

Economic Contribution of the Iowa State University Veterinary Diagnostic Laboratory

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Executive Summary

The Veterinary Diagnostic Laboratory is a fully accredited, diagnostic, teaching and research laboratory located on the campus of Iowa State University's College of Veterinary Medicine. The laboratory offers comprehensive advanced diagnostics with fast and reliable results and prompt expert interpretation and consultation.

The laboratory serves as a primary hub of activity, yet its economic benefits extend well beyond campus borders. Iowa citizens, veterinarians, and agricultural industries benefit from the services provided by the Iowa State University Veterinary Diagnostic Laboratory (ISUVDL).

The overriding objective of this study was to describe the economic contribution of the ISUVDL. Particular objectives included:

1. Estimate the total economic contribution of the ISUVDL.
2. Estimate the total economic contribution of construction activity associated with a new ISUVDL.
3. Estimate the total economic contribution of animal agriculture production in Iowa.
4. Estimate the total economic contribution of the animal processing sector in Iowa.
5. Describe the contribution of the ISUVDL in relation to business continuity in animal agriculture, competitiveness, surge capacity, and the importance to human, companion animals, wildlife, research, and teaching.

Objectives 1 through 4 considered the contribution of various workings to the Iowa economy. Impacts were calculated using the IMPLAN Input-Output (I-O) modeling system. Objective 5 describes the contribution of the ISUVDL across several key aspects. Many of these benefits cannot be precisely quantified and others will exist only in times of emergency. Therefore, a panel of experts was used to evaluate the contribution of the ISUVDL. These experts are all independent of the ISUVDL but familiar with its services.

Key Findings

- The ISUVDL had \$22.5 million in expenditures in 2015, and 140 jobholders earning \$11.00 million in labor income. After considering all multiplied through relationships with suppliers to the ISUVDL and workers converting their incomes into household spending, the ISUVDL annually supports \$39.00 million in regional output and \$23.34 million in value added, of which \$19.57 million is labor income to 265 jobholders.
- Construction-related spending of \$124 million between 2016 and 2020 for a new ISUVDL would stimulate \$41.16 million in total annual output in the region and \$20.10 million in value added, of which \$14.95 million would be labor income to 227 total jobholders.
- The Iowa animal producing industry, after considering all multiplied-through linkages, explains \$21.20 billion in total output and \$13.03 billion in value added, of which \$6.72 billion was labor income to 118,895 Iowa jobholders. The Iowa animal products processing industry, after considering all multiplied-through linkages, explains \$21.48

billion in output and \$4.42 billion in value added, of which \$2.77 billion was labor income to 56,308 jobholders.

- Livestock production in Iowa has a direct economic impact of \$14.62 billion. In addition, the industries that process livestock and livestock products provide \$17.96 billion in direct economic value. The combined impact of livestock production and processing, \$32.58 billion, equates to \$10,487 for each of Iowa's 3.107 million people. The \$124 million cost of a new ISUVDL equals about 0.38% of the annual direct economic value of the livestock sector. Therefore, a contribution to the size of the Iowa livestock sector by the ISUVDL of 0.38% would, from a statewide perspective, pay for a new lab within just one year.
- Workers linked to animal producing sectors generated \$339 million in state tax receipts for Iowa in 2015. Those in animal products production accounted for \$140 million in state taxes. The total tax contribution from both groups is \$479 million.
- A panel of experts was asked about the contribution of ISUVDL to the livestock sector in Iowa. They were asked to provide this value as a percent of the total added value of the livestock sector under both normal conditions (peacetime) and under an animal health emergency. This value was then compared to the income and sales taxes paid by participants in the livestock sector to the state of Iowa. The results suggest that the lab generates enough tax receipts to repay a \$124 million state investment in two years under normal circumstances and in less than one year in an emergency. Using the minimum estimates from the survey under normal circumstances, suggests a 4.7-year payback period.

IOWA STATE UNIVERSITY VETERINARY DIAGNOSTIC LABORATORY AND AFFECTED INDUSTRIES ECONOMIC CONTRIBUTIONS TO THE STATE OF IOWA

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Introduction

The accompanying tables describe different economic values either attributable to the operations of the Iowa State University Veterinary Diagnostic Laboratory (ISUVDL) at Iowa State University or in industries that directly or indirectly depend on ISUVDL services. The analysis describes the region-wide or the state-wide economic contributions of:

1. The ISUVDL annual operations at Iowa State University.
2. The temporary annual construction values of a new ISUVDL at Iowa State University.
3. Animal production in Iowa:
 - a. Beef cattle ranching and farming (including feedlots).
 - b. Dairy cattle and milk production.
 - c. Poultry and egg production.
 - d. Swine production.
 - e. All other animal production (sheep, lambs, goats, equine, and all other).
4. Meat, poultry, and dairy product processing in Iowa:
 - a. Milk, cheese, ice cream and all other related processing.
 - b. Animal slaughtering and processing (except poultry).
 - c. Poultry processing.
5. Combined animal production (without duplication).
6. Combined animal products processing (without duplication).

The economic contributions were determined using a current input-output model of the regional and the state economy. Economic values associated with ISUVDL operations and with the construction of a new ISUVDL were modeled using a regional model consisting of Story, Boone, and Polk County. State government or university services are typically modeled using the region from which the majority of workers are drawn. The economic values associated with all animal production and animal products manufacturing were modeled using a state of Iowa model as these industries are distributed across the entire state. Characteristics of the modeling system are contained in Appendix A. In addition, the imputed value of state government tax collections associated with the incomes supported by these industries and activities are also reported.

Primer on Reading Input-Output Tables

Before looking at the results, it is useful to have a short primer on economic impact terminology. Input-output models produce an array of information for analysts. For our purposes, however, there are four types of data and four levels of data comprising a typical input-output results table.

The types of economic impact data are:

Output. This is the value of industrial productivity over the course of a year. It represents the worth of what was produced whether it was sold or not. For the ISUVDL, it is its annual budget. For all other industries, output is often analogous to annual sales.

Labor income. These are wage and salary payments to workers, including the value of employer-provided benefits like health care and retirement. Management payments and net profits to proprietors are also counted as labor income payments.

Value added. Value added includes all labor income (mentioned above) plus payments to investors (dividends, interests, and rents), and indirect tax payments to governments. Value added is the equivalent of Gross Domestic Product (GDP), which is the standard measure of economic activity across the states and for the nation.

Jobs. There are many kinds of jobs. I-O models measure the annualized job value in different industries. Many industries have mostly full-time jobs, but many others have mostly part-time and seasonal jobs. This is especially true in agricultural production. I-O models do not convert jobs into full-time equivalencies, but they do convert them into annualized equivalencies. As many people have more than one job, there are always more jobs in an economy than there are employed persons.

The levels of economic data are:

Direct values. These are the aforementioned data types specifically for the industry that we are evaluating. In this study—the ISUVDL facility, annual construction activity, animal production, and animal processing in the manufacturing sector.

Indirect values. All direct firms require intermediate inputs into production. They must buy supplies, utilities, other manufactured inputs, transportation, and services, just to name a few.

Induced values. When the workers in the direct industry (e.g., the ISUVDL, animal producers, animal processors) and those in the indirect industries (the supplying sectors) convert their labor incomes into household spending, they induce a third round of economic activity. Induced values are sometimes called the household values.

Total values. The sum of direct, indirect, and induced activity constitutes the total economic effect that is being measured. In short, it gives us the economic sums of the studied industry, its suppliers, and all affected households.

Regional or Statewide Economic Contribution Tables

Veterinary Diagnostic Laboratory Annual Economic Contribution

Table 1 contains the annual economic contribution of the ISUVDL as an Iowa State University diagnostic, teaching and research facility. As all of the following table interpretations follow the same format, a description of the individual elements of Table 1 will be provided here, but in many of the remaining tables, just the total economic values will be described along with any notes or cautions about interpretation.

The ISUVDL had \$22.50 million in expenditures in 2015, and 140 jobholders earning \$11.00 million in labor income. The ISUVDL required \$5.34 million in regionally-supplied inputs, supplying which in turn supported 38 workers earning \$2.30 million in labor income. When the direct jobholders (ISUVDL) and the supplying-sectors jobholders convert their labor incomes into household spending, they induced \$11.15 million in regional output, which in turn employed 87 workers earning \$3.77 million in labor incomes. Summed, the ISUVDL annually supports \$39.00 million in regional output and \$23.34 in value added, of which \$19.57 million is labor income to 265 jobholders.

Table 1. Total Economic Contribution of ISUVDL Annual Operations, 2015

Impact Type	Jobs	Labor Income \$	Value Added \$	Output \$
Direct	140	11,000,000	13,500,000	22,500,000
Indirect	38	2,303,096	3,246,847	5,339,366
Induced	87	3,770,196	6,593,681	11,153,119
Total	265	19,573,292	23,340,528	38,992,484

Veterinary Diagnostic Laboratory Temporary Construction Impacts

Table 2 represents the annualized value of constructing the new ISUVDL. These are considered short-term or temporary impacts that are highly localized. They are appropriately measured on an annualized basis as the construction occurs. Accordingly, this estimates the worth considering \$124 million in total construction-related spending between 2016 and 2020, which translates into \$24.50 million spent annually. In all, the new construction would stimulate \$41.16 million in total annual output in the region and \$20.08 million in value added, of which \$14.95 million would be labor income to 227 total jobholders.

Table 2. Annual Economic Impact of New ISUVDL Construction (2016–2020)

Impact Type	Jobs	Labor Income \$	Value Added \$	Output \$
Direct	110	8,980,466	10,645,810	24,500,000
Indirect	50	3,062,129	4,356,527	8,063,349
Induced	67	2,906,935	5,080,120	8,595,777
Total	227	14,949,530	20,082,456	41,159,126

Animal Production Economic Contributions

Table 3 through Table 7 itemize the economic contributions of specific animal production subsectors that benefit from ISUVDL activities in Iowa. These sectors are presented to demonstrate the statewide importance of the industries the ISUVDL helps to sustain.¹

Dairy and Milk Production

Table 3 lists the economic contribution of dairy cattle and fluid milk production in Iowa. This industry had \$834.90 million in direct output in 2015, which required 1,693 jobholders and farmers making \$248.36 million in labor income. That sector required \$319.45 million in inputs, which in turn employed 1,189 persons making \$65.18 million in labor income. When the direct and the indirect jobholders spent their labor incomes, they induced \$213.74 million in output and \$66.30 million in labor income to 1,755 jobholders. After considering all multiplied through effects, the Iowa's dairy and milk production industry contributed \$1.37 billion in output to the state's economy and \$704.79 million in value added, of which \$379.84 million was labor income to 4,636 jobholders.

Table 3. Total Economic Contribution of Dairy and Milk Production in Iowa, 2015

Impact Type	Jobs	Labor Income \$	Value Added \$	Output \$
Direct	1,693	248,358,126	467,714,094	834,897,920
Indirect	1,189	65,175,578	116,597,917	319,453,920
Induced	1,755	66,304,556	120,482,231	13,737,338
Total	4,636	379,838,260	704,794,242	1,368,089,178

Cattle and Calves Production

Table 4 represents the total economic worth of cattle and calves production in Iowa in 2015. In all, after all multiplied through relationships are taken into account, this sector contributed \$6.91 billion in total output and \$3.35 million in value added, of which \$1.55 billion was labor income to 35,215 jobholders supported primarily or secondarily by this type of agriculture.

Table 4. Total Economic Contribution of Cattle and Calves Production in Iowa, 2015

Impact Type	Jobs	Labor Income \$	Value Added \$	Output \$
Direct	20,690	908,668,230	2,148,787,775	4,414,172,672
Indirect	7,384	368,522,522	712,081,369	1,624,999,014
Induced	7,141	269,719,588	490,056,529	869,392,388
Total	35,215	1,546,910,340	3,350,925,672	6,908,564,073

¹ As an initial caution, the individual values of the several tables should not be summed into a grand total as there will be some double-counting contained within the subsectors. For example, the modeling system assumes that the cattle and calves sector buys animals from the dairy cattle sector, and vice versa. Those transactions will have been accounted for in the indirect purchases of their respective tables. The tables should therefore be interpreted individually for each animal type understanding that summing the individual tables will inflate the total values. A summary table that strips out the double-counting is provided later in the report.

Poultry and Egg Production

Table 5 contains poultry and egg production economic contributions. The industry contributed \$3.34 billion in output and \$1.30 billion in value added, of which \$591.03 million was labor income to 7,001 jobholders supported primarily or secondarily by this type of animal production.

Table 5. Total Economic Contribution of Poultry and Egg Production in Iowa, 2015

Impact Type	Jobs	Labor Income \$	Value Added \$	Output \$
Direct	1,590	309,995,387	788,416,357	1,855,874,048
Indirect	2,676	177,578,211	328,546,735	1,150,897,255
Induced	2,735	103,453,608	188,035,445	333,535,219
Total	7,001	591,027,205	1,304,998,538	3,340,306,523

Swine Production

Table 6 lists the economic contribution of Iowa swine production. The sector accounted for \$10.89 billion in statewide output and \$8.34 billion in value added, of which \$4.52 billion was labor income to 78,293 jobholders supported primarily or secondarily by swine producers.

Table 6. Total Economic Contribution of Swine Production in Iowa, 2015

Impact Type	Jobs	Labor Income \$	Value Added \$	Output \$
Direct	53,315	3,492,841,257	6,482,772,653	7,442,022,230
Indirect	4,158	239,697,498	424,879,044	904,091,862
Induced	20,819	788,207,347	1,432,097,582	2,540,637,366
Total	78,293	4,520,746,101	8,339,749,278	10,887,158,862

All Other Animal Production

Table 7 is an estimate of the statewide economic contribution of all other animal production in Iowa. This includes sheep and lambs, goats, equine, and all other animals. That sector of Iowa's economy generated \$102.28 million in statewide output and \$78.35 million in value added, of which \$42.47 million was labor income to 922 jobholders.

Table 7. Total Economic Contribution of All Other Animal Production in Iowa, 2015

Impact Type	Jobs	Labor Income \$	Value Added \$	Output \$
Direct	628	32,815,230	60,905,624	69,917,770
Indirect	49	2,251,957	3,991,737	8,493,940
Induced	245	7,405,205	13,454,551	23,869,278
Total	922	42,472,392	78,351,913	102,284,816

Animal Products Processing Economic Contributions

The following tables represent Iowa manufacturing activity that depends on animal products as production inputs. These are important industries in Iowa, and they depend on a reliable supply of animals and animal products. The manufacturers were organized into three cohesive groups from nine individual subsectors in the modeling system:

- Milk, cheese, ice cream, and all other related processed milk products
- Animal slaughtering and animal processing
- Poultry slaughtering and processing

Because the manufacturing sectors all contain upstream linkages to their respective animal product suppliers, and as those values have been estimated by type of animal production in the previous section, the total economic contributions of animal products manufacturing sectors have been calculated net of those agricultural linkages. That means the resulting values contain no animal production linkages and therefore contain no double-counting with the agriculture production section.² The values in the following tables are for 2014, the latest data in the modeling system.

Milk, Cheese, Ice Cream, and Related Processing

Table 8 is the manufacturing sector that produces fluid and dry milk products, cheese, condensed and powdered milk, and ice cream. This sector accounted for \$3.70 billion in total output in the Iowa economy in 2014 and \$840.93 million in value added, of which \$517.92 million was labor income to 9,456 jobholders.

Table 8. Total Economic Contribution of Milk, Cheese, Ice Cream and Related Processing, 2014

Impact Type	Jobs	Labor Income \$	Value Added \$	Output \$
Direct	3,359	210,372,762	342,586,721	2,591,607,072
Indirect	3,687	216,128,506	332,066,244	810,299,582
Induced	2,410	91,415,438	166,280,375	294,903,917
Total	9,456	517,916,706	840,933,340	3,696,810,571

Animal Slaughtering and Animal Processing

Table 9 contains the economic contributions of Iowa animal slaughter and processing industries. These values are mainly swine with some beef processing. This sector contains Iowa's very large slaughter and processing operations as well as much smaller ones, to include conventional locker plants. As the animal processing industry buys directly from the separate animal slaughtering

² However, as was the case in the previous section, there are sales across these industries. Animal slaughtering will make sales to animal processing, for example. Accordingly, there is also a degree of double-counting when looking at the sectors individually. Summing all sectors together will contain some double-counting, and the tables are best interpreted individually for each industrial grouping. A table stripping out all double-counting in the animal products processing sectors is provided later in the report.

sector, care was taken to eliminate double-counting when combining these into one sector. In 2014, this combined sector generated \$17.42 billion in total contribution to the Iowa economy and \$3.42 billion in value added, of which \$2.13 billion was labor income to 43,939 jobholders.

Table 9. Total Economic Contribution of Animal Processing and Slaughtering in Iowa, 2014

Impact Type	Jobs	Labor Income \$	Value Added \$	Output \$
Direct	25,877	1,314,171,397	2,122,382,775	14,678,814,320
Indirect	8,157	437,611,666	617,483,861	1,533,839,831
Induced	9,905	375,752,789	683,522,110	1,212,158,160
Total	43,939	2,127,535,852	3,423,388,746	17,424,812,311

Poultry Slaughtering and Processing

Table 10 is Iowa's poultry product processing sector. It generated, after all multiplied-through relationships were taken into account, \$936.78 million in total output and \$249.10 million in value added, of which \$182.76 million was labor income to 3,956 jobholders.

Table 10. Total Economic Contribution of Poultry and Related Product Processing in Iowa, 2014

Impact Type	Jobs	Labor Income \$	Value Added \$	Output \$
Direct	2,329	109,599,737	132,693,040	694,296,320
Indirect	776	40,879,555	57,691,038	138,365,721
Induced	851	32,276,222	58,712,664	104,121,123
Total	3,956	182,755,514	249,096,742	936,783,164

Unduplicated Aggregated Economic Values

As indicated above, summing the individual animal production sectors (Table 3 through Table 7) or the individual processing sectors (Table 8 through Table 10) leads to double-counting, as there are transactions among the sectors. The modeling parameters were modified for the following tables by setting the regional purchases among these sectors from one another to zero. This eliminates the double-counting problem. Once done, the direct values of the individual animal sectors or the individual processing sectors can be run through the system with a minimum of exaggeration.

Aggregated Animal Production Economic Contributions, 2015

Table 11 lists the animal production summary. After controlling for double-counting and after all relationships have multiplied through, the animal producing industry explains \$21.20 billion in total output and \$13.03 billion in value added, of which \$6.72 billion was labor income to 118,895 Iowa jobholders.

Table 11. Total Economic Contribution of Combined Animal Production Sectors in Iowa, 2014

Impact Type	Jobs	Labor Income \$	Value Added \$	Output \$
Direct	77,916	4,992,678,229	9,948,596,504	14,616,884,640
Indirect	9,776	546,545,724	938,576,214	2,781,382,309
Induced	31,203	1,178,593,357	2,141,536,240	3,797,723,728
Total	118,895	6,717,817,310	13,028,708,958	21,195,990,677

Aggregated Animal Products Processing Economic Contributions, 2014

Table 12 summarizes the animal products processing industries. After controlling for double-counting and after all relationships have multiplied through, the animal products processing industry explains \$21.48 billion in output and \$4.42 billion in value added, of which \$2.77 billion was labor income to 56,308 jobholders.

Table 12. The Total Economic Contribution of Animal Product Food Processing in Iowa, 2014

Impact Type	Jobs	Labor Income \$	Value Added \$	Output \$
Direct	31,565	1,634,143,896	2,597,662,535	17,964,717,712
Indirect	11,729	645,963,577	925,955,658	1,923,498,641
Induced	13,015	493,667,560	898,028,104	1,592,040,724
Total	56,308	2,773,775,033	4,421,646,297	21,480,257,076

State Government Tax Collections

Labor incomes generated in Iowa are subject to personal income taxes, and the conversion of those incomes into household spending results in additional sales, use, and excise tax payments by consumers. U.S. Census data on state government tax collections for fiscal 2014 coupled with Iowa total personal income data adjusted to reflect that fiscal year generates tax category coefficients that indicate the proportion of income that goes to different tax groups.

It must be noted that these tax collections are, in turn, consumed by state residents in the form of state-supplied services. These payments do not represent a surplus of receipts and should not be represented as such; they are estimates of the expected taxes that are generated by the workers involved in these industries.

The ISUVDL current operations and the annual construction activity would generate fewer than \$1 million in taxes. Detail for each agricultural or industrial group is provided in Table 13. Aggregated (without double-counting), the workers linked to animal producing sectors generated \$339 million in state tax receipts. Those in animal products production accounted for \$140 million in state taxes.

Table 13. Expected State Government Tax Collections From Total Labor Income Economic Contributions (in Millions \$)

	General Sales and Gross Receipts	Selective Sales and Gross Receipts	Individual Income	Total Taxes
VDL Annual Operations, 2015	0.377	0.158	0.453	0.988
New VDL Construction (Years 2016-2020)	0.288	0.120	0.346	0.754
Cattle and Calve Production in Iowa, 2015	29.781	12.462	35.811	78.054
Dairy and Milk Production in Iowa, 2015	7.313	3.060	8.793	19.166
Poultry and Egg Production in Iowa, 2015	11.379	4.761	13.682	29.822
Swine Production in Iowa, 2015	87.034	36.418	104.654	228.106
All Other Animal Production in Iowa, 2015	0.818	0.342	0.983	2.143
Milk, Cheese, Ice Cream and Related Processing, 2014	9.971	4.172	11.990	26.133
Animal Processing and Slaughtering in Iowa, 2014	40.960	17.139	49.252	107.351
Poultry and Related Product Processing in Iowa, 2014	3.518	1.472	4.231	9.221
Combined Animal Production Sectors in Iowa, 2015 (no double-counting)	129.333	54.117	155.516	338.966
Combined Animal Product Food Processing in Iowa, 2014 (no double-counting)	53.401	22.345	64.212	139.958

CONTRIBUTION OF THE IOWA STATE VETERINARY DIAGNOSTIC LABORATORY TO IOWA'S LIVESTOCK SECTOR AND TO IOWA

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Introduction

As shown earlier in this report, aggregated livestock production in Iowa has an annual direct economic impact of \$14.62 billion (Table 11). In addition, combined the industries that process livestock and livestock products provide \$17.96 billion annually in direct economic value (Table 12). Annually, Iowa's livestock production and processing sectors contribute \$32.58 billion in direct economic output to the state's economy. The \$124 million cost of a new ISUVDL equals about 0.38% of the annual direct economic value of the livestock sector. A contribution to the size of the Iowa livestock sector by the ISUVDL of 0.38% would, from a statewide perspective, pay for a new laboratory within just one year.

This industry, and the relatively high density of animals associated with it, would not have flourished without the ability to manage animal health to maintain high levels of productivity. This is made possible in part by the ISUVDL. This document describes the various ways in which the lab is vital to the success of the livestock sector. Many of these benefits cannot be precisely quantified and others will exist only in times of emergency. Therefore, a panel of veterinarians and producers that actively use the facility and commodity group leaders who represent producers who benefit from the facility is used to evaluate the contribution of the ISUVDL. These experts are all independent of the ISUVDL.

Are Substitute Labs Available?

State full-service veterinary diagnostic labs similar to the ISUVDL exist in other states. These type of full-service veterinary diagnostic labs or laboratory systems within a given state are almost exclusively located and/or otherwise affiliated with colleges of veterinary medicine at land grant universities. Many agriculturally focused land-grant universities maintain a high-quality infectious disease focused veterinary diagnostic laboratory. Michigan State University, UC-Davis (California VDL System), Cornell University (New York VDL System), and Texas A&M University (Texas VDL System) would be other examples of the few veterinary diagnostic laboratories or state-based laboratory networks that provide full range of diagnostic services similar to the ISUVDL (e.g., inclusive of toxicology and drug testing). A portion of the routine testing that involves the use of commercially available test kits for specific diseases that do not require significant analytical or professional diagnostician interpretation done by the ISUVDL

could be handled by private labs. However, there are specific transboundary diseases that would result in closure of state borders that would preclude the transportation of diagnostic samples and infected animals across state borders. As will be discussed below, some of the most important contributions of the ISUVDL occur when transboundary diseases first enter the United States or when new diseases emerge. Responding effectively to emerging and transboundary diseases requires surge capacity and advanced diagnostic research to develop and validate new diagnostic tests that are not available in private facilities within the state.

Business Continuity

Livestock production in Iowa depends on extensive movement of animals. Approximately 46.6 million hogs and pigs were marketed in Iowa in 2015 (USDA-NASS, 2016a). Hogs and pigs shipped into Iowa for feeding or breeding purposes amounted to 27.5 million in 2015. Cattle marketings totaled 2.1 million head and calf marketings totaled 104,500 head in Iowa in 2015, and 1.5 million head of cattle and calves entered Iowa as in-shipments in 2015 (USDA-NASS, 2016a).

Many of the diagnostic tests at the ISUVDL are performed to comply with regulations or allow for the movement, exhibition and sale of animals and animal products. Examples include mandatory testing for salmonella enteritidis, testing requirements associated with certificate of veterinary inspection for exhibition and interstate movement of animals and testing requirements for international movements of animals. These tests are a normal business practice and without them, many businesses would not be able to function. This has also allowed the U.S. livestock sector to integrate across state lines, and in so doing, reduce costs and allow for the benefits of specialization.

Mitigation of Transboundary and Foreign Animal Diseases

The ISUVDL is one of only 11 Tier 1 labs in the U.S. National Animal Health Laboratory Network. As such, the lab plays a key role in national surveillance and animal health programs for detection and diagnosis of emerging and foreign diseases that impact interstate and international trade and public health. In addition to initial diagnosis, the ISUVDL also provides diagnostic support needed for the nation's and state's response to such disease incursions. This includes producer and industry participation in continuity of business programs that allow for the permitted movement and/or sale of non-affected animals, meat, milk, or eggs during a time of animal health crisis.

Foreign animal diseases such as classical swine fever (hog cholera) (CSF), African swine fever, foot and mouth disease (FMD) in cattle or swine or avian influenza are highly disruptive trade limiting diseases. Other transboundary diseases, such as porcine epidemic diarrhea (PED) in swine are potentially production-limiting disease that can lead to death or reduced animal productivity.

A 2011 report by the Food and Agricultural Policy Research Institute at Iowa State used an econometric model to evaluate the impact of a FMD and CSF outbreak in the United States. The

report assumed that the outbreak would result in an immediate cessation of U.S. pork and beef exports in the case of FMD and of pork exports in the case of CSF. For FMD, the cumulative impact on beef and pork sectors is \$12.8 billion per year nationally. The impact spread well beyond these sectors. Revenues fall significantly for poultry, corn and soybean producers, and employment in rural areas is negatively impacted as the U.S. pork and beef sectors are forced to downsize.

A 2015 report on the same issue by Agralytica described how farm level losses would extend to upstream and downstream industries. The examples included unemployment of workers on farms that are closed, loss of revenue for owners of buildings used for contract finishing, businesses supplying feed, genetics, animal health products, supplies and other products to impacted farms and lenders to farms that are forced into bankruptcy.

In 2014, a PED virus outbreak led to the death of millions of animals. The ISUVDL quickly developed a polymerase chain reaction (PCR) test and organized the reporting of outbreaks. This virus had existed in Asia for twenty years. Yet, it was not until the outbreak in the United States that the test and treatment protocol was developed.

The ISUVDL allows for rapid testing of suspect animals to prevent positive animals from infecting others, and testing of animals as they enter the state to prevent the importation of positive animals or animal products from other states. Iowa hog and pig production equaled 12.5 billion pounds in 2015 (USDA-NASS, 2016a). Iowa cattle and calf production totaled 1.9 billion pounds in 2015 (USDA-NASS, 2016a). In 2015, Iowa produced 9.1 million turkeys or 354 million pounds of turkey production (USDA-NASS, 2016b). Iowa sold for slaughter 11.3 million chickens, or 37.3 million pounds of chicken production, in 2015 (USDA-NASS, 2016b). Iowa egg production totaled 12,463 million eggs in 2015 (USDA-NASS, 2016b). Iowa produced 4,841 million pounds of milk and 183.5 million pounds of milk fat in 2015 (USDA-NASS, 2016c).

Iowa is an enormous net exporter of beef, pork, poultry, dairy and egg products. Events that restrict the ability of the United States to export these products or which restrict the ability of Iowa to ship these products out of the state could be devastating to the economy. If one of these trade-limiting diseases is detected in another state, the ISUVDL will play an instrumental role in preventing the importation of positive animals from that state while allowing for the normal importation of animals that are free of the disease.

If such a disease outbreak were to occur, it is likely that countries that import U.S. livestock products would prohibit the importation of products from states where an outbreak has been diagnosed, but allow the continued importation from states that are shown to be free of the disease. This compartmentalization requires large scale and rapid testing protocols that are the hallmark of the ISUVDL.

Competitiveness

The ISUVDL is the only fully accredited veterinary diagnostic laboratory providing comprehensive diagnostic services in Iowa. The ISUVDL plays an active role on the front lines of animal agriculture processing more than 75,000 case submissions and conducting more than 1.2 million diagnostic assays per year. The ISUVDL provides timely and high-quality diagnosis of disease and toxicosis for veterinarians and animal owners. The flow of case material is used for teaching purposes and drives the ISUVDL's applied research efforts.

The ISUVDL's services are used extensively on a daily basis to help its clientele enhance the health and well-being of their animals and business operations through the mitigation of endemic and/or emerging diseases or toxicosis of high relevance to Iowa's livestock industries and public health. These activities contribute to the productivity and global competitiveness of Iowa's animal agriculture industries.

Surge Capacity

During the 2015 avian influenza outbreak on Iowa egg and poultry farms the ISUVDL provided large scale testing of suspected flocks. This required an enormous ramp up in personnel. Farms identified as positive were depopulated and the disease was successfully controlled. Sales of eggs from farms that were free of the disease would not have been possible without this testing. When PED virus swept through the U.S. pork industry, the ISUVDL was again at the forefront of the efforts to meet the surge in testing requests to help curb the devastating consequences of this challenging disease.

Iowa has successfully conducted several eradication programs. Other diseases could arise that may demand eradication efforts. Iowa must have the labor force, technology, commitment, and capital to successfully conduct these efforts.

Human Health

The ISUVDL plays a critical role in supporting public health and the safety of our food supply. The ISUVDL routinely conducts rabies testing on both domestic animals and wildlife that have had close contact with humans. Rapid determination of the rabies status of an animal in question plays a vital role in providing exposed individuals, and their physicians, guidance on the appropriate course of treatment or action. The ISUVDL conducts more than 300,000 diagnostic assays per year on animal diseases that have the potential for being transferred from animals to humans. In addition to rabies, other infectious diseases of significant consequence include salmonellosis, brucellosis, tuberculosis, influenza, campylobacteriosis, colibacillosis (E-coli), and array of mycotic (fungal, spore-forming) and clostridial diseases. The ISUVDL also conducts testing on animals and animal feeds for a wide-array of toxins, pesticides, drugs, and heavy metals that have the potential for causing significant human health concerns if they were to make their way into the food chain.

Companion Animals

The ISUVDL conducts a wide range of testing and provides pet owners access to more in depth diagnostic investigation and services not currently provided by private laboratories. The ISUVDL processes approximately 7,500 cases submissions and completes more than 30,000 diagnostic assays originating from companion animals each year.

Wildlife

The ISUVDL works closely with Iowa's Department of Natural Resources in providing a wide array of diagnostic services in supporting the health and well-being of Iowa's wildlife. The ISUVDL tests for chronic wasting disease in wild deer and avian influenza in wild ducks and geese. It also tests for epizootic hemorrhagic disease that can jump from deer to cattle. These tests are an integral part of plans to eradicate wildlife diseases. If wildlife disease can be eliminated or contained in a relatively small part of the state, losses in hunter expenditures, agency costs, and lost profits of wildlife farmers and feed dealers are minimized.

Research

The ISUVDL is in the Veterinary Diagnostic and Production Animal Medicine (VDPAM) department in the Iowa State University College of Veterinary Medicine. Faculty in the department published 111 peer-reviewed manuscripts and were involved with a total of 102 active research grants for \$27.6 million in 2015.

When gaps arise in case investigations they often become applied research projects. For example, from 2013-2016 PED virus was first diagnosed in the U.S., highly pathogenic avian influenza (HPAI) devastated poultry production in Iowa and the U.S., and Senecavirus A (SVA) emerged as a vesicular disease that initiated an unprecedented number of foreign animal disease investigations to rule out FMD. In 2013-2016, ISUVDL faculty were involved with 65 grants for nearly \$6 million advancing knowledge on diagnosis and control of PED, HPAI and SVA.

ISUVDL faculty were the first to definitively reproduce porcine circovirus type 2 (PCV2) - associated disease with an infectious clone of PCV2. The first federally licensed PCV2 vaccine was developed jointly by the ISUVDL and faculty at Virginia Tech University. The PCV2 vaccine is the most widely used pig vaccine in the United States. Producers report a 4:1 return on investment in the vaccine, which costs approximately \$1.50 per pig vaccinated. Assuming 73 million pigs vaccinated annually in the United States, a 4:1 return would produce a \$438,000,000 return to the U.S. pig industry and the impact in Iowa, which produces 25% of U.S. pork, would be \$109,500,000.

Other selected examples of notable successes that have come from research conducted by the ISUVDL include the first polymerase chain reaction (PCR) test and first test using oral fluids for PED virus. The ISUVDL also provides information about the genomic sequences of pathogens

and virus isolates for master seeds used by private companies to create vaccines. The ISUVDL was the first to identify the causative agent for shaker pig disease (congenital tremors) in swine. As was made obvious during the PED and avian influenza outbreaks, the existence of such a strong research group provides the state with the ability to quickly identify and develop treatment protocols for emerging diseases and following the land grant mission of Iowa State University, quickly convey these results to producers.

Teaching

The ISUVDL and the VDPAM department have a national and international reputation for excellence in training food animal veterinarians. The VDPAM department now teaches 97 courses (including courses taught in collaboration with other departments) for undergraduate, professional, and graduate students.

In the last year, six courses were added. The overall pass rate for ISU veterinary graduates for the 2015 North American Veterinary Licensing Examination was 97% (compared to 95% for all other schools). When scores are broken down by species area, ISU students out-performed their counterparts at other schools on the food animal section (overall), the bovine subsection and the porcine subsection. This is reflective of the quality and relevance of the food animal curriculum at ISU and the effectiveness of those who deliver it.

The ISUVDL and the VDPAM department are directly responsible for training a large number of future food animal veterinarians in the state of Iowa. Over 60% of the ISU College of Veterinary Medicine students chose the mixed animal or food animal medicine track in their fourth and final year of veterinary college. For the class of 2016, 64% of our students selected the mixed animal (53) or food animal (39) track in their fourth year. This positions the ISUVDL to have a major influence on the animal protein food supply chain in the United States. This level of interest in food animal medicine reflects very positively on the curriculum and mentorship provided by VDPAM and ISUVDL faculty.

Expert Survey

The role and functioning of the ISUVDL is not well understood among the general population. Those who are in the best position to judge the contribution of the facility are those who use it. Therefore, a survey was sent to veterinarians and producers that actively use the facility and to the commodity group leaders who represent producers who benefit from the facility. The survey instrument is provided in Appendix B. Experts were asked to provide a measure of how the ISUVDL “contributes to the overall economic value of the livestock production and processing sectors in Iowa”. They were asked to provide this estimate for “peacetime” and “emergency,” (i.e., a normal operating environment and for a period when there was an animal health crisis). The use of a proportional value in the survey was done to link the results of the survey to the estimates of the economic contribution of animal agriculture provided earlier in this report.

Table 14a. Results of a Survey of Independent Experts; ISUVDL Contribution to Livestock Production and Processing Industry During Peacetime

Peacetime	Average of Minimum Peacetime	Average of Most Likely Peacetime	Average of Maximum Peacetime
Industry Association			
Swine	5.0	11.0	40.0
Industry Association Average	5.0	11.0	40.0
Producer			
Swine	2.0	8.0	14.0
Mail-order hatchery	17.5	35.0	75.0
Producer Average	9.8	21.5	44.5
Veterinarian			
Swine	3.5	5.9	10.1
Beef	6.7	23.3	30.0
Commercial layers	5.0	15.0	30.0
Layer breeder	0.0	5.0	10.0
Veterinarian Average	4.1	10.9	16.8
Overall Average	5.5	13.3	25.5

Table 14b. Results of a Survey of Independent Experts; ISUVDL Contribution to Livestock Production and Processing Industry During an Emergency

Emergency	Average of Minimum Emergency	Average of Most Likely Emergency	Average of Maximum Emergency
Industry Association			
Swine	27.5	42.5	65.0
Industry Association Average	27.5	42.5	65.0
Producer			
Swine	6.0	10.0	27.5
Mail-order hatchery	87.5	90.0	100.0
Producer Average	46.8	50.0	63.8
Veterinarian			
Swine	21.9	28.9	41.7
Beef	20.0	40.0	51.7
Commercial layers	50.0	75.0	100.0
Layer breeder	10.0	50.0	100.0
Veterinarian Average	22.8	37.3	53.9
Overall Average	28.6	40.7	57.3

The survey was sent to 45 experts and completed questionnaires were received from 18 of them. This is a 40% response rate. Results of the survey of independent experts are shown in Tables 14a and 14b.

The average of the most likely values under peacetime is 13.3%. This rises to 40.7% under an animal health emergency. The results show a wide range of estimates; this is not surprising given the challenges associated with valuing the contribution of an organization such as the ISUVDL to the overall economic value of the livestock production and processing sectors in Iowa.

The economic analysis presented earlier shows that workers linked to animal producing sectors generated \$339 million in state tax receipts for Iowa. Those in animal products production accounted for \$140 million in state taxes. The total tax contribution from both groups is \$479 million. Using the peacetime contribution of 13.3%, suggests that the ISUVDL is responsible for \$63 million in state taxes in normal years and would be worth \$194 million in an emergency. This means that the lab would repay a \$124 million state investment in two years under normal circumstances and in less than one year in an emergency. Using the *minimum* estimates from the survey under peacetime, the lab contributes \$26.34 million per year. This suggests a 4.7-year payback period.

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- Agralytica Study on Swine Catastrophic Disease Final Report for Acquisition Services Directorate and Risk Management Agency July 10, 2015.

APPENDICES

Appendix A. The Modeling System Used in This Analysis

All input-output analysis in this report was done using the IMPLAN, Inc., modeling system. This system originated as a USDA project that later was spun-off into a private firm known as the Minnesota Implan Group (MIG). It is the most widely used modeling system in the United States by virtue of its ease of use and its thorough transparency. Major users of the modeling system include land grant universities and federal and state agencies. The Iowa State University Department of Economics has maintained a statewide IMPLAN modeling capacity since the mid-1980s, and the modeling system has been used throughout that time to evaluate a range of industrial and policy situations in the state and beyond.

Input-output systems are tables of transactions among all industry groups, institutions, and households in the state. They track all buying and selling relationships among these entities, as well as import-based and export-based transactions. They are based significantly on the Quarterly Census of Employment and Wages data continuously collected and compiled by the Bureau of Economic Analysis; a range of industrial surveys by the Department of Commerce, Department of Transportation, and the USDA; a range of other income-related data compiled at the state and substate levels by the Bureau of Economic Analysis (BEA); and the benchmark U.S. input-output tables that are updated quinquennially also by BEA.

Input-output models are straightforward projection models that contain a very high amount of actual and estimated information. They allow for flexible geographic coverage, and in the case of Iowa, analysis at the county, multiple-county, and the state.

The base data in this analysis was for 2014. Owing to the ease of modification in the model, data for animal production were updated to reflect gross sales in 2015. In addition, the animal production and the animal products manufacturing sectors were significantly modified to avoid inevitable double-counting errors when analyzing sets of industries that have strong buy-sell relationships with one-another.

Appendix B. Expert Survey Instrument

This email is sent on the behalf of Drs. Lee Schulz, Dermot Hayes and Derald Holtkamp to request two minutes of your time to complete a survey. Your responses will be used to help estimate the economic impact of the Iowa State University Veterinary Diagnostic Lab on the livestock and processing sectors in Iowa. To respond, simply hit reply -> enter your responses where indicated below -> and send.

We would like to get your best estimate of how much the Iowa State University Veterinary Diagnostic Laboratory (ISU VDL) contributes to the overall economic value of the livestock production and processing sectors in Iowa. We are asking that you provide an estimate of the ISU VDL's economic contribution, in percentage terms, relative to the overall size and scale of Iowa's livestock sector. We realize that this is a difficult question and therefore we would like you to provide a range of estimates. Please feel free to respond with tenths, hundredths, thousandths, ten-thousandths of a percent if relevant.

Question 1. Peacetime Activities.

The ISU VDL is the only fully-accredited veterinary diagnostic laboratory providing comprehensive diagnostic services (all-species) in Iowa. The ISU VDL's services are used to help its clientele enhance the health and well-being of their animals and business operations through the mitigation of endemic and/or emerging diseases or toxicosis of high relevance to Iowa's livestock industries and public health. In peacetime (i.e., in absence of an acute animal health crisis actively impacting interstate and international trade), how much smaller would the livestock sector in Iowa be if the ISU VDL's services were eliminated? Please provide the minimum, maximum, and most likely percent value.

Minimum _____ %
Most likely _____ %
Maximum _____ %

Question 2. Emergency Activities.

Events such as the introduction of high-path avian influenza, foot and mouth disease, pseudorabies or hog cholera, may result in widespread culling, restrictions on animal movements, and on interstate and international trade. In addition to initial diagnosis, the ISU VDL would provide the diagnostic support needed for the nation's and state's response to such disease incursions and for producer and industry participation in continuity of business programs that allow for the permitted movement and/or sale of non-affected animals, meat, milk, or eggs. In a time of an animal health crisis, how much would you value the contribution of the ISU VDL measured as a portion of the size of Iowa's livestock sector. Provide the minimum, maximum and most likely percent value.

Minimum _____ %
Most likely _____ %
Maximum _____ %

Thank you.