of the revenue of a processing plant would be spent on cattle. That estimate came from the IMPLAN model, which provides information on the spending patterns of industries. The IMPLAN model also is utilized to calculate multiplier impact, as described later.

Direct economic effects are presented in both *Table 6.2* and *Appendix Table 6.1*. The average cattle production county would add 44 direct jobs, $1.09 million in labor income (including some proprietor income), $4.56 million in value-added, and $27.45 million in output. The average county with a beef processing facility would have 1,130 jobs, $49.50 million in labor and proprietor's income, $60.44 million in value-added, and $513.97 million in output.

Table 6.3 shows the aggregate direct economic impact of expanded cattle production and beef processing across Nebraska. The direct economic impact is $2,145.78 million; the direct economic impact in terms of value-added is $281.68 million; the labor income impact is $172.51 million; and the jobs impact is 4,362 positions, with the average labor income per job of $39,500.

The multiplier impact is calculated utilizing the IMPLAN model. The IMPLAN model can be used to calculate economic multipliers for every county, state, or combination of counties and states in the U.S. in over 400 industries. Economic multipliers show the additional dollars of impact or jobs for each direct dollar of output, value-added labor income or direct jobs. These economic multipliers represent the additional economic activity in each county, as ranches, feedlots or beef processing facilities purchase supplies, or as their employees spend their paychecks.[1]

[1]To avoid double counting, purchases of cattle are excluded from the multiplier impact of the beef processing facilities.

Table 6.2. Direct Economic Impact of Cattle Production and Beef Processing Counties

Average Direct Impact	Jobs	Labor Income	Value-Added	Output
Cattle County (22)	44	$ 1,091,286	$ 4,562,539	$ 27,448,498
Processing County (3)	1,130	$49,501,785	$60,435,561	$513,971,178

Source: Authors' calculations using IMPLAN model

Table 6.3. Total Direct Economic Impact of the Cattle Industry Expansion

Direct Economic Impact	Jobs	Labor Income	Value-Added	Output
Statewide	4,362	$172,513,639	$281,682,547	$2,145,780,495

Source: Authors' calculations using IMPLAN model

Summary *Table 6.4* shows the average multiplier impact in a county with expanded cattle production and a county with a beef processing facility (*Appendix Table 6.2* shows the multiplier impact for each of the 25 counties). *Table 6.4* also shows the average multiplier impact on the rest of each region from the expanded cattle production or processing activity located in that region. Finally, the table shows the impact on the rest of the state from the expanded cattle production.

Average values for the 22 cattle production only counties, the three beef processing counties, the rest of the counties in each region (rest of region) and the rest of the state can be summed to yield the total multiplier impact statewide. The total multiplier impact statewide is shown in *Table 6.5*, with the total multiplier impact being $1,275.28 million in output, and 7,299 jobs. These economic multiplier impacts reflect the additional robustness which value-added activity brings to an economy. As can be seen here in the comparison of entries in *Table 6.1* with those in *Table 6.5*, the jobs, wages, and incomes expand by some multiple of the direct effects. And the greater the economic activity of moving raw materials and commodities to more complex final products in a local economy, the greater that economic multiple will be.

The total economic impact is the sum of the direct economic impact and the multiplier impact (*Appendix Table 6.3*). *Table 6.6* shows the average total economic impact for cattle production counties and beef processing counties.

Table 6.4. Multiplier Economic Impact on Cattle Production and Beef Processing Counties

Average Total Impact	Jobs	Labor Income	Value-Added	Output
Cattle County (22)	76	$ 2,508,932	$ 5,805,622	$ 18,439,031
Processing County (3)	895	$29,169,465	$ 51,667,926	$131,380,241
Rest of Region	159	$ 7,254,984	$ 11,683,970	$ 24,376,225
Rest of State	1,674	$73,731,665	$118,317,171	$280,475,175

Source: Authors' calculations using IMPLAN model

Table 6.5. Total Multiplier Economic Impact of the Cattle Industry Expansion

Multiplier Economic Impact	Jobs	Labor Income	Value-Added	Output
Statewide	7,299	$274,476,435	$494,516,396	$1,275,284,379

Source: Authors' calculations using IMPLAN model

Table 6.6 Average Total Economic Impact of Cattle Production and Beef Processing Counties

Average Total Impact	Jobs	Labor Income	Value-Added	Output
Cattle County (22)	120	$ 3,600,218	$ 10,368,161	$ 45,887,529
Processing County (3)	2,025	$78,671,251	$112,103,487	$645,351,419
Rest of Region	159	$ 7,254,984	$ 11,683,970	$ 24,376,225
Rest of State	1,674	$73,731,665	$118,317,171	$280,475,175

Source: Authors' calculations using IMPLAN model

The total economic impact of cattle industry expansion on the state of Nebraska is $3,421.1 million of output (*Table 6.7*). The total economic impact in terms of value-added is $776.2 million; and the total labor income impact (including proprietor income) is $447 million, spread over 11,661 jobs added to the state's employment role. This is an average annual compensation of $38,300 per job, including wages and benefits.

In addition to the total impact, it is also important to consider the distribution of economic effects across the multicounty region. As evidenced in *Appendix Table 6.3*, cattle industry expansion can generate considerable economic growth and distribute it widely across a multicounty region.

Tax Implications for Area Economics

The local tax revenue impact associated with fed cattle expansion is more muted than that of other livestock species expansion, since it is likely expansion of feedlot activity can be accommodated within existing facilities. There is no increase in the value of agricultural properties. (Note: Feedlots generally operate at less than 100 percent animal capacity and can rather easily add 10 percent additional animal numbers.) Nevertheless, will the expansion of non-agricultural property be coming onto the tax rolls? The number and value of homes and local businesses would likely expand as local population and income expands, particularly in the area economies surrounding the processing facilities. In Nebraska, statewide there was $1.64 in taxable real and personal property (excluding agricultural property) for each $1 in income. This ratio was used to estimate the increase in taxable property due to the increase in income resulting from the multiplier impact. The property value was then multiplied by the county property tax rate for residential and commercial property.

The sales tax revenue impact was the last component of the local tax impact. Local taxable sales were estimated based on income. A comparison of statewide taxable sales and income indicates there is $0.396 in taxable sales in Nebraska for each $1 in income. We utilize this ratio to estimate the taxable spending impact for each county. This taxable spending, however, can occur anywhere in Nebraska, including in the Omaha and Lincoln areas. To estimate the share of spending that occurs in each county, we utilized pull factor estimates for each Nebraska county (developed by the UNL Department of Agricultural Economics). The pull factor ranges from 0.09 (trade leakage) to greater than 1.00 (trade surplus), depending on the retail viability of the respective county. The estimated spending in each county is then multiplied by the relevant local option sales tax to yield the estimated sales tax revenue impact in each county. The average tax revenue impacts from additional property and sales taxes are

Table 6.7. Total Multiplier Economic Impact of the Cattle Industry Expansion

Total Economic Impact	Jobs	Labor Income	Value-Added	Output
Statewide	11,661	$446,990,074	$776,198,943	$3,421,064,874

Source: Authors' calculations using IMPLAN model

shown in *Table* 6.8 and the results for the individual counties appear in *Appendix Table 6.4*.

Table 6.9 shows the total annual local tax revenue impact to be $16.12 million. The largest source is other property tax revenue generated due to the multiplier effect. Sales taxes account for a fairly small share of local tax revenues. As true of any economic expansion of this nature, there will be some additional public expenditure for services as part of increased population numbers and households in the area. In turn, the net fiscal impact will be something less than the additional tax revenues collected. Nevertheless, there would be a net gain experienced for the public sector, which would equate with improved services and/or reduced taxes for existing taxpayers.

Feed Input Requirements of the Cattle Expansion Scenario

Whenever consideration is given to the potential entry of a larger livestock operation, it is important to consider the demand for livestock feed and its implications on availability and price. Can the region accommodate the additional feed demand from existing supply without triggering higher feed input prices for all competing livestock producers and, in turn, tighten profit margins? To address that issue, we used a three-step process:

- First, we calculated the associated corn input needs for the fed cattle expansion, based on typical feed rations (the corn bushel equivalent of grain, corn silage, and dried distillers grain was estimated to be 80 bushels per head).
- Second, we assessed corn production volume down to county levels relative to county-level usage by the existing livestock industry in the respective counties — in short, we determined if counties are currently corn surplus or deficit and, if surplus, by how much annually. This was done for 2010, a rather typical corn production year, as well as for 2012, which had pervasive drought for many areas and yield shortfalls under dry-land corn production.
- Third, the step involved a county-by-county determination to see if the typical corn surplus was sufficient to meet the needs of this fed cattle expansion.

Table 6.8 Average Local Tax Revenue Impact of the Cattle Industry Expansion

Average Tax Revenue Impact	Other Local Property Tax	Local Sales Tax	Total Local Tax Revenue
Cattle County (22)	110,544	14,741	125,285
Processing County (3)	2,636,408	205,820	2,842,228
Rest of Region	226,680	20,720	247,400
Rest of State	2,418,399	437,966	2,856,365

Source: Authors' calculations

Table 6.9 Total Local Tax Revenue Impact of Cattle Production and Beef Processing Counties

Total Tax Impact	Other Local Property Tax	Local Sales Tax	Total Local Tax Revenue
Statewide	$14,573,034	$1,545,490	$16,118,524

Source: Authors' calculations

For the 24 major fed cattle production counties, all but four could have accommodated this expansion from the county corn production surplus, even in the shortest surplus year of 2010 or 2012. In fact, in most instances the 10 percent expansion of in-county cattle feeding represented a very modest usage of the annual production surplus. And in those four counties where deficits in corn occurred, three of them were already operating in a deficit before this expansion was considered — implying that feed input was being economically shipped into those counties from nearby surplus counties. In conclusion, our analysis would indicate that the additional feed requirements associated with a 10 percent increase in fed cattle production, based on corn-based feed, would be easily accommodated from existing local grain surpluses.

In terms of total in-state utilization of corn production associated with a 10 percent expansion in fed cattle production, the annual increase in use would approach 45 million bushels. Ironically, this amount is roughly equivalent to the average annual increase in Nebraska's corn production over the past decade.

Economics of Manure Byproducts from Feedlot Expansion

The use of livestock manure as a substitute for commercial fertilizer is growing in prominence in cash-grain regions where this option exists. Partly due to the steady rise of commercial fertilizer prices and partly due to improved management of organic-based fertilizer, it is likely that the economics of this substitution will only expand in the future. According to industry officials and the Nebraska Department of Environmental Quality, the minimum guideline is to spread the manure from three head of cattle onto one acre of cropland. Assuming a soil nutrient value of $60 per acre, a total of nearly 187,000 acres of cropland could be treated annually with this organic substitute, for a total soil nutrient value of $11.2 million.

At a smaller geographic level, the above suggests if a county were to experience a 10,000 head expansion in fed cattle production, the manure fertilizer co-product would be sufficient to fertilize more than 3,300 acres, with an economic value of $198,000 to that respective county's economy.

CHAPTER 6: APPENDIX

Appendix Table 6.1. Direct Economic Impact of Cattle Production and Beef Processing Counties

	Job	Labor Income	Value-Added	Output
Cattle County 1	86	$ 2,443,449	$ 8,376,529	$ 50,393,680
Cattle County 2 and Processing County 1	1,164	$ 46,108,980	$ 59,977,208	$ 535,782,154
Cattle County 3	27	$ 669,188	$ 2,918,074	$ 17,555,298
Cattle County 4 and Processing County 2	1,132	$ 53,287,610	$ 64,252,208	$ 517,083,327
Cattle County 5	50	$ 1,018,854	$ 7,260,007	$ 43,676,617
Cattle County 6	67	$ 1,481,727	$ 3,901,325	$ 23,470,594
Cattle County 7	58	$ 1,025,830	$ 5,871,170	$ 35,321,295
Cattle County 8	41	$ 462,946	$ 1,891,402	$ 11,378,783
Cattle County 9	80	$ 1,734,419	$ 7,057,222	$ 42,456,652
Cattle County 10	36	$ 843,479	$ 4,481,763	$ 29,128,325
Cattle County 11	48	$ 874,045	$ 4,112,362	$ 24,740,207
Cattle County 12	114	$ 3,434,023	$ 14,943,592	$ 89,901,504
Processing County 3	1,093	$ 49,108,766	$ 57,077,266	$ 489,048,054
Cattle County 13	33	$ 783,564	$ 2,828,161	$ 17,014,378
Cattle County 14	52	$ 1,317,262	$ 5,081,595	$ 30,571,163
Cattle County 15	51	$ 773,785	$ 3,153,165	$ 18,969,621
Cattle County 16	14	$ 406,446	$ 1,596,205	$ 9,602,862
Cattle County 17	18	$ 744,442	$ 2,518,067	$ 15,148,834
Cattle County 18	38	$ 1,675,714	$ 6,588,306	$ 39,635,629
Cattle County 19	18	$ 881,358	$ 2,533,214	$ 15,239,961
Cattle County 20	15	$ 776,585	$ 1,897,303	$ 11,414,286
Cattle County 21	20	$ 605,057	$ 1,916,017	$ 11,526,869
Cattle County 22	19	$ 287,311	$ 1,813,910	$ 10,912,587
Cattle County 23	14	$ 256,497	$ 1,478,963	$ 8,897,528
Cattle County 24	76	$ 1,512,302	$ 7,797,513	$ 46,910,287
Rest of Region 1	0	$0	$0	$0
Rest of Region 2	0	$0	$0	$0
Rest of Region 3	0	$0	$0	$0
Rest of Region 4	0	$0	$0	$0
Rest of Region 5	0	$0	$0	$0
Rest of Region 6	0	$0	$0	$0
Rest of Region 7	0	$0	$0	$0
Rest of Region 8	0	$0	$0	$0
Region 1 Total	1,277	$ 49,221,617	$ 71,271,811	$ 603,731,132
Region 2 Total	1,249	$ 55,788,191	$ 75,413,540	$ 584,230,538
Region 3 Total	178	$ 3,223,195	$ 14,819,794	$ 89,156,730
Region 4 Total	1,291	$ 54,260,313	$ 80,974,983	$ 632,818,090
Region 5 Total	135	$ 2,874,611	$ 11,062,921	$ 66,555,162
Region 6 Total	69	$ 2,826,602	$ 10,702,578	$ 64,387,325
Region 7 Total	53	$ 2,263,000	$ 6,346,534	$ 38,181,116
Region 8 Total	109	$ 2,056,110	$ 11,090,386	$ 66,720,402
Rest of State	0	$0	$0	$0
Total	4,362	$172,513,639	$281,682,547	$2,145,780,495

Source: Authors' calculations using IMPLAN model

Appendix Table 6.2. Multiplier Economic Impact of Cattle Production and Beef Processing Counties

	Job	Labor Income	Value-Added	Output
Cattle County 1	141	$ 4,010,965	$ 9,755,560	$ 32,083,218
Cattle County 2 and Processing County 1	992	$ 31,110,356	$ 60,137,558	$ 146,012,907
Cattle County 3	91	$ 3,808,813	$ 6,383,603	$ 19,639,134
Cattle County 4 and Processing County 2	827	$ 25,939,769	$ 47,856,860	$ 105,697,613
Cattle County 5	285	$ 9,303,818	$ 22,039,066	$ 57,727,595
Cattle County 6	27	$ 822,502	$ 1,793,750	$ 3,673,625
Cattle County 7	61	$ 1,627,530	$ 3,993,808	$ 13,931,863
Cattle County 8	7	$ 104,866	$ 196,027	$ 1,826,633
Cattle County 9	100	$ 3,307,198	$ 7,784,865	$ 25,778,123
Cattle County 10	60	$ 1,729,374	$ 4,839,490	$ 17,053,002
Cattle County 11	124	$ 5,084,186	$ 9,398,394	$ 27,928,281
Cattle County 12	204	$ 6,674,720	$ 16,125,972	$ 56,324,312
Processing County 3	867	$ 30,458,271	$ 47,009,360	$ 142,430,203
Cattle County 13	45	$ 1,437,898	$ 3,491,747	$ 11,086,253
Cattle County 14	67	$ 2,233,980	$ 5,260,965	$ 18,056,166
Cattle County 15	70	$ 2,166,451	$ 4,900,665	$ 14,798,750
Cattle County 16	27	$ 886,767	$ 2,067,354	$ 6,335,318
Cattle County 17	24	$ 849,313	$ 2,139,367	$ 8,096,328
Cattle County 18	85	$ 3,196,679	$ 7,561,277	$ 24,623,572
Cattle County 19	33	$ 1,086,813	$ 2,760,813	$ 9,188,330
Cattle County 20	28	$ 873,058	$ 2,096,113	$ 7,154,140
Cattle County 21	28	$ 942,744	$ 2,247,490	$ 7,476,747
Cattle County 22	14	$ 289,287	$ 1,065,316	$ 5,076,581
Cattle County 23	22	$ 573,501	$ 1,616,962	$ 5,163,763
Cattle County 24	129	$ 4,186,040	$ 10,205,080	$ 32,636,917
Rest of Region 1	115	$ 4,735,441	$ 7,412,456	$ 16,878,251
Rest of Region 2	886	$ 44,394,857	$ 68,194,644	$ 134,545,625
Rest of Region 3	29	$ 663,228	$ 1,900,722	$ 8,347,316
Rest of Region 4	204	$ 6,924,914	$ 13,251,555	$ 27,030,501
Rest of Region 5	12	$ 475,702	$ 936,559	$ 2,814,923
Rest of Region 6	6	$ 206,314	$ 461,975	$ 1,777,149
Rest of Region 7	4	$ 115,121	$ 214,342	$ 629,486
Rest of Region 8	13	$ 524,294	$ 1,099,510	$ 2,986,549
Region 1 Total	1,338	$ 43,665,575	$ 83,689,177	$ 214,613,510
Region 2 Total	2,025	$ 80,460,946	$139,884,320	$ 301,644,458
Region 3 Total	197	$ 5,702,822	$ 13,875,422	$ 49,883,965
Region 4 Total	1,460	$ 50,871,465	$ 90,624,771	$ 270,766,299
Region 5 Total	194	$ 6,314,031	$ 14,589,936	$ 46,756,092
Region 6 Total	141	$ 5,139,073	$ 12,229,973	$ 40,832,367
Region 7 Total	93	$ 3,017,736	$ 7,318,758	$ 24,448,703
Region 8 Total	177	$ 5,573,122	$ 13,986,868	$ 45,863,810
Rest of State	1,674	$ 73,731,665	$118,317,171	$ 280,475,175
Total	7,299	$274,476,435	$494,516,396	$1,275,284,379

Source: Authors' calculations using IMPLAN model

Appendix Table 6.3. Total Multiplier Economic Impact of the Cattle Industry Expansion

	Job	Labor Income	Value-Added	Output
Cattle County 1	227	$ 6,454,414	$ 18,132,089	$ 82,476,898
Cattle County 2 and Processing County 1	2,156	$ 77,219,336	$120,114,766	$ 681,795,061
Cattle County 3	118	$ 4,478,001	$ 9,301,677	$ 37,194,432
Cattle County 4 and Processing County 2	1,959	$ 79,227,379	$112,109,068	$ 622,780,940
Cattle County 5	336	$ 10,322,672	$ 29,299,073	$ 101,404,212
Cattle County 6	94	$ 2,304,229	$ 5,695,075	$ 27,144,219
Cattle County 7	119	$ 2,653,360	$ 9,864,978	$ 49,253,158
Cattle County 8	47	$ 567,812	$ 2,087,429	$ 13,205,446
Cattle County 9	180	$ 5,041,617	$ 14,842,087	$ 68,234,775
Cattle County 10	96	$ 2,572,853	$ 9,681,253	$ 46,181,327
Cattle County 11	172	$ 5,958,231	$ 13,510,756	$ 52,668,448
Cattle County 12	318	$ 10,108,743	$ 31,069,564	$ 146,225,816
Processing County 3	1,961	$ 79,567,037	$104,086,626	$ 631,478,257
Cattle County 13	78	$ 2,221,462	$ 6,319,908	$ 28,100,631
Cattle County 14	119	$ 3,551,242	$ 10,342,560	$ 48,627,329
Cattle County 15	120	$ 2,940,236	$ 8,053,830	$ 33,768,371
Cattle County 16	41	$ 1,293,213	$ 3,663,559	$ 15,938,180
Cattle County 17	41	$ 1,593,755	$ 4,657,434	$ 23,245,162
Cattle County 18	122	$ 4,872,393	$ 14,149,583	$ 64,259,201
Cattle County 19	51	$ 1,968,171	$ 5,294,027	$ 24,428,291
Cattle County 20	42	$ 1,649,643	$ 3,993,416	$ 18,568,426
Cattle County 21	49	$ 1,547,801	$ 4,163,507	$ 19,003,616
Cattle County 22	33	$ 576,598	$ 2,879,226	$ 15,989,168
Cattle County 23	36	$ 829,998	$ 3,095,925	$ 14,061,291
Cattle County 24	205	$ 5,698,342	$ 18,002,593	$ 79,547,204
Rest of Region 1	115	$ 4,735,441	$ 7,412,456	$ 16,878,251
Rest of Region 2	886	$ 44,394,857	$ 68,194,644	$ 134,545,625
Rest of Region 3	29	$ 663,228	$ 1,900,722	$ 8,347,316
Rest of Region 4	204	$ 6,924,914	$ 13,251,555	$ 27,030,501
Rest of Region 5	12	$ 475,702	$ 936,559	$ 2,814,923
Rest of Region 6	6	$ 206,314	$ 461,975	$ 1,777,149
Rest of Region 7	4	$ 115,121	$ 214,342	$ 629,486
Rest of Region 8	13	$ 524,294	$ 1,099,510	$ 2,986,549
Region 1 Total	2,616	$ 92,887,192	$154,960,988	$ 818,344,642
Region 2 Total	3,274	$136,249,137	$215,297,860	$ 885,874,996
Region 3 Total	375	$ 8,926,017	$ 28,695,216	$ 139,040,695
Region 4 Total	2,751	$105,131,778	$171,599,754	$ 903,584,389
Region 5 Total	330	$ 9,188,642	$ 25,652,857	$ 113,311,254
Region 6 Total	210	$ 7,965,675	$ 22,932,551	$ 105,219,692
Region 7 Total	146	$ 5,280,736	$ 13,665,292	$ 62,629,819
Region 8 Total	286	$ 7,629,232	$ 25,077,254	$ 112,584,212
Rest of State	1,674	$ 73,731,665	$118,317,171	$ 280,475,175
Total	11,661	$446,990,074	$776,198,943	$3,421,064,874

Source: Authors' calculations using IMPLAN model

Appendix Table 6.4. Local Tax Revenue Impact of the Cattle Industry Expansion by County

	Other Local Property Tax	Local Sales Tax	Total Local Tax Revenue
Cattle County 1	$ 208,921	$ 24,230	$ 233,151
Cattle County 2 and Processing County 1	$ 2,662,347	$ 355,938	$ 3,018,285
Cattle County 3	$ 159,165	$ 26,599	$ 185,764
Cattle County 4 and Processing County 2	$ 2,479,120	$ 183,538	$ 2,662,658
Cattle County 5	$ 290,572	$ 60,397	$ 350,969
Cattle County 6	$ 78,980	$ 6,132	$ 85,112
Cattle County 7	$ 88,077	$ 12,483	$ 100,559
Cattle County 8	$ 14,821	$0	$ 14,821
Cattle County 9	$ 155,774	$ 22,730	$ 178,504
Cattle County 10	$ 69,337	$ 7,855	$ 77,192
Cattle County 11	$ 158,943	$ 11,137	$ 170,080
Cattle County 12	$ 295,012	$ 41,131	$ 336,143
Processing County 3	$ 2,767,757	$ 77,984	$ 2,845,741
Cattle County 13	$ 69,736	$ 8,603	$ 78,340
Cattle County 14	$ 109,346	$ 6,047	$ 115,393
Cattle County 15	$ 97,527	$ 17,430	$ 114,957
Cattle County 16	$ 44,871	$ 7,006	$ 51,877
Cattle County 17	$ 52,391	$ 2,360	$ 54,752
Cattle County 18	$ 151,744	$ 20,288	$ 172,032
Cattle County 19	$ 61,039	$ 2,876	$ 63,915
Cattle County 20	$ 44,727	$ 5,536	$ 50,264
Cattle County 21	$ 43,056	$ 2,985	$ 46,041
Cattle County 22	$ 15,617	$0	$ 15,617
Cattle County 23	$ 26,129	$ 4,629	$ 30,758
Cattle County 24	$ 196,185	$ 33,848	$ 230,034
Rest of Region 1	$ 161,621	$ 14,064	$ 175,685
Rest of Region 2	$ 1,386,839	$ 131,853	$ 1,518,691
Rest of Region 3	$ 19,940	$ 1,313	$ 21,253
Rest of Region 4	$ 203,583	$ 15,425	$ 219,008
Rest of Region 5	$ 15,120	$ 1,256	$ 16,376
Rest of Region 6	$ 6,789	$ 545	$ 7,333
Rest of Region 7	$ 3,298	$ 266	$ 3,564
Rest of Region 8	$ 16,252	$ 1,038	$ 17,290
Region 1 Total	$ 3,192,053	$ 420,832	$ 3,612,885
Region 2 Total	$ 4,235,511	$ 381,920	$ 4,617,430
Region 3 Total	$ 278,612	$ 36,526	$ 315,137
Region 4 Total	$ 3,494,631	$ 153,532	$ 3,648,164
Region 5 Total	$ 291,730	$ 33,336	$ 325,066
Region 6 Total	$ 255,795	$ 30,199	$ 285,994
Region 7 Total	$ 152,121	$ 11,663	$ 163,784
Region 8 Total	$ 254,183	$ 39,516	$ 293,699
Rest of State	$ 2,418,399	$ 437,966	$ 2,856,365
Total	$14,573,034	$1,545,490	$16,118,524

Source: Authors' calculations

Chapter 7: Economic Impact of Poultry Expansion

Poultry production in Nebraska has historically been a minor component of the state's animal industry, but the egg-laying component has been present and growing over time. USDA statistics indicate that from 2000 to 2012 the value of Nebraska's egg production grew by 92 percent. However, over the same time period, neighboring states were growing much faster: Iowa, 311 percent; Missouri, 144 percent; and South Dakota, 159 percent. Given that Nebraska has similar resource endowments to these other states, it is believed egg production in the state could grow significantly in the years ahead; hence, a threefold expansion scenario was considered realistic and analyzed here.

The Expansion Scenario

The scenario assumed an expansion of 20 million layers in the state, located in the two regions where most egg production is currently — the northeast and the southeast regions of the state.

The Findings

Table 7.1 shows the direct economic impact from the expansion. Employment estimates are based on 45 employees in a 2-million bird complex, with 10 million total layers in each region. Output (sales) is expected to be the same in the two regions, at $181 million, with labor income and value-added being slightly different due to modestly different wage rates prevailing in northeast and southeast Nebraska. The total direct employment is 450.

Table 7.2 shows the multiplier impact of the poultry expansion on the two regions and the rest of the state. There is a substantial economic multiplier impact in both the northeast and southeast regions. The employment multiplier impact is 364 in the northeast and 293 in the southeast. Both employment impacts are larger than the direct job impact. Multiplier impacts in terms of labor income, including proprietor and wage and salary income, are also significant. The same can be said of the overall economic impact in terms of output and the impact in terms of value-added. One striking result is the

Table 7.1 Direct Economic Impact of the Poultry Industry Expansion by Region

Direct Impact	Jobs	Labor Income	Value-Added	Output
Northeast Nebraska	225	$21,691,345	$33,850,788	$181,000,000
Southeast Nebraska	225	$22,142,701	$33,844,719	$181,000,000
Total	450	$43,834,046	$67,695, 507	$362,000,000

Source: Authors' calculations using IMPLAN model

Table 7.2. Multiplier Economic Impact of the Poultry Industry Expansion

Multiplier Impact	Jobs	Labor Income	Value-Added	Output
Northeast Nebraska	364	$12,566,380	$22,174,721	$ 53,101,735
Southeast Nebraska	293	$ 9,852,431	$18,911,367	$ 49,062,477
Rest of State	533	$25,753,230	$44,053,554	$142,139,920
Total	1,190	$48,172,041	$85,139,642	$244,304,132

Source: Authors' calculations using IMPLAN model

substantial multiplier impact on the rest of the state. The multiplier impact is 533 jobs and $26 million in the rest of the state, for example. The total multiplier impact is $244 million, including $85 million in value-added, of which $48 million is labor income. That labor income is spread over 1,190 jobs.

As seen in *Table 7.3*, when direct and multiplier impacts are combined, the total economic impact of this expansion would create 1,640 jobs, of which 67 percent would be located in the two regions with the remainder in the rest of the state. Labor income from the expansion would exceed $92 million annually, with 72 percent of those earnings accruing in the two regions. The contribution to the state's economy in terms of value-added would be nearly $153 million, of which about 71 percent would be located in the economies of the two regions. The annual economic impact would be $606 million.

Construction of egg-laying facilities to support the expansion would be substantial, with the development of approximately 55 houses with 360,000 birds apiece. Typically, six of these houses would be clustered on a single location. Construction costs are approximately $30 per bird, so total construction costs would be around $600 million, spread across the two regions. These new facilities would generate approximately $6.5 million in property tax revenue per year given prevailing assessment and tax rates for agricultural property in these regions of Nebraska. There also would be other local property and sales tax impacts due to the economic impact, as seen in *Table 7.4*. A portion of the $92 million annual income expansion would be spent on goods and services subject to sales tax and on rent or mortgage payments on property subject to property tax. The overall local property and sales tax impact would be $9.8 million per year, of which 90 percent would be collected within the two regions.

Poultry rations rely heavily on soybean meal, so the increased poultry production in the above scenario would significantly increase in-state usage of soybean meal. The amount could approach 140,000 tons annually, representing nearly a 20 percent increase in the state's total soybean meal used for feed across all animal production in Nebraska.

Table 7.3. Total Economic Impact of the Poultry Industry Expansion

Total Impact	Jobs	Labor Income	Value-Added	Output
Northeast Nebraska	589	$34,257,725	$ 56,025,509	$234,101,735
Southeast Nebraska	518	$31,995,132	$ 52,756,086	$230,062,477
Rest of State	533	$25,753,230	$ 44,053,554	$142,139,920
Total	1,640	$92,006,087	$152,835,149	$606,304,132

Source: Authors' calculations using IMPLAN model

Table 7.4. Fiscal Impact of the Poultry Industry Expansion

Tax Revenue	Property Tax	Local Sales Tax	Total
Northeast Nebraska	$4,363,653	$127,182	$4,490,835
Southeast Nebraska	$4,289,440	$118,782	$4,408,222
Rest of State	$ 844,706	$ 95,609	$ 940,315
Total	$9,497,800	$341,573	$9,839,372

Source: Authors' calculations using IMPLAN model

Chapter 8. Economic Impact of a Pork Plant Closure in Nebraska

Large pork processing plants located in Nebraska generate a substantial economic impact in their local communities and for the state as a whole. The location of these plants relies on the availability of an abundant supply of market-weight hogs within the region. That level of supply, however, is not fully maximized, given permit and other regulatory issues that have restrained the expansion of the hog finishing sector within Nebraska.

As discussed elsewhere in this report, there is significant potential for growth in hog finishing in Nebraska, particularly given reform and rationalization of this regulatory process. Just as importantly, expansion of hog finishing can help increase the odds of retaining employment in Nebraska, by reducing the probability of losing a pork processing plant in the state over the long run.

The Scenario

This section briefly considers the potential economic impact of the loss of a major pork processing facility in Nebraska. The scenario assumes that Nebraska could retain its current hog finishing activity. A decline in hog processing activity, therefore, is not part of the negative multiplier impact of the processing plant closure scenario, although many other industries are impacted. Impact estimates are based on an average operating level, employment and value-added at existing pork processing facilities in the state. Results are general and naturally do not pertain to any individual plant.

The Findings

Using the IMPLAN model for the Nebraska economy, *Table 8.1* below shows the direct economic impact from the loss of a hypothetical Nebraska pork processing plant. The direct impacts are substantial. The decline in economic output would be $635.39 million on an annual basis, including $71.90 million in value-added. There would be a loss of $61.50 million each year in labor income, spread over an estimated 1,426 jobs. Essentially, all of these impacts would be occurring in non-metropolitan Nebraska. While the brunt of the impacts would occur within the economy of the county where the plant closing occurs, there would inevitably be negative economic spillovers into surrounding counties where the commuter portion of the workforce reside.

Table 8.1. Direct, Multiplier, and Total Economic Impact from Loss of Pork Processing Facility in Nebraska

	Jobs	Labor Income	Value-Added	Output
Direct Impact	-1,426	-$ 61,502,955	-$71,897,539	-$635,385,834
Multiplier Impact	-578	-$ 38,553,636	-$19,476,750	-$208,510,283
Total Impact	-2,004	-$100,056,591	-$91,374,289	-$843,896,116

Source: Authors' calculations using IMPLAN model

The total economic impact is the sum of the direct impact and multiplier impact. The total economic impact from the closure of a pork processing plant would be a loss of $844 million in economic output in Nebraska each year, an annual loss of over $91 million in value-added activity. In terms of the labor market, there would be an estimated loss of approximately 2,000 jobs and $100 million in labor income. These figures indicate a substantial economic loss for both the county where the plant is located and the entire state of Nebraska.

Chapter 9. The Livestock and Poultry Industry and the Future of Nebraska's Economy

"Almost all rural Nebraskans recognize the importance of livestock and poultry production to the state's economy. Ninety-seven percent agree or strongly agree with the statement that animal production is important to Nebraska's economy."

—2011 Nebraska Rural Poll, Report #11-2

The above quote is from the findings of the 2011 Nebraska Rural Poll, a survey based on nearly 2,500 responses from Nebraskans living in the 84 non-metropolitan counties of the state. The opinion rendered here is convincing that citizens of non-metropolitan Nebraska are keenly aware of the linkage. This research study and the findings presented in the previous chapters of this report attempt to provide a clearer economic resolution (and factual support) to this strongly-held public opinion.

Nebraska, like several neighboring states, has what could be described as a *bio-economy,* in that natural resource-based production has a substantial impact on the state's economic momentum. Starting from a strong foundation of crop and livestock production, the Nebraska economy works upward and outward, integrating a vast and expanding array of value-added industries. These are the support industries and services that also generate dollar revenues, incomes, and jobs—beyond the individual farm and ranch level. And it is these multiplier effects which can add considerable *economic traction* to any changes in the basic industries. In the case of animal agriculture here in Nebraska, this study has shown that because of these multipliers the direct economic effects are more than doubled at the state level for value-added activity (gross state product) and labor and proprietor income, and are even greater for job numbers (*Table 9.1*).

Table 9.1. Economic Impact Multipliers of Various Livestock Scenarios for the State and Expanding Regions

Expansion Scenario and Geographic Area	Economic Multipliers For:		
	Employment (Jobs)	Labor and Proprietor Income	Value-Added Activity
Hog Finishing Expansion:			
State Total	4.2	2.4	3.5
Sub-state Regions	3.3	1.9	2.7
Dairy Expansion:			
State Total	2.8	2.5	2.1
Sub-state Regions	2.4	2.1	1.9
Fed Cattle Expansion:			
State Total	2.7	2.6	2.8
Sub-state Regions	2.3	2.2	2.3
Poultry Expansion:			
State Total	3.6	2.1	2.2
Sub-state Regions	2.5	1.5	1.6

More importantly, the bulk of those multiplier impacts are experienced within those non-metropolitan regions which embrace the livestock expansion. While each animal species has rather unique production and processing configurations, the sub-state regional multipliers across all of the expansion scenarios are such that total impacts of expansion are still in the range of twice or more of the direct effects. In short, the agricultural production complex is the primary economic engine of the state's non-metropolitan economies that goes far beyond the farm and ranch level.

Table 9.2 summarizes the four expansion scenarios and the various impact metrics. In terms of the economic impacts of these various expansions relative to the total Nebraska economy, the impact may seem relatively modest. As of 2010, the state's animal industry generated 106,000 jobs (8.7 percent of total state employment), $4.2 billion of labor income (7.9 percent of total labor earnings in the state), and $7.7 billion of gross state product (8.7 percent of Nebraska's total GDP). Even the combined effect of all the expansion scenarios occurring would total 19,040 jobs (18 percent increase in job numbers of the animal industry and a 1.5 percent increase of total state employment numbers), $784 million of additional labor income (19 percent increase for the animal industry and a 1.5 percent increase for the state economy), and $1.4 billion of gross state product (6.3 percent increase for the animal industry resulting in a 1.7 percent increase to Nebraska's total economy).

However, as previously noted, the economic impacts of livestock expansion occur almost entirely in non-metropolitan Nebraska and often are widely distributed across rural counties. Here is where the **"economic footprint"** can be, and is, particularly significant. For example, in a typical rural county the addition of 50 to 75 jobs with wage levels above county averages would be quite beneficial to that county's economy. In many instances, this converts to young people having the opportunity for returning to the rural community and joining an existing family farm or starting a new business.

Table 9.2. Summary of Livestock Expansion Impacts

Impacts	Livestock Expansion Scenarios			
	25% Increase in Market-Weight Hogs	Doubling of State Dairy Cow Numbers	10% Increase in Fed Cattle Production	Tripling of Egg Production
Annual Livestock Number Increase	1,300,000 hd	60,000 hd	560,000 hd	20 mi. layers
Economic Impacts (Annual):				
Employment Numbers	2,700	3,100	11,600	1,640
Labor Income	$116 mi.	$129 mi.	$447 mi.	$90 mi.
Value-Added Activity	$185 mi.	$301 mi.	$776 mi.	$153 mi.
Local Tax Impacts (Annual):				
Property Tax (Facilities)	$1,930,000	$1,451,000	$250,000	$6,500,000
Property Tax (Other)	$3,781,000	$4,233,000	$14,573,000	$2,958,400
Local Sales Tax	$405,000	$501,000	$1,545,000	$341,600
Total Local Tax Revenue	$6,116,000	$6,186,000	$16,118,000	$9,800,000
Revenue Value of Manure (Annual)	$6,180,000	$1,200,000	$8,400,000	$4,560,000

More employment opportunities mean a growing work force and income earnings to sustain more households in the community. Moreover, 500 or more jobs added from a new or expanded processing facility represents a powerful economic expansion that spills across the entire multicounty regional economy. Bottom line: Few — if any — other economic development alternatives could boast comparable job and income outcomes for the rural agricultural-based economy. But in addition, these value-added effects of further livestock development essentially can provide greater economic diversity and resiliency to those rural economies that embrace it. To a large extent, the crop and livestock sectors tend to counterbalance one another in terms of profitability from year to year; which in turn can provide more stable economic conditions for rural mainstreet.

To be sure, the high crop commodity prices of recent years have led to extremely high profits for crop producers, while at the same time creating higher feed input costs and shrinking profit margins for the livestock sector. Currently, however, we are coming down from recent years of record-shattering profits for crop producers to more normalized commodity price levels and, subsequently, the associated return of profitability conditions for livestock producers. (The most recent USDA projections out to 2020 are for corn prices to remain below $5 per bushel.) Likewise, ethanol producers can move back into the black where, previously, reduced production and even complete shutdown of plants was the likely outcome. In short, a larger livestock presence bodes well for any rural agricultural economy in the years ahead.

Value-added agriculturally based products, rather than standardized agricultural commodities, are the future.

Additionally, the associated processing to livestock production adds another layer of economic stability to the economy. While the economies of farming areas relying heavily on commodity markets can be highly cyclical from year to year, it has long been recognized that related aspects of food manufacturing and other value-added activity tend to be steady and much less cyclical than commodity markets (Barkema, et.al, 1990).

Finally, as a major producer of crops, livestock and most recently, bio-fuels, Nebraska has a unique and competitive bio-economy — the Golden Triangle**.** However, at this juncture it would appear that the livestock component of this unique system has considerable potential for further expansion. As noted in Chapter 3, several of the major livestock producing states have experienced very robust expansion of their livestock industries over the past decade. Accordingly, these same states saw net farm income levels significantly outpace other areas of the country. Nebraska essentially has all the necessary resources to have done similarly, but in fact saw much more modest livestock development. And while its agricultural economy was being propelled by high crop prices, that era has proven to be short-lived. In fact, the long-term economic sustainability of the total crop/livestock/bio-fuels system and its ability to thrive in the future, may well hinge heavily upon more deliberate livestock expansion, as global demand for food products — particularly protein-based — rises. Value-added agriculturally based products, rather than standardized agricultural commodities, are the future.

To be sure, there are other important considerations of livestock expansion beyond the economic metrics presented in this analysis; factors such as environmental and societal impacts which are usually experienced more directly by members of the local community. We address these briefly here.

Environmental Implications

Wherever expansion of livestock production, particularly in larger concentrated numbers is being considered, concerns will arise about possible water and air pollution encountered by nearby residents and property owners whose property values may be affected. Here is where regulations regarding proper set-back provisions and facility construction, as well as sound manure management are effective preventative measures. For example, proper manure management and fertilizer application has made considerable strides in recent years to protect water sources while enhancing soil nutrient quality. Likewise, facility ventilation systems designed for inward air flow into the facility and then vented through filtering systems greatly reduces air pollutants and odor from confinement facilities.

In addition, already on the horizon for next-generation confined livestock operations is anaerobic methane digester technology that essentially captures the methane (and associated manure odor) from the manure and turns it into a useable bio-fuel. From a more macro perspective, atmospheric emissions of methane are one of the most serious environmental challenges facing today's production agriculture (on a per-unit basis, methane is more than 20 times more damaging to the atmosphere than CO_2). Given this, and the likelihood of more stringent federal emission standards being forthcoming, any future livestock facility operation will be factoring this into account and embracing these newer technologies (See Appendix B of this report for a discussion of this technology).

Bottom line: the general perception of large-scale livestock operations being serious pollution sources is ill-founded. Quite the contrary, such operations must be in compliance to local, state, and federal environmental regulations. Also, frequently these livestock operations seek to be above the minimum standards for greater economic efficiency and profitability (the increased use of animal manure as a co-product of livestock production to be used as soil nutrients is a case-in-point). For today's investor in livestock expansion, environmentally-sound practices are a critical component of long-term economic sustainability.

Societal Implications

As for societal and community-based issues associated with livestock expansion, the concerns raised often arise from reaction to change and fear of change. To varying degrees, this is a normal human response. As individuals, we don't particularly appreciate change occurring in our day-to-day routine and community unless it is clearly a positive one that we see as beneficial. So, when a proposed livestock expansion surfaces, the reaction of community residents may initially be guarded at best.

Here is where careful thought about the community's long-term viability is essential. Two factors are critical to this thought process, both individually and collectively.

First, it must be realized that change in agriculture and in the agriculturally-based communities is inevitable. And a good part of that change is in the form of structural shifts towards larger production units that dwarf the typical farm and ranching operations of just a few generations ago. In Nebraska, the bulk of agricultural production is accounted for by large farm units. In the 2007 Census of Agriculture, the latest census data available at this writing, the largest five percent of farm units (in terms of dollar value of annual production output), accounted for about 60 percent of Nebraska's total output; while the smallest 60 percent of farm units on the size continuum were

responsible for just five percent of total agricultural production. This is what could be called the *5 and 60 Rule;* and the forthcoming results of the 2012 Agricultural Census will likely indicate this contribution disparity is only getting more pronounced. To assume this trend will be or even should be reversed is not realistic, even though individuals may have nostalgic memories of an earlier time. Large-scale production units in both the crop and livestock sectors will continue to carry the bulk of American agriculture's production output in the future. (Note: this is not to say that smaller niche-type farming units can't co-exist. In fact, it will be beneficial for any rural agricultural economy if they do. But, these niche and often part-time units will serve more selective and specialized consumer demands, and not serve as the mainstay of U.S agricultural production.)

Large-scale production units in both the crop and livestock sectors will continue to carry the bulk of American agriculture's production output in the future.

Second, concerns regarding community culture and the associated quality of life for residents need to be thoughtfully evaluated. The impact analysis contained in this report would suggest considerable economic benefits in terms of jobs, income earnings, and new business startups flowing into the local economy. Greater economic opportunity means more people and households as well as enhanced local tax revenues. In fact, without investment of this nature, the future of many rural communities may be in jeopardy. But with new residents and more robust economic activity, some change in culture is inevitable. In fact, in today's dynamic world, "no change" is not an option. So the point is, "Will the change carry net positive implications for community well-being or not?"

To examine that in some detail, we analyzed 15 years of data collected from the Annual Nebraska Rural Poll, in which each year more than 2,000 respondents from non-metropolitan Nebraska rate their personal satisfaction with their home community. Using various satisfaction measures from the annual surveys, we conducted a cross-sectional analysis comparing the satisfaction levels of residents residing in the 23 counties which have designated themselves *Livestock Friendly,* with that of residents living in the remaining Nebraska counties. (Note: Following state legislation enacted in 2003, counties can voluntarily designate themselves as L*ivestock Friendly,* implying the county holds the livestock industry in high regard and would be open to consideration of further development.) The analysis suggested somewhat lower community satisfaction levels by residents of the livestock friendly counties over the years; however, the difference appears to be minimal (see Appendix A to this report for more discussion). Moreover, the counties that make up the livestock friendly group historically have relatively lower median and average income levels; and income is one factor that has some direct correlation with community satisfaction levels. So livestock expansion, as it raises job numbers and earnings, may very likely raise community satisfaction levels in those counties; particularly if current community residents are actively participating in this economic expansion.

Bottom line: Some changes to the community makeup will be an inevitable part of any substantive livestock expansion. Community residents need to be a part of the discussion process with those who are looking to expand livestock production. The developers need to be committed to being "good citizens and neighbors" in the community — running environmentally-sound operations, hiring a qualified workforce (and compensating accordingly), purchasing inputs locally, and always keeping the communication channels open with the community. Likewise, the community and other policy entities need to be willing to work with the proposed development, seeing that zoning and other regulatory

procedures are carried out in an efficient and orderly manner. (Note: a bill introduced into the 2014 Nebraska Unicameral session, calling for provisions to support needed infrastructure and provide tax incentives for livestock development is in the spirit of that type of support.) With the above, there would certainly be a strong likelihood that the net societal aspects of the expansion would be "win-win" for both the expanding livestock operation and the community.

A Final Note

Certainly, decisions of whether or not to pursue livestock expansion activity will depend heavily on community stakeholders at the local levels across the state as they consider these economic and other implications. But likewise, all Nebraskans and their policy makers have a vital stake in the outcome. Any one of the possible expansion scenarios analyzed here represents thousands of potential jobs and associated earnings distributed widely within and across Nebraska communities and households. And with that additional value-added economic activity, developed in an environmentally and socially responsible manner, comes the potential for enhanced quality of life for all Nebraskans into the future. In sum, the economic challenges posed, as well as the associated economic opportunities afforded are simply too weighty in Nebraska's economic future to ignore. It is time to act.

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APPENDIX A
Community Well-being and the Livestock Industry

The Department of Agricultural Economics, University of Nebraska–Lincoln, in partnership with the NU Rural Initiative (Center for Applied Rural Innovation) has conducted an annual survey since 1996. The questionnaires have several parts, including current issues and community well-being. While the current issues by nature keep changing on a year-to-year basis, the questions pertaining to the community well-being have been consistent over the years. This provides a basis to compare how the satisfaction level among counties has changed over the years.

The Nebraska Department of Agriculture (NDA), under the direction of the Nebraska Unicameral, has developed a Livestock Friendly County program which is used to designate a county either Livestock Friendly (LF) or Non-Livestock Friendly (NFL). It is a voluntary program aimed at encouraging and promoting livestock industry within the state. The process to get a livestock friendly designation is fairly simple: county officials must hold a public hearing, pass a resolution, then submit an application for the designation to the NDA. As of December 2013, there were 23 livestock friendly counties in Nebraska, out of a total of 93 counties. Dodge County is the latest to receive the designation.

An analysis combining the Livestock Friendly County program designation and the survey was done to see how satisfied the community residents of non-livestock friendly counties were compared to their counterparts in the livestock friendly counties. In doing so, it was found for the years 1996-2013, an average of 63 percent of the residents residing in the LF counties were satisfied/very satisfied with their community, compared to 65 percent of the residents residing in the NLF counties. Moreover, for the same time period, on average 20 percent of the residents residing in the LF counties were dissatisfied/very dissatisfied with their community, compared to 18 percent of the residents residing in the NLF counties. Similarly, for the same time period, an average of 27 percent of the residents residing in the LF counties thought that their community was changing for the better, compared to 30 percent of the residents residing in the NLF counties. The average satisfaction level of residents of NLF counties was higher, compared to that of the residents of LF counties. A further statistical analysis was done to see if this difference was statistically significant over the time span observations. In doing so, it was found that the difference was statistically significant at a 1 percent level (p-value for paired t-test 0.019). The case for the dissatisfaction level was the same; on average, residents of LF counties had a higher dissatisfaction level; and the difference was statistically significant at a five percent level (p-value for paired t-test 0.0061).

In order to further investigate the satisfaction level, average annual pay data for every Nebraska county since 1990 was collected from the Bureau of Labor Statistics. For the year 2013, data was unavailable for average weekly pay until November, so an estimate for an annual average wage was used. Once again, an analysis was done combining the Livestock Friendly County program designation and the average annual wage over

the years. In doing so, an interesting observation was made. For every year of the time period 1990-2013, average annual wage for the LF counties was less than for the NLF counties. The average annual wage for the LF counties was $22,019, and $22,452 for the NLF counties. The difference was highest in 1999, with a maximum of $789, and a minimum in the year 1990, with a maximum of $31. (See *Figure A-1* which shows the average annual pay for LF and NLF counties, as a percentage of state average annual pay.) Upon conducting a statistical analysis to check if there was a real annual average wage difference, it was found that the difference was statistically significant at a 1 percent level (p-value for paired t-test less than 0.0001).

As stated earlier, the community satisfaction survey was conducted from 1996–2013, and the annual average pay goes back to 1990. While analyzing the data it was found that even from 1990–1995 the average annual pay for the LF counties was lower compared to NLF counties. The difference of $344 was highest in 1995 and lowest in 1990, at $32. Thus, the average annual pay from the beginning for the NLF counties has always been higher compared to the LF counties.

In conclusion, a causational relationship cannot be determined and/or established for the community satisfaction level in regards to either LF designation or average annual pay. However, an important fact is that the counties designated LF would be making an even lower annual pay if it were not for the livestock industry presence in those counties. This would lead to other indirect economic effects, resulting in adverse economic conditions for the counties. Thus, the livestock industry is playing a key role in terms of supporting the economic viability of these counties.

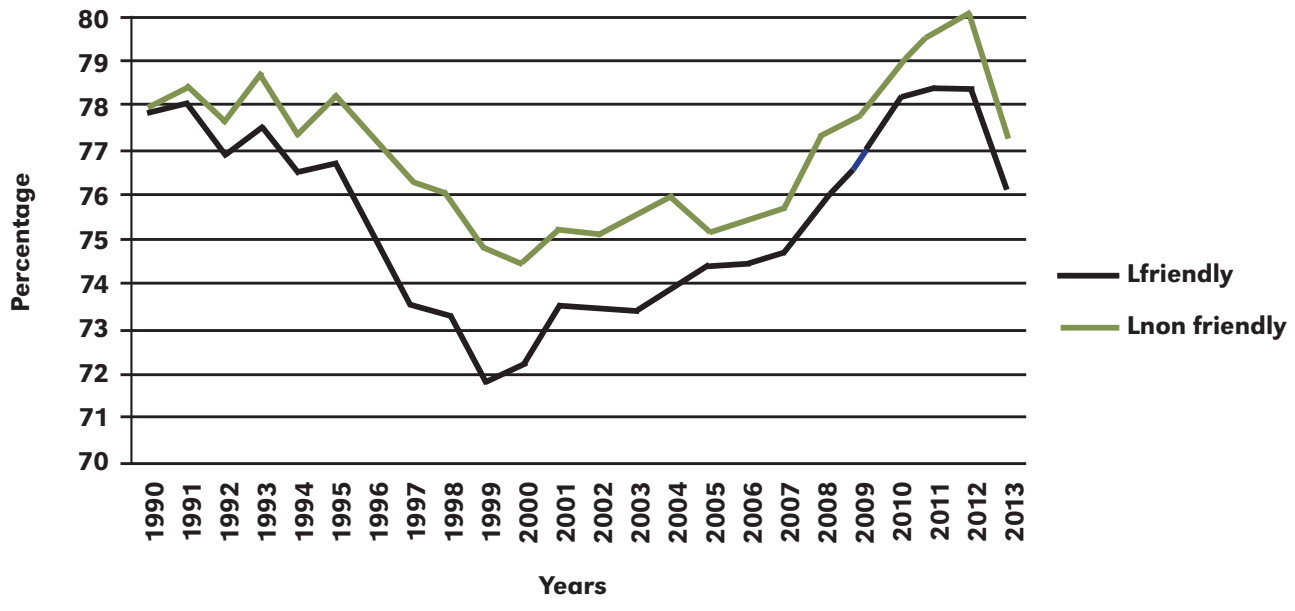

Figure A-1. Annual Pay as a Percent of State Annual Pay

APPENDIX B

Environmental Impacts and Mitigation Options In the Nebraska Livestock Industry

Introduction

The increase in global demand of animal protein offers Nebraska a significant opportunity for expanding livestock production. As evidenced in this study, a doubling of dairy cow numbers, a 10 percent increase in fed cattle production, a 25 percent increase in finishing hogs and a three-fold increase in poultry and egg production can potentially increase local tax revenue by an estimated $30 million and create nearly 19,000 jobs, the bulk of which would be created in the state's non-metropolitan counties.

While expanding livestock production can offer positive economic outcomes, it also creates environmental impacts to be accounted for and appropriately managed for the best interests of the local community, as well as for the greater global environment. In fact, in the global perspective, livestock production impacts climate change, atmospheric and water pollution, biodiversity and land use. The Environmental Protection Agency (EPA) estimates that production agriculture accounts for 8 percent of greenhouse gas (GHG) emissions (nitrous oxide N_20, methane (CH_4) and carbon dioxide (CO_2). CH_4 and N_20 are characterized by a global warming potential (GWP)[1] of 21 and 310, respectively, and a lifetime of 21 and 310 years. More than a third of the U.S. CH_4 emanates from livestock through enteric fermentation (23%) and manure management (9%). Livestock emits N_2O through the breakdown of manure and urine, which contributed to 5 percent of N_2O emissions in 2011 (EPA, 2012).

Both N_20 and CH_4 are regulated by the EPA under the Federal Clean Air Act (CAA). Animal wastes also generate nutrients such as nitrogen (N) and phosphorus (P), which in excess can result in ground and surface water contamination, which are regulated under the CAA. Additionally, ammonia volatilization from animal production systems can impact air quality through their odors. During the period 1990-2007, odor nuisance lawsuits have cost the livestock industry more than $100 million in compensation and settlements. During this period there have been 10 lawsuits, of which one was in Nebraska (Keske, 2011).

Hence, livestock expansion in Nebraska or anywhere in the U.S. requires thorough consideration of mitigation options to combine profitability and sustainability. In this appendix, we address the environmental performance of U.S. and Nebraska agriculture and associated Federal EPA policies, before addressing particular methane mitigation options for beef and dairy cattle, and to some extent odors from both hog and cattle production.

[1]The Global Warming Potential (GWP) for a gas is a measure of the total energy that a gas absorbs over a particular period of time (usually 100 years), compared to carbon dioxide. Methane's and nitrous oxide's 100-year GWP are 21 and 310, respectively, which means that methane and nitrous oxide will cause, respectively, 21 and 310 times as much warming as an equivalent mass of carbon dioxide over a 100-year time period, (EPA, 2010).

Environmental Performance of the U.S. and Nebraska Agriculture with Respect to GHGs

Nebraska's economy is dominated by the agricultural sector, which positions Nebraska among the top five livestock producing states. The magnitude of the state's livestock industry, and more particularly the cattle sector, explains the relatively high volume of CH_4 emitted. The performance considered here looks first at the livestock methane footprint — defined as the volume of methane emitted per volume of livestock product produced. Second, an environmental efficiency measurement in terms of the ability of producers to obtain from a given set of inputs, the maximum desirable output (crops and livestock) without increasing GHGs, or to expand simultaneously the desirable outputs while contracting GHGs and inputs.

Among the major cattle producing states, Nebraska's methane footprint is estimated to be 0.006, meaning that for every unit ton of beef produced, 6 kg of methane (126 kg of C02) is released. This measure for Nebraska suggests a relatively better performance than that of Texas, California, and South Dakota, which are 0.121, 0.255, and 0.221, respectively (USDA, 2013[2] and EPA, 2013). This performance difference may be attributed to differences in state regulations, as well as different patterns of livestock rations and manure management.

On the basis of the environmental efficiency measures, Nebraska exhibits a potential increase in crop and livestock production of around 9 percent, and a simultaneous reduction in inputs and GHG emissions of 8 percent. This figure assumes that producers incur no cost to dispose of CH_4 and N_20. Should this disposability be reversed, the potential increase in desirable outputs can be decreased to 5 percent and the simultaneous contraction in CH_4, N_2O and inputs drop to 4 percent. Of the top agricultural states, and more specifically livestock producers, Nebraska's environmental performance outpaces that of Texas, Kansas, Wisconsin, and South Dakota but lags behind the performance of Iowa, California, and Illinois.

Pursuant to these efficiency measures, it would suggest a contraction of GHGs while expanding desirable outputs. The following section elaborates on mitigation technologies, which indeed can allow for increased livestock production in Nebraska while reducing methane emissions.

Livestock Expansion and the U.S. EPA Regulation on Livestock Production

Based on EPA estimates (1993), an expansion of 60,000 head dairy cows and 560,000 head fed cattle can increase the CH_4 emissions by nearly 44,000 tons per year, which corresponds to 918.33 Gg of $C0_2e$. With an emission of 1.5 kg CH_4/head per year, an expansion of 1,300,000 head of finishing hogs can add up to 40.95 Gg of CO_2e to CH_4 emissions. All the expansion scenarios generate livestock production units falling under the EPA definition of the Concentrated Animal Feeding Operations (CAFOs) category. They are subject to permitting requirements per the National Pollutant Discharge Elimination System (NPDES), under the Federal Clean Water Act as source pollution. CAFOs are also required to obtain a GHG stationary source permit under the Clean Air Act (CAA).[3] Under the New Source Review (NSR) and the Prevention of Significant Deterioration (PSD) programs, any facility emitting or having the potential to emit more than 250 tons of regulated pollutants (CO_2e in occurrence) is subject to the permit requirement. Title V of the CAA, on the other hand, requires that any stationary sources emitting more than 100 CO_2e obtain an operating permit. With a threshold of 100 CO_2e emissions, dairy facilities of over 25 cows, beef cattle operations of 50 cattle, and swine operations with over 200 hogs are subject to operating permits (USDA, 2004).

[2]Methane footprint is computed based on USDA's data on beef production and cattle methane emissions from the EPA.

[3]From the CAA, the New Source Review (NSR), and the Prevention of Significant Deterioration (PSD) programs, major stationary sources are required to obtain a permit before building or modifying any facility that would increase the emissions of regulated pollutants. Under the NSR and PSD programs, any facility emitting or having the potential to emit more than 250 tons of regulated pollutants (CO_2e in occurrence) is subject to permit requirements. Title V of the CAA, on the other hand, requires that any stationary sources emitting more than 100 CO_2e obtain an operating permit.

The average cost to obtain a Title V and a PSD permit for an agricultural source is estimated to be $23,000 and $59,000, respectively (Chappell, 2010). If the Title V fees and the presumptive minimum rate is applied, the cost to livestock producers would amount to $182.20 per dairy cow; $91.10 per beef cow; and 22.75 per hog.[4] This regulation is likely to undermine the competitiveness of the livestock sector if other countries do not impose any restrictions on greenhouse emissions. This corroborates the impact of the GHG regulation on livestock trade flow (Kim and Koom, 2011). The loss of desirable outputs is estimated to be 6.3 percent on national average from the impact of the EPA regulations (Kabata, 2013). Should this regulation be imposed and enforced, Nebraska could have given up to 3.8 percent of crops and livestock production *ceteris paribus*. Of the major livestock producers, California exhibits the least loss of 0.1 percent and Iowa the greatest loss of 5.4 percent. The magnitude of the loss can be reduced given that producers, aware of the loss associated with the regulation, are likely to adopt mitigation technologies of some kind, especially those associated with productivity improvement. The regulation impacts on livestock producers can be substantially reduced with the adoption of mitigation technologies.

Methane Mitigation Technologies in Livestock Production

Livestock release two main GHGs: CH_4 and NO_2. About three to 12 percent of the energy consumed by ruminants (cattle and sheep), is converted to methane in the rumen (referred to as enteric methane) and released into the atmosphere. Nitrous oxide is emitted during the breakdown of nitrogen in livestock manure and urine. GHG, CH_4, and NO_2 released in the atmosphere trap heat and contribute to climate warming. These GHGs can be mitigated by upfront technologies that the following literature describes. Substantial mitigation in livestock GHGs can be achieved by efficiency improvement in nutrition and animal waste management, genetics, and biotechnology use (ionophores, hormone implants, beta-agonists, recombinant bovine somatotropin (rbST), and anaerobic digesters). Of the most effective strategies to reducing methane emissions from ruminants, the USDA (2004) suggests: 1) increasing the digestibility of forages and feeds by making feed digestion more efficient; 2) using feed additives to tie up hydrogen in the rumen, because hydrogen is an important intermediate product to produce methane; 3) inhibiting rumen bacteria (methanogens) that produce methane; 4) enhancing rumen microbes to produce usable product rather than methane; and 5) improving meat or milk production efficiency to reduce animal numbers.

Biotechnologies Approach to Mitigating Methane Livestock

Combining biotechnological treatments has drastically improved efficiency and environmental impact in livestock production, as documented by numerous studies. Ionophores, such as monensin, are antimicrobials commonly fed to beef and dairy cattle to improve feed efficiency and modify rumen fermentation (McGuffey et al., 2001). Cattle treated with monensin and tylosin, in addition to some implants, reveal a reduction of methane CO_2e of 31 percent per kg of weight gain (Cooprider, et al., 2011). Stackhouse, et al., (2012) established that cattle treated with ionophores and implants reduced the carbon footprint of the system by 7 percent, and ammonia emissions by 8 percent. A combined treatment with ionophores, implants, and beta-adrenergic agonists cut down the system's carbon footprint by 9 percent, and ammonia emissions by 13.5 percent. The use of growth-enhancing technologies such as steroid implants, in-feed ionophores, in-feed hormones, and beta-adrenergic agonists results in an overall carbon footprint increase of 9.8 percent, and more specifically an increase of 10.2 and 9.2 percent, respectively, in methane and nitrous oxide (Capper and Hayes, 2012).

[4]These estimates are slightly lower than the ones presented earlier in 1991 by officials of the Illinois Farm Bureau. *http://democrats.energycommerce.house.gov/sites/default/files/documents/Testimony-Nelson-EP-HR-910-Energy-Tax-Prevention-Act-2011-2-9.pdf*

Contrarily, a free-biotechnology system would require feedstuff use to increase by 10.6 percent, land use by 10.0 percent, water use by 4.2 percent, fertilizer use by 7.3 percent, and fossil and fuel energy use by 7.6 percent. Such a system would also generate up to 10 percent of animal waste (manure, nitrogen, and phosphorus excretion).

Biotechnologies represent one of the most effective strategies to improve livestock productivity while mitigating GHG emissions; however, their adoptability is still contingent on consumers' perception, in part due to the media focusing on their potential negative aspects and misinforming consumers (McCluskey and Swinnen, 2004).

Animal Dietary and Waste Management Approach to Mitigating Livestock GHG

The dietary approach to methane mitigation is likely one of the most appealing because it reduces emissions while improving profitability. Dietary modification also offers a great potential to reducing nutrient excretion and the amount of land needed to apply manure. General technologies consist of efficiency enhancers that improve the conversion of feed nutrients to product (meat, milk, and eggs). Enzymes, ß-agonists, ionophores, and somatotropin increase animal performance and result in a remarkable reduction in manure output and excretion. ß-agonist inclusion in diets for finishing swine and feedlot cattle increase meat yield while reducing manure volume and excretion (Woods et al., 2011). The use of bovine somatotropin in dairy cattle reduces manure output by 6.8 percent, and N and P by 9.1 and 11.8 percent, respectively (Capper et al., 2008).

In dairy cattle, reducing the crude protein (CP) content of the diet reduces N excretion by 25 percent without affecting milk production (Agle, et al., 2010). A study by Knowlton, et al., (2007) has shown that phytase added to diets decreased fecal P excretion of dairy cows. In swine and poultry diets, an enzyme such as phytase can reduce approximately 20 to 50 percent of P excretion, whereas ß-glucanase and xylanase increases body weight gain, feed conversion efficiency, and nutrient utilization. Technically, reducing P excretion decreases its concentration in the manure and, thus, decreases the land needed for application of manure.

Distiller Grains Diet to Mitigating Livestock Methane

Byproducts from the ethanol industry, such as dried distillers grains (DDG) are a source of protein and energy for beef and dairy cattle diets. It is also documented that ruminants submitted to DDG, plus a soluble diet have shown remarkable reduction in enteric methane release. Such findings offer Nebraska a unique advantage in reducing their methane footprint, while expanding beef and dairy production. In fact, Nebraska is ranked second as a corn-based ethanol and distiller grain producing state, and third in corn production. Corn distiller dried grains (CDDG) in the diet of growing beef cattle can reduce enteric CH_4 production by more than 16 percent (McGinn, et al., 2009). The potential reduction ranges from 16-38 percent, depending on whether or not CDDGS plus soluble is combined with bran hay (Behlke, et al., 2007). In a recent study by Hünerberg, et al., (2013), it reports that a 1 percent increase in supplemental fat to CDDGS is associated with a 6.3 percent reduction in CH_4 emissions.

However, the effectiveness of DDG in reducing methane is contingent upon the state of its use (wet, modified or partially dried, or dried distiller grains plus solubles) and its oil content. However, a partial downside to using DDG in dairy and beef cattle rations to abate methane is their potential to negatively impact the environment through greater nitrogen content of the excretion. Excess N can be turned into ammonia, which

can contribute to groundwater and surface water pollution, eutrophication, soil acidity, and formation of nitrous oxide[5] (N_2O), with global warming potential amounts to 310. It is also documented that excess N contributes to groundwater and surface water pollution through runoff and leaching.[6] This suggests measuring the environmental effect of feeding DDG to growing beef and dairy cattle through use of a life cycle assessment that accounts for both enteric CH_4 and N excretion. Moreover, the accessibility to DDG is contingent on the grain markets volatility, the prevalence of the ethanol mandate and related incentives. Should ethanol production subsidies be reduced, suspended or suppressed, one should expect higher prices of DDG, which could limit its use in livestock rations *ceteris paribus.*

Should the CDDGS be used to mitigate the enteric CH_4 emissions, ethanol plants would need to refrain from lowering oil content levels below the effective minimum (Erickson, et al., 2014) and (Beauchemin, et al., 2008). Overall, a life cycle assessment is suggested to determine the impact of DDG diet on the net GHG budgets and on the ammonia (NH_3) emissions.

Animal Waste Management Technologies to Mitigate Livestock GHGs: Anaerobic Digester

Mitigating livestock environmental impacts also can be addressed by improving animal waste such as manure, which is responsible for 12-41 percent of total agricultural CH_4 emissions and 30-50 percent of total agricultural N_2O emissions (Chadwick, et al., 2011). Substantial mitigation can be achieved through the employment of adequate technologies in the form of anaerobic digesters. As of November 2013, the U.S. had 223 anaerobic digester projects, largely located on dairy farms (81 percent), mainly concentrated in the Midwest, west, and northeast. Digesters constructed at swine farms represent 12 percent, whereas those at beef and poultry farms represent 4 percent each. The remaining 3 percent consists of digesters implanted on mixed farms (EPA, 2013).[7] Currently, Nebraska has only one AD operating (applied to a swine production facility).

Manure digesters' advantages and benefits include:

- odor level reduction by 90 percent or more;
- reduction of bacteria/pathogens;
- nutrient management by converting the organic nitrogen in the manure into ammonium, the primary constituent of commercial fertilizer;
- co-generation and energy cost reduction; and
- potential use of final products for composting as bedding material or as a soil amendment, or sold off the farm as an organic-based fertilizer/soil enhancer (Oregon Department of Energy 2008).

With respect to GHG reduction, the use of AD across states results in direct reduction and avoided emissions of about 1.38 and 0.38 $MMTCO_2e$, respectively. Direct reduction corresponds to CO_2 emissions from burning 5,900 railcars of coal, or CO_2 emissions from electricity use of 206,587 U.S. homes in one year. On the other hand, avoided emissions are equivalent to carbon sequestered by 311,475 acres of U.S. forests in one year, or CO_2 emissions from 42,600,897 gallons of gasoline consumed.[8] While offering these benefits, water waste from the AD remains an issue requiring

[5](IPCC, 2006; Hristov et al., 2011).
[6](IPCC, 2006)
[7]*http://www.epa.gov/agstar/projects/index.html*
[8]*http://www.epa.gov/agstar/about-us/accomplish.html*

adequate technology such as a Livestock Water Recycling System which reduces the cost of handling nutrients and odors.[9]

Overall, environmental benefits are obtainable at a large capital investment. The economics of ADs reveal that the viability has mixed results. For some, ADs are not economically viable as a renewable source of energy, as long as its maintenance and production costs outpace the electricity price on the grid. Electricity price remains the determinant factor of the economic viability of AD as a renewable source of energy. Our sensitivity analysis reveals that for a 2,500- cow dairy, complex mix and Plug Flow digesters are economically feasible only at a retail electricity price of eight and 10 cents per kwh, respectively. With an electricity price amounting to 4.5 cents per kwh in Nebraska and the maintenance cost of the AD of about 2 cents per kwh, the AD is economically less attractive as a renewable source of energy (Rice, 2013).

But this figure changes completely when capacity and performance incentives, feed and tariff pricing, net metering laws, carbon credit, tipping fees, permit cost, and avoided compensation for odor nuisance are accounted for. These factors contrast the non-economic viability of the AD and substantiate the drastic increase in its adoption. In fact, the number of operational ADs across the states has increased from 157 in 2010 to 223 in 2013, plus 22 projects under construction in 2013, which represents a drastic growth of 36 percent in a three-year period.

Conclusion

Expanding livestock production in Nebraska offers a remarkable potential increase in local tax revenue and job creation. However, desirable livestock products are jointly produced with greenhouse gas emissions, water pollution, and odors. Such externalities are regulated under the Clean Air Act and the Clean Water Act to the extent that the livestock industry is held accountable for more careful environmental management — particularly in those areas where livestock production is prominent and likely to expand. The challenge for the industry is to combine profitability and sustainability. Fortunately, the state of technology provides unique opportunities for mitigation of negative environmental spillovers that may even be economically enhancing — manure management as organic fertilizer, use of distillers grains, anaerobic digesters, and dietary and biotechnologies to improve animal performance. However, some of these technologies are more capital intensive than others (anaerobic digesters), whereas others are contingent to consumers' acceptance (biotechnologies). For ethanol producing states like Nebraska, the use of distillers grains in livestock rations offers promising prospects for mitigating livestock methane, but requires a thorough life cycle assessment to determine a net budget of greenhouse gas emissions.

[9] *http://livestockwaterrecycling.com/page/anaerobic-digesters*

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