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Quantities of Corn and Soybeans Requiring Transportation Out of Iowa Counties

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Contents

Introduction	3
Other Sources of Grain Sales Information	3
Commercial Grain Sales	3
Livestock Production Estimates	3
Feed Consumption	4
Grain Production and Estimated Sales	5
Appendix A	9
Appendix B	19
List of Tables	2

List of Tables

- Table 1. Estimated annual bushels of corn consumed by livestock class, 1994-1995 crop year. Page 4
- Table 2. Data used in calculating the corn-feeding rate for grain fed cattle. Page 4
- Table 3. Estimated livestock production in Iowa for the 1994-1995 crop year. Page 5
- Table 4. Estimated bushels of corn produced, fed and sold and bushels of soybeans sold into commercial channels by county in Iowa, 1994-1995, in millions of bushels. Pages 6-7
- Table 5. Estimated bushels of corn produced, fed, and sold and bushels of soybeans sold into commercial channels by crop reporting district, Iowa, 1994-1995, in millions of bushels. Page 8
- Table 6. Comparisons of corn produced, fed and sold through commercial channels in selected years in millions of bushels, Iowa, 1994-1995. Page 8
- Table 7. Comparison of the estimated grain sales from this report and from the Iowa grain flow survey by crop reporting district, in millions of bushels, Iowa, 1994-1995. Page 8
- Table A1. Estimated number of cattle, sheep, and poultry by counties in Iowa, 1994-1995. Pages 10-11
- Table A2. Estimated hog production by facility type and sow-unit inventories in counties in Iowa, 1994-1995. Pages 12-13
- Table A3. Estimated bushels of corn fed to cattle, sheep, and poultry by county, in Iowa 1994-1995, in thousands of bushels. Pages 14-15
- Table A4. Estimated quantities of corn fed to hogs, by type of production and sow-unit inventories, in counties in Iowa 1994-1995, in thousands of bushels. Pages 16-17
- Table A5. Estimated quantities of corn fed from Wright and Hardin counties to hogs produced in other counties, by type of production and county, Iowa, 1994-1995, in thousands of bushels. Page 19

Introduction

Iowa agriculture is undergoing major changes. The swine industry is shifting to large confinement feeding facilities. The poultry industry continues to return from California to North central and northwestern Iowa and is concentrating in large laying and broiler operations. This concentration of the swine and poultry industries means that some large corn-producing counties could become corn-deficit counties.

The changes in Iowa agriculture also are affecting transportation. Farmers are buying larger trucks to haul grain from combines at harvest time. After harvest, these large trucks can be used to haul grain to country elevators located on different rail lines that carry it into in-state and out-of-state processor and barge markets. Mergers of class I railroads will likely lead to the formation of more short line railroad companies and the abandonment of some rail lines. All of these changes create the potential for investment and disinvestment in the grain transportation and distribution system. These investment and disinvestment decisions require information on the quantities of corn and soybeans moving through grain hauling facilities and over the transportation system.

The purpose of this report is to provide estimates of the amount of corn and soybeans from the 1994 crops moving out of individual counties in Iowa and into commercial channels. Thus, the estimated supplies of corn and soybeans in this report are the record bushels harvested during the fall of 1994 and marketed during the period from October 1, 1994 through September 30, 1995. This report is essentially an update of a report by McVey, Baumhover and Baumel (1990)¹.

Other Sources of Grain Sales Information

The Iowa Crop and Livestock Reporting Service prepares annual estimates of the quantities of grain sold off the farms where the grain is produced. However, these estimates, which include both farm-

to-farm and farm-to-elevator-to-farm sales, do not measure the amount of grain moving beyond elevators. Moreover, these estimates are state totals, not county totals. Thus, this report is a unique source of information on the volumes of grain requiring transportation services to and from Iowa counties. It represents a potentially useful input in planning efficient handling and transportation systems to maintain Iowa's competitive position in national and international markets.

Commercial Grain Sales

Commercial grain sales for 1994-1995 marketing year are defined, in this report, as the residual after subtracting the estimated on-farm usage of corn, soybeans, and oats from the reported county production. The differences between reported production and estimated on-farm usage are assumed to be sold through commercial channels. The specific equations to estimate commercial grain sales are presented in appendix B. Estimates of 1994 corn, soybeans, and oat production by county were taken directly from Iowa Agricultural Statistics Service reports.

Livestock Production Estimates

Iowa Agricultural Statistics no longer report livestock production by counties. However, total Iowa livestock production, by class of livestock, is available on a quarterly basis. Therefore, total Iowa livestock production was obtained for the period October 1, 1994 through September 30, 1995 to correspond with the 1994-1995 crop year.

These livestock production estimates were converted to county estimates for each livestock class by using the 1992 county shares of the total Iowa production estimates from the 1992 U.S. Agricultural Census data. Adjustments were made to these county production estimates for poultry and swine production.

The most important reason for these adjustments is the major shifts poultry and swine production among counties since 1992. Moreover, poultry production estimates were not reported for several counties in the U.S. Agricultural Census because of potential disclosure of some individual poultry operations. Thus, exclusive use of the 1992 Census shares for these two classes of livestock would lead to major errors in the county estimates. To correct for those

¹ McVey, Marty J., Stephen B. Baumhover and C. Phillip Baumel, (1990), *Quantities of Grain and Fertilizer Requiring Transportation: 1985-1988 and Projections to 1992-1993 by Counties in Iowa*, Iowa State University Extension, Ames, Iowa.

omissions, turkey, layer and broiler county production estimates for the 1994-1995 crop year were obtained from William Owings, Extension Poultry Specialist, Iowa State University.

Extensive adjustments also were made to the county swine production estimates because of the large concentration of confinement hog feeding operations in north central and northwestern Iowa. Data were obtained from the Iowa Department of Natural Resources on the number, capacity, and county locations of hog confinement operations that have received building permits since 1992. These data also identify each confinement operation as a nursery, sow unit, or finishing unit. The aggregate capacity of the confinement finishing units was subtracted from the estimated hogs marketed for the period October 1, 1994 - September 30, 1995. The remainder was then allocated among counties based on the county hogs marketed shares in the 1992 Census of Agriculture.

Three new classes of swine production were created to calculate the amount of corn fed to swine. These three new classes are finished hogs, sow units, and nursery pigs produced in confinement units. These three classes of swine production were added to the production in the county where the confinement operation is located. Two final adjustments were made to the swine feed consumption estimates. The analysis assumes that all Iowa Select and Decoster company-produced hogs, except these in Ringgold County, were fed with feed produced in Wright County. Thus, the number of head that were fed by the Iowa Select and Decoster companies in Greene, Hamilton, Hancock, Hardin, and Humboldt counties but fed with feed produced in Wright County were added to the number of hogs produced in Wright County. Finally, it also was assumed that Heartland Pork Enterprises fed 13,500 hogs in Hamilton County and 40,000 hogs in Humboldt County by using corn produced in Hardin County.

Feed Consumption

Table 1 shows the estimated annual corn consumption per head by class of livestock. Feeding rates were developed through discussions with Iowa State University Extension staff. Total feeding requirements for each county were estimated by multiplying the number of head of livestock by the respective estimated corn-feeding rates per head.

The feeding rate of 55.3 bushes per year for grain fed cattle was calculated from the data shown in Table 2.

Table 1. Estimated annual bushels of corn consumed by livestock class, 1994-1995 crop year.

Livestock class	Bushels of corn consumed per year per head
Milk cows	102.0
Beef cows	4.0
Grain-fed cattle	55.3
Hogs marketed	12.6
Confinement swine	
Finishers (per marketing)	8.6
Sow-units (inventory)	27.9
Nursery (per marketing)	0.85
Sheep and lambs	6.8
Poultry	
Broilers (per marketing)	0.11
Layers (inventory)	0.93
Turkeys (per marketing)	0.89

Table 2. Data used in calculating the corn-feeding rate for grain fed cattle.

Item	Calves	Yearlings
Percent of grain fed to cattle	40	60
Percent fed		
hay	67	67
silage	33	33
Bushels of corn consumed per head when fed		
hay	63	58
silage	44	47

The estimate of 55.3 bushes per year is the weighted average of the four rates of corn consumed by calves and yearlings when fed hay or silage.

Table 3 presents the estimated livestock production in Iowa for the 1994-1995 crop year and the sources of the production estimates.

Table 3. Estimated livestock production in Iowa for the 1994–1995 crop year

Livestock class	Total production	Source of data
Milk cows	265,000	Iowa Agricultural Statistics
Beef cows	1,165,000	Iowa Agricultural Statistics
Grain fed cattle	1,470,000	Iowa Agricultural Statistics
Hogs marketed	19,703,090	Iowa Agricultural Statistics
Confinement swine		
Finishers	3,611,410	Iowa Department of Natural Resources
Sow-units	137,115	Iowa Department of Natural Resources
Nursery	1,784,366	Iowa Department of Natural Resources
Sheep and lambs	364,000*	Iowa Agricultural Statistics
Poultry		
Broilers	15,000,000	William Owings
Layers	8,000,000*	Iowa Agricultural Statistics
Turkeys	15,613,000	Iowa Agricultural Statistics

*1994 production. Estimates of 1995 production were not available in time for this publication.

Grain Production and Estimated Sales

The final step in calculating county grain sales was accomplished by using the equations presented in Appendix B, along with the projected livestock numbers and the corn feeding rates. Table 4 shows the estimated corn production, corn sales, and soybeans sales by county. Table 5 shows the estimated corn and soybeans sales by crop reporting district. Table 6 presents a comparison between corn produced and corn fed or sold commercially for selected years. Table 7 compares the estimated grain sales for each crop reporting district from this report to estimates obtained from grain producers in a report by Baumel, Gervais, O'Riley and Hommes (1996)². Livestock numbers are presented in Appendix A along with quantities of corn fed to livestock class.

All counties continue to have positive corn sales. Even Wright County, with its large increase in

chicken and swine confinement feeding operations, had corn sales of 8.6 million of bushels in 1994–1995. Only a significant reduction in corn production or very large increase in livestock feeding above the 1994–1995 levels will result in deficit corn supplies in any Iowa county. From a glance at Table 6, it can be seen that the quantity of corn fed to livestock has steadily declined from 1979 to 1995. The estimated quantity of corn sales for 1995 is the highest of all the years presented in Table 6. Because the quantity of corn fed has declined over the years, it is clear that the sharp increase in corn sales is mainly due to an increased corn production. Table 7 indicates that, for all the districts, the differences in the estimated sales of soybeans between the two reports are very small. There was only a 0.4 percent difference in the two estimates of soybeans sales for the state. The difference between the two estimates for corn was 1.8 percent. The highest variation between the two estimates of corn is for the north central crop reporting district (CRD) and the smallest is for the southeast CRD.

²Baumel, C. P., J.P. Gervais, C. O'Riley and H. Hommes, (1996), *The Iowa Grain Flow Survey: Where and How Iowa Grain producers Ship their Corn and Soybeans*, Iowa State University Extension, Ames, Iowa, Forthcoming.

Table 4. Estimated bushels of corn produced, fed and sold and bushels of soybeans sold into commercial channels by county in Iowa, 1994-1995, in millions of bushels.

County	Produced	Corn Fed	Sold	Soybeans sold	Combined corn and soybean sales
Adair	16.4	2.4	14.0	3.8	17.8
Adams	9.1	2.1	7.0	2.2	9.2
Allamakee	10.6	4.7	5.9	0.4	6.3
Appanoose	4.1	0.8	3.3	1.0	4.3
Audubon	15.8	4.3	11.5	4.0	15.5
Benton	26.2	4.3	21.9	7.2	28.9
Black Hawk	22.9	3.5	19.4	5.3	24.7
Boone	24.0	2.5	21.6	6.4	28.0
Bremer	18.1	3.4	14.7	3.6	18.3
Buchanan	26.2	4.3	21.8	4.4	26.2
Buena Vista	26.4	7.7	18.7	7.5	26.2
Butler	21.3	4.4	17.0	4.8	21.8
Calhoun	28.7	2.7	26.0	8.4	34.4
Carroll	25.4	9.2	16.2	6.4	22.6
Cass	19.0	3.0	16.1	4.5	20.6
Cedar	26.6	4.6	22.0	4.8	26.8
Cerro Gordo	24.5	2.3	22.2	5.2	27.4
Cherokee	21.4	5.1	16.3	6.2	22.5
Chickasaw	18.8	3.9	14.9	3.7	18.6
Clarke	4.8	1.2	3.6	1.0	4.6
Clay	22.6	2.6	20.0	6.3	26.3
Clayton	20.7	7.9	12.8	0.4	13.2
Clinton	31.3	4.5	26.8	4.4	31.2
Crawford	26.3	5.0	21.3	6.0	27.3
Dallas	21.2	1.3	19.9	5.8	25.7
Davis	5.0	1.8	3.3	1.2	4.5
Decatur	4.5	1.7	2.7	1.2	3.9
Delaware	27.9	10.6	17.3	2.0	19.3
Des Moines	12.2	1.5	10.7	3.1	13.8
Dickinson	12.8	2.1	10.7	3.7	14.4
Dubuque	17.1	10.5	6.6	0.4	7.0
Emmet	16.9	2.2	14.7	4.5	19.2
Fayette	27.9	6.3	21.5	4.2	25.7
Floyd	19.6	2.7	16.9	4.7	21.6
Franklin	26.8	4.2	22.6	5.9	28.5
Fremont	16.6	1.4	15.2	5.2	20.4
Greene	25.8	2.2	23.7	7.6	31.3
Grundy	24.2	3.8	20.4	6.5	26.9
Guthrie	16.7	3.9	12.8	3.9	16.7
Hamilton	28.3	7.5	20.8	7.3	28.1
Hancock	25.8	4.3	21.5	5.3	26.8
Hardin	27.2	6.5	20.6	6.2	26.8
Harrison	23.1	2.9	20.2	6.4	26.6
Henry	14.2	2.9	11.3	3.2	14.5
Howard	15.0	2.9	12.1	3.4	15.5
Humboldt	21.3	3.3	18.0	5.6	23.6
Ida	17.9	2.9	15.0	4.5	19.5
Iowa	19.7	3.4	16.4	2.7	19.1
Jackson	14.4	4.9	9.5	0.5	10.0
Jasper	26.1	5.1	21.0	5.8	26.8

Table 4 (continued). Estimated bushels of corn produced, fed and sold and bushels of soybeans sold into commercial channels by county in Iowa, 1994-1995, in millions of bushels.

County	Produced	Corn		Soybeans sold	Combined corn and soybean sales
		Fed	Sold		
Jefferson	10.8	2.2	8.6	2.8	11.4
Johnson	17.6	4.5	13.2	3.3	16.5
Jones	22.9	6.0	17.0	2.6	19.6
Keokuk	17.4	4.6	12.8	3.7	16.5
Kossuth	47.6	6.1	41.6	10.4	52.0
Lee	12.4	2.9	9.5	3.0	12.5
Linn	22.1	2.9	19.2	4.6	23.8
Louisa	13.7	1.4	12.3	3.4	15.7
Lucas	3.5	0.9	2.6	0.8	3.4
Lyon	23.4	7.7	15.7	6.5	22.2
Madison	10.6	3.0	7.7	2.8	10.5
Mahaska	19.8	7.4	12.4	4.6	17.0
Marion	12.4	2.6	9.8	3.2	13.0
Marshall	22.2	2.9	19.3	5.0	24.3
Mills	14.7	1.3	13.5	4.2	17.7
Mitchell	19.2	4.9	14.3	3.8	18.1
Monona	21.7	2.4	19.3	5.8	25.1
Monroe	4.1	1.5	2.7	0.9	3.6
Montgomery	12.6	1.5	11.1	3.5	14.6
Muscatine	16.0	2.3	13.7	3.1	16.8
O'Brien	24.3	6.5	17.8	6.9	24.7
Osceola	16.3	4.7	11.6	4.9	16.5
Page	13.3	2.1	11.2	3.8	15.0
Palo Alto	23.7	3.9	19.7	5.8	25.5
Plymouth	32.2	9.6	22.6	8.8	31.4
Pocahontas	28.2	2.8	25.3	7.9	33.2
Polk	16.1	0.9	15.2	4.4	19.6
Pottawattamie	35.3	4.8	30.6	9.0	39.6
Poweshiek	17.7	2.6	15.1	4.2	19.3
Ringgold	6.4	3.0	3.3	1.8	5.1
Sac	26.0	5.8	20.1	7.2	27.3
Scott	21.0	2.9	18.1	3.1	21.2
Shelby	26.6	4.7	21.9	5.4	27.3
Sioux	38.4	21.1	17.3	8.6	25.9
Story	24.9	2.4	22.6	7.0	29.6
Tama	25.5	3.2	22.3	5.5	27.8
Taylor	9.2	3.6	5.7	2.7	8.4
Union	7.5	1.6	5.8	1.7	7.5
Van Buren	6.3	1.7	4.6	1.7	6.3
Wapello	8.8	1.1	7.6	2.3	9.9
Warren	11.6	1.8	9.8	2.8	12.6
Washington	20.2	8.7	11.5	4.6	16.1
Wayne	6.6	1.1	5.5	1.8	7.3
Webster	32.4	2.6	29.8	9.1	38.9
Winnebago	19.5	1.3	18.2	3.7	21.9
Winneshiek	17.8	6.1	11.7	1.2	12.9
Woodbury	26.8	4.6	22.2	5.6	27.8
Worth	16.5	1.5	15.0	3.5	18.5
Wright	27.3	18.7	8.6	7.2	15.8
Total	1,930.5	403.1	1,527.4	438.5	1,965.9

Table 5. Estimated bushels of corn produced, fed, and sold and bushels of soybeans sold into commercial channels by crop reporting district, Iowa, 1994–1995, in millions of bushels.

Crop reporting district	Corn			Soybeans sold	Combined corn and soybeans sold
	Produced	Fed	Sold		
Northwest	286.6	76.2	210.4	77.5	287.9
North central	269.6	53.5	215.9	60.2	276.1
Northeast	223.0	64.3	158.7	29.1	187.8
West central	280.6	50.4	230.2	71.1	301.3
Central	289.8	41.2	248.6	73.1	321.7
East central	217.9	40.1	177.8	36.3	214.1
Southwest	146.4	22.0	124.4	38.9	163.3
South central	76.0	19.2	56.8	18.8	75.6
Southeast	140.8	36.2	104.6	33.5	138.1
Total	1,930.5	403.1	1,527.4	438.5	1,965.9

Table 6. Comparisons of corn produced, fed and sold through commercial channels in selected years in millions of bushels, Iowa, 1994–1995.

Year	Produced	Fed	Sold
1979	1,663.7	477.7	1,186.0
1984	1,444.8	429.4	1,015.4
1987	1,306.5	425.2	881.3
1995	1,930.5	403.1	1,527.4

Table 7. Comparison of the estimated grain sales from this report and from the Iowa grain flow survey by crop reporting district, in millions of bushels, Iowa, 1994–1995.

Crop reporting district	Corn			Soybeans		
	Estimated* grain sales	Iowa** grain flow sales	Percentage difference	Estimated** grain sales	Iowa** grain flow sales	Percentage difference
Northwest	210.4	223.5	6.2	77.5	78.2	0.9
North central	215.9	234.2	8.5	60.2	60.2	0.0
Northeast	158.7	149.9	-5.5	29.1	29.3	0.7
West central	230.2	244.3	6.1	71.1	71.6	0.7
Central	248.6	264.0	6.2	73.1	73.5	0.5
East central	177.8	163.1	-8.3	36.3	36.4	0.2
Southwest	124.4	116.1	-6.7	38.9	38.7	-0.5
South central	56.8	59.2	4.2	18.8	18.8	0.0
Southeast	104.6	100.6	-3.8	33.5	33.7	0.6
Total	1,527.4	1,554.9	1.8	438.5	440.4	0.4

* Estimates in this report.

** Estimates from Baumel, Gervais, O'Riley and Hommes (1996).

Appendix A

Appendix A contains the tables showing the estimated livestock and poultry numbers by county and the amount of corn fed to each livestock class. Table A1 shows the estimated number of cattle, sheep, and poultry by county. Table A2 shows the number of hogs produced by type of production by county. Table A3 shows the estimated number of bushels of corn fed to cattle, sheep, and poultry by county. Table A4 shows the estimated number of bushels of corn fed to hogs by type of hog production by county. The following adjustments, discussed earlier, also are included in those tables. DeCoster and Iowa Select companies fed hogs in Greene, Hamilton, Hancock, Humboldt, and Hardin counties from feed mills in Wright County. Heartland Pork enterprises fed hogs in Hamilton and Humboldt counties from Hardin County. Table A5 presents the estimated number of bushels of corn fed from corn produced in Wright County and the county location of the hogs fed by Wright County corn. These estimated bushels of corn fed are based on estimates of the number of hogs produced in these facilities.

Table A1. Estimated number of cattle, sheep, and poultry by counties in Iowa, 1994-1995.

County	Milk cows	Beef cows	Hens and pullets	Broilers	Grain-fed cattle	Sheep and lambs	Turkeys
Adair	887	26,494	0	0	16,806	3,200	0
Adams	179	19,564	0	750,000	9,890	800	0
Allamakee	17,568	20,650	0	0	15,949	1,200	0
Appanoose	391	25,931	0	0	10,290	1,400	0
Audubon	199	10,086	0	0	17,435	1,700	0
Benton	2,373	12,739	0	0	26,868	2,900	0
Black Hawk	2,022	3,523	0	0	7,088	2,700	0
Boone	242	6,090	0	0	10,404	2,200	0
Bremer	8,309	4,420	0	0	7,203	2,700	616,000
Buchanan	4,758	5,925	0	0	8,232	2,000	0
Buena Vista	482	4,775	0	0	15,778	3,100	2,200,000
Butler	3,234	5,344	0	0	8,918	4,400	0
Calhoun	133	4,584	0	0	9,547	4,000	0
Carroll	349	12,975	0	0	48,819	1,400	0
Cass	399	20,680	0	750,000	20,351	3,000	0
Cedar	921	11,134	0	0	11,319	5,700	0
Cerro Gordo	412	3,658	0	0	3,087	1,100	0
Cherokee	1,587	12,592	0	0	21,151	4,200	0
Chickasaw	6,020	5,513	0	0	14,749	4,700	0
Clarke	478	22,056	0	0	8,632	1,700	0
Clay	122	5,857	0	1,100,000	11,033	5,300	0
Clayton	27,235	19,265	0	0	17,607	1,900	0
Clinton	3,126	11,600	0	0	27,382	2,800	0
Crawford	1,055	22,592	0	0	22,066	3,700	0
Dallas	256	7,990	0	0	6,860	1,500	0
Davis	1,779	21,559	0	0	9,718	8,300	0
Decatur	380	22,278	0	0	19,207	1,400	0
Delaware	23,100	7,881	0	0	20,408	1,200	0
Des Moines	831	6,412	0	0	4,116	1,600	0
Dickinson	640	4,233	0	1,300,000	15,835	5,500	0
Dubuque	34,301	14,246	0	0	31,326	1,000	0
Emmet	405	0	625,000	0	7,660	1,100	0
Fayette	15,824	10,543	0	0	17,035	5,100	0
Floyd	618	4,319	0	0	7,546	1,800	0
Franklin	984	4,332	400,000	0	6,974	3,200	0
Fremont	0	12,710	0	0	12,805	700	0
Greene	0	0	0	0	8,632	2,500	0
Grundy	838	3,657	0	0	17,778	5,200	440,000
Guthrie	434	17,868	1,500,000	0	10,747	1,500	0
Hamilton	423	1,531	0	0	5,145	1,400	2,200,000
Hancock	516	3,172	625,000	0	7,317	2,000	0
Hardin	165	7,308	1,000,000	0	11,147	2,800	0
Harrison	126	13,788	0	0	14,234	0	0
Henry	373	7,304	0	0	4,173	2,400	1,056,000
Howard	5,269	6,993	0	0	8,689	1,700	0
Humboldt	470	2,258	625,000	0	6,688	1,300	0
Ida	515	9,024	0	0	15,034	2,000	0
Iowa	1,103	17,933	0	0	18,236	4,000	0
Jackson	8,198	30,035	0	0	32,470	1,900	0
Jasper	1,671	20,829	0	0	19,436	3,400	0

Table A1 (continued). Estimated number of cattle, sheep, and poultry by counties in Iowa, 1994-1995.

County	Milk cows	Beef cows	Hens and pullets	Broilers	Grain-fed cattle	Sheep and lambs	Turkeys
Jefferson	636	10,984	0	0	6,345	5,200	0
Johnson	3,143	14,050	0	0	10,747	6,300	352,000
Jones	4,230	16,684	0	0	28,868	1,500	0
Keokuk	237	15,301	606,500	0	8,175	7,900	0
Kossuth	1,783	6,184	0	0	14,177	4,700	0
Lee	1,638	11,207	0	0	8,803	3,000	0
Linn	2,394	13,200	0	0	15,092	3,700	0
Louisa	0	12,710	0	0	3,601	700	0
Lucas	455	21,407	0	0	7,546	3,200	0
Lyon	3,975	12,860	0	1,100,000	49,448	11,200	0
Madison	160	24,801	1,500,000	0	9,604	2,400	0
Mahaska	1,615	12,480	2,000,000	0	18,693	3,400	0
Marion	1,297	14,451	0	0	8,289	5,600	0
Marshall	913	9,464	0	0	10,175	3,600	0
Mills	94	6,375	0	0	8,460	900	0
Mitchell	3,235	3,315	0	0	15,206	1,500	440,000
Monona	221	10,864	0	0	17,950	2,200	0
Monroe	969	21,181	0	0	10,747	2,400	0
Montgomery	262	11,244	0	0	9,432	1,900	0
Muscatine	1,521	8,191	0	0	5,031	2,700	440,000
O'Brien	1,032	5,253	0	1,455,000	18,350	5,500	0
Osceola	1,849	2,276	0	1,455,000	14,005	5,100	0
Page	267	16,477	0	0	12,290	1,500	0
Palo Alto	392	4,566	0	0	11,490	3,900	0
Plymouth	2,190	20,230	0	0	45,275	7,400	0
Pocahontas	370	2,057	0	0	7,603	3,000	0
Polk	475	5,161	0	0	4,345	1,900	0
Pottawattamie	533	20,645	0	0	36,471	2,100	0
Poweshiek	887	19,025	0	0	13,662	3,100	0
Ringgold	152	29,340	0	1,630,000	11,890	1,700	0
Sac	845	8,130	0	0	25,438	7,200	0
Scott	2,317	5,987	0	0	8,918	1,800	0
Shelby	410	13,245	0	750,000	17,835	4,600	0
Sioux	10,337	11,070	625,000	1,450,000	126,506	62,200	0
Story	973	4,259	0	0	6,631	3,500	0
Tama	1,336	16,569	0	0	12,348	8,500	0
Taylor	455	18,642	1,500,000	1,630,000	9,261	2,300	0
Union	241	21,669	0	1,630,000	11,147	0	0
Van Buren	754	15,812	0	0	5,145	3,000	0
Wapello	418	13,467	0	0	5,602	7,100	0
Warren	1,316	21,068	0	0	9,890	1,700	0
Washington	1,180	11,260	606,500	0	8,518	7,100	1,056,000
Wayne	392	21,028	0	0	8,232	2,300	0
Webster	423	3,807	0	0	3,258	1,500	0
Winnebago	887	1,348	0	0	1,543	1,500	0
Winneshiek	23,331	17,496	0	0	19,207	2,200	0
Woodbury	260	16,778	0	0	39,787	3,200	0
Worth	380	3,317	0	0	4,745	1,500	0
Wright	119	1,818	4,000,000	0	4,402	1,300	0
Total	264,999	1,165,003	15,613,000	15,000,000	1,480,003	364,000	8,800,000

Table A2. Estimated hog production by facility type and sow-unit inventories in counties in Iowa, 1994-1995.

County	Type of production			Total
	Farrow to finish	Nursery	Sow-units	
Adair	114,959	0	0	124,703
Adams	69,908	0	0	137,420
Allamakee	188,751	0	0	188,751
Appanoose	14,758	0	0	14,758
Audubon	202,732	0	0	305,015
Benton	230,695	0	0	230,695
Black Hawk	233,802	0	2,134	240,662
Boone	136,708	193,400	0	332,242
Bremer	145,253	0	0	145,253
Buchanan	285,068	0	0	285,068
Buena Vista	334,780	0	0	410,122
Butler	293,612	0	0	303,037
Calhoun	170,885	0	0	182,717
Carroll	448,186	0	0	119,752
Cass	139,039	0	0	6,650
Cedar	313,031	0	0	19,700
Cerro Gordo	171,662	0	0	5,955
Cherokee	265,649	0	2,680	43,856
Chickasaw	201,179	0	0	21,158
Clarke	45,828	0	9,390	0
Clay	148,360	0	2,580	0
Clayton	379,832	0	0	0
Clinton	233,802	0	0	0
Crawford	255,551	0	0	70,676
Dallas	69,131	0	0	9,251
Davis	85,443	0	0	0
Decatur	52,819	0	0	0
Delaware	598,099	0	0	0
Des Moines	86,996	0	0	11,029
Dickinson	75,345	0	0	6,032
Dubuque	472,265	0	0	0
Emmet	81,559	0	0	24,631
Fayette	334,003	0	0	14,867
Floyd	184,867	0	0	8,932
Franklin	265,649	0	0	9,744
Fremont	54,373	0	0	0
Greene	119,620	0	0	52,281
Grundy	192,634	0	0	0
Guthrie	135,155	0	0	27,932
Hamilton	282,738	212,066	28,555	575,238
Hancock	241,570	0	0	90,004
Hardin	314,585	236,600	7,312	166,239
Harrison	121,173	0	0	73,080
Henry	140,592	0	0	0
Howard	143,699	0	0	40,986
Humboldt	160,788	0	0	101,770
Ida	162,341	0	0	8,700
Iowa	194,965	0	0	16,240
Jackson	215,160	0	0	0
Jasper	303,710	0	0	30,403

Table A2 (continued). Estimated hog production by facility type and sow-unit inventories in counties in Iowa, 1994-1995.

County	Type of production				Total
	Farrow to finish	Nursery	Sow-units	Finishers	
Jefferson	143,699	0	0	3,988	147,687
Johnson	267,979	0	0	13,533	281,512
Jones	338,664	0	0	0	338,664
Keokuk	280,407	0	0	9,744	290,151
Kossuth	310,701	0	0	154,218	464,919
Lee	182,537	0	0	0	182,537
Linn	170,885	0	0	0	170,886
Louisa	86,996	0	0	19,120	106,116
Lucas	41,945	0	0	0	41,945
Lyon	351,092	0	0	17,400	368,492
Madison	86,219	0	0	2,784	89,003
Mahaska	315,361	0	0	57,439	372,800
Marion	160,011	0	0	18,792	178,803
Marshall	170,885	0	0	14,113	184,998
Mills	63,694	0	0	0	63,694
Mitchell	236,909	0	3,113	60,613	300,635
Monona	98,647	0	0	26,796	125,443
Monroe	55,149	0	0	12,180	67,329
Montgomery	76,122	0	0	0	76,122
Muscatine	133,601	0	0	0	133,601
O'Brien	365,850	0	0	84,359	450,209
Osceola	182,537	0	0	157,015	339,552
Page	107,969	0	0	0	107,969
Palo Alto	200,402	0	0	91,348	291,750
Plymouth	549,940	0	1,500	22,736	574,176
Pocahontas	177,099	0	0	24,163	201,262
Polk	52,819	0	0	0	52,819
Pottawattamie	206,616	0	0	22,136	228,752
Poweshiek	160,788	0	0	0	160,788
Ringgold	64,470	209,300	11,442	111,041	396,253
Sac	338,664	0	0	26,100	364,764
Scott	185,644	0	0	0	185,644
Shelby	295,166	0	0	10,672	305,838
Sioux	868,409	0	935	135,652	1,004,996
Story	152,243	0	0	0	152,243
Tama	198,848	0	1,410	0	200,258
Taylor	80,782	0	0	56,704	137,486
Union	66,024	0	0	18,222	84,246
Van Buren	100,978	0	2,851	3,248	107,077
Wapello	62,140	0	0	0	62,140
Warren	91,657	0	0	0	91,657
Washington	521,201	0	3,038	6,042	530,281
Wayne	57,480	0	0	0	57,480
Webster	173,992	0	0	30,844	204,836
Winnebago	97,871	0	0	0	97,871
Winneshiek	257,882	0	0	0	257,882
Woodbury	189,527	0	2,580	5,220	197,327
Worth	93,987	0	0	6,496	100,483
Wright	117,290	933,000	57,615	550,588	1,658,493
Total	19,703,087	1,784,366	137,135	3,611,410	25,235,979

Table A3. Estimated bushels of corn fed to cattle, sheep, and poultry by county, in Iowa 1994-1995, in thousands of bushels.

County	Milk cows	Beef cows	Hens and pullets	Broilers	Grain-fed cattle	Sheep and lambs	Turkeys
Adair	91	106	0	0	929	22	0
Adams	18	78	0	83	547	5	0
Allamakee	1,792	83	0	0	882	8	0
Appanoose	40	104	0	0	569	10	0
Audubon	20	40	0	0	964	12	0
Benton	242	51	0	0	1,486	20	0
Black Hawk	206	14	0	0	392	18	0
Boone	25	24	0	0	575	15	0
Bremer	848	18	0	0	398	18	548
Buchanan	485	24	0	0	455	14	0
Buena Vista	49	19	0	0	872	21	1,958
Butler	330	21	0	0	493	30	0
Calhoun	14	18	0	0	528	27	0
Carroll	36	52	0	0	2,700	10	0
Cass	41	83	0	83	1,125	20	0
Cedar	94	45	0	0	626	39	0
Cerro Gordo	42	15	0	0	171	7	0
Cherokee	162	50	0	0	1,170	29	0
Chickasaw	614	22	0	0	816	32	0
Clarke	49	88	0	0	477	12	0
Clay	12	23	0	121	610	36	0
Clayton	2,778	77	0	0	974	13	0
Clinton	319	46	0	0	1,514	19	0
Crawford	108	90	0	0	1,220	25	0
Dallas	26	32	0	0	379	10	0
Davis	181	86	0	0	537	56	0
Decatur	39	89	0	0	1,062	10	0
Delaware	2,356	32	0	0	1,129	8	0
Des Moines	85	26	0	0	228	11	0
Dickinson	65	17	0	143	876	37	0
Dubuque	3,499	57	0	0	1,732	7	0
Emmet	41	0	581	0	424	7	0
Fayette	1,614	42	0	0	942	35	0
Floyd	63	17	0	0	417	12	0
Franklin	100	17	372	0	386	22	0
Fremont	0	51	0	0	708	5	0
Greene	0	0	0	0	477	17	0
Grundy	85	15	0	0	983	35	392
Guthrie	44	71	1,395	0	594	10	0
Hamilton	43	6	0	0	285	10	1,958
Hancock	53	13	581	0	405	14	0
Hardin	17	29	930	0	616	19	0
Harrison	13	55	0	0	787	0	0
Henry	38	29	0	0	231	16	940
Howard	537	28	0	0	481	12	0
Humboldt	48	9	581	0	370	9	0
Ida	53	36	0	0	831	14	0
Iowa	113	72	0	0	1,008	27	0
Jackson	836	120	0	0	1,796	13	0
Jasper	170	83	0	0	1,075	23	0

Table A3 (continued). Estimated bushels of corn fed to cattle, sheep, and poultry by county, in Iowa 1994-1995, in thousands of bushels.

County	Milk cows	Beef cows	Hens and pullets	Broilers	Grain-fed cattle	Sheep and lambs	Turkeys
Jefferson	65	44	0	0	351	35	0
Johnson	321	56	0	0	594	43	313
Jones	431	67	0	0	1,596	10	0
Keokuk	24	61	564	0	452	54	0
Kossuth	182	25	0	0	784	32	0
Lee	167	45	0	0	487	20	0
Linn	244	53	0	0	835	25	0
Louisa	0	51	0	0	199	5	0
Lucas	46	86	0	0	417	22	0
Lyon	405	51	0	121	2,734	76	0
Madison	16	99	1,395	0	531	16	0
Mahaska	165	50	1,860	0	1,034	23	0
Marion	132	58	0	0	458	38	0
Marshall	93	38	0	0	563	24	0
Mills	10	26	0	0	468	6	0
Mitchell	330	13	0	0	841	10	392
Monona	23	43	0	0	993	15	0
Monroe	99	85	0	0	594	16	0
Montgomery	27	45	0	0	522	13	0
Muscatine	155	33	0	0	278	18	392
O'Brien	105	21	0	160	1,015	37	0
Osceola	189	9	0	160	774	35	0
Page	27	66	0	0	680	10	0
Palo Alto	40	18	0	0	635	27	0
Plymouth	223	81	0	0	2,504	50	0
Pocahontas	38	8	0	0	420	20	0
Polk	48	21	0	0	240	13	0
Pottawattamie	54	83	0	0	2,017	14	0
Poweshiek	91	76	0	0	756	21	0
Ringgold	16	117	0	179	658	12	0
Sac	86	33	0	0	1,407	49	0
Scott	236	24	0	0	493	12	0
Shelby	42	53	0	83	986	31	0
Sioux	1,054	44	581	160	6,996	423	0
Story	99	17	0	0	367	24	0
Tama	136	66	0	0	683	58	0
Taylor	46	75	1,395	179	512	16	0
Union	25	87	0	179	616	0	0
Van Buren	77	63	0	0	285	20	0
Wapello	43	54	0	0	310	48	0
Warren	134	84	0	0	547	12	0
Washington	120	45	564	0	471	48	940
Wayne	40	84	0	0	455	16	0
Webster	43	15	0	0	180	10	0
Winnebago	91	5	0	0	85	10	0
Winneshiek	2,380	70	0	0	1,062	15	0
Woodbury	27	67	0	0	2,200	22	0
Worth	39	13	0	0	262	10	0
Wright	12	7	3,720	0	243	9	0
Total	27,030	4,658	14,519	1,651	81,842	2,474	7,833

Table A4. Estimated quantities of corn fed to hogs, by type of production and sow-unit inventories, in counties in Iowa 1994-1995, in thousands of bushels.

County	Type of production				Total
	Farrow to finish	Nursery	Sow-units	Finishers	
Adair	1,448	0	0	84	1,532
Adams	881	0	0	581	1,462
Allamakee	2,378	0	0	0	2,378
Appanoose	186	0	0	0	186
Audubon	2,554	0	0	880	3,434
Benton	2,907	0	0	0	2,907
Black Hawk	2,946	0	0	59	3,005
Boone	1,723	164	60	0	1,947
Bremer	1,830	0	0	0	1,830
Buchanan	3,592	0	0	0	3,592
Buena Vista	4,218	0	0	648	4,866
Butler	3,700	0	0	81	3,781
Calhoun	2,153	0	0	102	2,255
Carroll	5,647	0	0	1,030	6,677
Cass	1,752	0	0	57	1,809
Cedar	3,944	0	0	169	4,113
Cerro Gordo	2,163	0	74	51	2,288
Cherokee	3,347	0	0	377	3,724
Chickasaw	2,535	0	262	182	2,979
Clarke	577	0	72	0	649
Clay	1,869	0	0	0	1,869
Clayton	4,786	0	0	0	4,786
Clinton	2,946	0	0	0	2,946
Crawford	3,220	0	0	608	3,828
Dallas	871	0	0	80	951
Davis	1,077	0	0	0	1,077
Decatur	666	0	0	0	666
Delaware	7,536	0	0	0	7,536
Des Moines	1,096	0	0	95	1,191
Dickinson	949	0	0	52	1,001
Dubuque	5,951	0	0	0	5,951
Emmet	1,028	0	0	212	1,240
Fayette	4,208	0	0	128	4,336
Floyd	2,329	0	0	77	2,406
Franklin	3,347	0	0	84	3,431
Fremont	685	0	0	0	685
Greene	1,507	0	0	263	1,770
Grundy	2,427	0	0	0	2,427
Guthrie	1,703	0	0	240	1,943
Hamilton	3,392	80	0	1,805	5,277
Hancock	3,044	0	0	363	3,406
Hardin	4,638	0	0	392	5,030
Harrison	1,527	0	0	628	2,155
Henry	1,771	0	0	0	1,771
Howard	1,811	0	0	352	2,163
Humboldt	1,522	0	0	875	2,397
Ida	2,045	0	0	75	2,120
Iowa	2,457	0	0	140	2,597
Jackson	2,711	0	0	0	2,711
Jasper	3,827	0	0	261	4,088

Table A4 (continued). Estimated quantities of corn fed to hogs, by type of production and sow-unit inventories, in counties in Iowa 1994–1995, in thousands of bushels.

County	Type of production				Total
	Farrow to finish	Nursery	Sow-units	Finishers	
Jefferson	1,811	0	0	34	1,845
Johnson	3,377	0	0	116	3,493
Jones	4,267	0	0	0	4,267
Keokuk	3,533	0	0	84	3,617
Kossuth	3,915	0	0	1,326	5,241
Lee	2,300	0	0	0	2,300
Linn	2,153	0	0	0	2,153
Louisa	1,096	0	0	164	1,260
Lucas	529	0	0	0	529
Lyon	4,424	0	0	150	4,574
Madison	1,086	0	0	24	1,110
Mahaska	3,974	0	0	494	4,468
Marion	2,016	0	0	162	2,178
Marshall	2,153	0	0	121	2,274
Mills	803	0	0	0	803
Mitchell	2,985	0	87	521	3,593
Monona	1,243	0	0	230	1,473
Monroe	695	0	0	105	800
Montgomery	959	0	0	0	959
Muscatine	1,683	0	0	0	1,683
O'Brien	4,610	0	0	725	5,335
Osceola	2,300	0	0	1,350	3,650
Page	1,360	0	0	0	1,380
Palo Alto	2,525	0	0	786	3,311
Plymouth	6,929	0	42	196	7,167
Pocahontas	2,231	0	0	208	2,439
Polk	666	0	0	0	666
Pottawattamie	2,603	0	0	190	2,793
Poweshiek	2,026	0	0	0	2,026
Ringgold	812	178	319	955	2,264
Sac	4,267	0	0	224	4,491
Scott	2,339	0	0	0	2,339
Shelby	3,719	0	0	92	3,811
Sioux	10,942	0	26	1,167	12,135
Story	1,918	0	0	0	1,918
Tama	2,505	0	39	0	2,544
Taylor	1,018	0	0	488	1,506
Union	832	0	0	157	989
Van Buren	1,272	0	80	28	1,380
Wapello	783	0	0	0	783
Warren	1,155	0	0	0	1,155
Washington	6,567	0	85	52	6,704
Wayne	724	0	0	0	724
Webster	2,192	0	0	265	2,457
Winnebago	1,233	0	0	0	1,233
Winneshiek	3,249	0	0	0	3,249
Woodbury	2,388	0	72	45	2,505
Worth	1,184	0	0	56	1,240
Wright	1,478	1,095	2,608	9,589	14,770
Total	248,256	1,517	3,826	31,135	284,734

Table A5. Estimated quantities of corn fed from Wright and Hardin counties to hogs produced in other counties, by type of production and county, Iowa, 1994-1995, in thousands of bushels.

Hog producing counties	Type of production			Total
	Farrow to finish	Nursery	Sow-units	
Greene	0	0	0	187
Hamilton	170	101	797	4,210
Hancock	0	0	0	412
Hardin	0	201	204	1,038
Humboldt	504	0	0	504
Total	674	302	1,001	4,779

Appendix B

Appendix B presents the basic equations used in the analysis. Equation 1 was used to estimate corn sales and equation 2 was used to estimate soybean sales.

Equation 1. Corn sales

$$CS_{it} = CP_{i(t-1)} - [\sum_k L_{kit} FR_{kit} - OP_{i(t-1)}]$$

where,

- CS_{it} = corn sales in county i , year t ,
- $CP_{i(t-1)}$ = corn production in county i , year $t-1$,
- L_{kit} = number of head in the k th class of livestock in county i , year t ,
- FR_{kit} = feeding rate for each class of livestock in county i , year t ,
- $OP_{i(t-1)}$ = oat production in county i , year t ,
= 0.7694 = the fraction of the previous year's oats fed to livestock based on the 1982 agricultural census,
- k = class of livestock 1, ..., 11.

Equation 2. Soybean sales

$$SS_{it} = SP_{it} - SAC_{it}(SR)$$

where,

- SS_{it} = soybean sales in county i , year t ,
- SP_{it} = soybean production in county i , year t ,
- SAC_{it} = acres of soybeans planted in county i , year t ,
- SR = seeding rate for soybeans (assumed to be 1 bu/acre).



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