AD ASTRA PER ASPERA
Kansas
Department of Agriculture

Agribusiness commodity flow study

Prepared for:

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Prepared by:

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Bridging Your Information Research Needs

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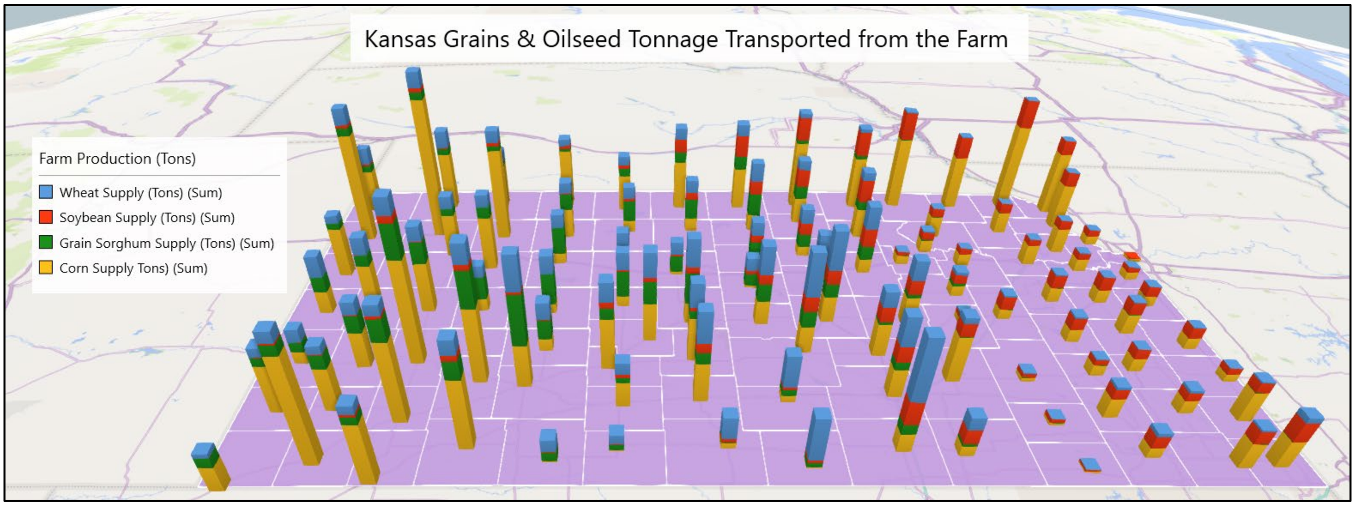
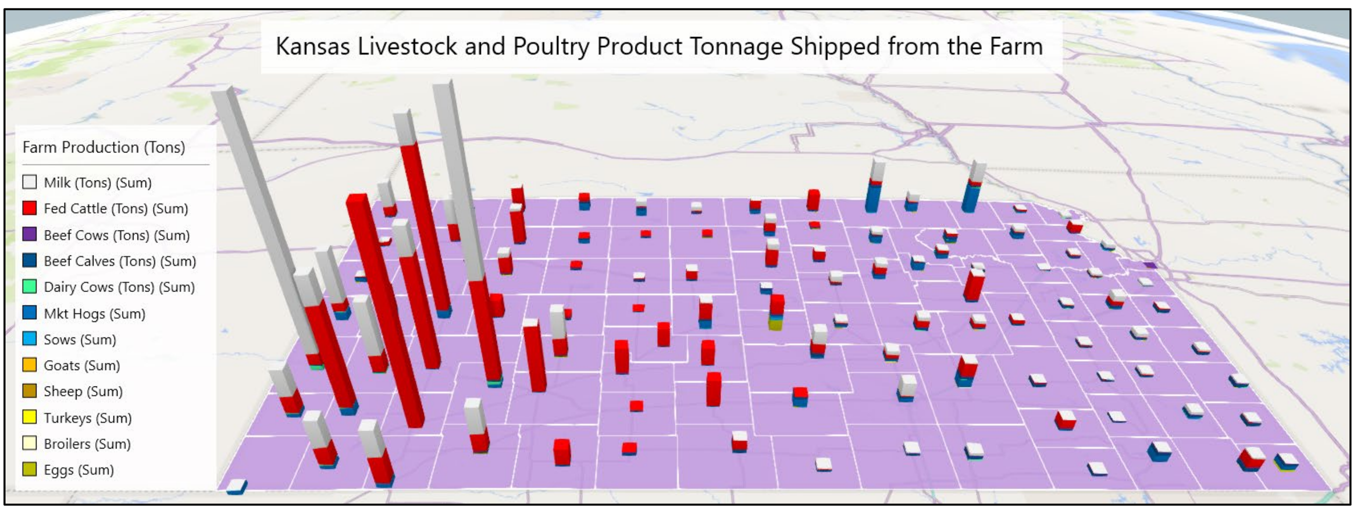
Contents

Executive summary

Commodity flow studies were conducted for four of the major crops in Kansas (corn, grain sorghum, soybeans and wheat), the major livestock species produced in Kansas (cows, fed cattle, market hogs, sheep, broilers, and turkeys), four major feed ingredients (dried distillers' grains (DDGs), soybean meal, wheat midds, and meat and bone meal), and two biofuels (ethanol and biodiesel).





In 2020, Kansas produced more than 44 million tons of these crop and livestock products. An estimated 19.3 million tons of these commodities are transported from production points within Kansas for first-level processing, use as feed, fuel, or other intermediate uses such as ingredients in pet foods. Local use, defined as within the same USDA Agricultural Statistics District (ASD), accounts for 72% of the commodity movement that stays inside the State of Kansas. There is clearly a synergy between:

- local production of grains and feeds and local livestock production
- local grain production and local grain/oilseed processing, and
- local livestock production and local livestock processing.

Kansas Ag Commodities - Summary of Net Flows			
		Percent	Percent
Commodity	Net Outflow	Regional	Out of Region
Corn (1,000 Bu)	395,050	84.7%	15.3%
Grain Sorghum (1,000 Bu)	176,928	93.7%	6.3%
Soybeans (1,000 Bu)	145,640	94.8%	5.2%
HRW Wheat (1,000 Bu)	245,872	48.9%	51.1%
SRW Wheat (1,000 Bu)	894	99.3%	0.7%
HWW Wheat (1,000 Bu)	3,365	99.9%	0.1%
DDGs (1,000 tons)	(1,265)	88.9%	11.1%
SBM (1,000 tons)	1,134	78.0%	22.0%
Wheat Midds (1,000 tons)	85	100.0%	0.0%
MBM (1,000 tons)	201	94.8%	5.2%
Cows (100 Head)	2,018	91.2%	8.8%
Fed Cattle (100 Head)	(20,973)	76.3%	23.7%
Market Hogs (100 Head)	32,933	100.0%	0.0%
Sheep (100 Head)	268	13.8%	86.2%
Milk (Cwts)	16,758,000	100.0%	0.0%
Ethanol (Million gallons)	350	78.2%	21.8%
Biodiesel (Million gallons)	16	83.8%	16.2%

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An estimated 4.9 million tons of these agricultural commodity products are brought into Kansas for use as feed, fuel, and first level processing from 315 counties outside of Kansas. Kansas ships an estimated 30.5 million tons of grains, feed ingredients, biofuels and livestock to an estimated 617 counties (including international export ports).

The seven most-used feed ingredients in Kansas and the 11-state region[1] are corn, grain sorghum, wheat, soybean meal, DDGs, and meat & bone meal, and wheat midds. Estimated total use of these ingredients in 2020 was 11.8 million tons in Kansas. Corn is by far the leading feed ingredient at 7.4 million tons in Kansas and 75.8 million tons in the region. For Kansas, the next most used ingredient is DDGs (2.4 million tons) followed by grain sorghum (986,000 tons), wheat midds (394,000 tons), soybean meal (331,000 tons), meat & bone meal (157,000 tons), and wheat (139,000 tons).

Key takeaways: Commodity Flow Studies

While there is substantial detail about commodity flows for each of the commodities in the full report, some key takeaways from the Commodity Flow Studies are:

1. Kansas grain and oilseed production is increasing with the greatest increases in corn and soybean production.
2. Even with robust ethanol production, Kansas has net inflows of DDGs. Kansas has net outflows of corn, grain sorghum, wheat, soybean meal, meat & bone meal, and wheat midds.
3. The bulk of these outflows are to demand points within the 11-state region identified as our study area. The exception is HRW wheat for which 51% of outflows are outside the region.
4. Finding ways to add more value to Kansas grains within Kansas is a way to increase revenues, decrease transportation costs, and reduce associated greenhouse gas emissions. Pathways for adding value to grains can include expanded livestock feeding and processing, increased biofuels production, and value-added grain processing such as protein extraction, synthetic amino acid production, and production of other grain-based nutritional derivatives.
5. Kansas has net outflows of biofuels with approximately 20% of biofuels moving outside the 11-state region. This implies that rail transport is an essential component of competitive biofuels production in Kansas. On a similar note, rail infrastructure is an essential part of moving the Kansas wheat crop to markets outside of Kansas and outside the 11-state region.
6. Kansas fed cattle processing facilities draw a significant share of their slaughter supply from outside the 11-state region. This suggests there may be an opportunity for more fed cattle feedlot production in Kansas; however, the Kansas-based supply shortage of DDGs would need to be addressed for more fed cattle feedlot production to be strongly competitive.

[1] The 11-state region includes Kansas, Illinois, Iowa, Nebraska, Missouri, Arkansas, Louisiana, Texas, Oklahoma, Colorado, and New Mexico.

7. While Kansas ships most of their hogs out of state for processing, there is substantial processing capacity just beyond the Kansas borders to the north, east, and southwest. Expansion of hog production needs to consider the needs and flows of the individual processing plants just outside of Kansas.
8. Kansas ships a substantial amount of soybean meal to poultry producing areas in Oklahoma and Texas. Additionally, when the announced soybean processing facility in Montgomery County, Kansas begins operation, there will be more soybean meal available that could be the basis for more value-added production via broiler production in southeastern Kansas.
9. Kansas has a substantial amount of on-farm storage and a strong country elevator and terminal elevator network. In addition, Kansas is well positioned with rail shuttle loading facilities within reasonable distances of the major crop growing areas (especially wheat).
10. Farm to market and other rural road infrastructure have become even more important to the viability of Kansas farms as farm-to-first-market transport of commodities has become reliant on 5, 6 and 7-axle semi-truck/trailer combinations.
11. Kansas produces 6 million tons of livestock and poultry products that move from the farm. All of this production moves from the farm to the first point of purchase, collection or processing by truck. While some of this movement is on state and/or federal highways, a significant portion of this movement occurs on county roads and farm-to-market roads.
12. Off-farm commercial and terminal storage for grains and oilseeds plays an integral role in the marketing flows of Kansas crops. Wheat moves very rapidly from farms and farm storage to commercial storage with only 9% in on-farm storage one quarter after harvest and 58% of the current harvest in commercial and terminal storage. Soybeans stay on farm a bit longer with about 17% on-farm after 90 days and 43% of the harvest in commercial storage. Corn moves a bit slower with 20% still on-farm after 90 days and 33% in off-farm storage.

Key takeaways: infrastructure

A few key takeaways regarding infrastructure utilization:

1. Overall, the counties producing most of the truck traffic are located on the western part of the state. This is more evident when all flows inbound, outbound, domestic, and exports are combined. Particularly, the SW [30] Crop Reporting District (CRD) and the NW [10] handled a combined 44% of the agricultural truck traffic, as measured by ton-miles (composed of 31% and 13%, respectively). Missouri is the top-trading partner for the movement of commodities by truck handling 20% of the total truck flows. Texas ranks in second place with 17% of the truck traffic, followed by Nebraska with 12%, and Oklahoma with 10%. Inbound and outbound truck traffic originating and terminating out of region accounted for 25%. The summary of total truck flows (domestic plus exports, originating, and terminating in Kansas and the lower 48) are illustrated below.

Summary total truck flows: Domestic + Exports, IB + OB (000s ton-miles, within KS only)

Crop Reporting Dist.		Total Truck (Dom+Exp, IB+OB)	Arkansas	Colorado	Illinois	Iowa	Louisiana	Missouri	Nebraska	New Mexico	Oklahoma	Texas	Out of Region	% by CRD (from Total)
NE	[70]	144,883	2,827	387	413	2,036	-	80,024	8,677	-	1,337	36,395	12,788	5%
SE	[90]	153,960	11,773	6,079	1,086	1,799	-	50,592	11,609	-	36,156	7,165	27,702	5%
EC	[80]	173,903	15,853	744	3,199	4,607	422	49,050	13,028	6,447	14,799	29,159	36,595	6%
WC	[20]	242,271	-	9,988	171	53,210	-	45,882	22,670	742	19,401	56,070	34,137	8%
C	[50]	277,772	3,512	1,663	26,126	3,994	-	60,781	21,050	-	20,652	23,584	116,410	9%
NC	[40]	323,164	8	4,467	8,341	4,420	-	13,279	26,456	1,023	26,736	79,992	158,441	11%
SC	[60]	380,987	13,042	24,200	13,054	343	-	28,494	42,112	20,847	85,582	29,561	123,751	13%
NW	[10]	403,873	-	6,814	3,426	357	-	2,518	37,294	-	53,733	183,386	116,344	13%
SW	[30]	932,967	5,594	69,687	14,674	137,755	1,179	262,801	193,083	7,408	41,850	55,409	143,525	31%
Total		**3,033,780**	**52,609**	**124,030**	**70,492**	**208,520**	**1,602**	**593,420**	**375,979**	**36,467**	**300,246**	**500,722**	**769,693**	**100%**
% by state		100%	2%	4%	2%	7%	0%	20%	12%	1%	10%	17%	25%	

Source: Bujanda & Allen, 2021.

2. For rail traffic, the counties with most rail traffic, considering inbound, outbound, domestic, and exports combined, are located on the NW [10] CRD, contributing to 27% of the ton-miles generated. The NC [40] contributed to 21% of the total agricultural flows by rail, followed by NE [70] with 13%. Texas is by far the top-trading partner for the movement of commodities by rail handling 85% of the total agricultural flows by rail. Inbound and outbound rail traffic originating and terminating out of region accounted for 12%. The summary of total rail flows (domestic plus exports, originating, and terminating in Kansas and the lower 48) are illustrated below.

Summary total rail flows: Domestic + Exports, IB + OB (000s ton-miles, within KS only)

Crop Reporting Dist.		Total Truck (Dom+Exp, IB+OB)	Arkansas	Colorado	Illinois	Iowa	Louisiana	Missouri	Nebraska	New Mexico	Oklahoma	Texas	Out of Region	% by CRD (from Total)
SE	[90]	24,845	125	34	35	209	-	888	397	-	-	18,618	4,539	1%
EC	[80]	97,463	168	8	104	527	7,699	881	721	-	-	77,753	9,603	4%
C	[50]	151,282	37	18	852	42	-	1,245	708	-	-	117,888	30,491	6%
SC	[60]	153,228	137	231	429	4	-	545	1,845	-	-	121,204	28,834	6%
SW	[30]	249,162	59	361	69	14,795	31,810	638	14,269	-	-	153,784	33,376	10%
WC	[20]	276,899	-	103	16	6,205	-	212	1,661	-	-	201,675	67,026	11%
NE	[70]	307,279	30	0	13	215	-	1,441	337	-	-	291,365	13,878	13%
NC	[40]	521,905	-	47	272	48	-	51	953	-	-	478,958	41,576	21%
NW	[10]	645,995	-	54	121	22	-	-	978	-	-	591,740	53,080	27%
Total		**2,428,058**	**557**	**856**	**1,912**	**22,066**	**39,509**	**5,902**	**21,868**	**-**	**-**	**2,052,984**	**282,403**	**100%**
		100%	0%	0%	0%	1%	2%	0%	1%	0%	0%	85%	12%	

Source: Bujanda & Allen, 2021.

Top transportation hurdles faced by agricultural producers documented by this report include harbor channel and inland waterway draft issues, market concentration for ocean carriers and equipment imbalances (i.e., headhaul fulls vs backhaul empties), and impacts from the COVID-19 pandemic into supply chains is provided. Additional hurdles documented, along with potential solutions, proposed by industry participants include:

- Marine terminal operations and trucking into terminals
- Additional land and warehousing near ports and inland
- Trucking costs and truck driver shortage
- Information/transparency of the supply chain
- Rail service at inland rail ramps for access to marine terminals
- Addressing chassis shortage issues
- Ocean carrier practices (Federal Maritime Commission enforcement)
- Creating a competitive marketplace
- Federal Agency contribution to increased export and import fluidity

Key takeaways: freight rates

A few key takeaways regarding how freight rates affect Kansas' ability to compete in the international arena are:

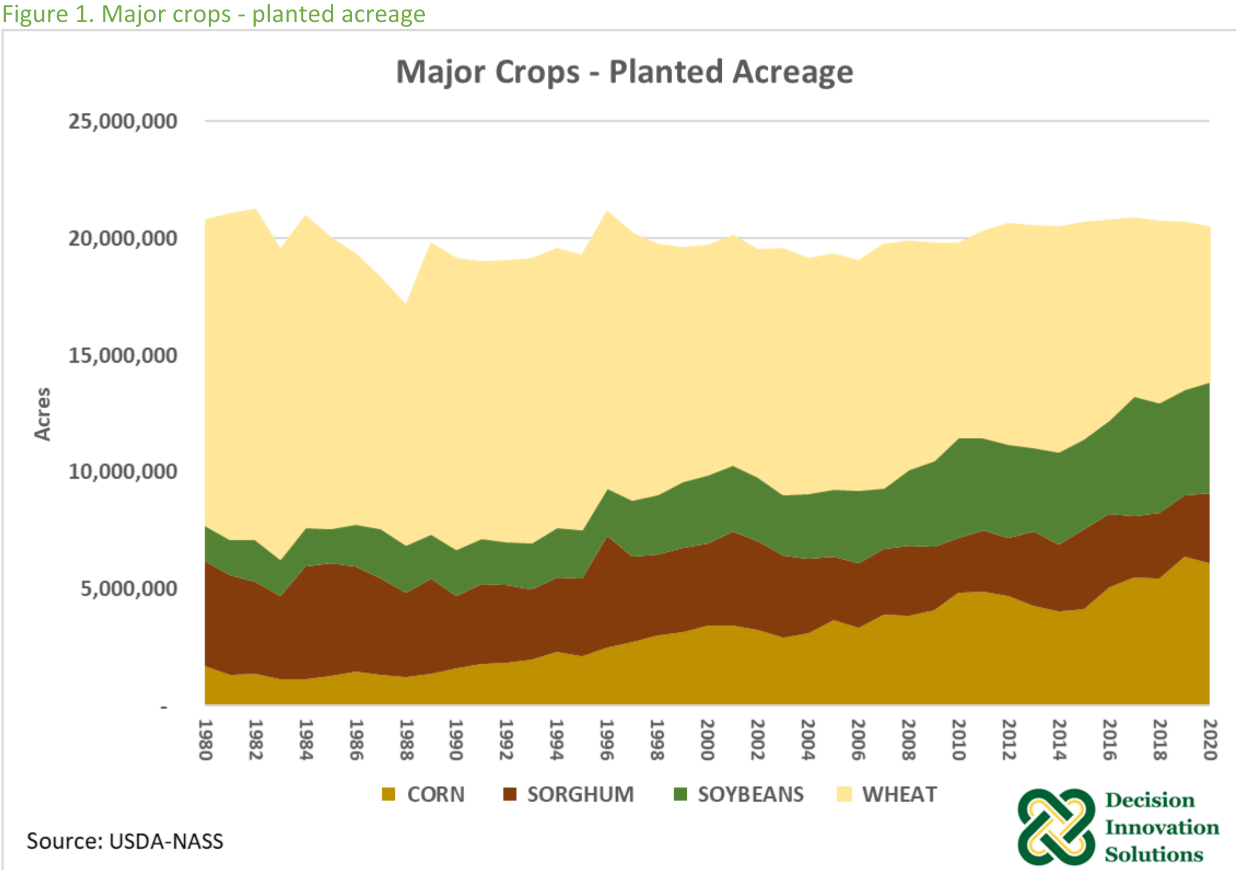
1. The analysis reported in Section 7 shows the potential savings that can be generated by replacing the inland rail transportation with transportation via the rivers, and how such savings vary for each of the target markets. For containers from Asia, inland cost savings from using a barge or ship from New Orleans are significant compared to shipping a box by rail more than 1,740 mi from San Pedro Bay to Kansas City and then trucking it 190 mi to its final destination. The savings from the barge route outweigh the increases in ocean shipping costs.
2. As the route cost analysis demonstrates, Marine Highways could provide a competitive alternative in terms of cost for containers on barge to/from New Orleans, particularly for those destined to or originating closer to river ports. However, not all beneficial cargo owners (BCOs) will be incentivized by cost alone. For some, transit times might be more critical, in which case, rail will remain the dominant mode.

1 Introduction

Kansas is a diverse state with multiple distinct climate and agricultural production areas. Commodities produced in Kansas flow to processors in Kansas, adjacent and distant states, as well as international destinations. Like many other Midwestern states reliant upon infrastructure to move agricultural commodities to markets, Kansas has an extensive transportation system that serves agriculture. Some aspects of the transportation and distribution system are world-class, others may need to be upgraded and modernized. While Kansas has several major interstate highways, the system is more than 50 years old. A range of commodities still move on state and local highway systems. Some Kansas commodities move to river ports that are on the border of Kansas or to neighboring states. The rail network system in Kansas is also instrumental in providing access for Kansas commodities to other states and to international export markets. Agricultural commodities produced in Kansas are often transported multi-modally and in many cases over long distances.

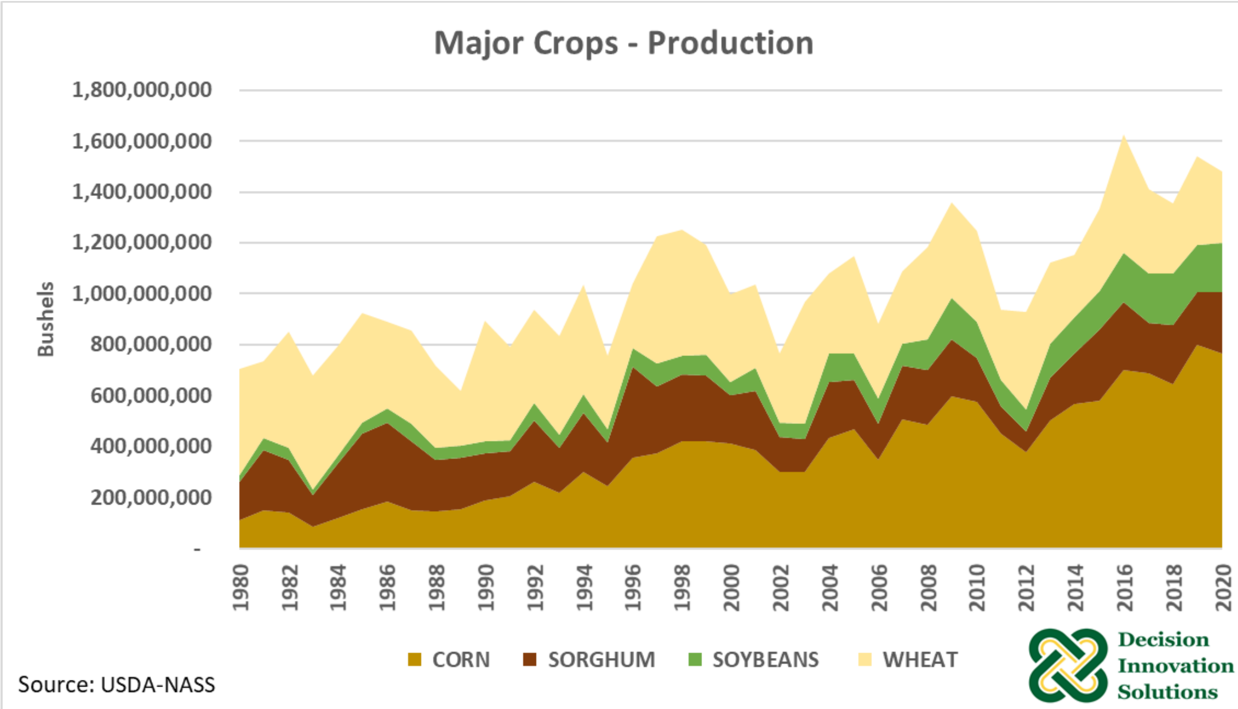
Kansas has a rich history of commodity production. The top 4 crops in Kansas have been planted on approximately 20 million acres for much of the past 40 years (Figure 1). The crop mix has changed over the years with significant growth in corn and soybean acreage and declines in acres planted to grain sorghum and wheat.

Figure 1. Major crops - planted acreage



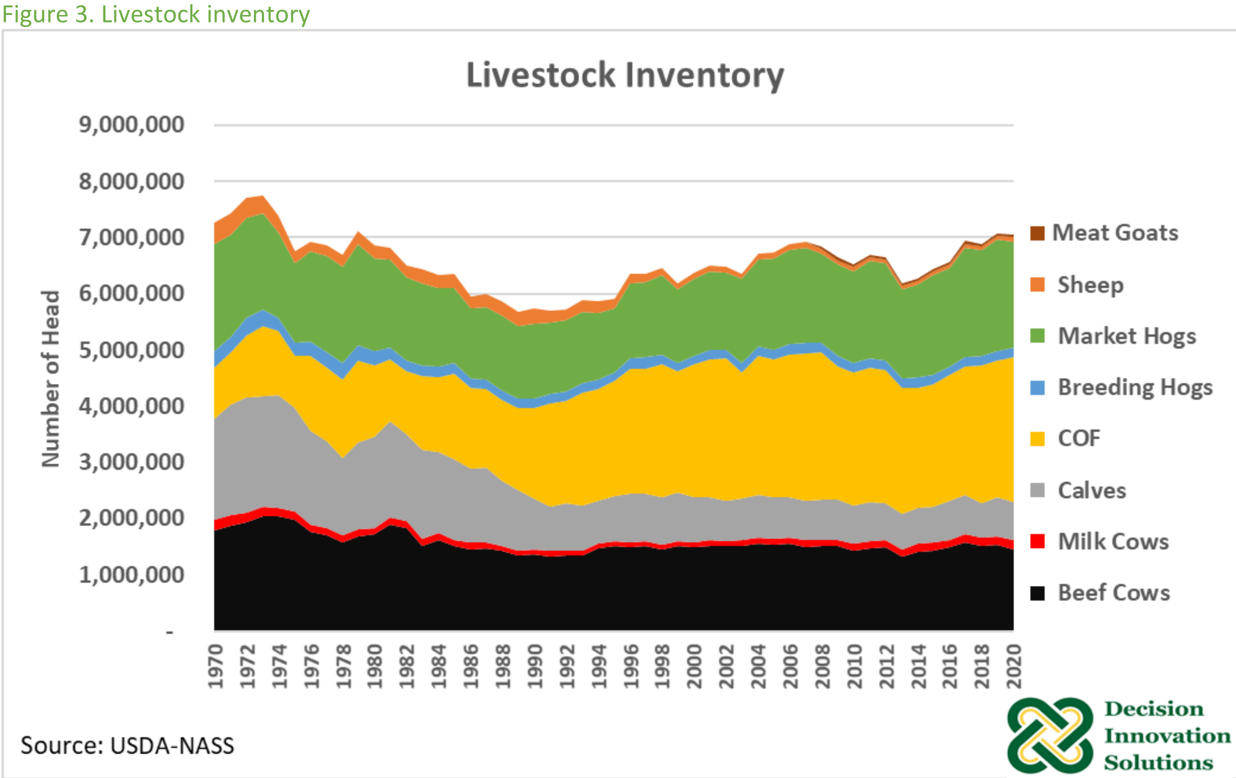
Despite the relatively stable number of acres planted to the 4 major crops, total crop production has increased significantly over the past 40 years (Figure 2). In 1980, the 4 major crops resulted in total production of 704 million bushels of grain. By 2020, total production of the 4 major crops has grown to 1.48 billion bushels, an increase of 110 percent from 1980 levels. This means that there is more demand for farm production assets, more demand for storage and transportation assets, more stress on key transportation infrastructure, and more opportunities for value-adding activities. It also means that there has been increased efficiency of the use of land, labor, and other factors of production such as machinery assets and seed.

Figure 2. Major crops - production



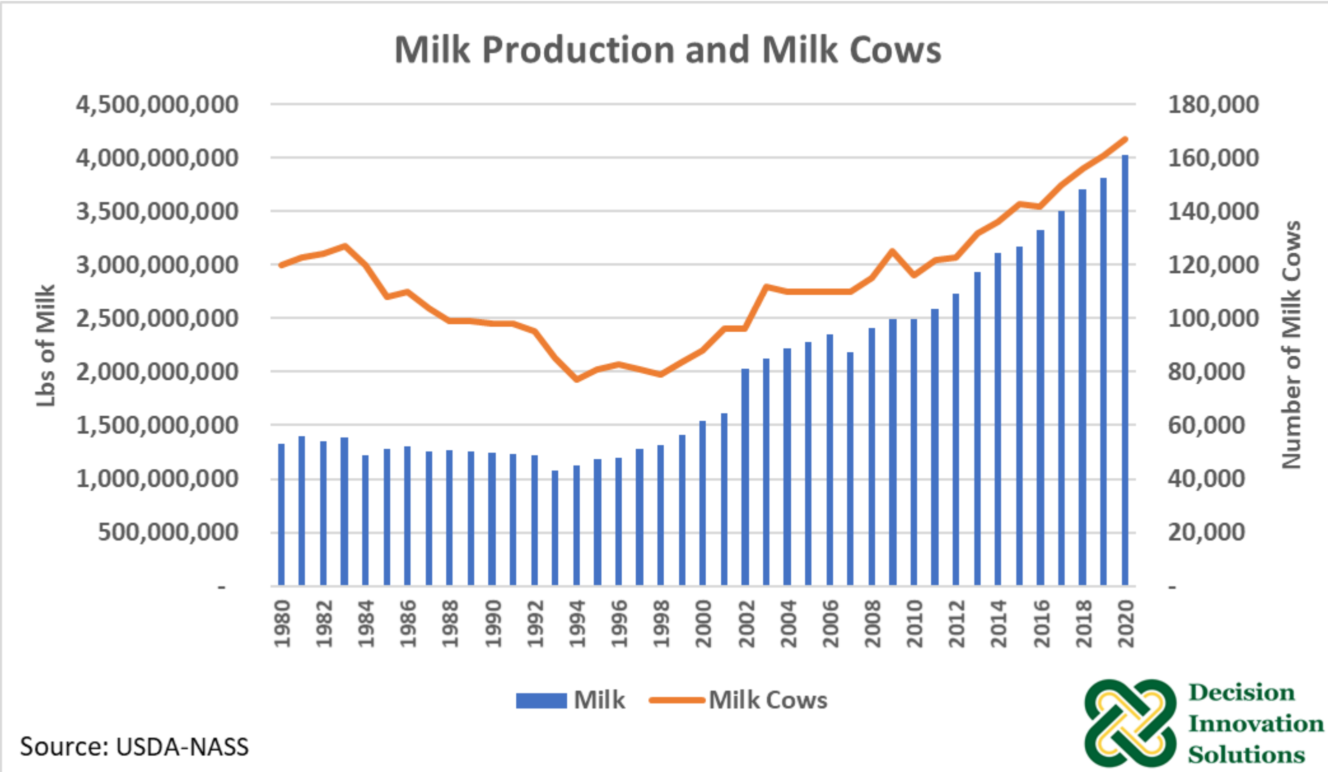
A significant source of value-adding in Kansas occurs through production of livestock. In 1980, there were 6.8 million head of cattle, hogs, and sheep in Kansas (Figure 3). In 2020, the total number of cattle, hogs, and sheep had increased to 7.0 million head, but the mix had changed significantly with fewer calves on farms and significantly more cattle on feed in Kansas feedlots.

Figure 3. Livestock inventory



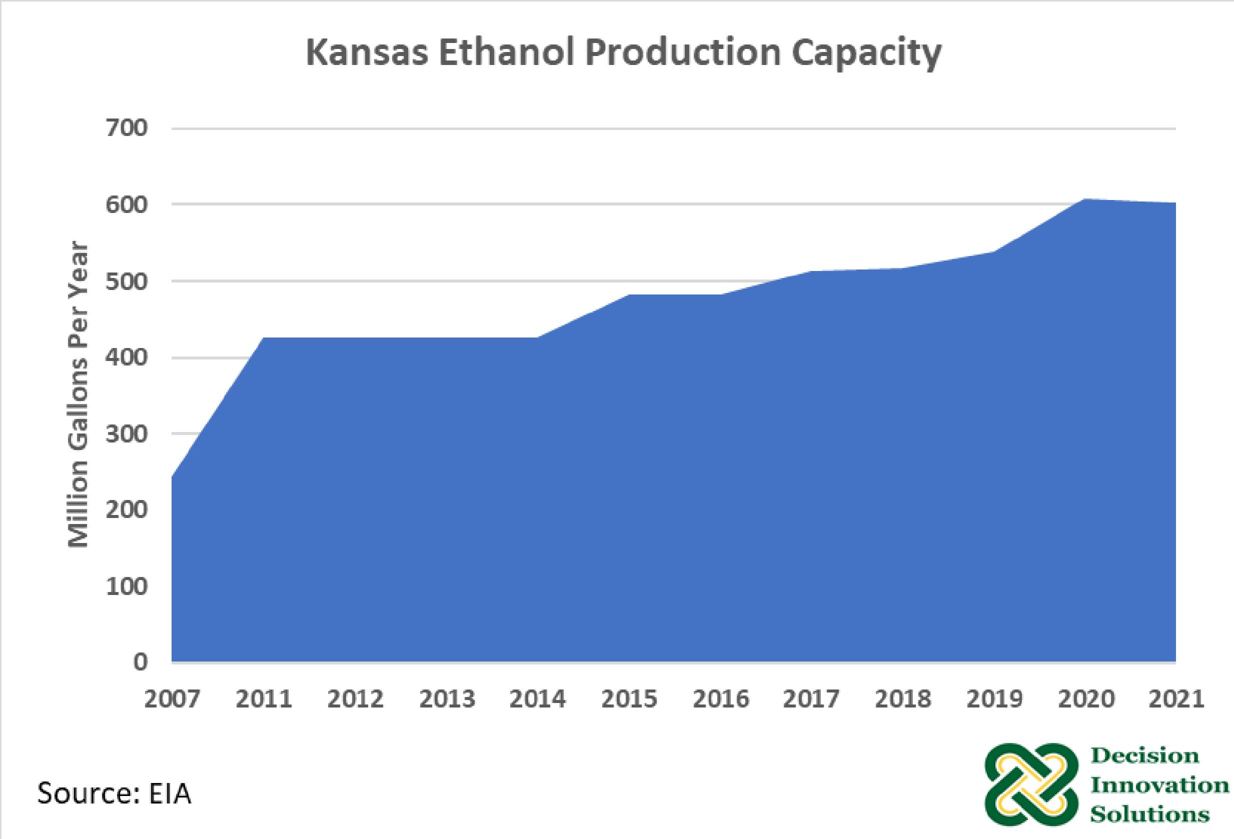
Dairy production is another avenue for adding value to crops and feed products in Kansas as well as providing opportunities for adding value through processing and product differentiation. In 1980, there were approximately 120,000 milk cows in Kansas producing 1.3 billion lbs of milk (Figure 4). In 2020, milk cow numbers had increased to 167,000 (an increase of 39% since 1980) whereas milk production has increased to 4 billion lbs (an increase of 203% since 1980). Increased production per cow is the leading driver of the overall increase in milk production.

Figure 4. Milk production and milk cows



Biofuels also play an important part of Kansas agricultural commodity and value-added production. Fuel ethanol production capacity is currently 603 million gallons per year (Figure 5) and uses corn, grain sorghum, and wheat starch as the feed stocks. Biodiesel production capacity in Kansas is currently at 60 million gallons per year.

Figure 5. Kansas ethanol production capacity



With such a rich history of commodity production during the last decades, it is imperative for Kansas farmers to have a clear understanding of such production trends, the intrinsic characteristics of commodity flows (e.g., origin-destination, volumes, transportation mode used, etc), and identify any potential challenges and areas of improvement aiming to increase the efficiencies of the stakeholders involved in the movement of commodities.

1.1 Objective

The objective of this study is to identify commodity markets and understand how these commodities (i.e., livestock, poultry, soybean, corn, grain sorghum, wheat, biofuels, biofuel co-products, etc.) flow from producers through markets to processors and other end users. This is done by analyzing the patterns, methods, and flow of commodities within and outside of Kansas. The study also identifies obstacles, bottlenecks, and challenges in the freight transportation system in Kansas and provide data for better understanding future transportation needs.

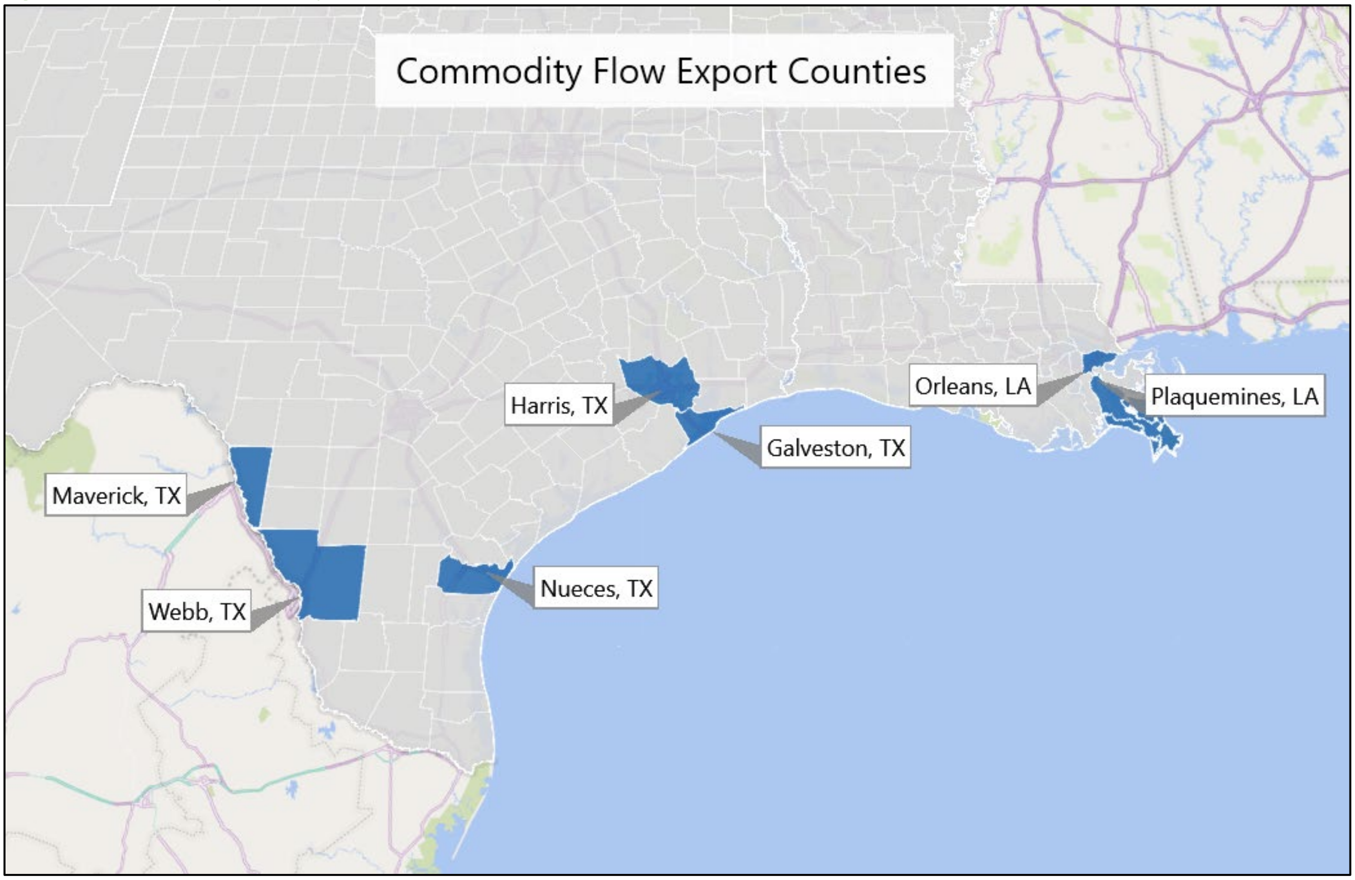
1.2 Report structure

This report is structured in ten (including this one) sections. ***Section 2*** presents the dynamic commodity flow for corn, grain sorghum, soybeans, wheat, and wheat middlings (midds). ***Section 3*** describes the dynamic crop and feed flow analysis and commodity volumes for local markets, including an assessment of the movement of commodities, market types, markets beyond initial purchaser, and secondary markets. ***Section 4*** presents the dynamic commodity flow for value-added processing, including: animal-based protein feed, pet food, livestock, poultry feed, grain milling, oilseed processing, biofuel, slaughterhouses, milk and dairy products, and elevators. ***Section 5*** describes the freight infrastructure and movement of commodities by transportation mode. ***Section 6*** presents an assessment of infrastructure described in Section 5, with emphasis on the Port of Catoosa in Tulsa, OK. ***Section 7*** analyzes the freight rates and aims to identify the most competitive alternatives for the movement of agribulk products. ***Section 8*** summarizes observations and market development opportunities. ***Section 9*** documents the economic impacts of public investment in infrastructure. ***Section 10*** documents the conclusions.

2 Dynamic commodity flow: grains and oilseeds

This section presents the outputs of our dynamic commodity flow for grains and oilseeds. Throughout the commodity flow analysis, commodity exports are modeled at border and port counties representing major points of entry and exit. Figure 6 shows all potential export counties inside the 11-state region.[2] The export counties used vary by commodity; not every county shown below is a designated export point for every commodity. The methodology for the dynamic commodity flow, including the allocation of imports and exports, is contained in *Appendix A: Methodology*.

Figure 6. Commodity Flow Export Counties

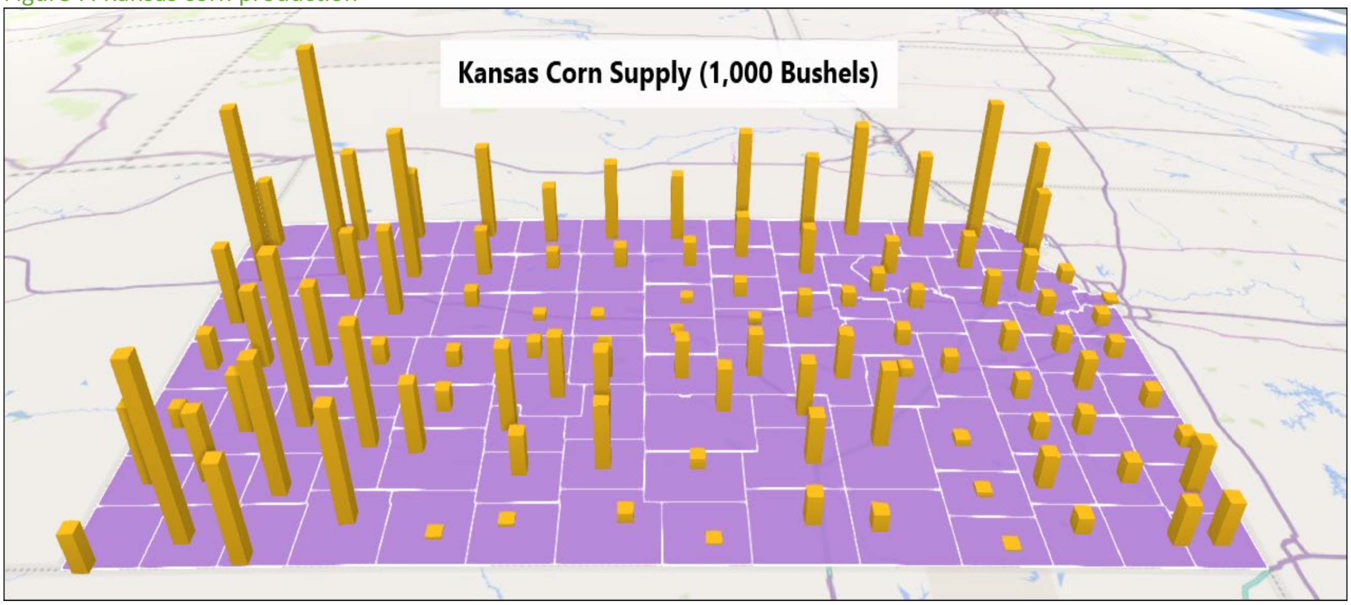


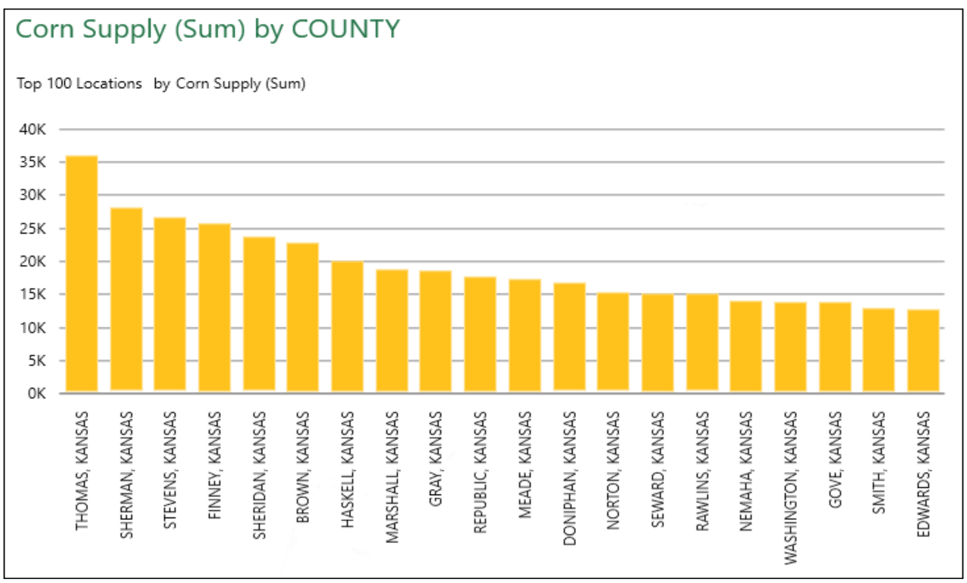
[2] The 11-state region includes Kansas, Illinois, Iowa, Nebraska, Missouri, Arkansas, Louisiana, Texas, Oklahoma, Colorado, and New Mexico.

2.1 Corn

Kansas is a net corn supplier to other states. Kansas produces 650 million to 800 million bushels of corn annually, with the most-current 5-year average being 726 million bushels. The value of the Kansas corn crop has varied between $2.2 billion to more than $4.0 billion, with the most recent 5-year average being $2.9 billion. Every county in Kansas produces corn, and there is also demand for corn in every county. Figure 7 shows the 2020 relative level of corn production by county in Kansas. The leading counties were: Thomas (36.2 million bu.), Sherman (28.2 million bu.), Stevens (26.7 million bu.), Finney (25.9 million bu.), and Sheridan (23.8 million bu.).

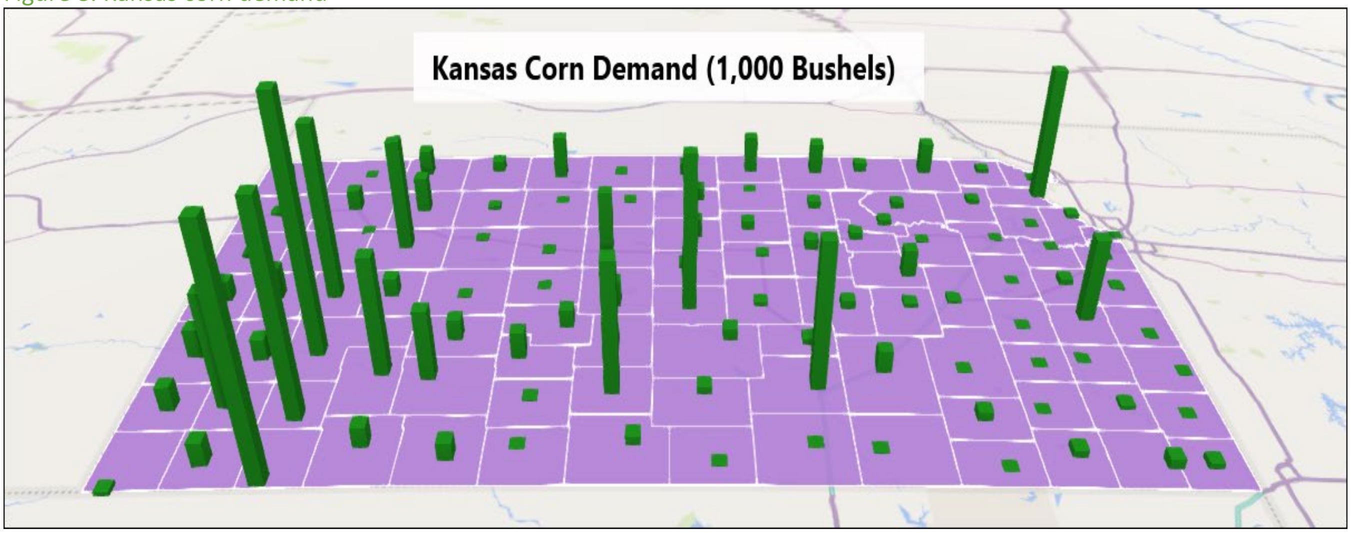
Figure 7. Kansas corn production

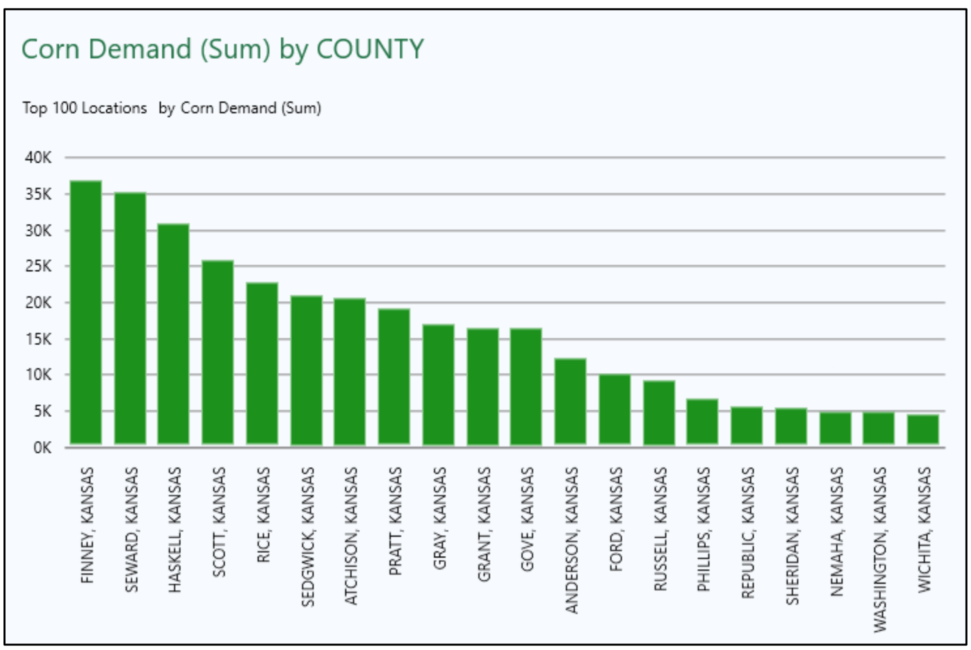




Total corn demand in Kansas in 2020 was 427.2 million bushels (Figure 8). Demand for corn in Kansas is driven by livestock feed demand (33% of Kansas corn) and processing demand (21%), with 46% of Kansas corn shipped out of state. Marketing patterns for corn were affected by COVID-19 with some disruptions to livestock production and ethanol processing in mid-2020 but were coupled with a very strong export market materializing in the latter part of 2020. This likely resulted in slightly less corn being used domestically than normal and more corn being moved to export ports. By the onset of the 2021-22 marketing year, USDA is projecting a moderate decline in corn exports for the 2021-22 marketing year and upticks in the amount of domestic corn usage.

Figure 8. Kansas corn demand

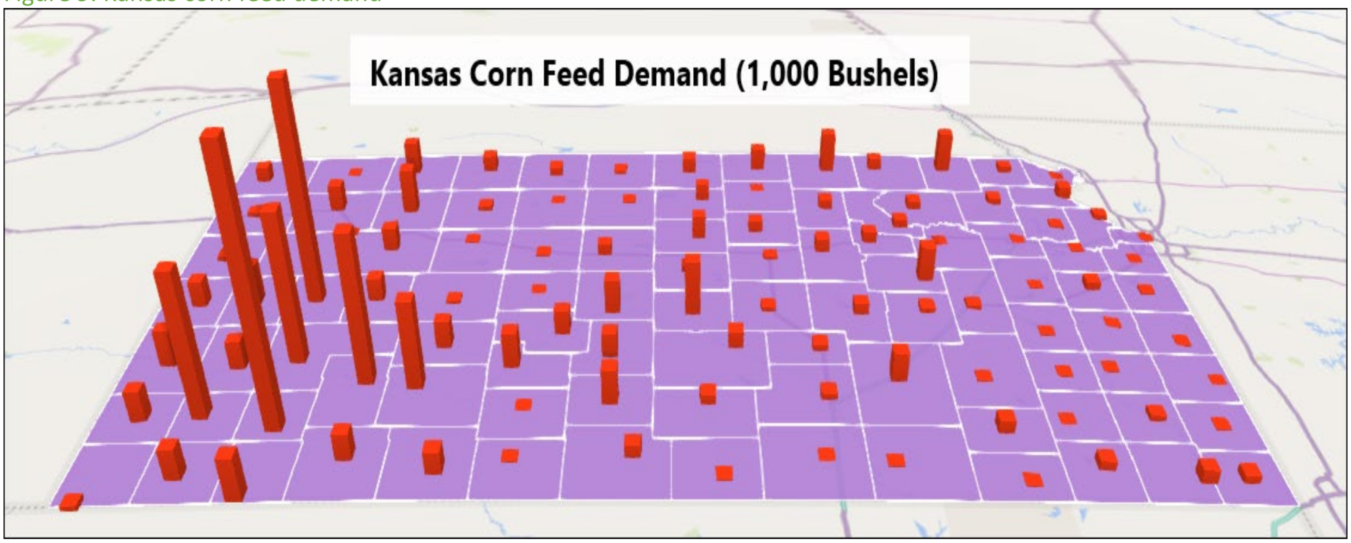


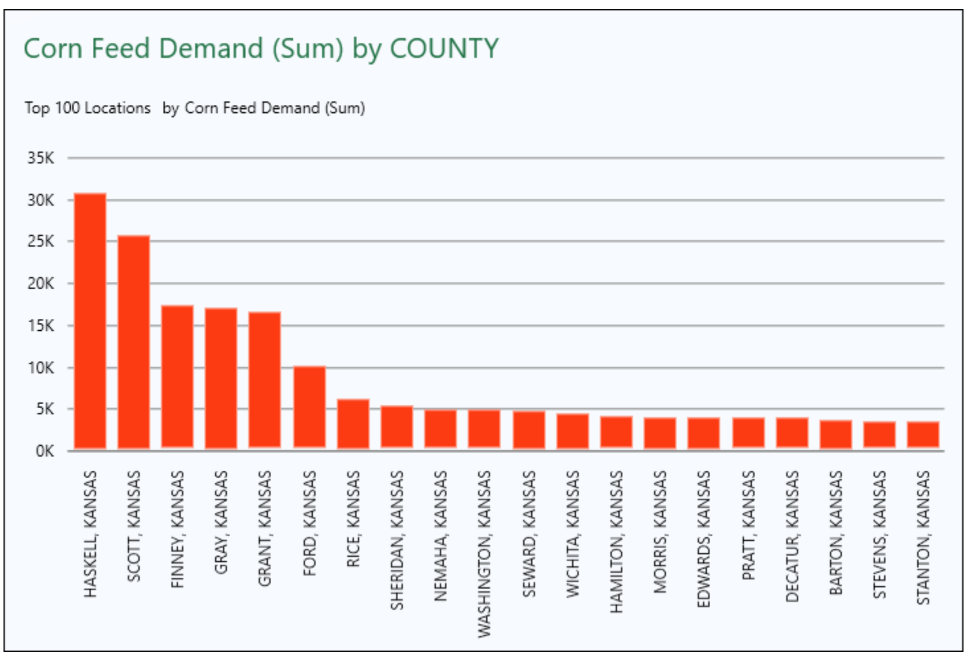


Total corn feed demand in Kansas in 2020 was estimated to be 263 million bushels (Figure 9). A significant portion (80%) of the feed demand is for beef cattle feeding; 4% is for dairy cows; 13% is for hog feeding; 2% for pet food manufacturing; and 1% for poultry feeding.

COVID-19 had mixed impacts on livestock feeding in 2020. Delays in marketings of fed cattle resulted in cattle remaining on-feed for longer periods than normal but also resulted in heavier placement weights for cattle entering feedlots. The net effect was a 1-2 percent increase in feed demand by cattle on-feed. Disruptions to hog marketings resulted in more feed being consumed per marketed hog in the first half of 2020, but adjustments in hog farrowings reduced feed demand for hogs in the last half of 2020, with only a minor impact on hog feed demand for the full year. Poultry producers were able to react quicker to COVID-19 induced market disruptions and feed demand from broiler and turkey feeding were down for 2020 compared to a “normal” year.

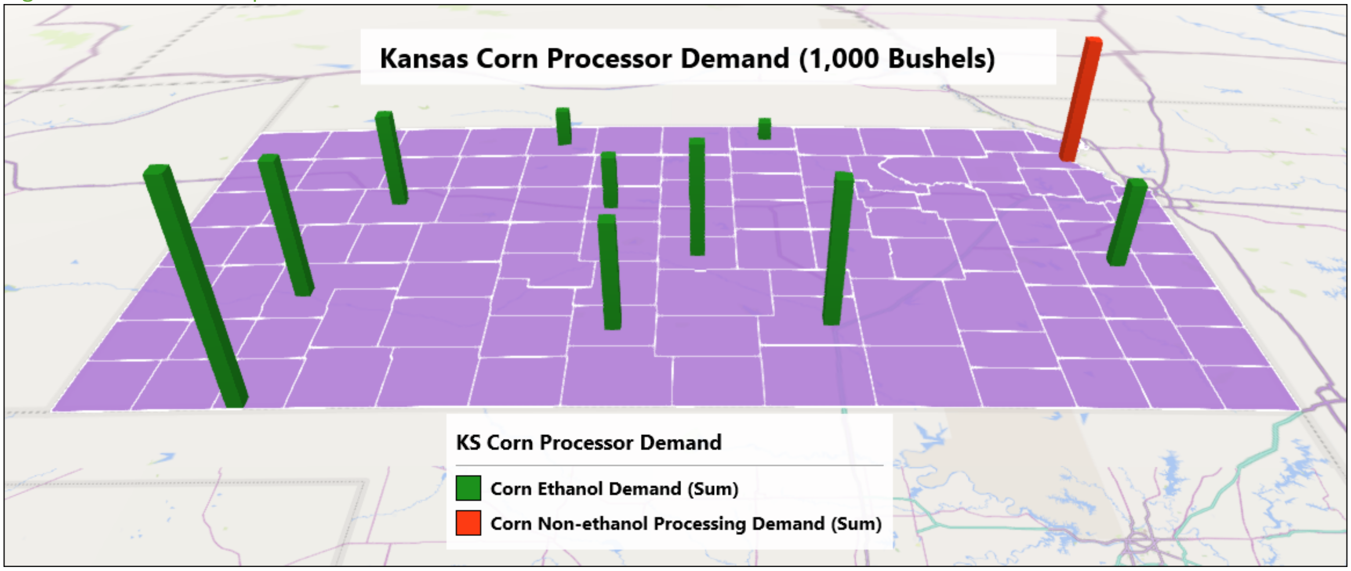
Figure 9. Kansas corn feed demand

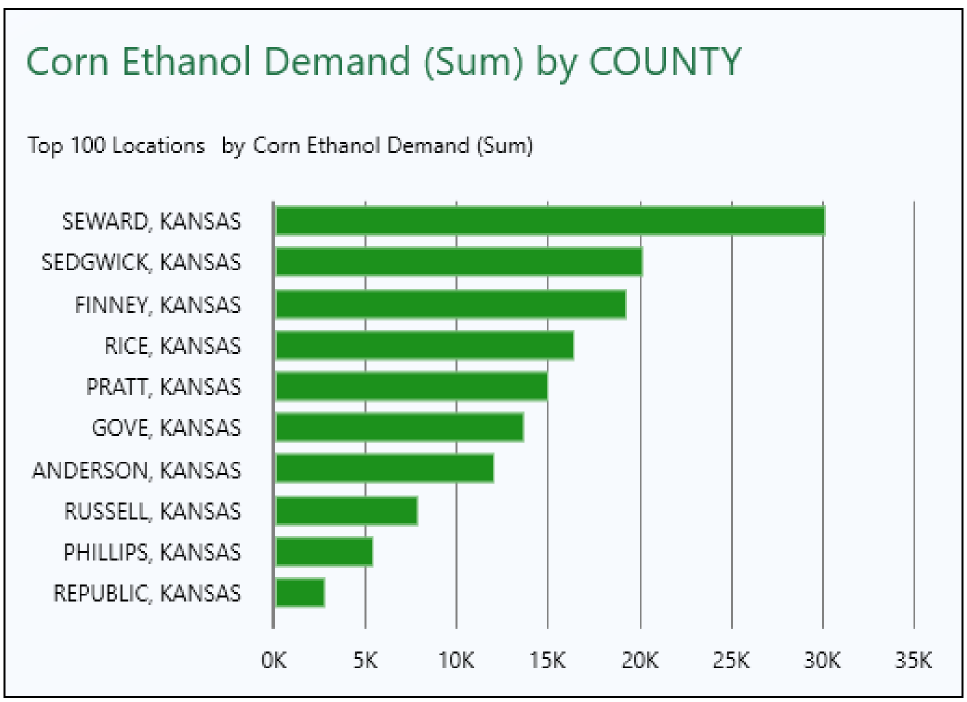


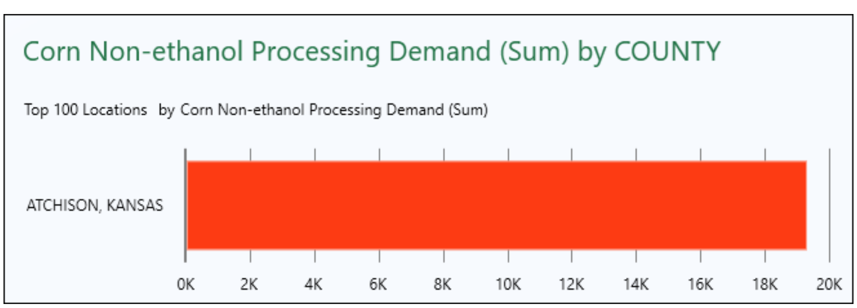


Processor demand for corn in Kansas during 2020 came from 11 ethanol plants that processed corn for ethanol and one non-ethanol corn processor. There is one ethanol plant in Kansas that uses only grain sorghum for ethanol production, three that can use corn or grain sorghum depending on market conditions, and one that produces ethanol from a combination of wheat starch and either corn or grain sorghum. In 2020, it is estimated that 163.7 million bushels of corn were used by corn processors in Kansas with 144.4 million bushels being used for ethanol production (Figure 10). COVID-19 had a negative impact on gasoline consumption in 2020 and thus a negative impact on ethanol demand and production. USDA projects corn processing for ethanol in the 2021-22 marketing year will be 8% higher than it was in the 2019-20 marketing year.

Figure 10. Kansas corn processor demand

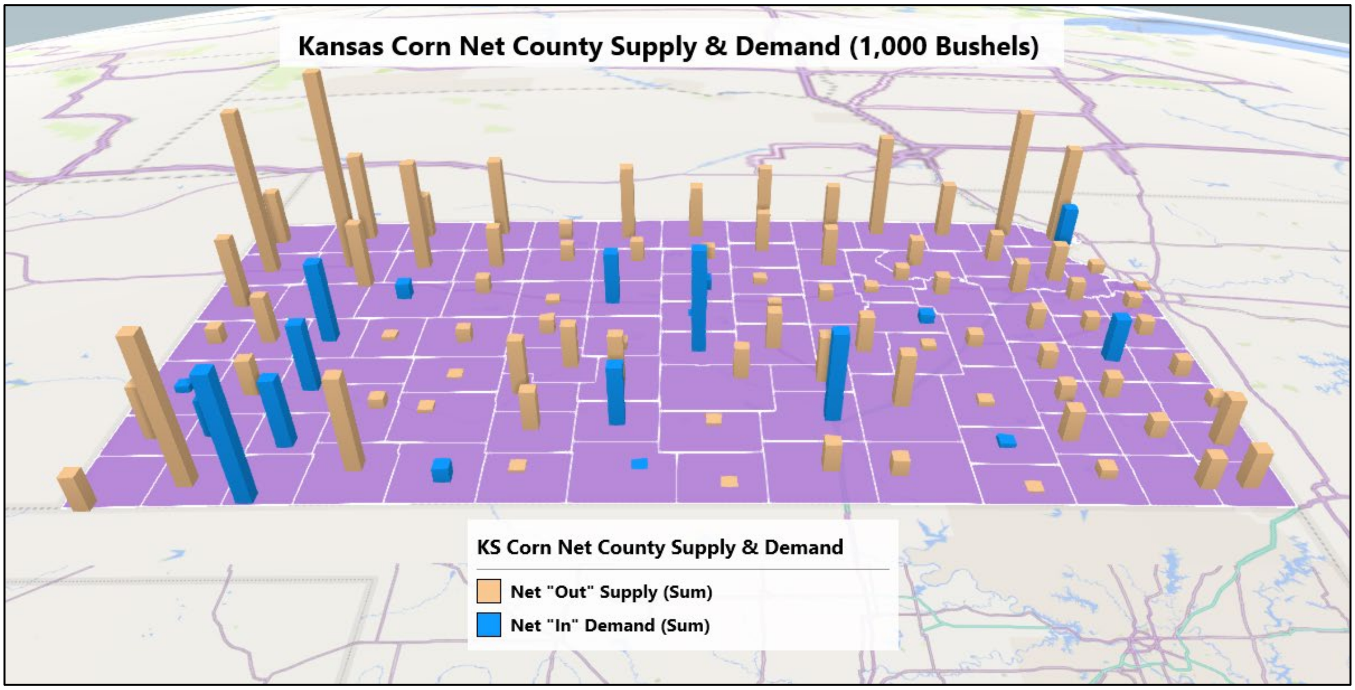


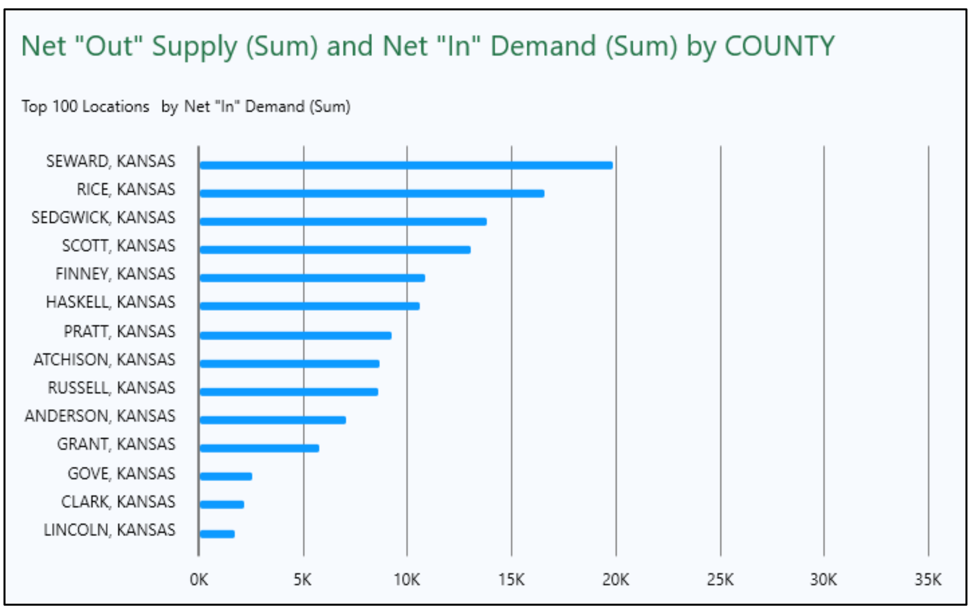


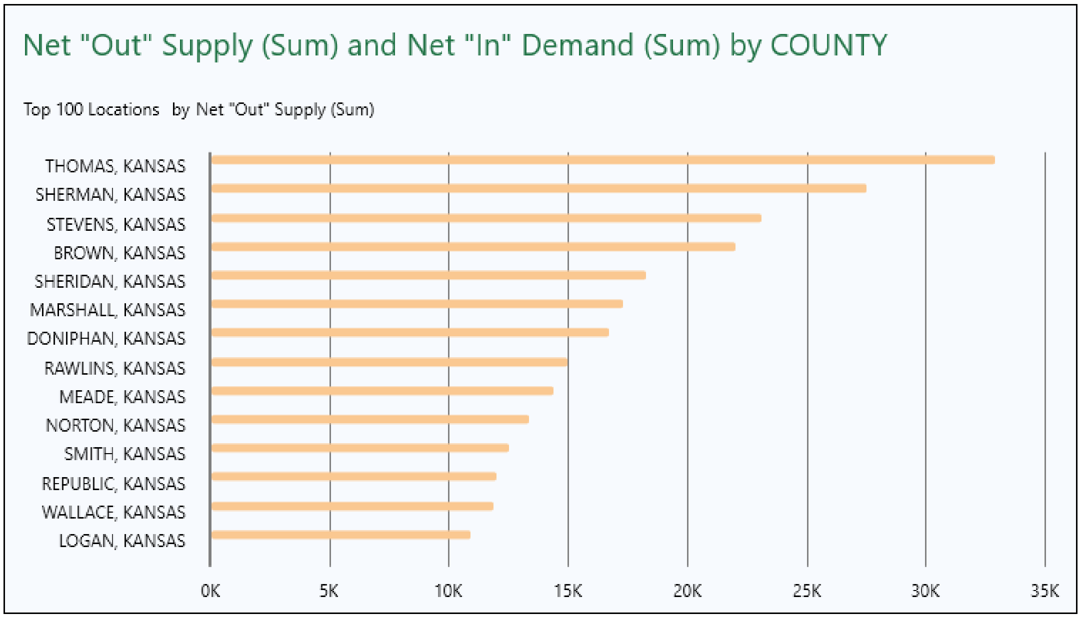


There are 16 counties in Kansas that use more corn than they produce with 6 of those having "inflow" demand of 10 million or more bushels of corn per year. There are 89 counties in Kansas that have net "outflows" of corn with 15 counties having outflows of 10 million or more bushels of corn per year (Figure 11).

Figure 11. Kansas corn net county supply & demand

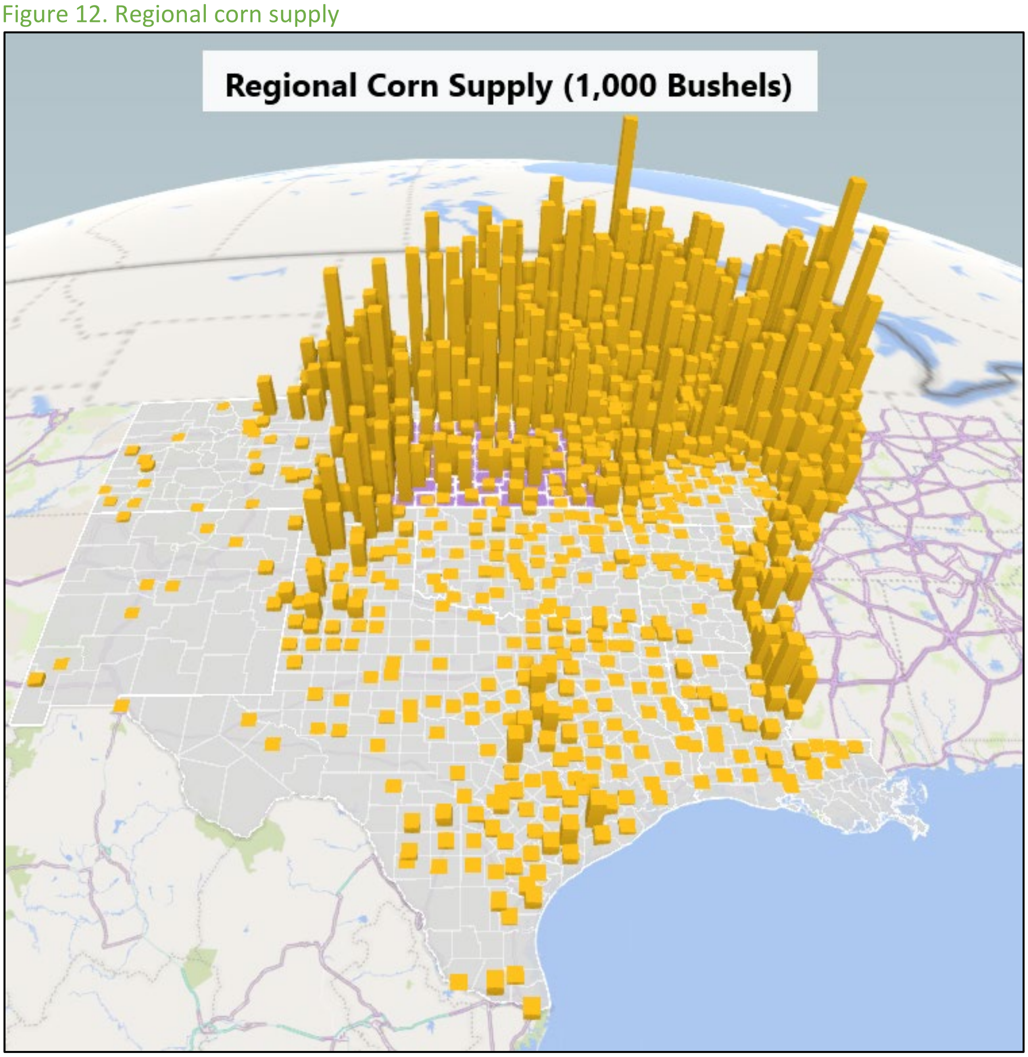






Kansas is part of a regional corn supply system in which corn flows from corn surplus areas to corn deficit areas. Figure 12 shows how Kansas compares and fits in as part of the regional corn supply. Kansas is a transition state with regards to corn production. There are many counties south of Kansas that have net inflow needs for corn.

Figure 12. Regional corn supply



In the 11-state region, total corn processing demand is 3.5 billion bushels. Kansas accounts for 4.7 percent of regional processing demand (Figure 13).

Figure 13. Regional corn processing demand

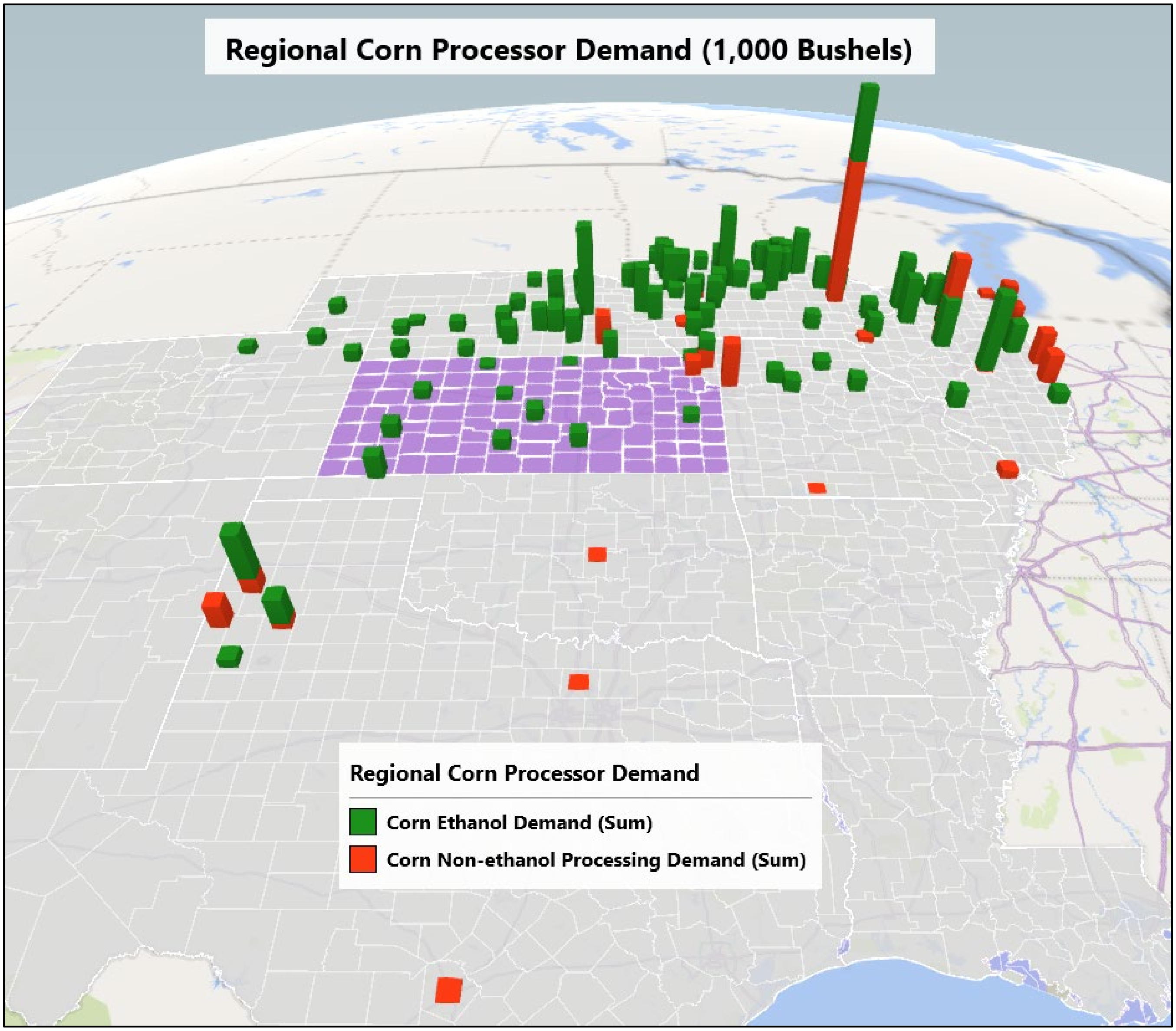
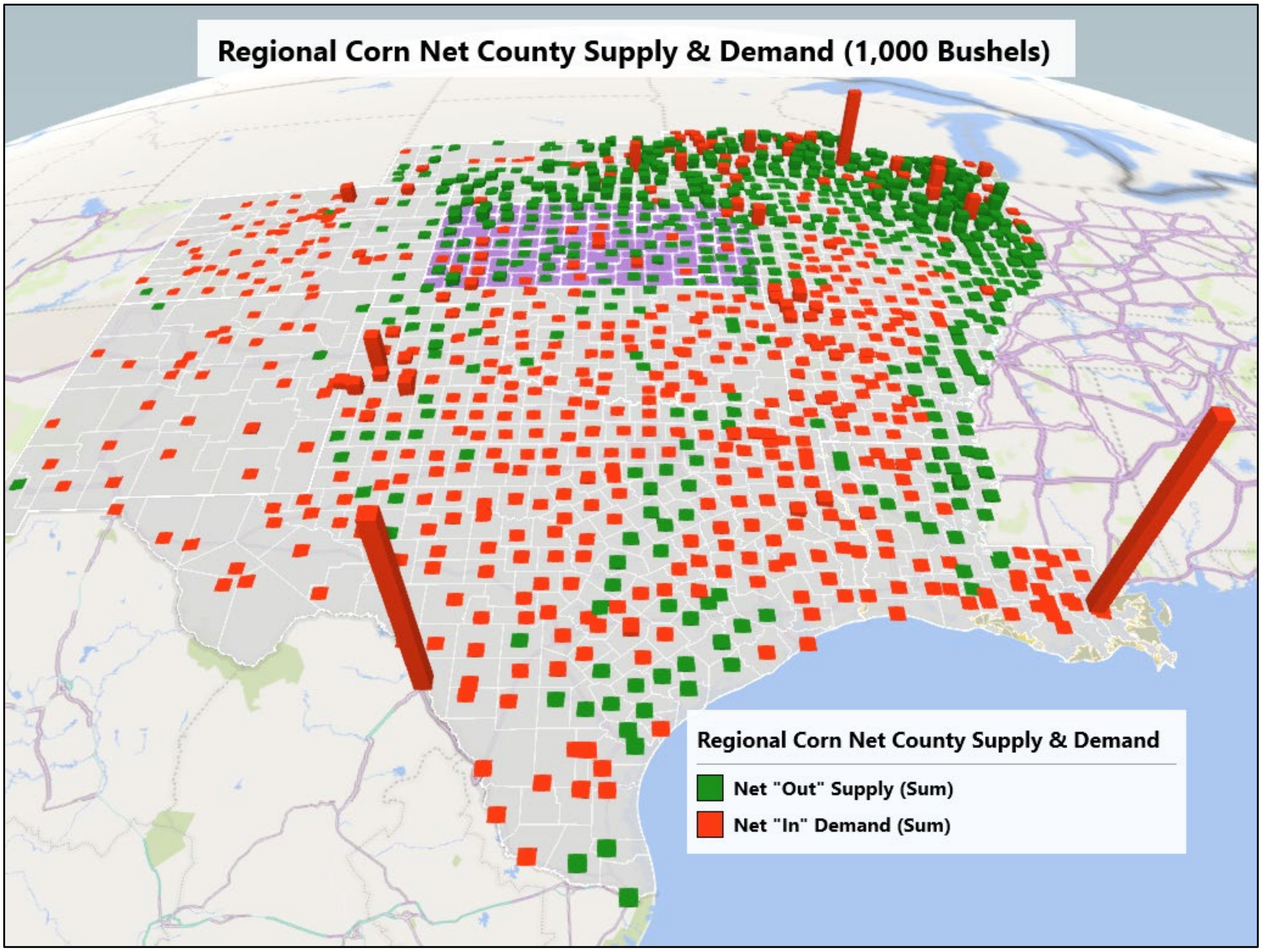


Figure 14 shows the summary of net corn supply and demand at the county level for the 11-state region. In general, a greater density of counties with surplus corn are situated north and east of Kansas and more counties that are deficit of corn supplies lie south and west of Kansas. Thus, Kansas becomes a significant source of corn for the corn-deficit counties situated south and west of Kansas. The two large demand points in Louisiana and Texas represent export demand through the Mississippi River ports and rail to Mexico.

Figure 14. Regional corn net county "in" and "out" movement



2.1.1 Corn flow

Table 1 summarizes the regional movement of corn. Kansas uses 388.1 million bushels of its own corn and sees movement of corn into Kansas from Missouri (250,000 bu.), Nebraska (38.9 million bu.), and Oklahoma (150,000 bu.). Figure 16 shows the counties that supply corn to Kansas.

Kansas sends corn to Arkansas (14.9 million bu.), Colorado (21.4 million bu.), Missouri (62.3 million bu.), Nebraska (7.2 million bu.), New Mexico (2.0 million bu.), Oklahoma (47.3 million bu.), Texas (219.1 million bu.), and areas outside the 11-state region (60.3 million bu.). Figure 15 shows the counties that receive corn from Kansas.

Table 1. Summary of regional corn movement (1,000 bushels)

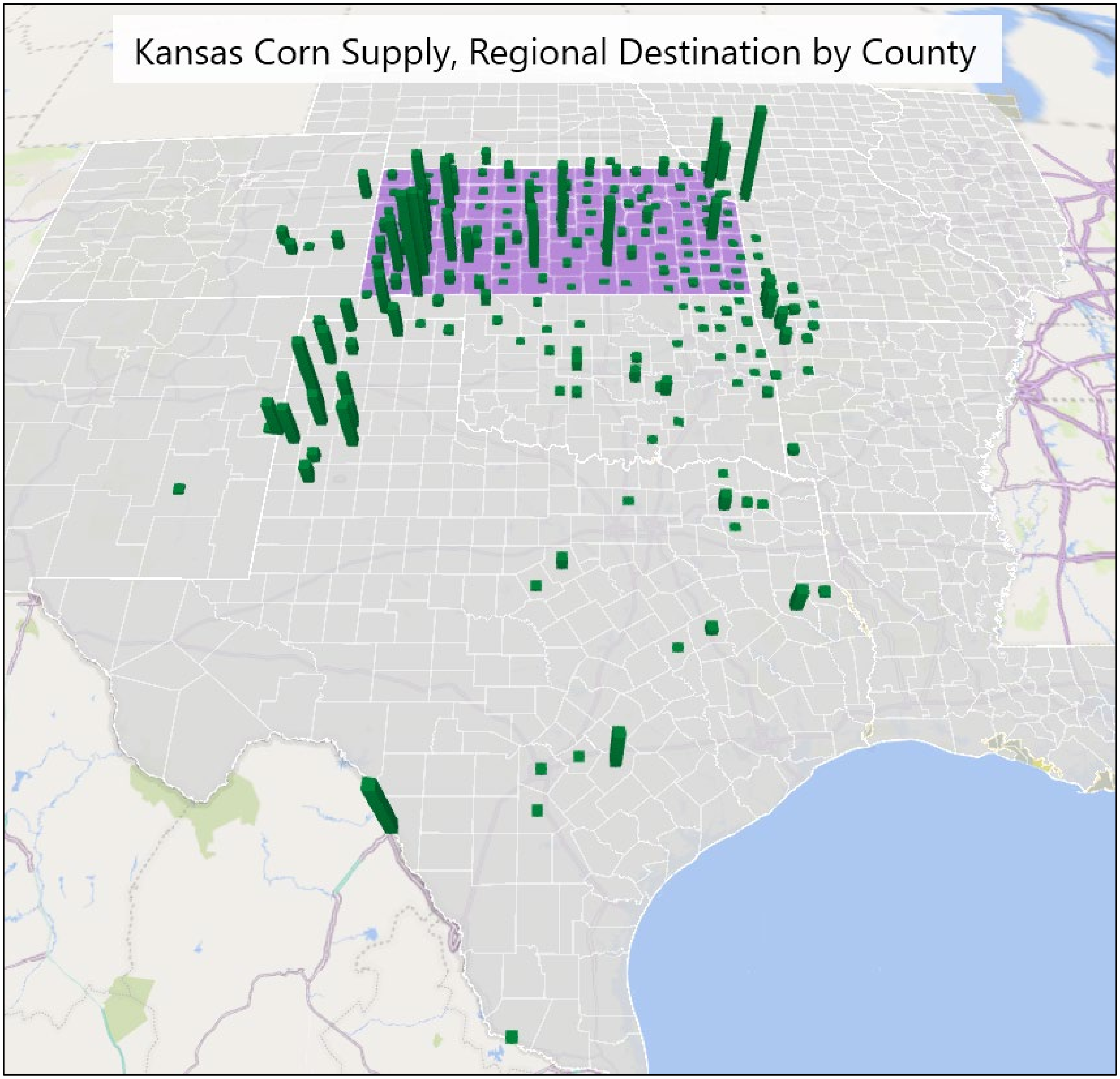
Summary of Regional Corn Movement (1,000 bu.)

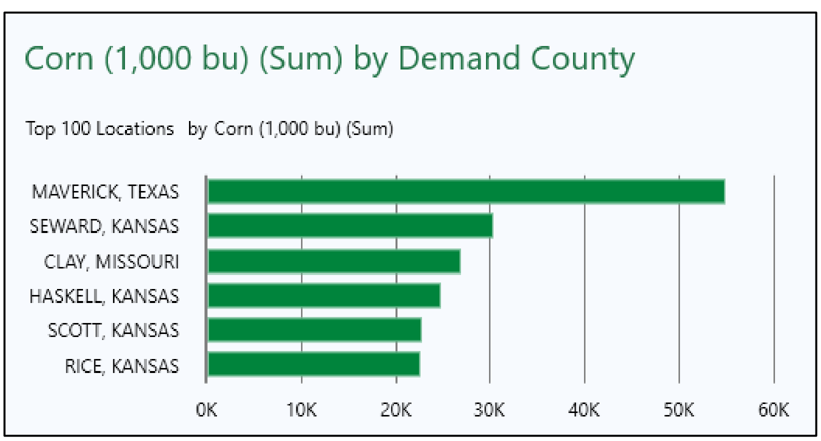
	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	112,300	-	-	-	-	2,850	200	-	-	2,100	11,400	-	128,850
CO	-	77,800	-	-	-	-	-	1,950	150	-	1,000	72,650	153,550
IA	2,350	-	2,092,350	1,600	-	-	9,150	13,050	-	-	268,550	220,250	2,607,300
IL	-	-	30,500	861,800	-	578,850	3,200	-	-	-	49,250	459,100	1,982,700
KS	14,900	21,350	-	-	388,050	-	62,250	7,200	2,000	47,300	219,050	60,250	822,350
LA	1,950	-	-	-	-	28,900	-	-	-	-	31,500	29,900	92,250
MO	67,650	-	4,550	900	250	32,350	342,750	250	-	-	56,200	1,200	506,100
NE	-	119,850	1,250	-	38,850	-	1,550	963,550	-	19,350	378,300	331,600	1,854,300
NM	-	50	-	-	-	-	-	-	5,000	-	250	1,550	6,850
OK	1,200	300	-	-	150	-	50	-	2,050	23,250	12,550	6,800	46,350
TX	200	-	-	-	-	-	-	-	16,250	9,400	225,000	26,800	277,650
Out of Region	16,100	150	72,600	35,000	-	22,500	1,550	2,900	750	-	10,500		162,050
Total	216,650	219,500	2,201,250	899,300	427,300	665,450	420,700	988,900	26,200	101,400	1,263,550	1,183,300	8,640,300

Notes: Read down to see where a state gets its corn. Read across to see where a state's corn goes for feed, processing, or export.

Kansas corn flows to every county within the state, and 47% of the corn produced in Kansas is used in the state. Kansas corn also flows to Arkansas (1.8%), Colorado (2.6%), Missouri (7.6%), Nebraska (0.9%), New Mexico (0.2%), Oklahoma (5.8%), Texas (26.6%), and to a few locations outside the region (7.3%). The single largest demand point for Kansas corn is corn destined for export to Mexico, represented on the map in Figure 15 by Maverick County, Texas.

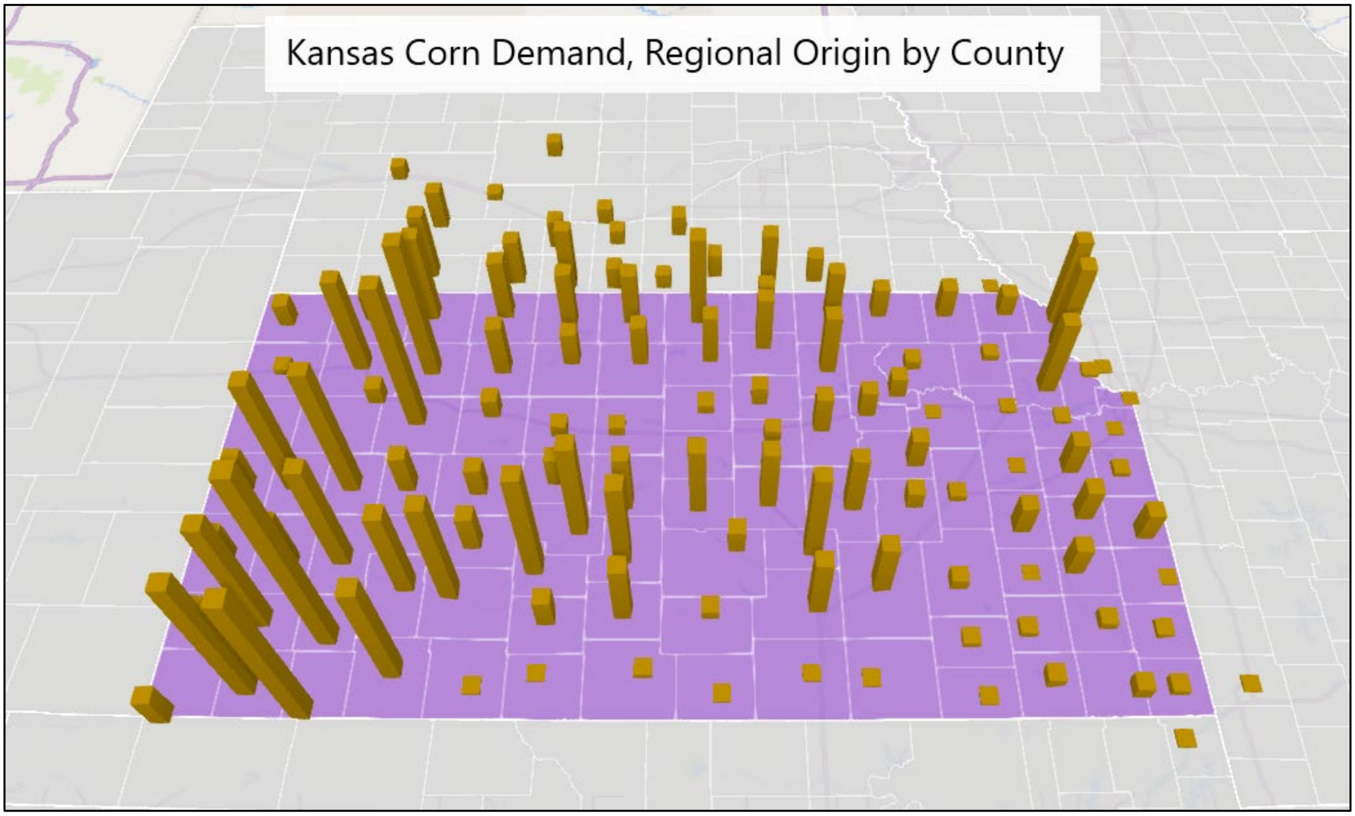
Figure 15. Kansas corn supply, regional destination by county





Kansas is the source of 89% of the corn used in Kansas; 10% comes from Nebraska (Figure 16).

Figure 16. Kansas corn demand, regional origin by county



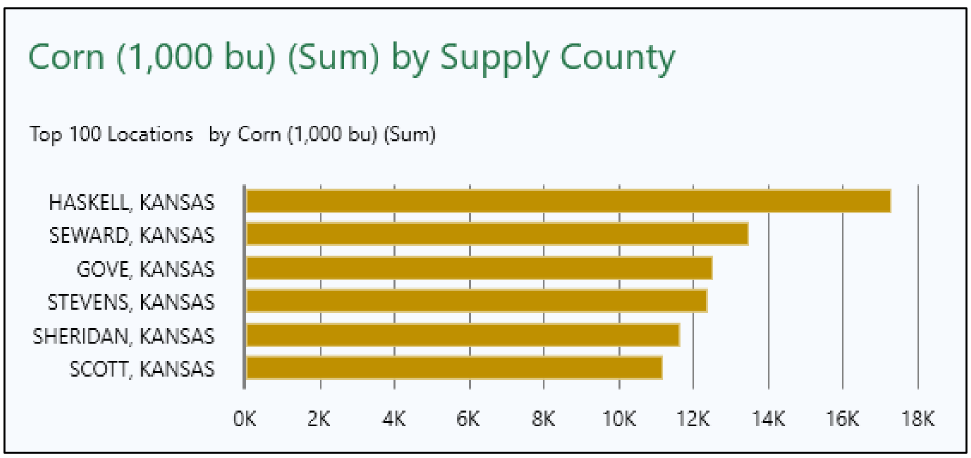
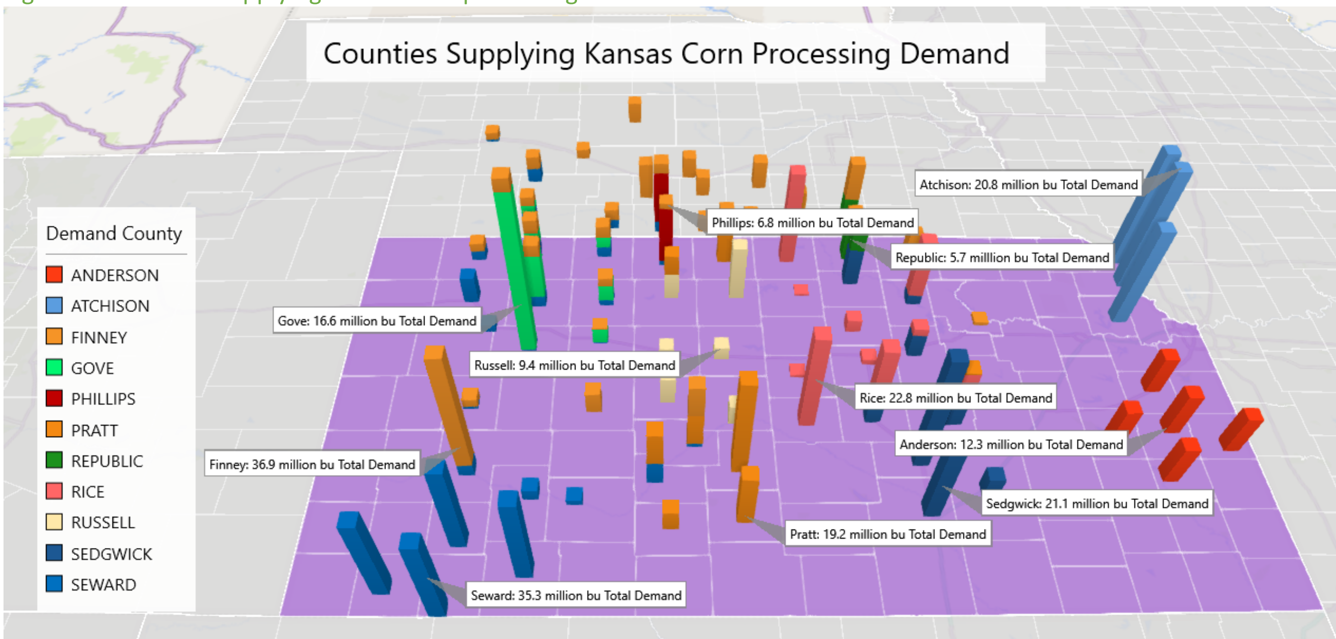


Figure 17 shows the flow of corn to the counties that have corn processing facilities. As shown, there are 11 corn processing demand points in Kansas (see Figure 10 for additional detail on type of corn processing facility).

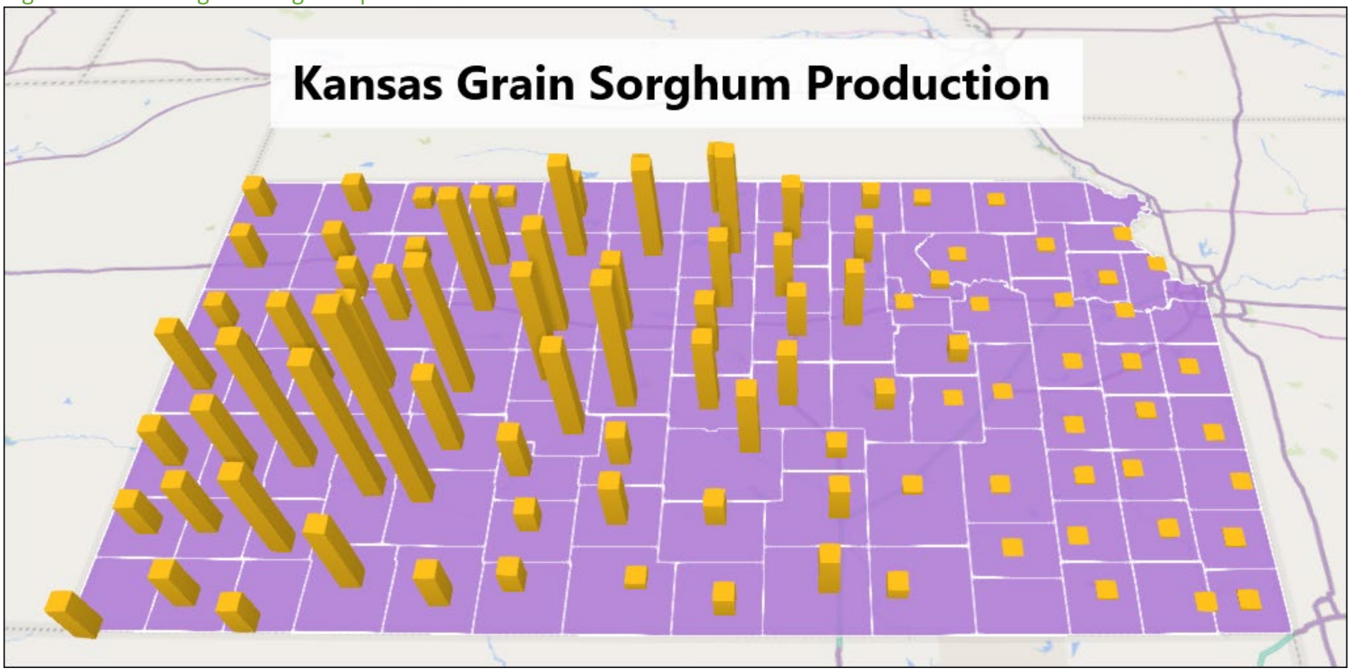
Figure 17. Counties supplying Kansas corn processing demand

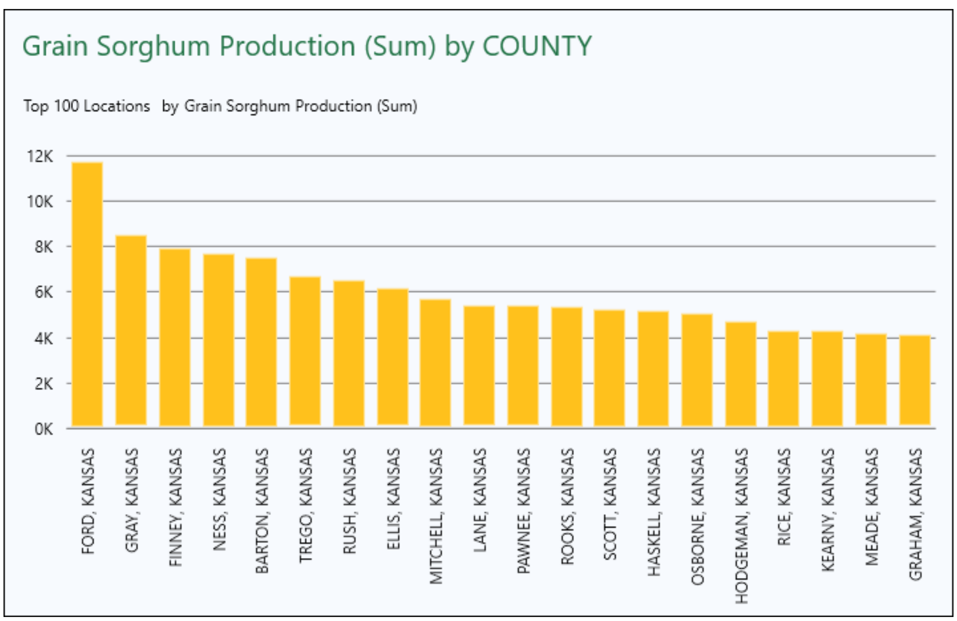


2.2 Grain sorghum

Grain sorghum is produced in most counties in Kansas (Figure 18). Production in 2020 was 231 million bushels, which is 61 percent of total U.S. production. The largest production areas are in the western crop reporting districts and in central and northcentral Kansas.

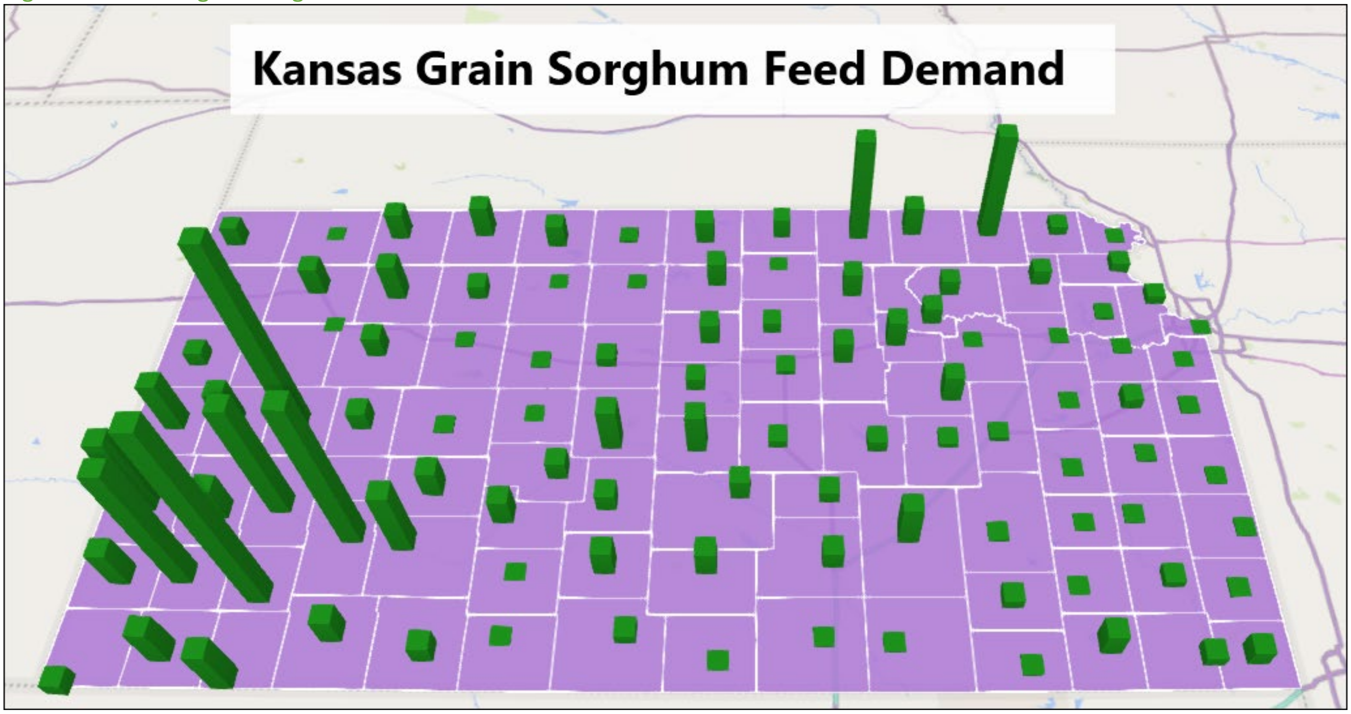
Figure 18. Kansas grain sorghum production

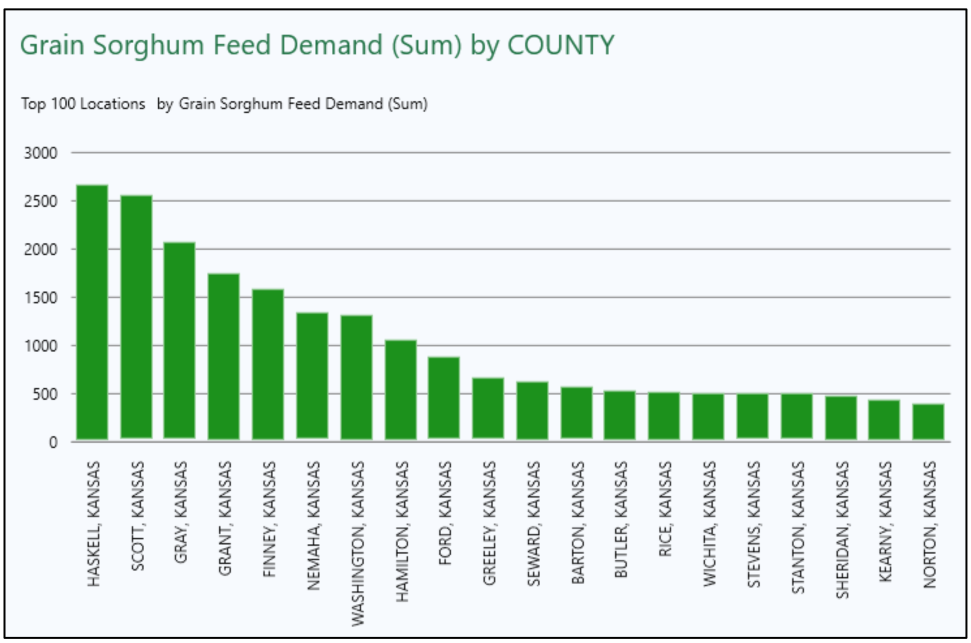




In 2020, Kansas used 32.3 million bushels of grain sorghum for feed which was 14 percent of Kansas grain sorghum production (Figure 19). Two percent of grain sorghum was for beef cows and calves, 11 percent for dairy cows, 56 percent for cattle on feed, 3 percent for breeding hogs, 28 percent for market hogs, and negligible amounts for other species.

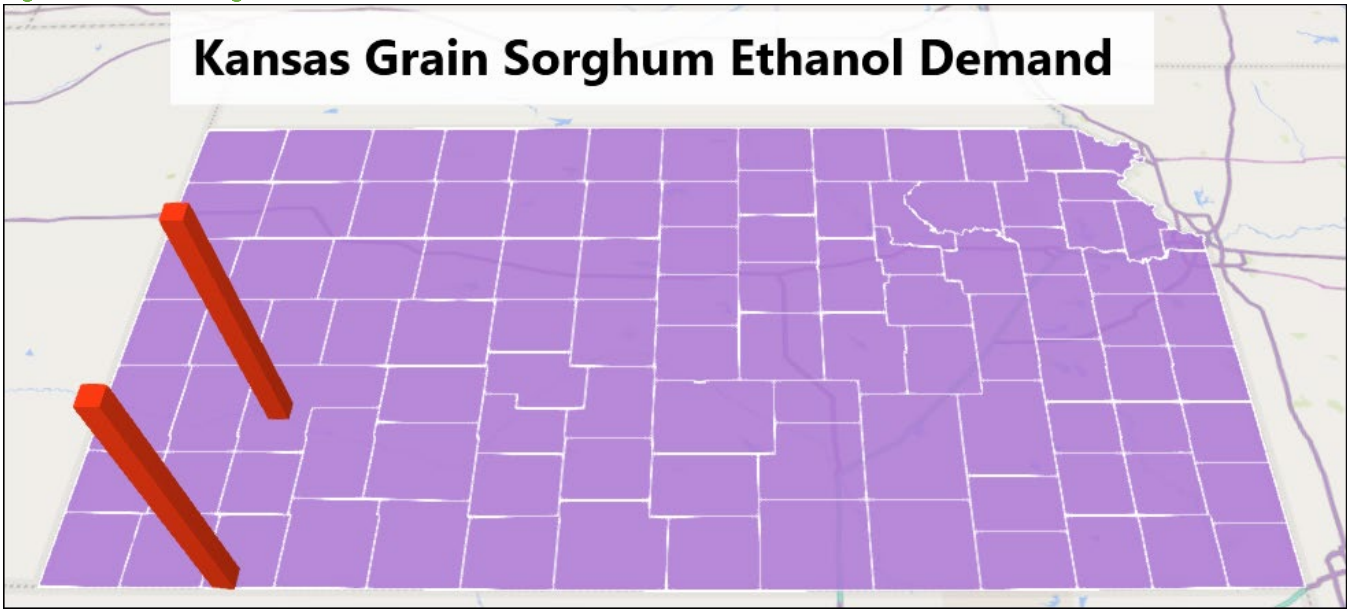
Figure 19. Kansas grain sorghum feed demand

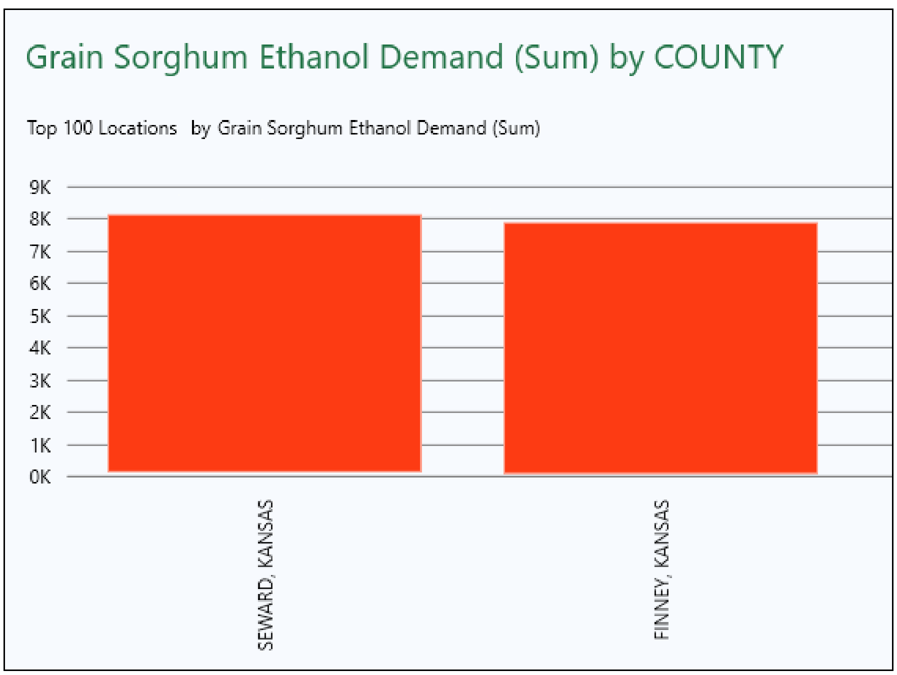




There are 5 ethanol plants in 4 counties in Kansas that may include grain sorghum as part of their input supply resources. However, in 2020, only three of these plants (located in two counties) used grain sorghum due to reduced supplies of grain sorghum and prices for grain sorghum that were sometimes higher than corn due to strong export demand. In 2020, it is estimated that 16.1 million bushels of grain sorghum were used for ethanol production in Kansas (Figure 20).

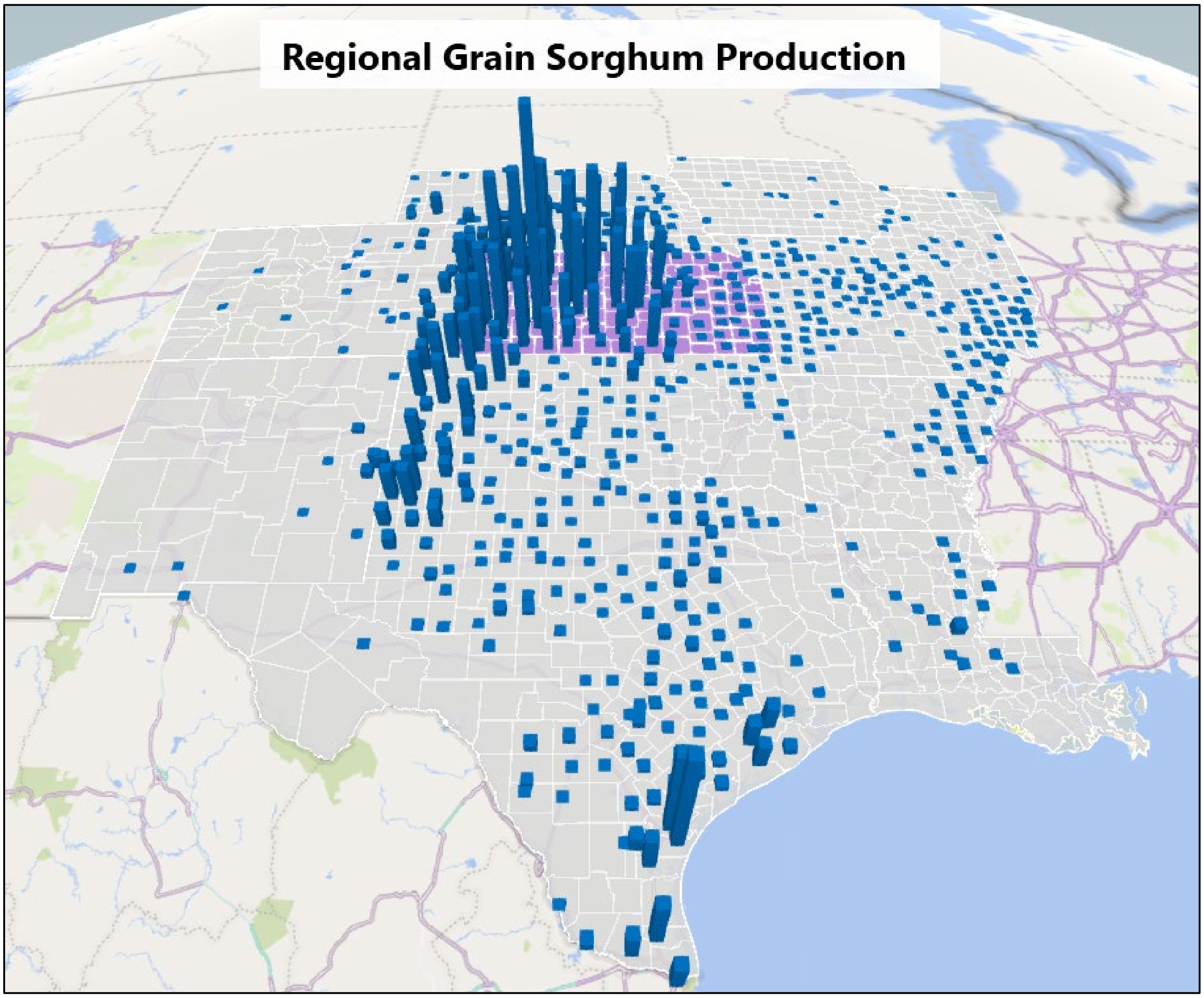
Figure 20. Kansas sorghum ethanol demand

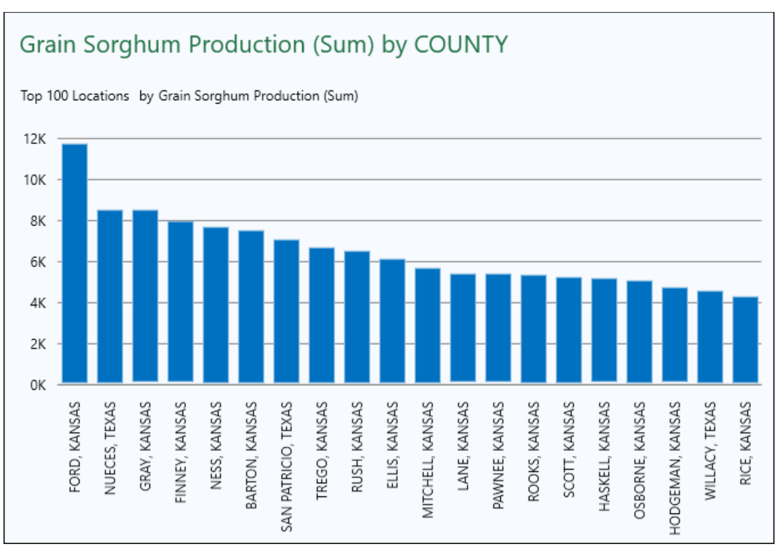




While Kansas dominates regional grain sorghum production, accounting for 65 percent of regional grain sorghum production, grain sorghum is produced in 585 counties within the 11-state region (Figure 21). Ford County, Kansas leads the region (and the nation) in grain sorghum production with more than 12 million bushels of production. Other leading Kansas counties for grain sorghum production are Gray, Finney, Ness, and Barton.

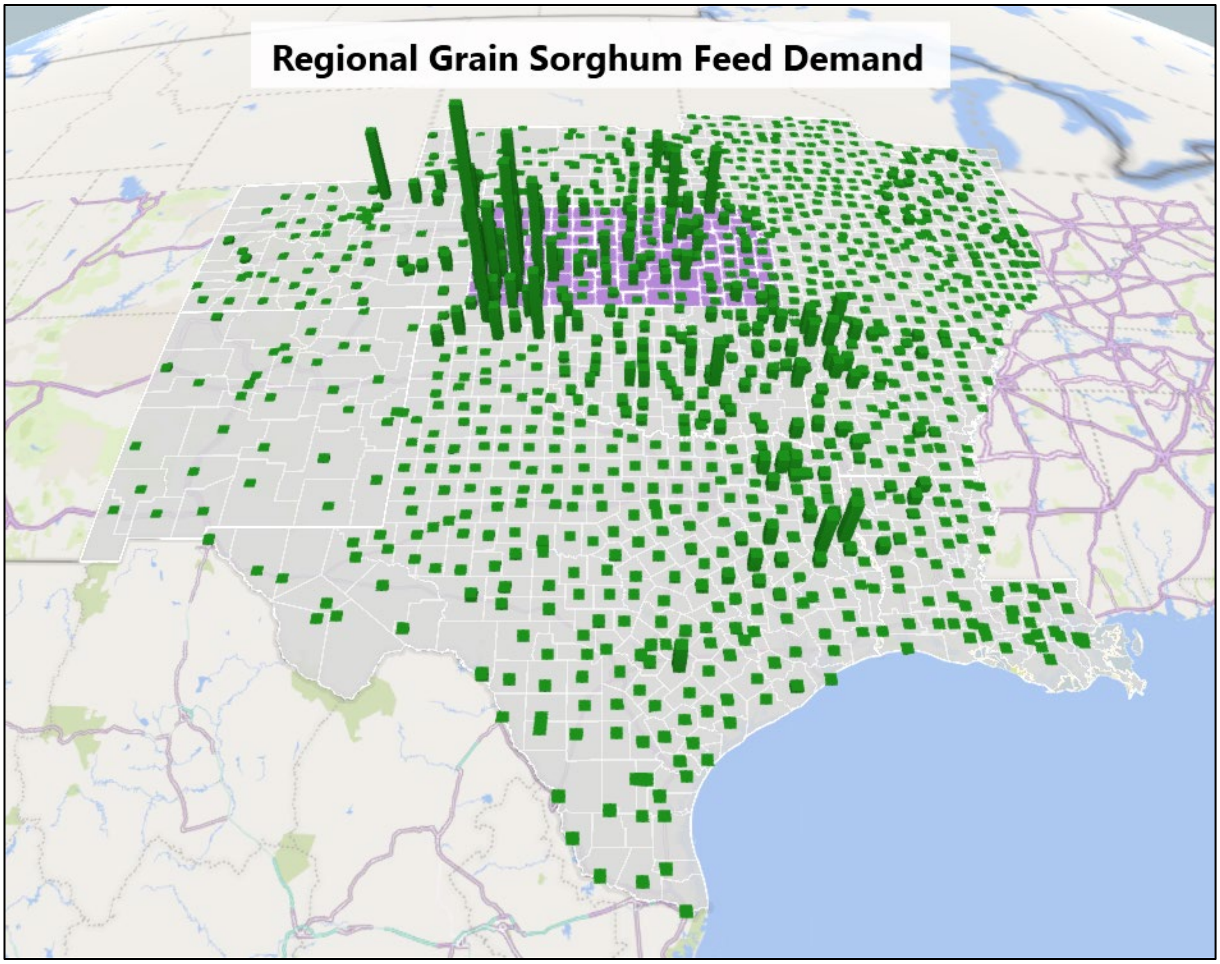
Figure 21. Regional grain sorghum production

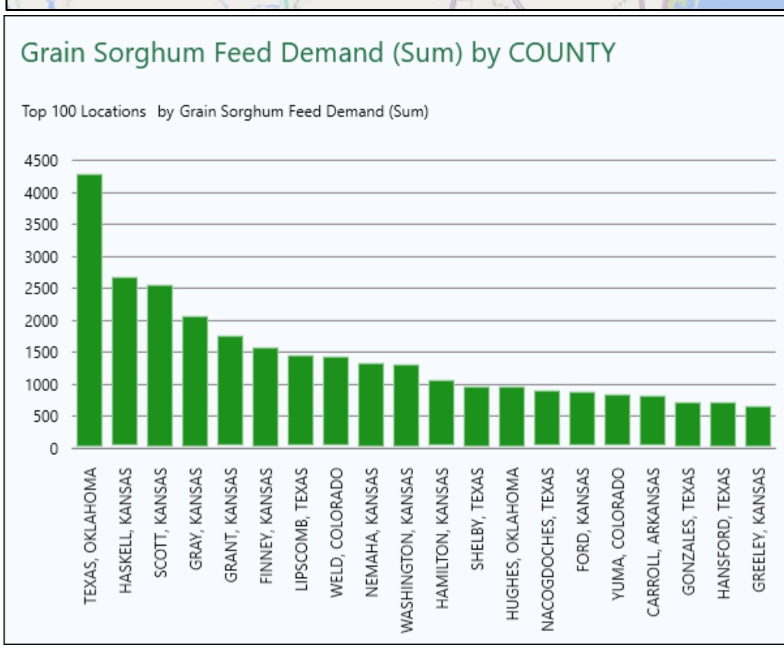




Kansas accounts for 38 percent of regional grain sorghum feed demand; Oklahoma (20%), Texas (16%), Arkansas (8%), and Nebraska (5%) make up most of the rest of feed demand for grain sorghum as the remaining 13% of grain sorghum feed demand is spread among the other 6 states in the 11-state region. While Texas County, Oklahoma leads in total grain sorghum feed demand, the Kansas counties of Haskell, Scott, Gray, Grant, and Finney are the next five in order of feed demand (Figure 22).

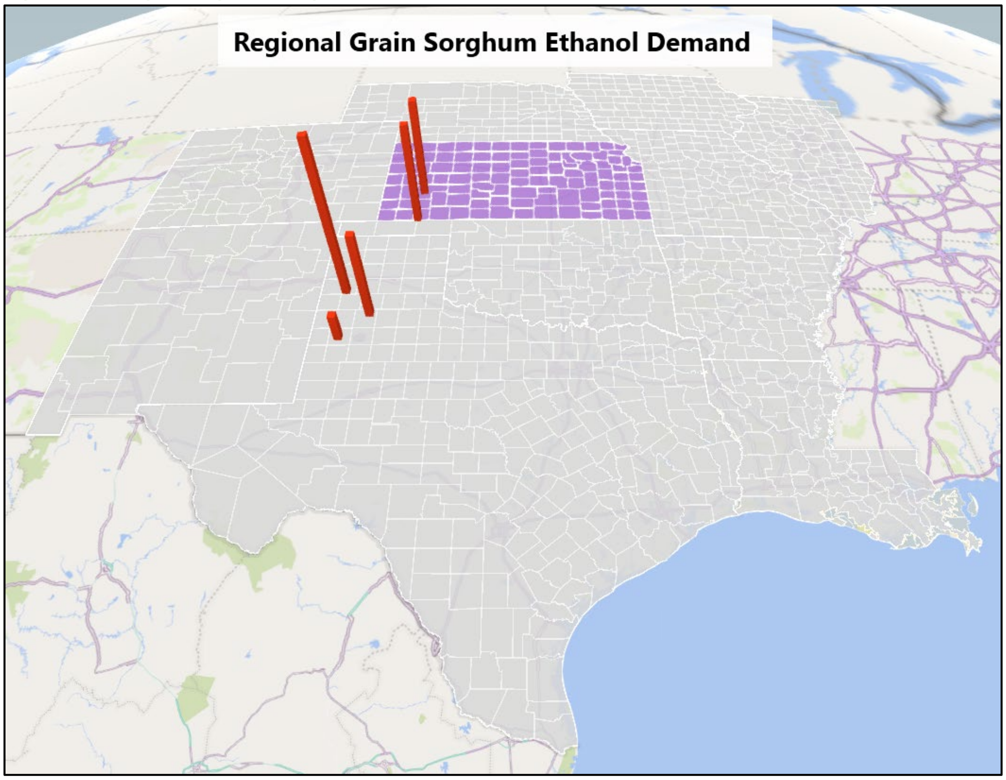
Figure 22. Regional grain sorghum feed demand

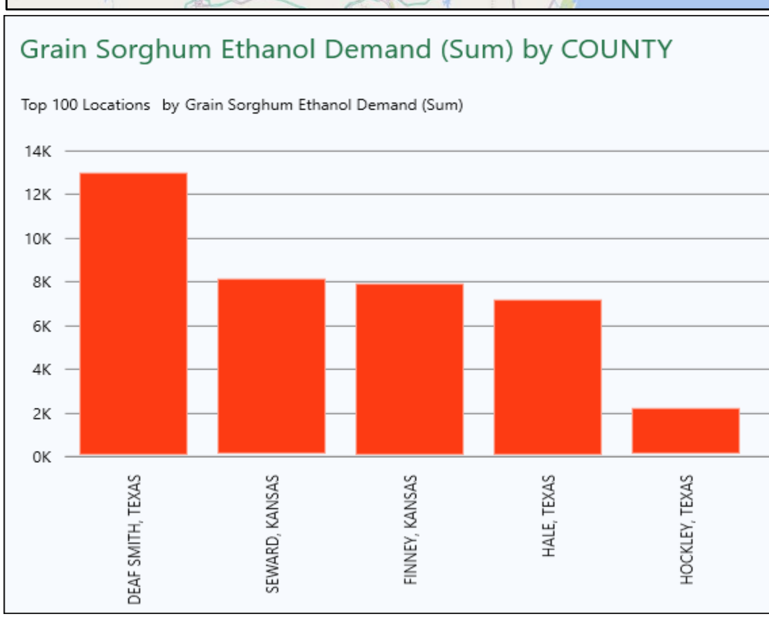




In 2020, 43.5 million bushels of grain sorghum, 11% of national grain sorghum supply, were used for ethanol production in the U.S. with 38 million bushels of grain sorghum used for ethanol production in the 11-state region (Figure 23). This was about 80 percent of normal usage for ethanol. In addition to the Kansas ethanol plants that use grain sorghum as a feedstock, there are three ethanol plants in Texas that also use grain sorghum as a feedstock for ethanol production and one in South Dakota.

Figure 23. Regional grain sorghum ethanol demand





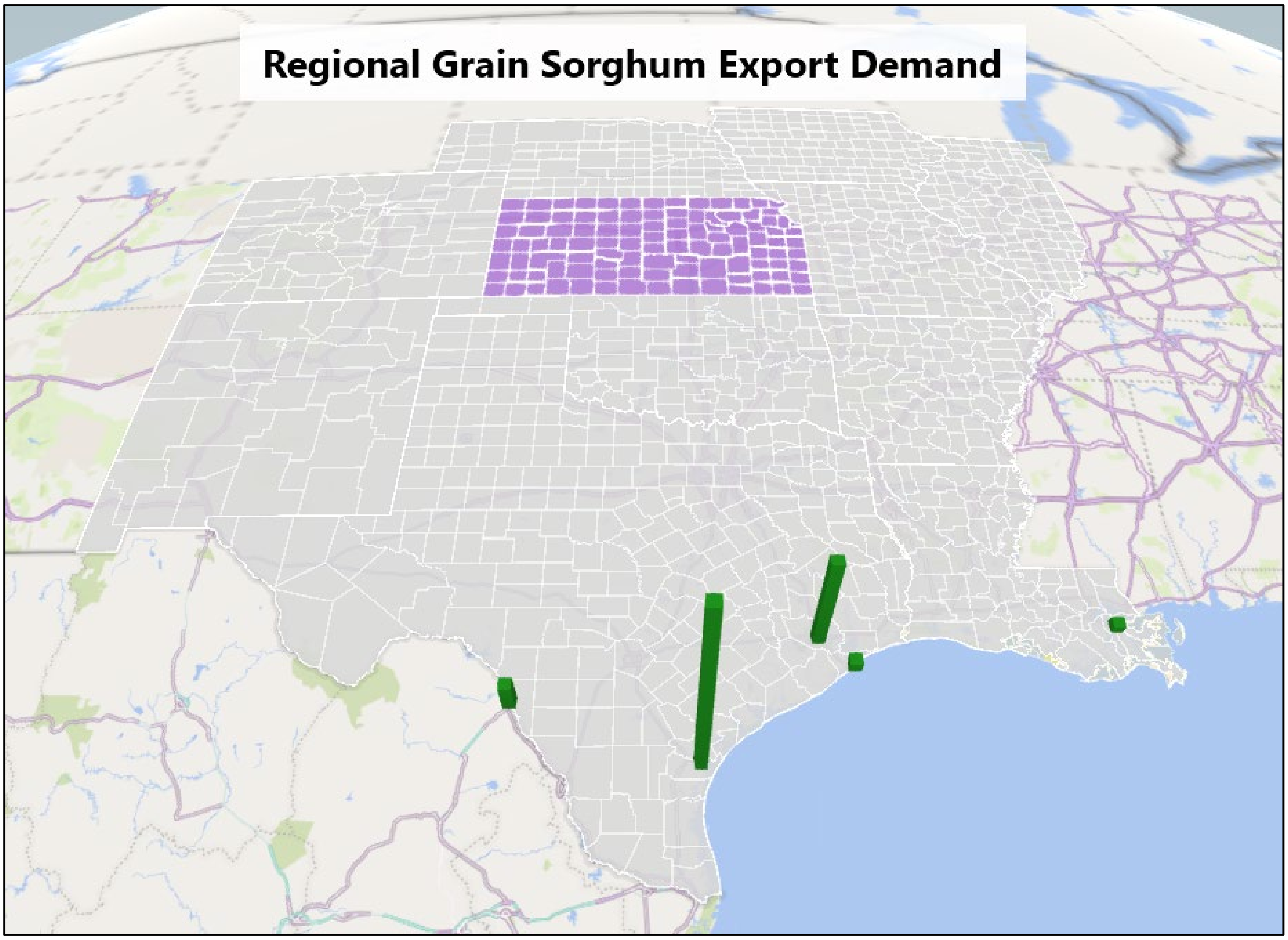
In addition to the demand for grain sorghum for ethanol production, there are milling facilities in 10 states[3] that mill small to moderate amounts of grain sorghum for flour. Total grain sorghum milling demand for flour is

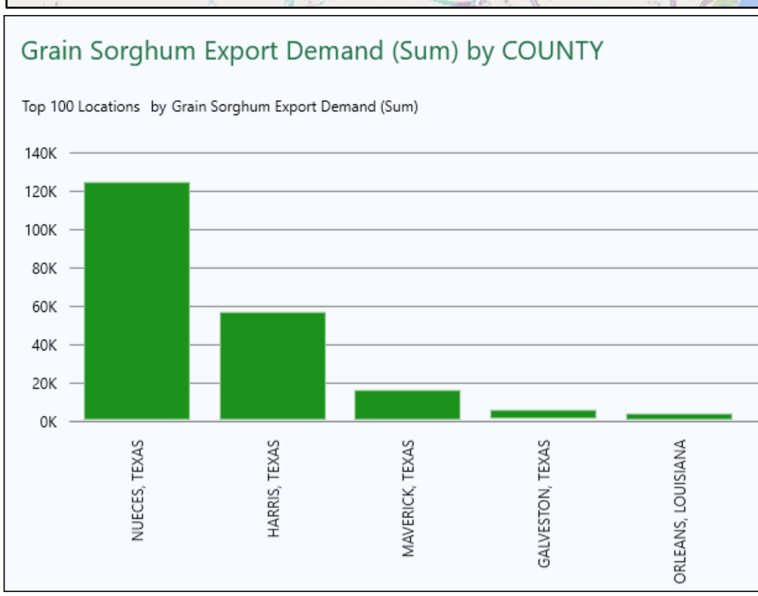
[3] States that have mills that grind grain sorghum for flour include: Colorado, Illinois, Kansas, Nebraska, North Dakota, Oregon, Pennsylvania, Texas, Utah, and Wisconsin.

about 6.7 million bushels per year (slightly less than 2% of grain sorghum supply) with 5.65 million bushels of grain sorghum milled for flour within the region.

In 2020, grain sorghum exports were 230 million bushels. Grain sorghum exports were shipped by rail to Mexico, and worldwide through the ports in Corpus Christi, Galveston, Houston and New Orleans (Figure 24). In Kansas there is an intermodal load-out terminal in Johnson County that ships containers of sorghum for export markets.

Figure 24. Regional grain sorghum export demand





2.2.1 Grain sorghum flow

Table 2 summarizes the regional movement of grain sorghum. Kansas consumes a total of 48.9 million bushels of grain sorghum. Of this amount, 47.9 million bushels (98%) comes from within Kansas. There is some small movement of grain sorghum into Kansas from Colorado (134,000 bu.), Missouri (56,000 bu.), Nebraska (494,000 bu.), and Oklahoma (348,000 bu.). Table 2 shows the counties that supply grain sorghum to Kansas.

Table 2. Summary of regional grain sorghum movement (1,000 bushels)

Summary of Regional Grain Sorghum Movement (1,000 bu.)

	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	528	-	-	-	-	-	12	-	-	-	-	52	592
CO	-	2,610	-	-	134	-	-	-	42	-	1,034	1,016	4,836
IA	-	-	24	-	-	-	-	4	-	-	-	2	30
IL	2	-	28	884	-	-	-	-	-	-	-	470	1,384
KS	4,128	552	-	342	47,902	-	44	500	-	7,010	154,288	11,096	225,862
LA	228	-	-	-	-	762	-	-	-	-	78	62	1,130
MO	454	-	100	506	56	-	808	-	-	-	-	274	2,198
NE	-	2,828	74	340	494	-	2	3,540	-	-	1,018	4,658	12,954
NM	-	-	-	-	-	-	-	-	208	-	854	516	1,578
OK	600	-	-	-	348	-	6	-	16	6,520	2,292	32	9,814
TX	1,170	-	-	-	-	4,620	-	-	16	3,912	79,894	58	89,670
Out of Region	116	4	34	444	-	128	-	92	8	-	2,450		3,276
Total	7,226	5,994	260	2,516	48,934	5,510	872	4,136	290	17,442	241,908	18,178	353,324

Notes: Read down to see where a state gets its grain sorghum. Read across to see where a state's grain sorghum goes for feed, processing, or export.

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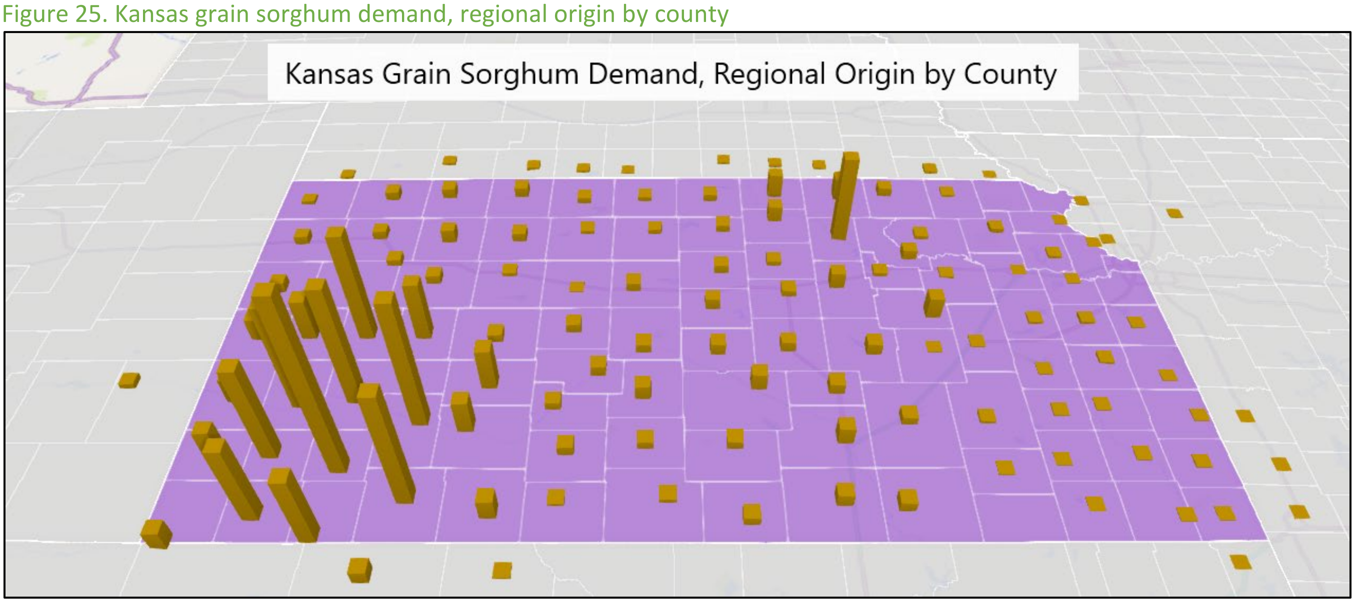
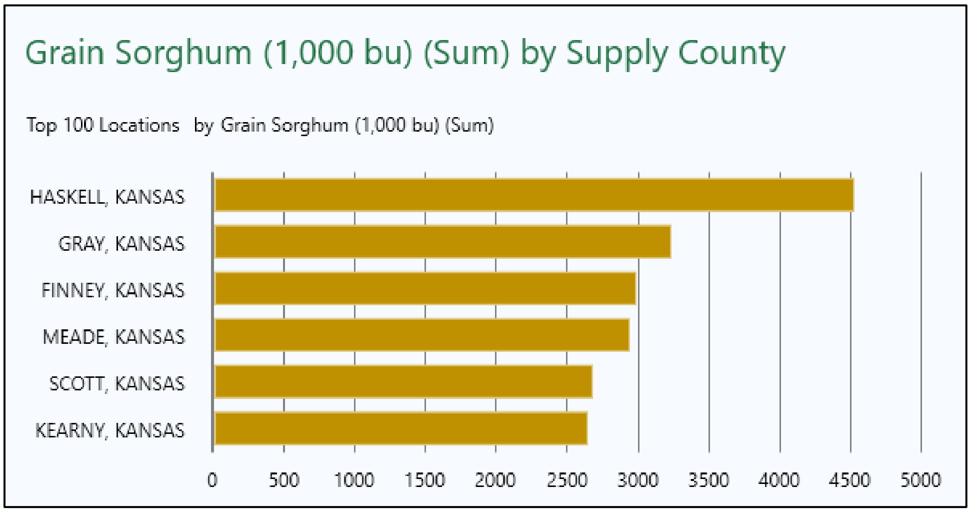
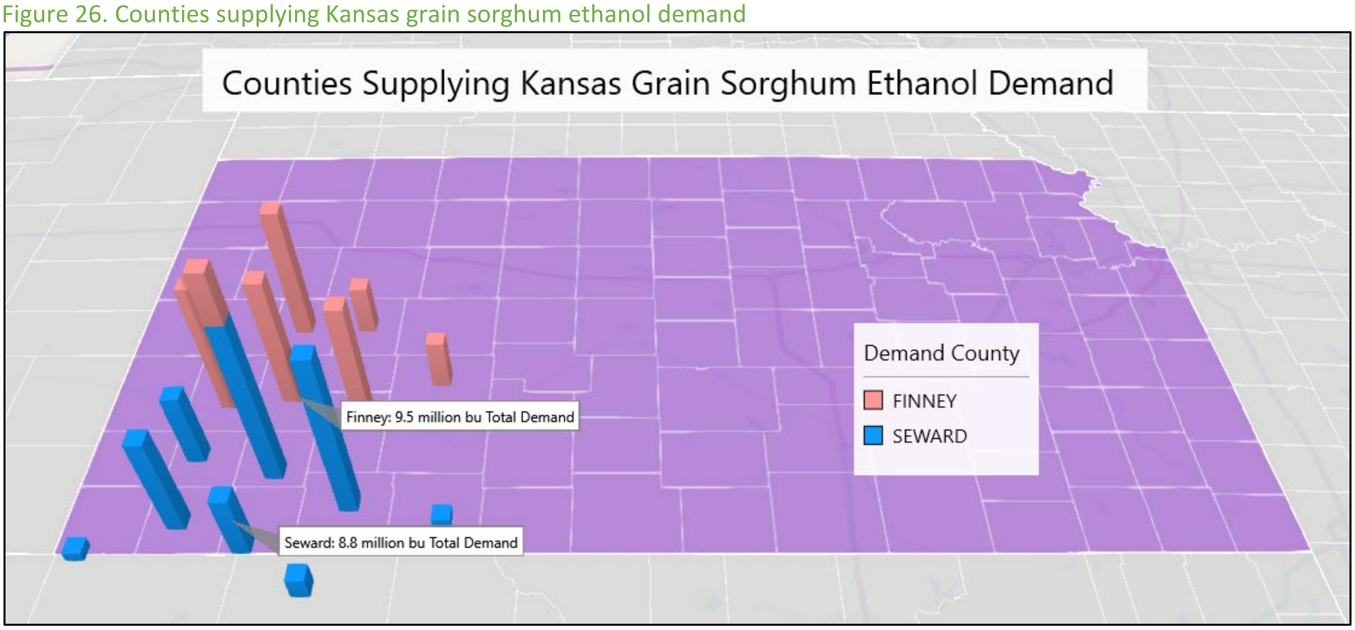
Figure 25. Kansas grain sorghum demand, regional origin by county





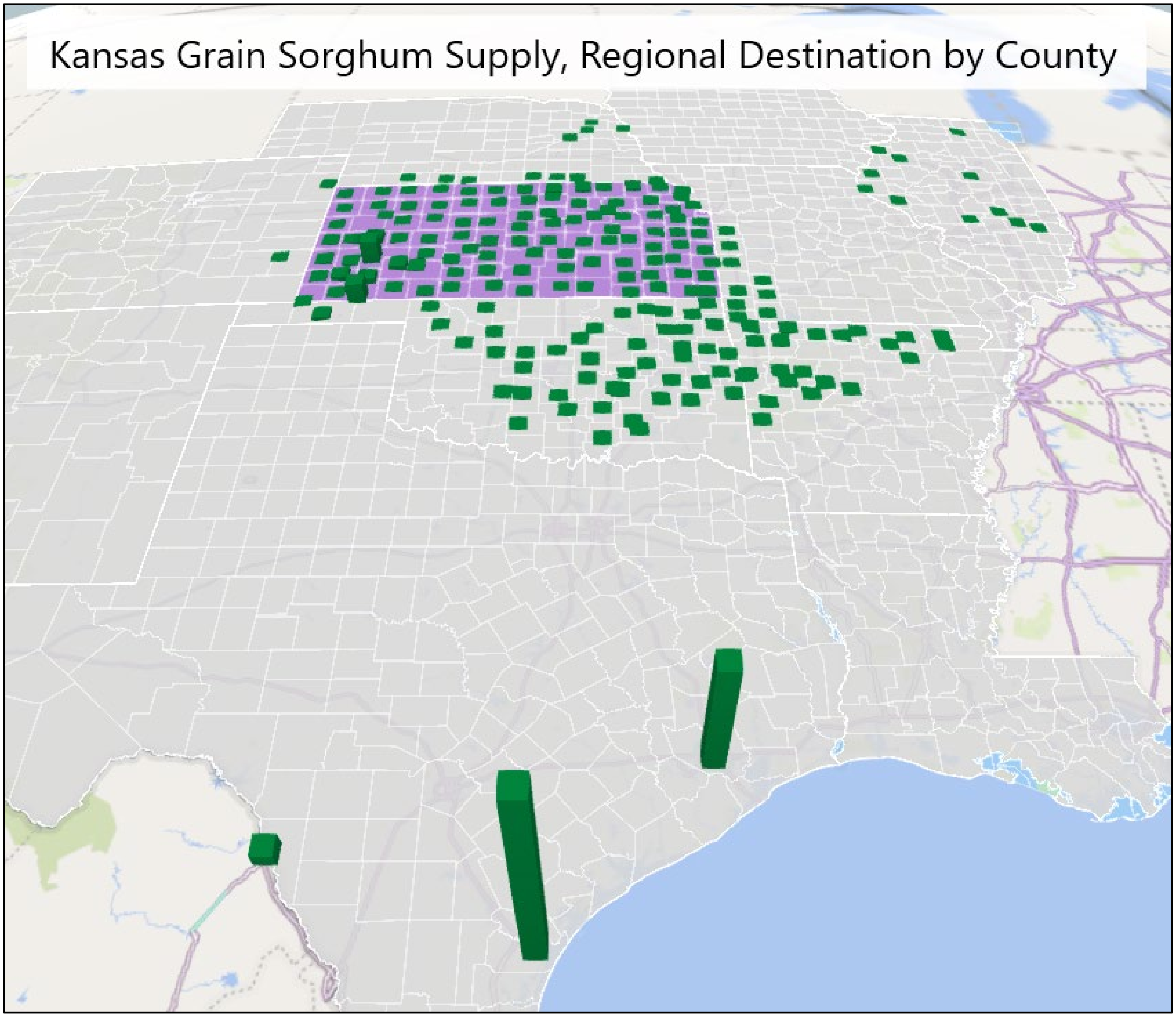
The two counties in Kansas with grain sorghum demand for ethanol production received their supply largely from nearby counties in Kansas, with a small amount coming from Oklahoma, as shown in Figure 26.

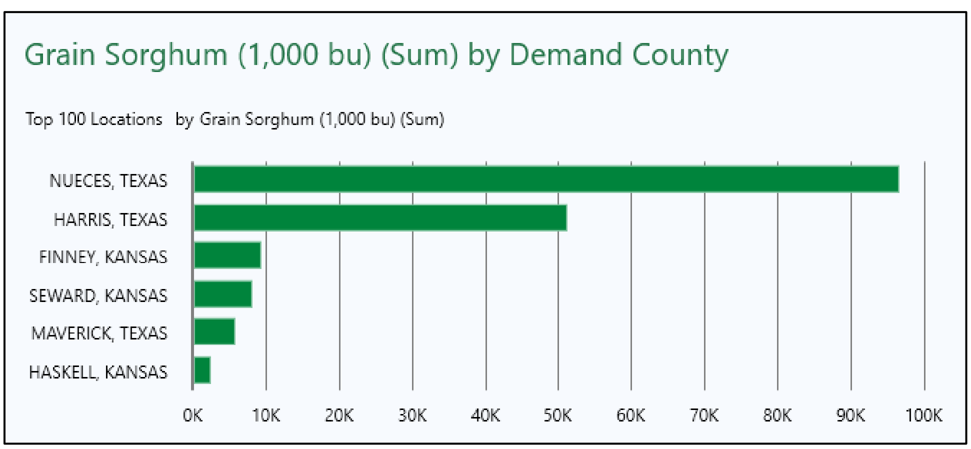
Figure 26. Counties supplying Kansas grain sorghum ethanol demand



Most of the grain sorghum produced in Kansas leaves the state, with 154.3 million bushels (68.3%) going to Texas for export. Kansas also sends grain sorghum to Arkansas (4.1 million bu.), Colorado (552,000 bu.), Illinois (342,000 bu.), Missouri (44,000 bu.), Nebraska (500,000 bu.), and Oklahoma (7.0 million bu.). Kansas sends 11.1 million bushels to states out of the region, of which a portion goes to the Pacific Northwest (PNW) for export (Table 2), which is an estimated 10.97 million bushels going to PNW for export. This is 98.8% of the supply going out of region and 4.9% of total Kansas' supply. Counties receiving Kansas grain sorghum supply are shown in Figure 27.

Figure 27. Kansas grain sorghum supply, regional destination by county

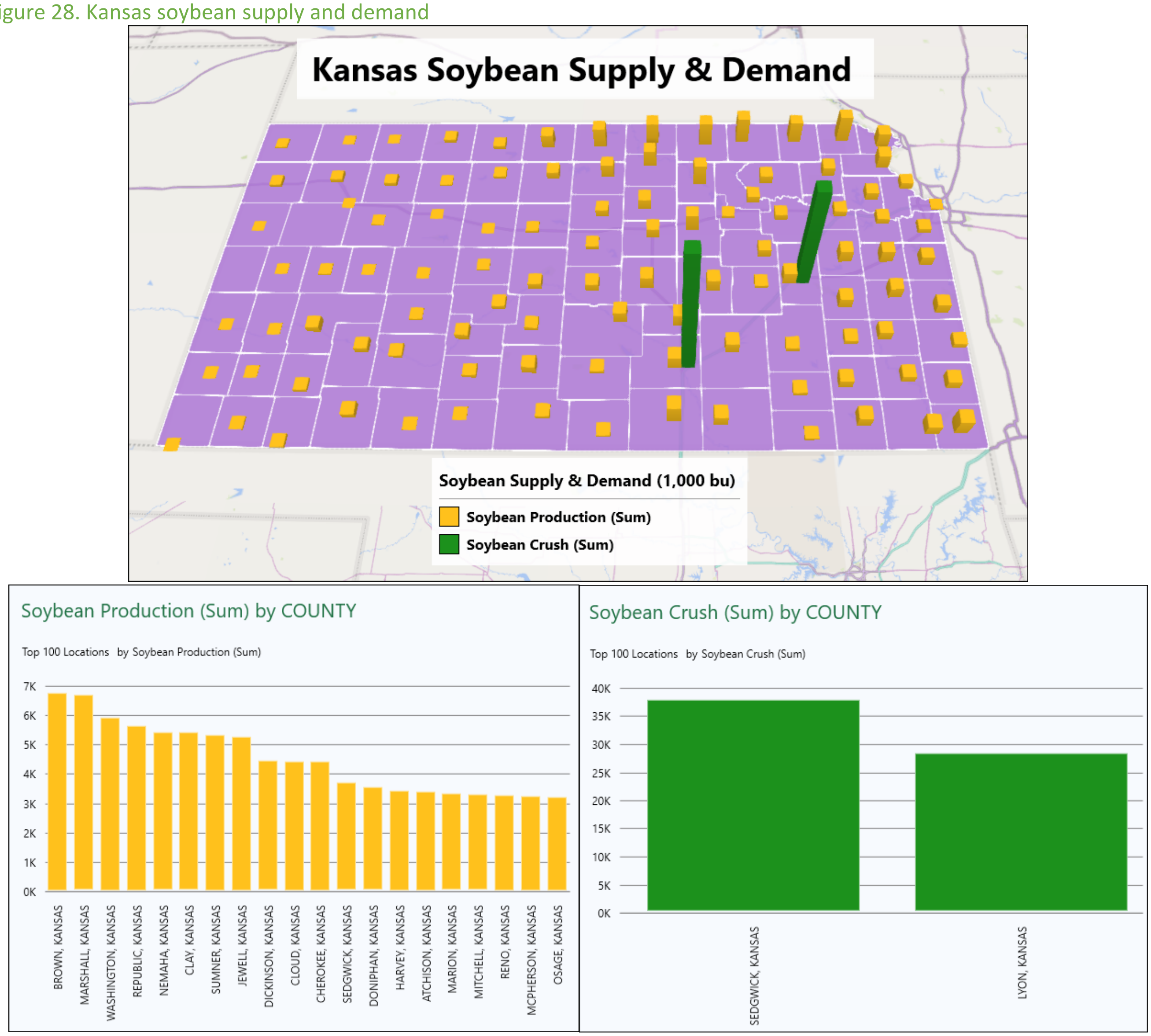




2.3 Soybeans

Kansas is a net supplier of soybeans to other states. Kansas produces between 185 million to 201 million bushels of soybeans with the most recent 5-year average being 194 million bushels per year. Kansas currently has 69.8 million bushels of soybean crush capacity with an estimated 61.6 million bushels of soybeans crushed in Kansas in 2020 (Figure 28). A new soybean processing facility that could process 38.5 million bushels of soybeans per year has been announced for Montgomery County.[4] Once this plant is operating it would raise Kansas's soybean processing capacity to 108.3 million bushels per year, which represents 56% of Kansas average soybean production over the past 5 years.

Figure 28. Kansas soybean supply and demand



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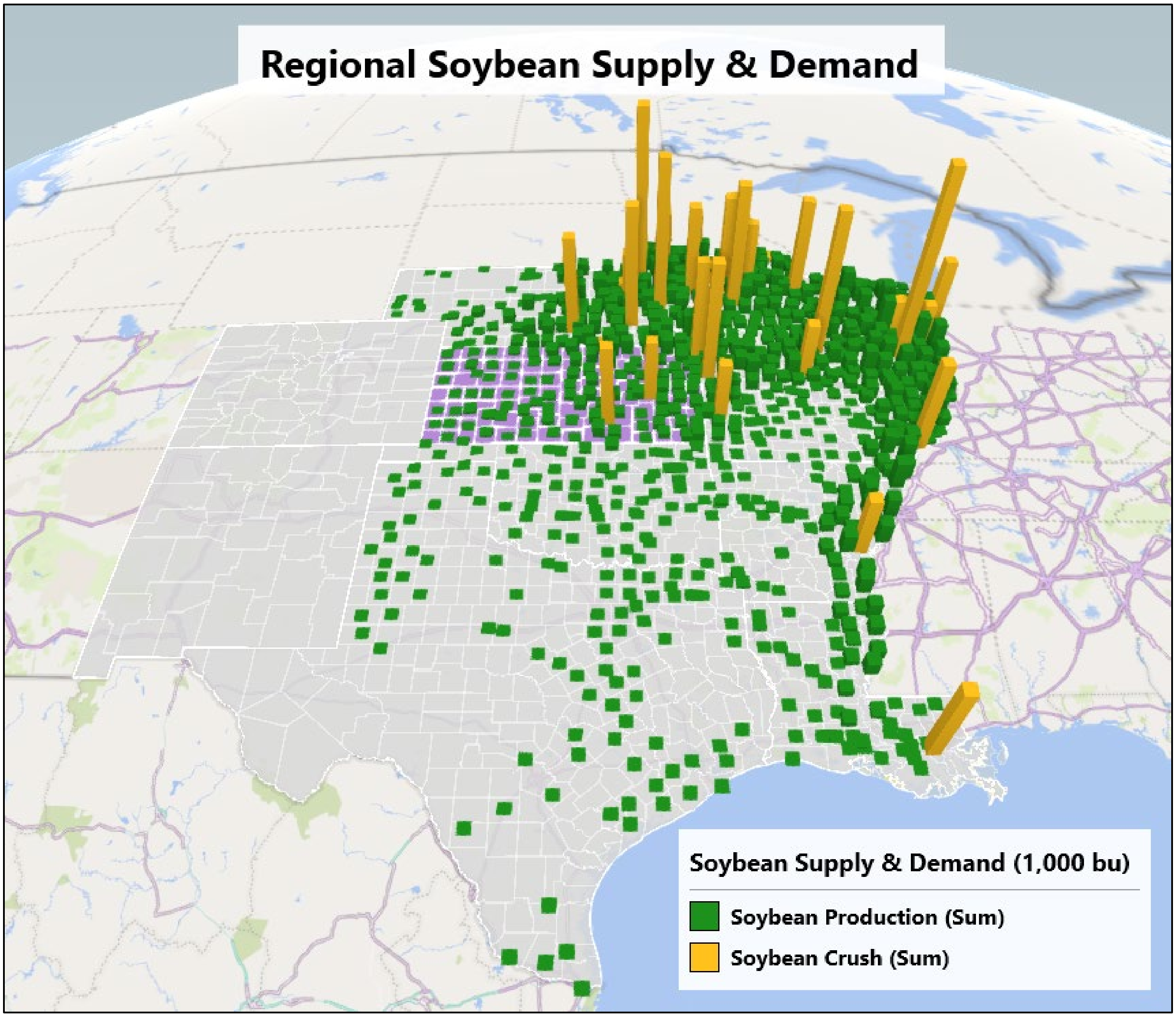
[4] Bartlett, a Savage Company, has obtained approval from the Board of County Commissioners of Montgomery County, Kansas to receive county-issued industrial revenue bonds to support Bartlett's development of a soybean crushing facility in Montgomery County. The Bartlett plant will be capable of handling approximately 38.5 million bushels of soybeans annually to crush into soybean meal and refined soybean oil, feedstock used in producing renewable fuels, food products and animal feeds.

The 11-state region accounts for 51 percent of national soybean production and 50 percent of national soybean processing. Kansas soybean production accounts for 9 percent of regional soybean production and 5 percent of regional soybean processing (Figure 29).

Figure 29. Regional soybean supply and demand



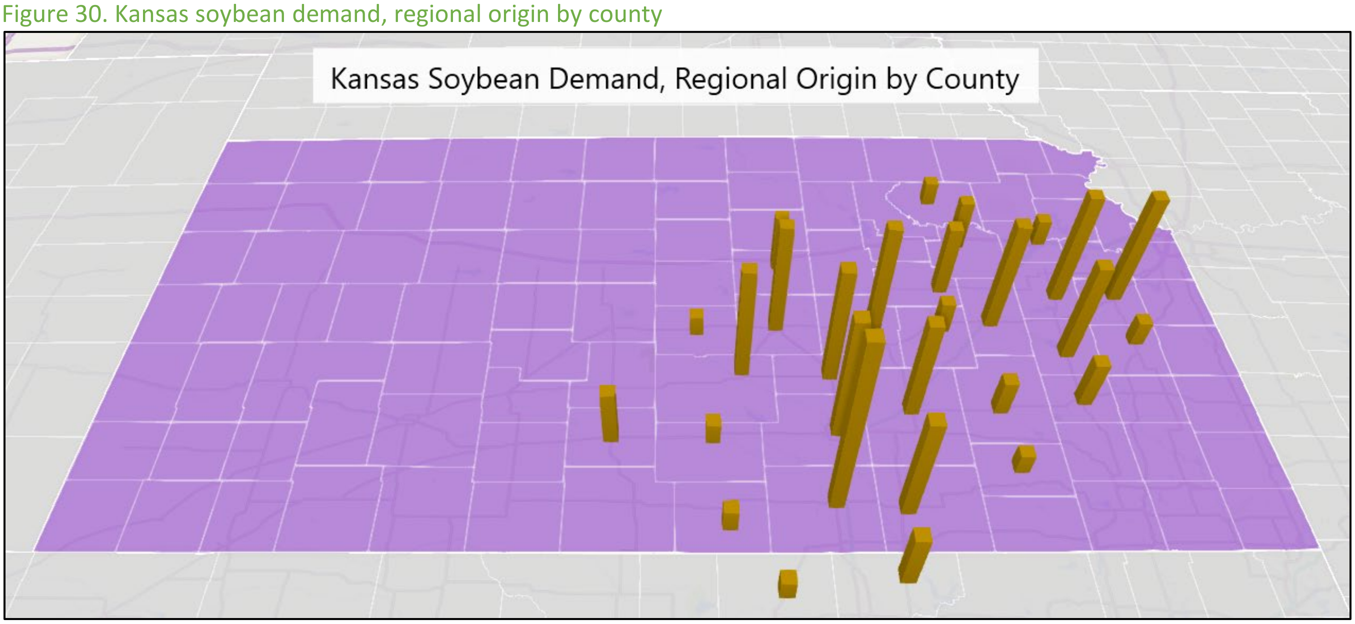
2.3.1 Soybean flow

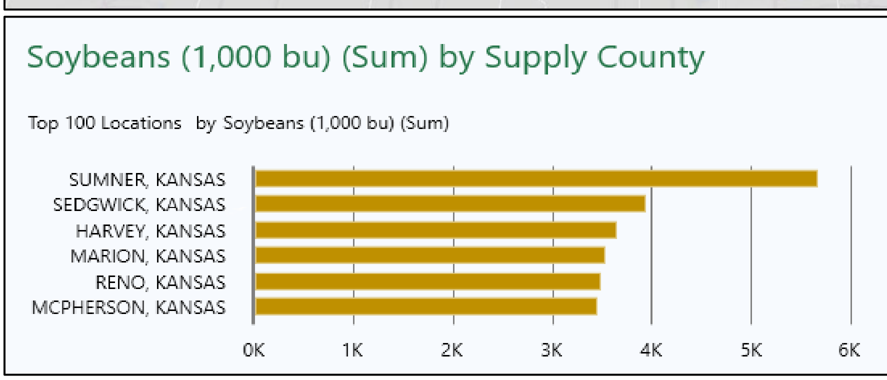
For 2020, Kansas is estimated to have used 61.6 million bushels of soybeans with 96% of those soybeans coming from within Kansas. Kansas received 2.4 million bushels of soybeans from Oklahoma. (Table 3 and Figure 30).

Table 3. Summary of regional soybean movement (1,000 bushels)

Summary of Regional Soybean Movement (1,000 bu.)													
	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	26,380	-	-	-	-	126,375	-	-	-	-	-	645	153,400
CO	-	-	-	-	-	-	-	-	-	-	-	-	-
IA	-	-	381,025	3,050	-	43,935	-	-	-	-	-	110,255	538,265
IL	-	-	-	189,400	-	414,465	-	-	-	-	-	50,370	654,235
KS	-	-	-	-	59,200	21,025	27,160	55	-	-	92,240	7,515	207,195
LA	-	-	-	-	-	57,520	-	-	-	-	1,975	-	59,495
MO	-	-	5,505	43,195	-	125,755	115,000	-	-	-	100	25,660	315,215
NE	-	-	27,170	-	-	-	-	125,955	-	-	66,670	98,590	318,385
NM	-	-	-	-	-	-	-	-	-	-	-	-	-
OK	-	-	-	-	2,355	5,145	-	-	-	-	9,735	-	17,235
TX	-	-	-	-	-	5	-	-	-	-	3,985	45	4,035
Out of Region	-	-	3,835	16,425	-	248,905	-	-	-	-	-		269,165
Total	26,380	-	417,535	252,070	61,555	1,043,130	142,160	126,010	-	-	174,705	293,080	2,536,625
Notes: Read down to see where a state gets its soybeans. Read across to see where a state's soybeans go for processing or export.													Decision Innovation Solutions

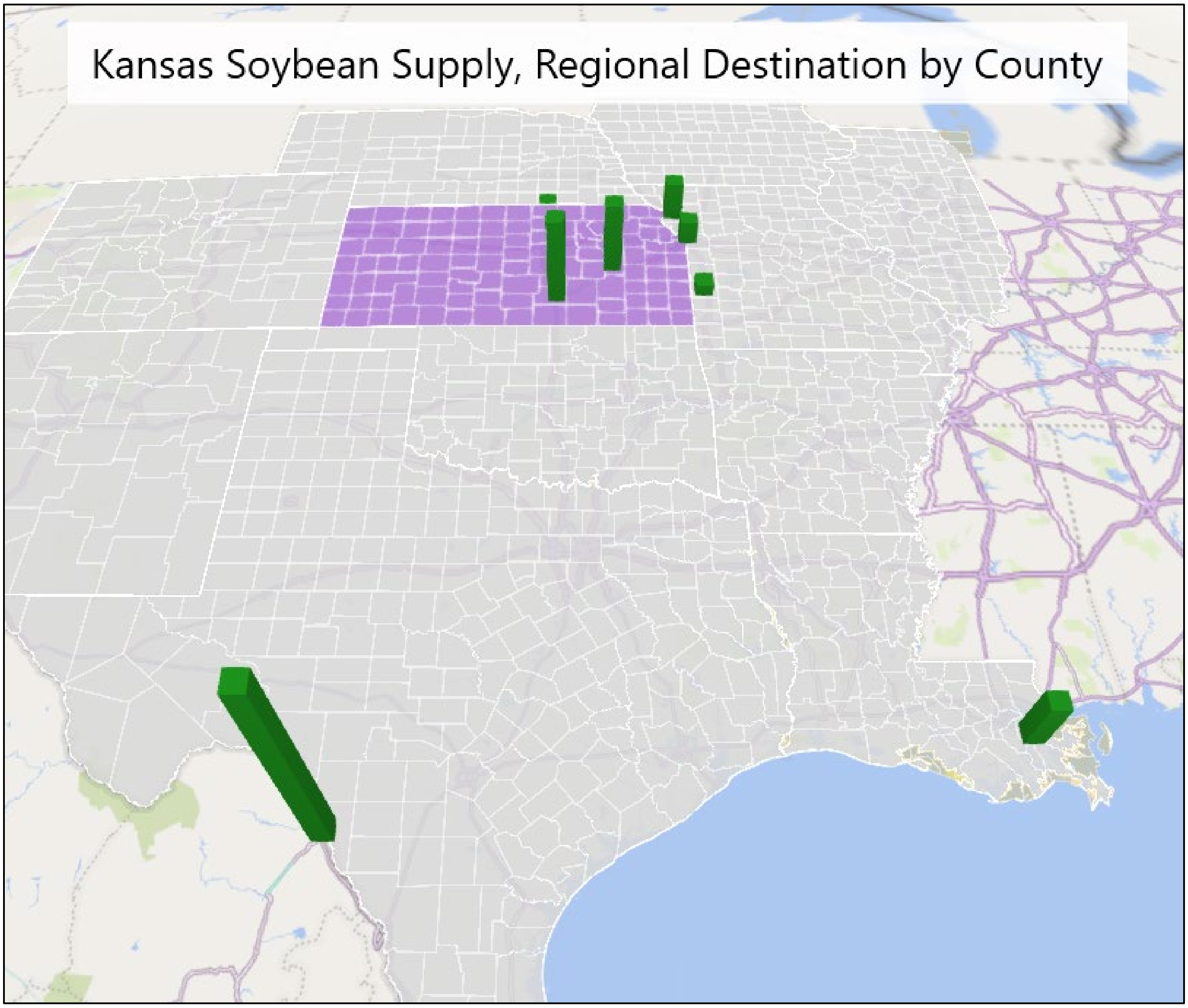
Figure 30. Kansas soybean demand, regional origin by county

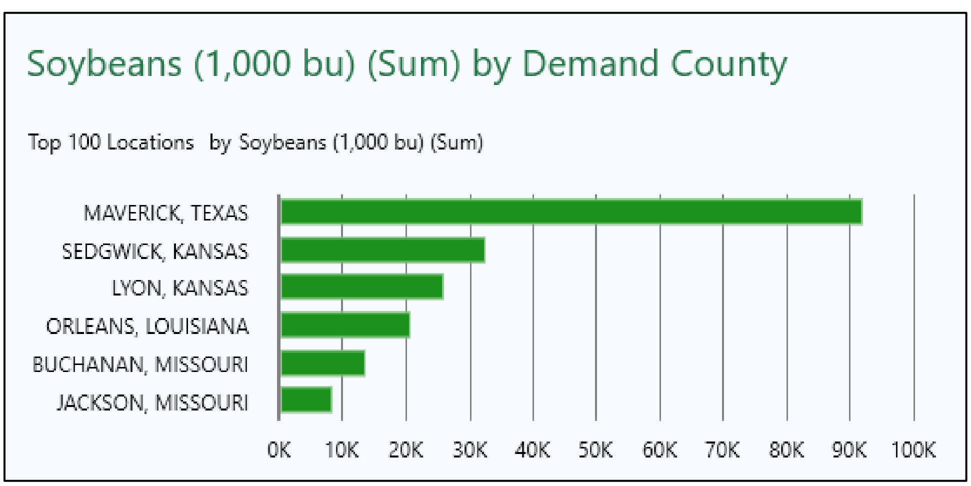




Within the regional study area, Kansas ships soybeans to processors in Missouri (27.2 million bu.), Nebraska (55,000 bu.), and to export ports in Louisiana (21 million bu.) and Texas (92.2 million bu.) Kansas also ships 7.5 million bushels of soybeans to west coast export ports. (Figure 31).

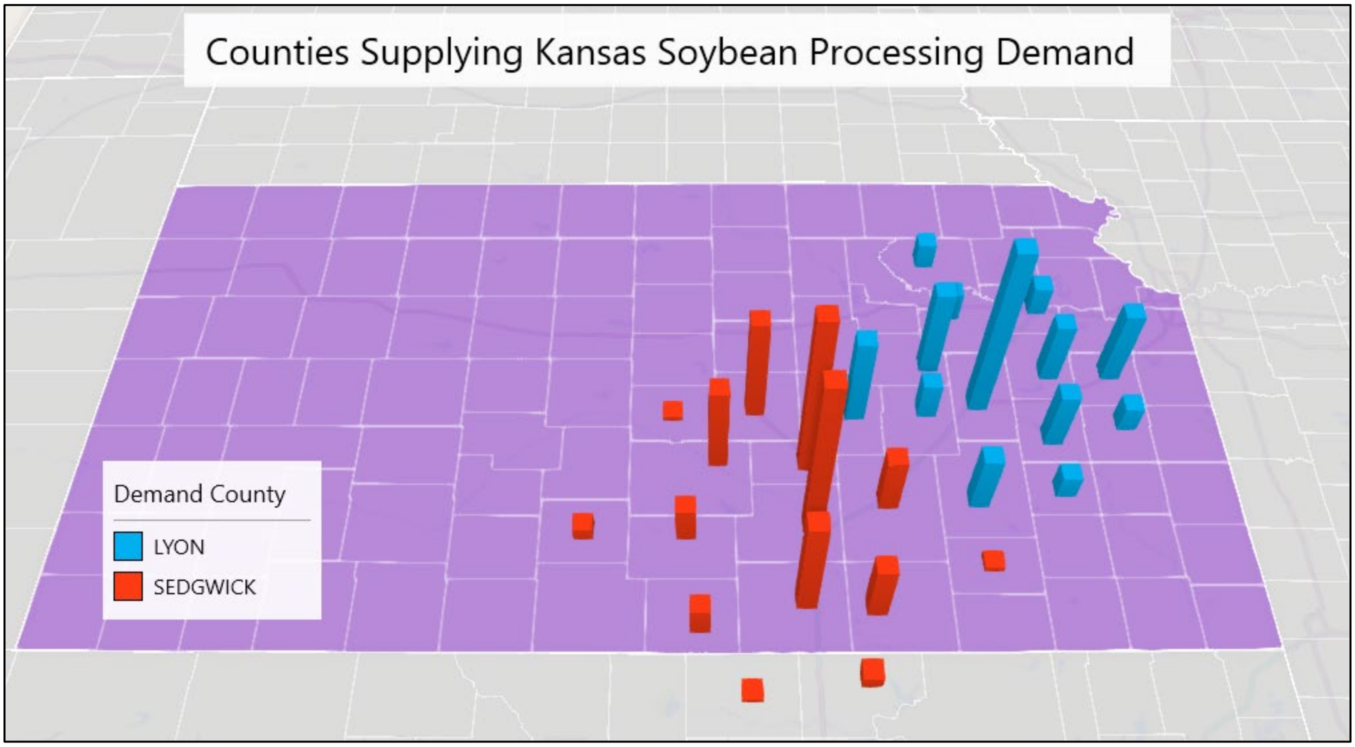
Figure 31. Kansas soybean supply, regional destination by county





Kansas soybean processors get 96% of their soybeans from within Kansas. Nearly all the soybean supply is procured from a radius that is about two and a half counties wide, about 75 miles (Figure 32).

Figure 32. Counties supplying Kansas soybean processing demand

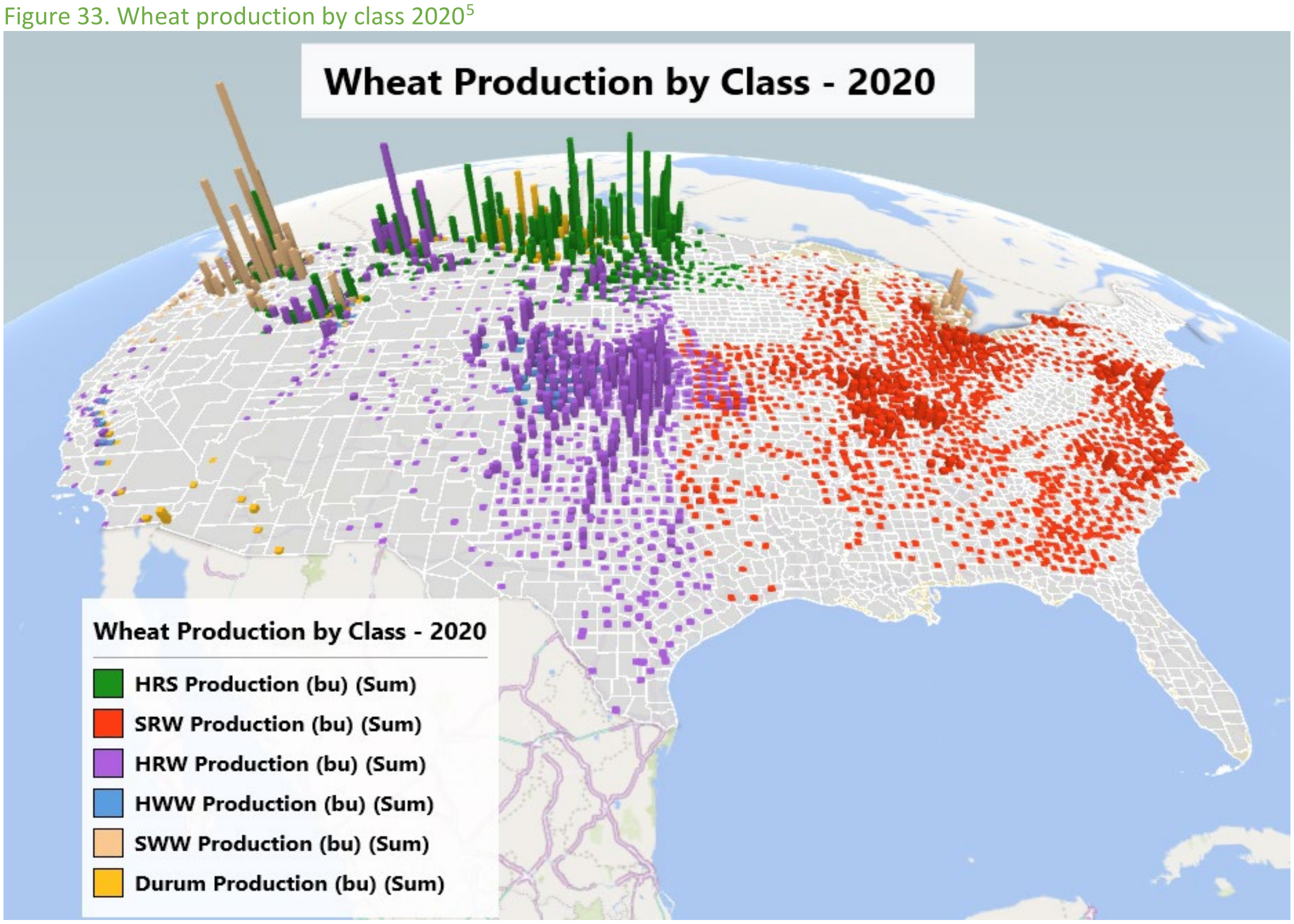


2.4 Wheat

In 2020, there were 1.83 billion bushels of wheat produced in the U.S. Figure 33 shows 2020 wheat production in the U.S. by class of wheat and the relative amount of each class of wheat by county.

- By class of wheat, production of hard red winter (HRW) led the U.S. with 659 million bushels in 2020. This represents 36 percent of U.S. wheat production and 56 percent of winter wheat production.
- **Hard red spring (HRS)** is the second most produced class of wheat in the U.S. In 2020, there were 531 million bushels of HRS wheat produced which was 29% of U.S. wheat production and 90 percent of spring wheat produced.
- **Soft red winter (SRW)** production in 2020 was 266 million bushels, comprising 15 percent of U.S. wheat production and 23 percent of winter wheat production.
- **Soft white winter (SWW)** wheat production in 2020 was 234 million bushels, comprising 13 percent of U.S. wheat production and 20 percent of winter wheat production.
- **Soft white spring (SWS)** wheat production in 2020 was 46 million bushels, comprising 2.5 percent of U.S. wheat production and 8 percent of spring wheat production.
- **Hard white winter (HWW)** wheat production in 2020 was 12 million bushels, comprising 0.7 percent of U.S. wheat production and 1 percent of winter wheat production.
- **Hard white spring (HWS)** wheat production in 2020 was 11 million bushels, comprising 0.6 percent of U.S. wheat production and 2 percent of spring wheat production.
- **Durum wheat** production in 2020 was 69 million bushels and comprised 3.8 percent of U.S. production.

Figure 33. Wheat production by class 2020[5]

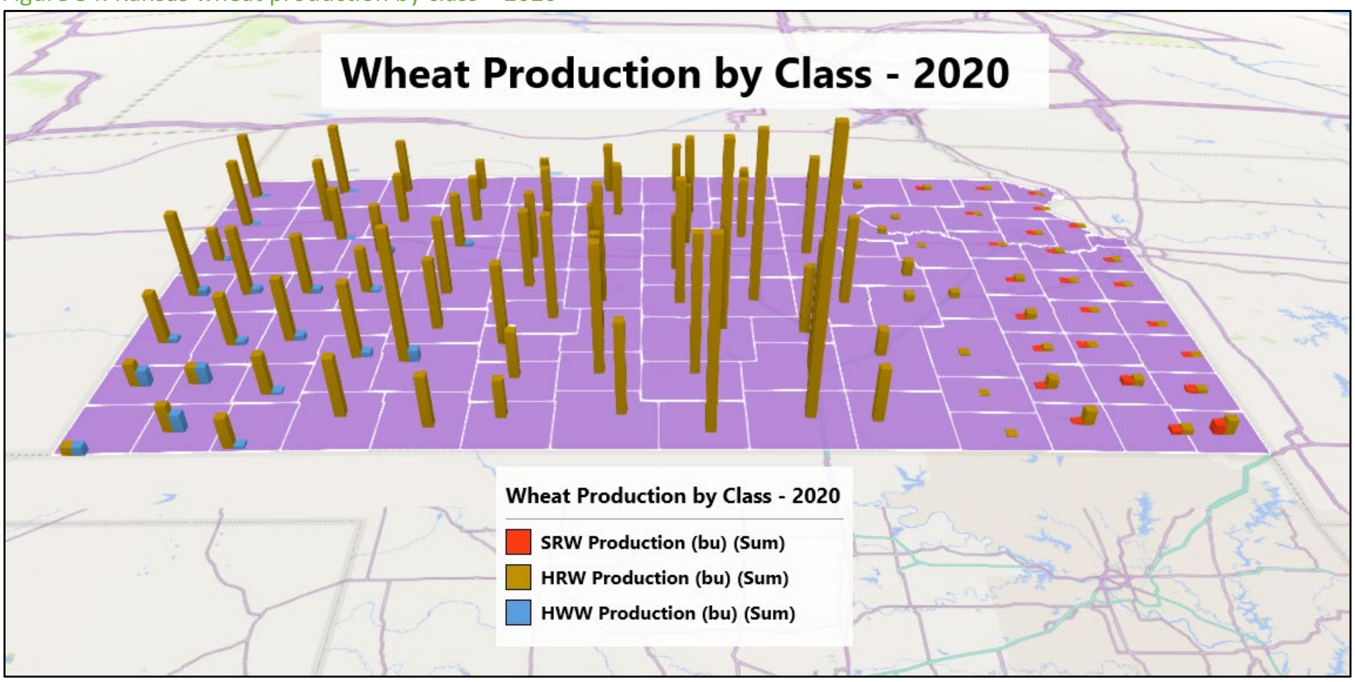


[5] The 46 million bushels of SWS wheat production is encompassed within the bars that shows HRS wheat in ID, OR and WA as USDA has not published any data on the breakout of spring wheat acres in ID, OR and WA between hard red spring and soft white spring wheats.

Kansas produced 281 million bushels of wheat in 2020 which was 15.3 percent of U.S. wheat production. Three classes of wheat are produced in Kansas. Figure 34 shows Kansas wheat production areas by class of wheat.

- **HRW wheat** is the primary wheat produced in Kansas with 270 million bushels produced in 2020. This is 41 percent of U.S. HRW wheat. HRW is produced in every county in Kansas although production is much greater in the central and western districts of the state.
- **HWW wheat** is the second most produced class of wheat in Kansas. In 2020, Kansas produced 8.4 million bushels of HWW wheat which is 3 percent of Kansas wheat production. HWW wheat in Kansas is mostly produced in southwest Kansas but some level of production is seen in all three western crop reporting districts of Kansas. HWW wheat production in Kansas is 69 percent of U.S. HWW production.
- **SRW wheat** is the third class of wheat produced in Kansas. In 2020, Kansas produced 2.8 million bushels of SRW wheat which is 1 percent of Kansas wheat production. SRW wheat in Kansas is produced primarily in the eastern crop reporting districts of Kansas. SRW wheat production in Kansas is 1 percent of U.S. SRW wheat production.

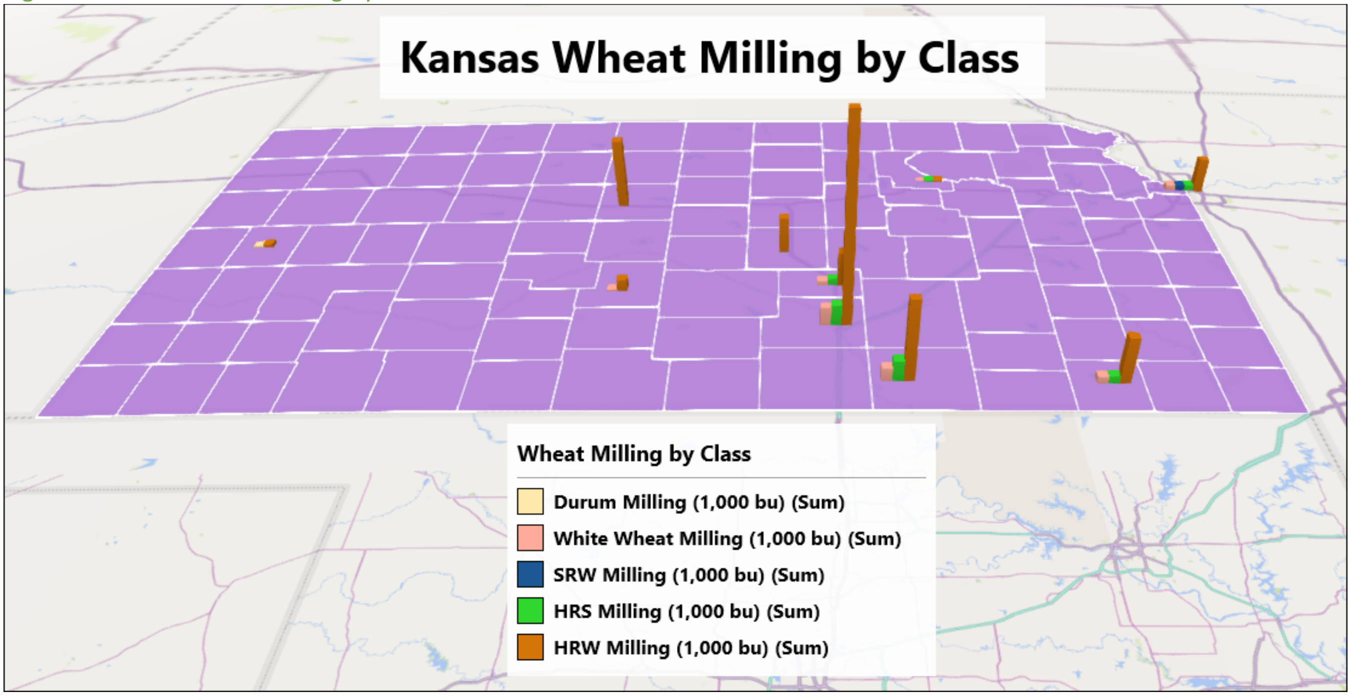
Figure 34. Kansas wheat production by class – 2020



There are 12 commercial wheat milling facilities in 10 counties in Kansas with a total daily milling capacity of 118,000 hundredweights of flour, equivalent to 97 million bushels per year of wheat if operated at full capacity (Figure 35). Eleven of the mills produce commercial flour and 1 mills wheat for wheat-protein extraction and uses the starch for ethanol production. HRW wheat accounts for 84 percent of the annual wheat milling in Kansas with 8 percent being HRS wheat, 7 percent white wheat, 1 percent SRW wheat, and 0.3 percent durum wheat.

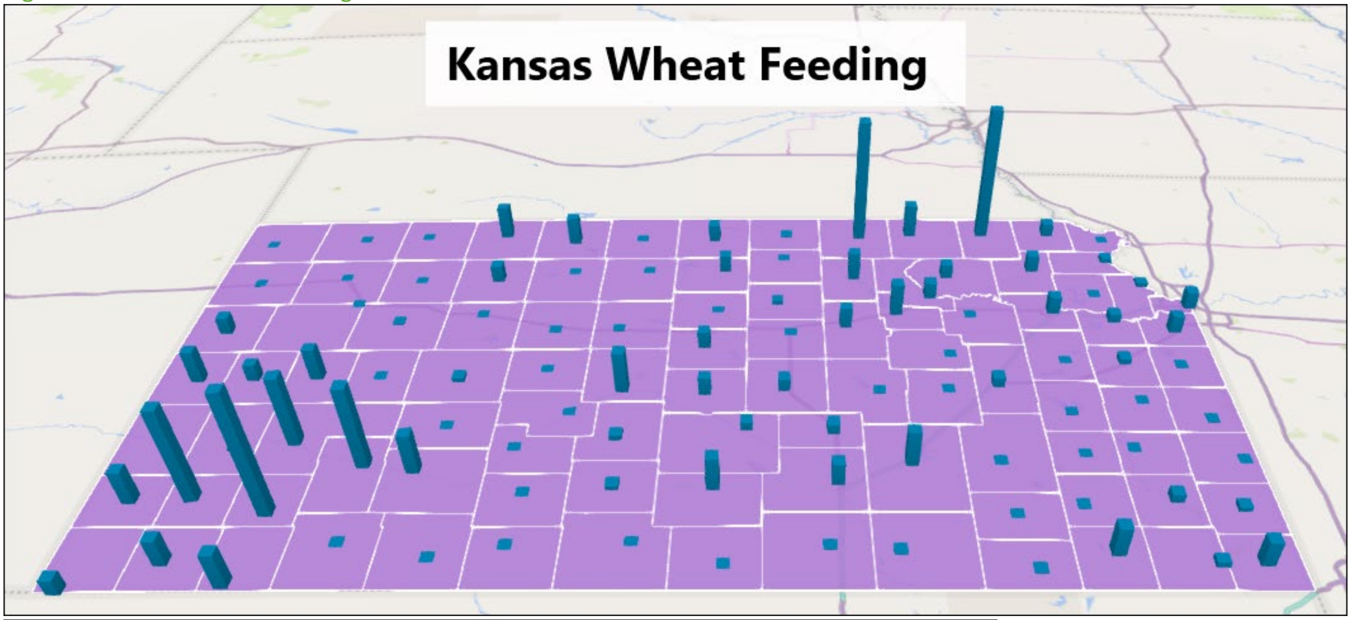
In 2020, Kansas wheat mills processed 83.9 million bushels of wheat, operating at an annual average capacity utilization rate of 86.5 percent. This included 70.7 million bushels of HRW wheat, 6.4 million bushels of HRS wheat, 5.6 million bushels of white wheat, 978,000 bushels of SRW wheat, and 279,000 bushels of durum wheat.

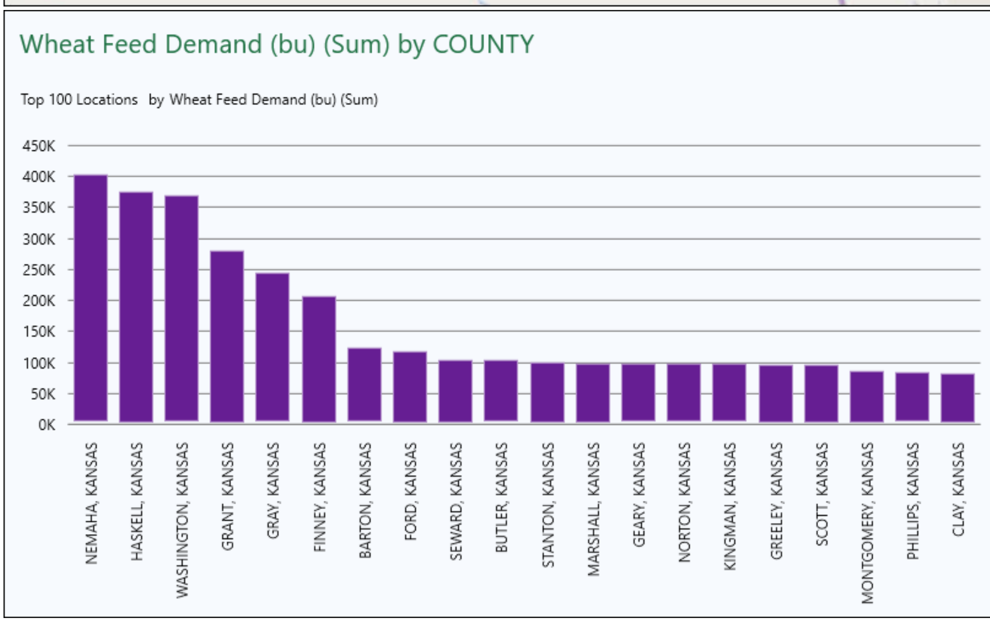
Figure 35. Kansas wheat milling by class



DIS estimates indicate that 4.6 million bushels of wheat in Kansas are used as a feed ingredient. Wheat is primarily fed to cattle and hogs with other species consuming minor amounts. By class, 90 percent of feed wheat is HRW, 3 percent is SRW, and 7 percent is white wheat. Wheat is fed in every county (Figure 36).

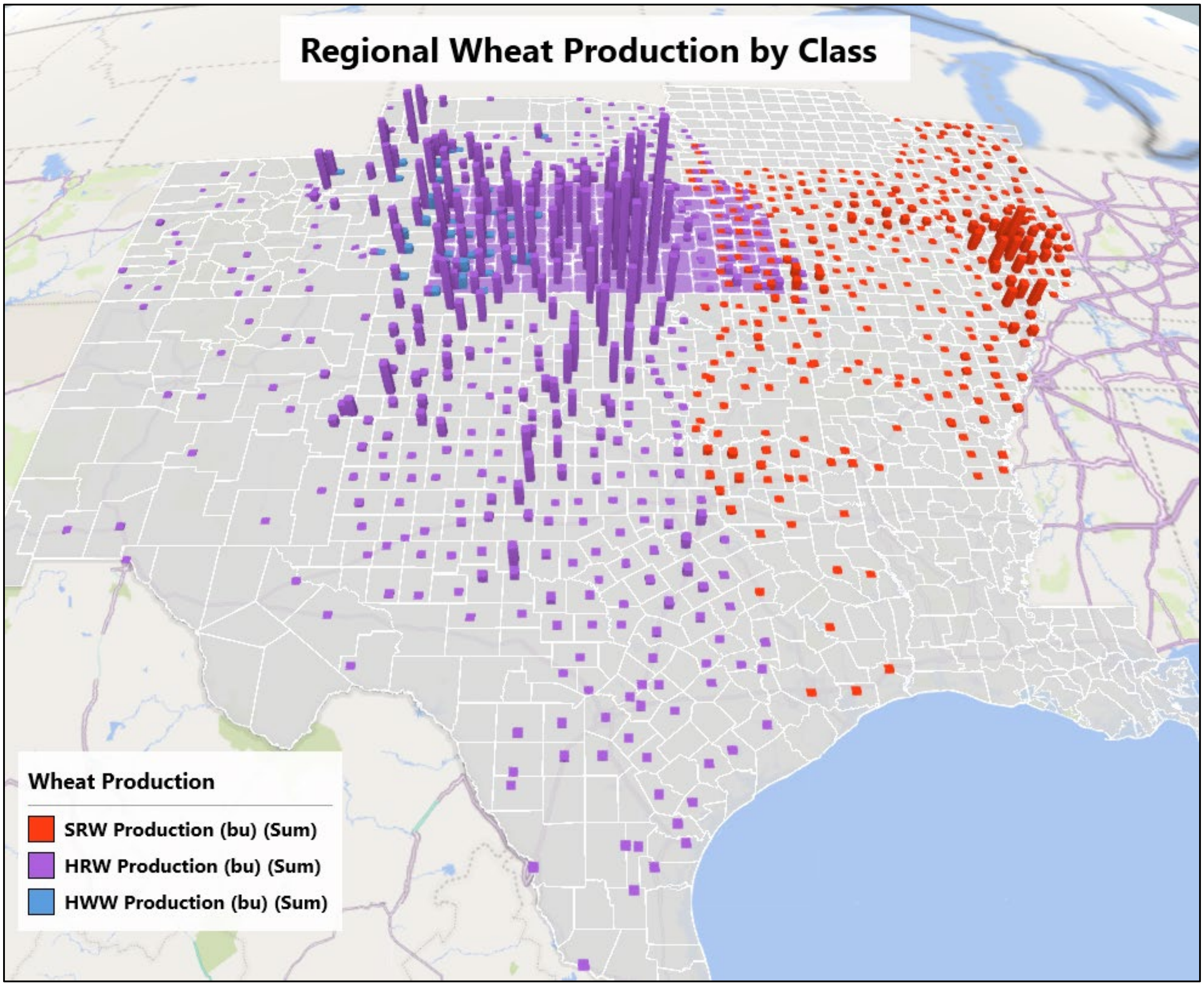
Figure 36. Kansas wheat feeding





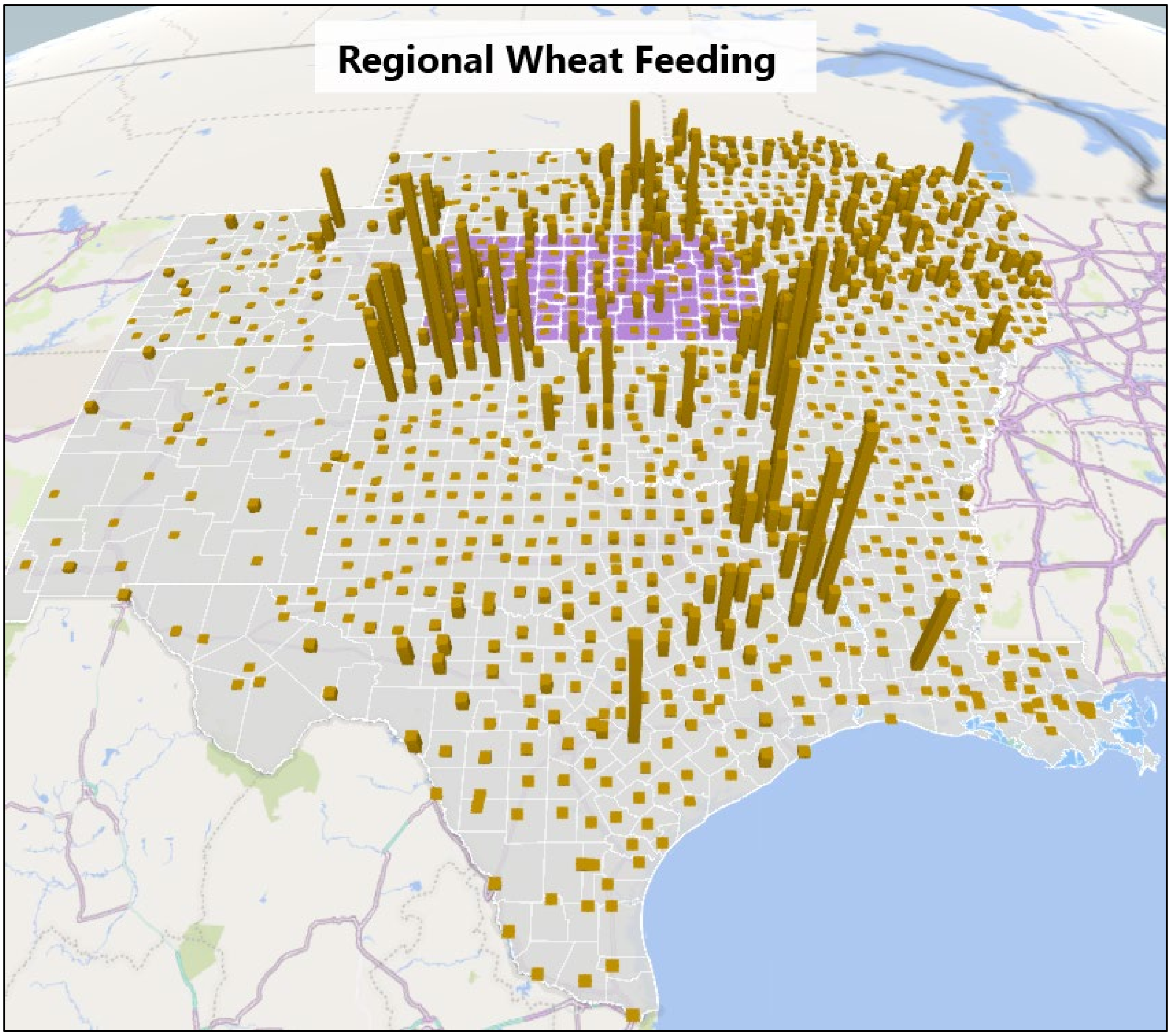
Kansas is the dominant wheat producer in the 11-state region, accounting for 48 percent of all wheat produced within such region. By class, Kansas produces 56 percent of the white wheat in the region, 54 percent of the HRW wheat in the region and 2 percent of the SRW in the region (Figure 37).

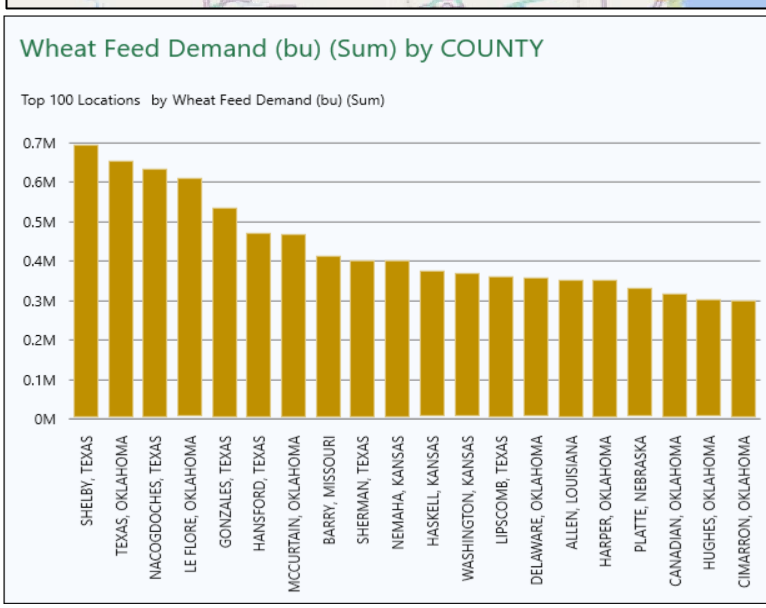
Figure 37. Regional wheat production by class



Regional wheat feeding is estimated to be greater in Texas (8.8 million bushels) and Oklahoma (5.8 million bushels) than in Kansas (4.6 million bushels), as indicated by the relative levels of wheat feeding by county for the 11-state region (Figure 38).

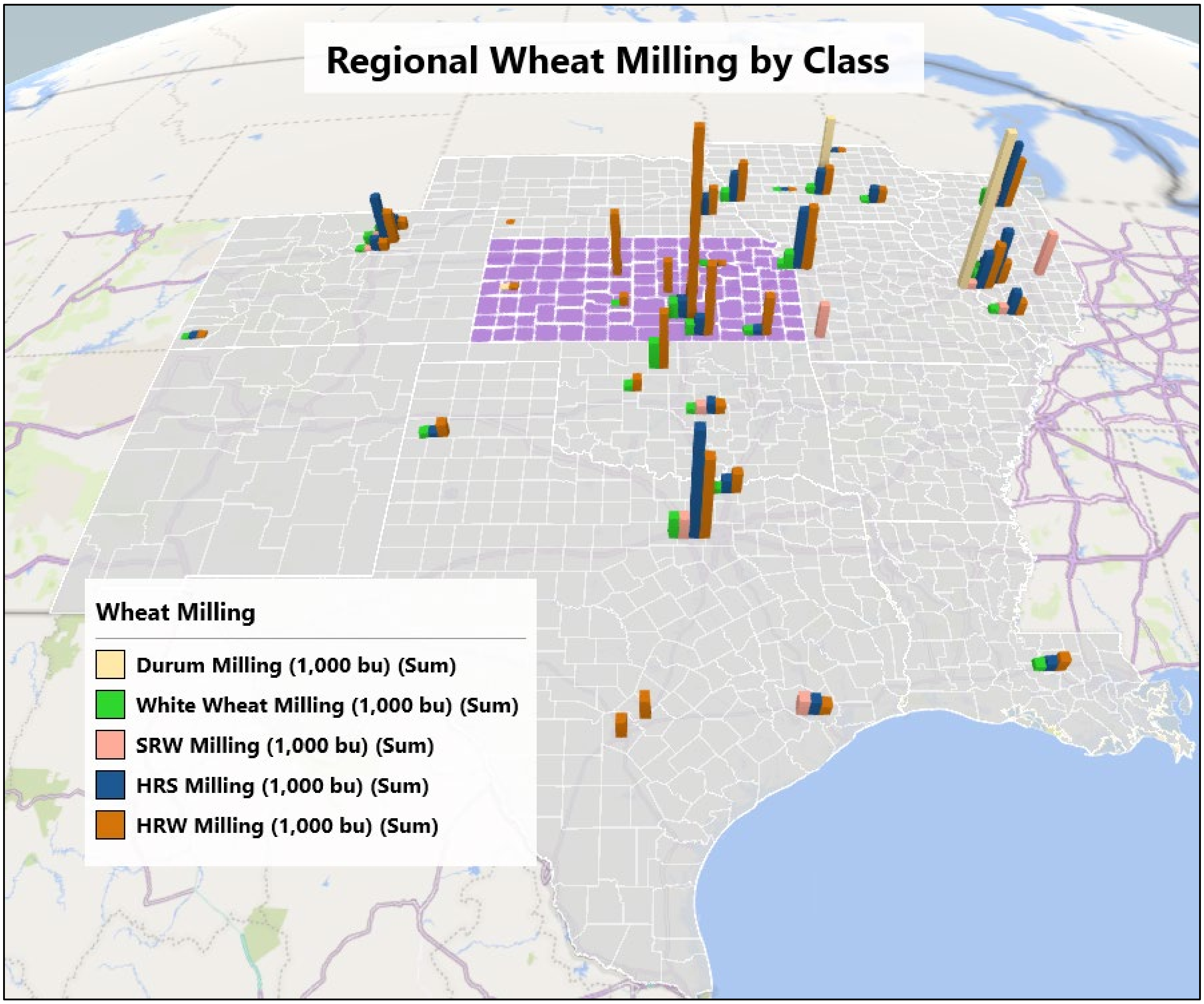
Figure 38. Regional wheat feeding





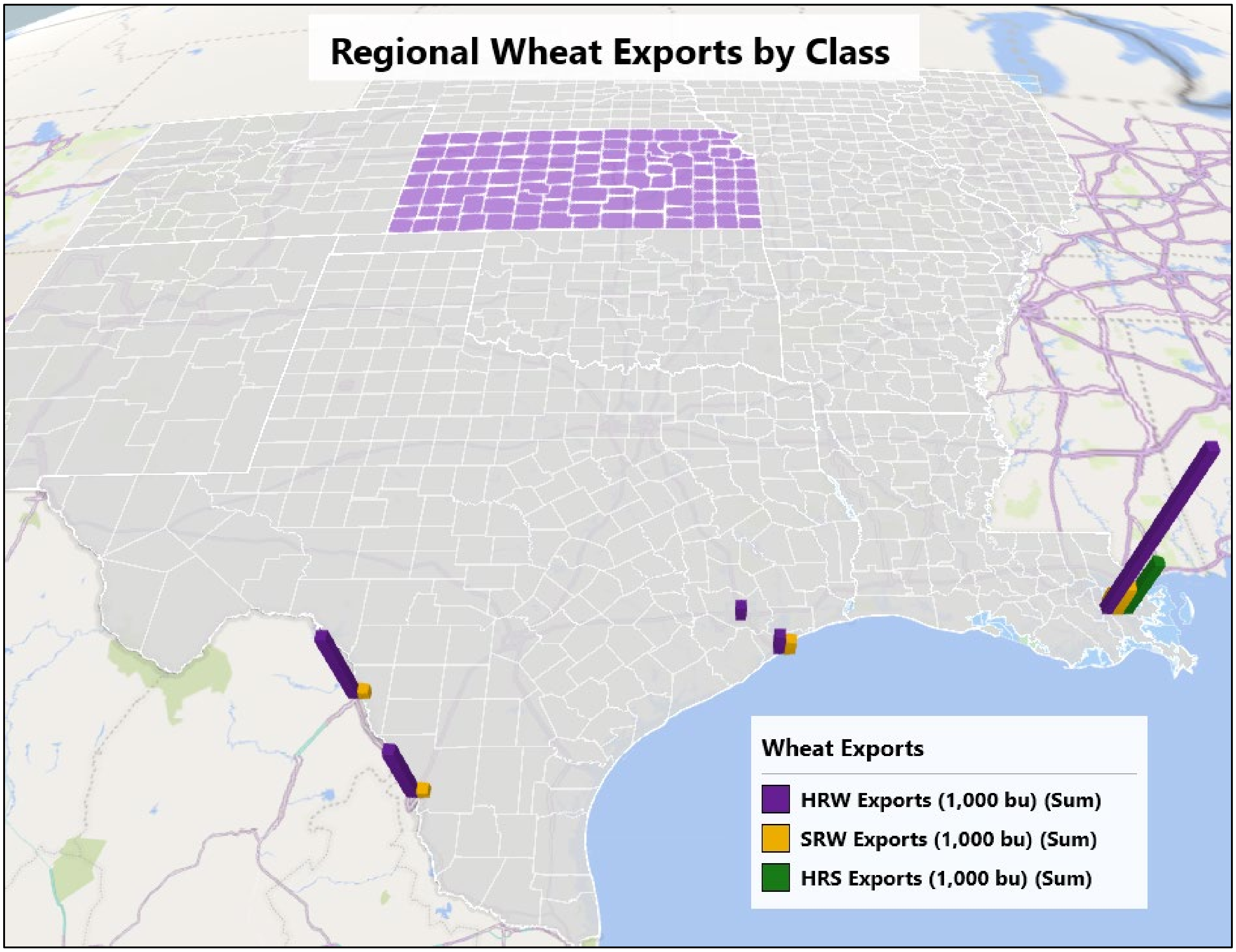
Regional wheat milling tends to occur near metropolitan areas. In 2020, 349 million bushels of wheat were processed in the 11-state region (Figure 39). Kansas accounts for 24 percent of regional wheat milling, with Missouri (19%), Texas (18%), Illinois (15%), Iowa (6%), Colorado (6%), Oklahoma (6%), Nebraska (5%), and Louisiana (1%).

Figure 39. Regional wheat milling demand



Regional wheat exports flow mostly through rail crossings to Mexico, Caribbean ports in Texas, and Mississippi River ports in Louisiana (Figure 40). A significant portion (45%) of HRW wheat for export flows through port facilities in the PNW region.

Figure 40. Regional wheat exports



2.4.1 Hard red winter wheat flow

Table 4 summarizes the regional state-to-state movement of hard red winter (HRW) wheat. Of the 309.9 million bushels of available HRW wheat supply in Kansas[6], 57.5 million bushels stay in Kansas for feeding and milling. Kansas HRW wheat is shipped to Colorado (32,000 bu.), Iowa (3.7 million bu.), Illinois (10.0 million bu.), Louisiana (66.4 million bu.), Missouri (13.9 million bu.), Nebraska (6.2 million bu.), Oklahoma (780,000 bu.), Texas (25.7 million bu.), and out of the region for both domestic milling and exports (125.6 million bu.). Figure 42 shows the counties in the 11-state region that use Kansas HRW wheat.

A total of 6.5 million bushels of HRW wheat are shipped into Kansas with 4,000 bushels coming from Missouri, 122,000 bushels from Nebraska, and 6.5 million bushels from Oklahoma. Figure 41 shows the counties in the 11-state region that supply wheat to Kansas.

Table 4. Summary of regional hard red winter (HRW) wheat movement (1,000 bushels)

Summary of Regional Hard Red Winter Wheat Movement (1,000 bu.)

	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	-	-	-	-	-	-	-	-	-	-	-	-	-
CO	-	7,632	-	460	-	-	-	44	16	66	-	32,772	40,990
IA	-	-	-	-	-	-	-	-	-	-	-	-	-
IL	-	-	-	-	-	-	-	-	-	-	-	-	-
KS	-	32	3,748	10,048	57,498	66,418	13,870	6,216	-	780	25,704	125,632	309,946
LA	-	-	-	-	-	-	-	-	-	-	-	-	-
MO	-	-	-	142	4	-	110	-	-	-	-	524	780
NE	-	62	1,688	970	122	-	-	4,750	-	-	-	30,550	38,142
NM	-	-	-	-	-	-	-	-	174	-	52	3,434	3,660
OK	-	-	-	-	6,450	9,826	48	-	-	12,564	50,968	36,738	116,594
TX	-	-	-	-	-	7,576	-	-	-	164	38,512	20,062	66,314
Out of Region	-	116	284	130	-	-	-	40	-	-	-	-	570
Total	-	7,842	5,720	11,750	64,074	83,820	14,028	11,050	190	13,574	115,236	249,712	576,996

Notes: Read down to see where a state gets its HRW wheat. Read across to see where a state's HRW wheat goes for feed, milling, or export.

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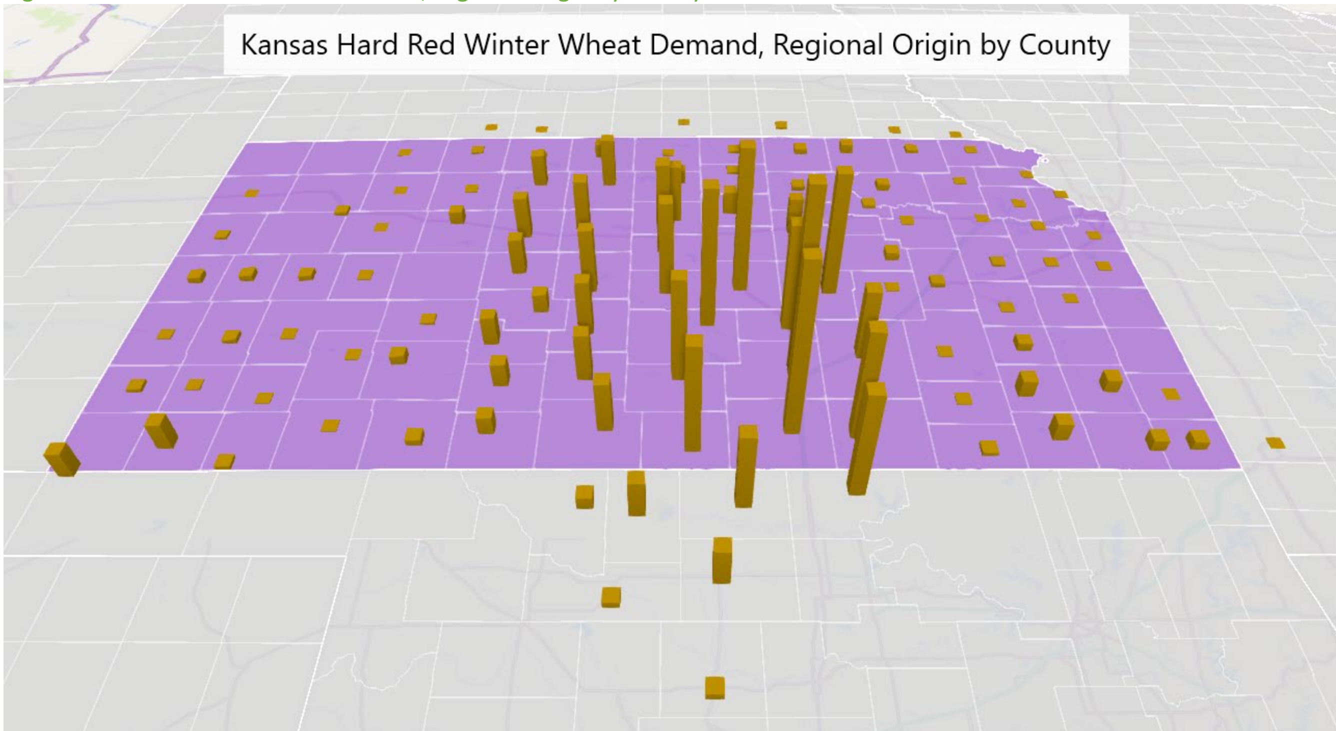
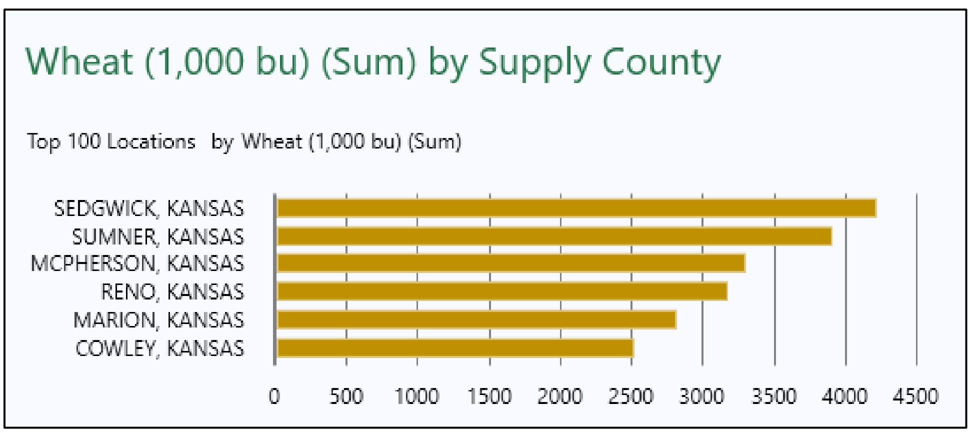
[6] Available supplies for calendar year 2020 include a portion of production and carryover stocks from the 2019-20 marketing year and a portion of the production from the crop harvested in the summer of 2020.

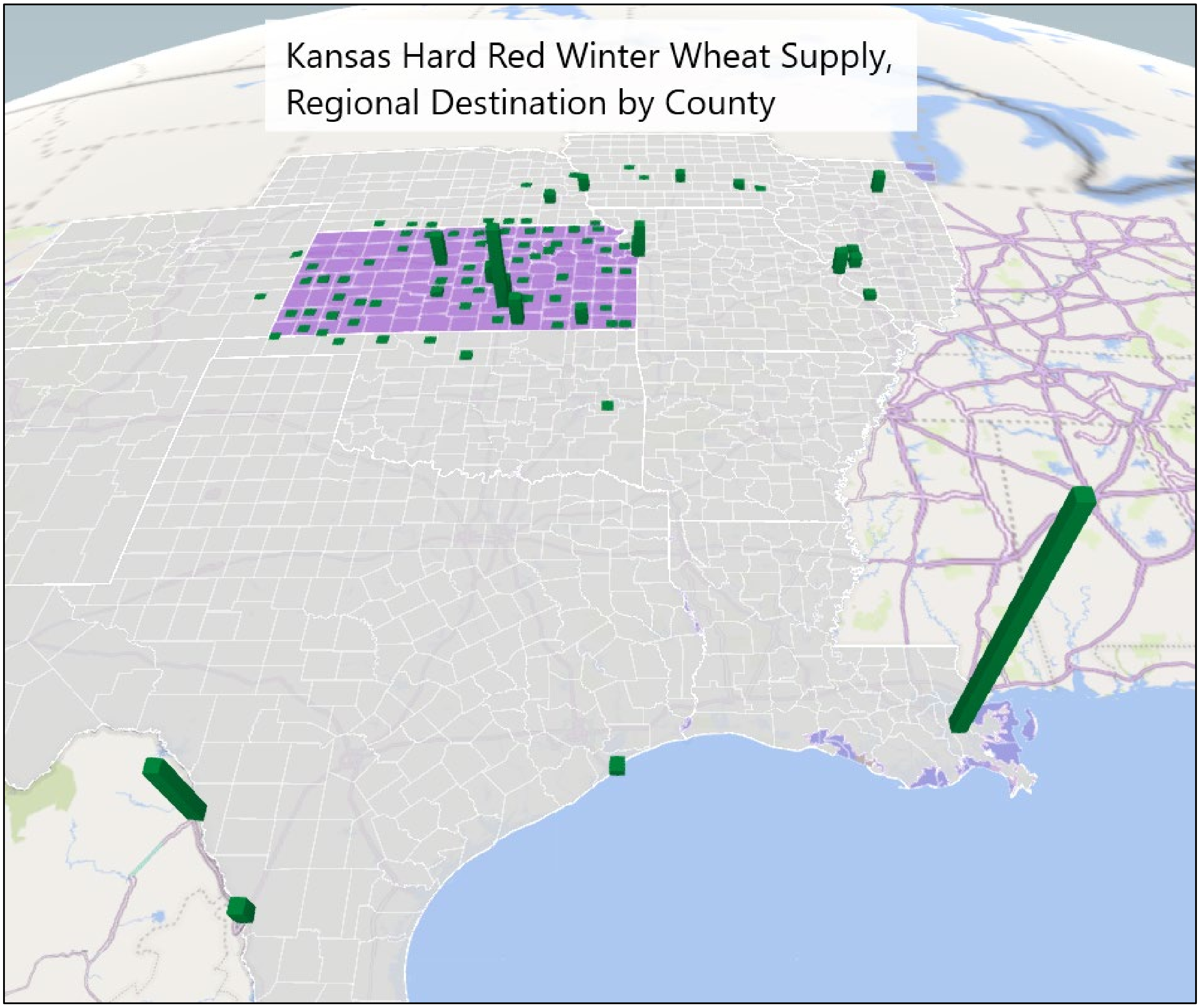
Figure 41. Kansas HRW wheat demand, regional origin by county

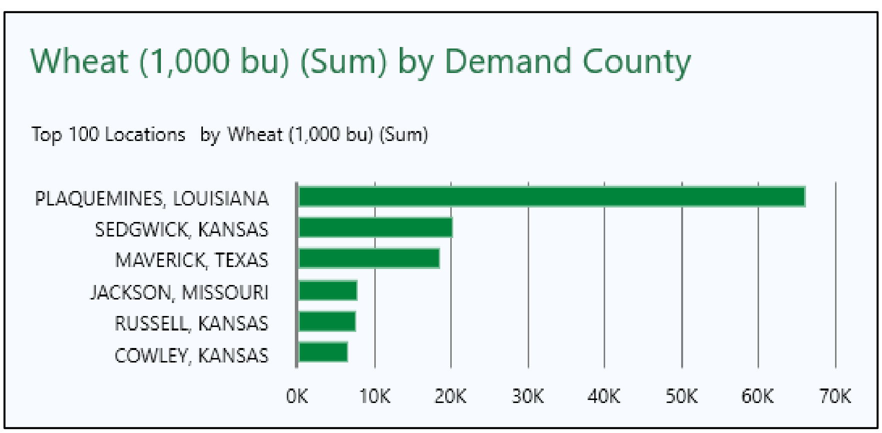




The top three destinations for Kansas wheat are export terminals on the Mississippi River, domestic mills in Wichita, Kansas, and rail crossing points for exports to Mexico (Figure 42). The largest milling demand destinations are in Wichita, Kansas; Kansas City, Missouri; Russell, Kansas; and Arkansas City, Kansas. Other significant regional destinations for Kansas HRW wheat are the greater Omaha area; Des Moines, Iowa; the greater St. Louis, MO/East St. Louis, IL area; and near Chicago.

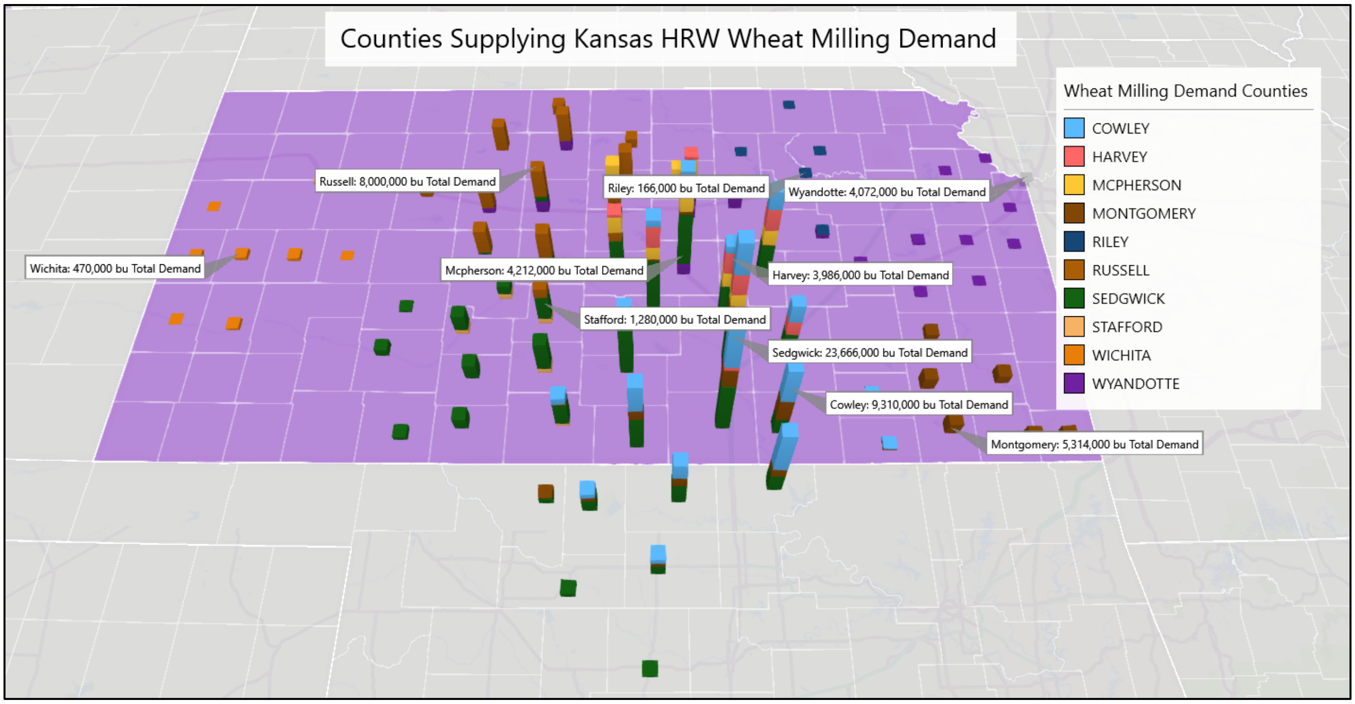
Figure 42. Kansas HRW wheat supply, regional destination by county





Kansas wheat mills procure their HRW supplies mainly from within a radius of about 2 or 3 counties around the mill (about a 60 to 100-mile radius) (Figure 43).

Figure 43. Counties supplying Kansas HRW wheat milling demand



2.4.2 Soft red winter wheat flow

Soft red winter wheat comprises about 1 percent of Kansas wheat production. In Kansas, it is often milled by the same mills that process HRW and HWW wheats for flour. In Table 5, it is estimated that 830,000 bushels of SRW wheat are used in Kansas. Kansas sends SRW wheat to Colorado (316,000 bu.), Iowa (36,000 bu.), Missouri (270,000 bu.), Nebraska (28,000 bu.), Oklahoma (320,000 bu.), and to locations out of the 11-state region (598,000 bu.). Table 5 shows the counties within the 11-state region that receive SRW wheat from Kansas.

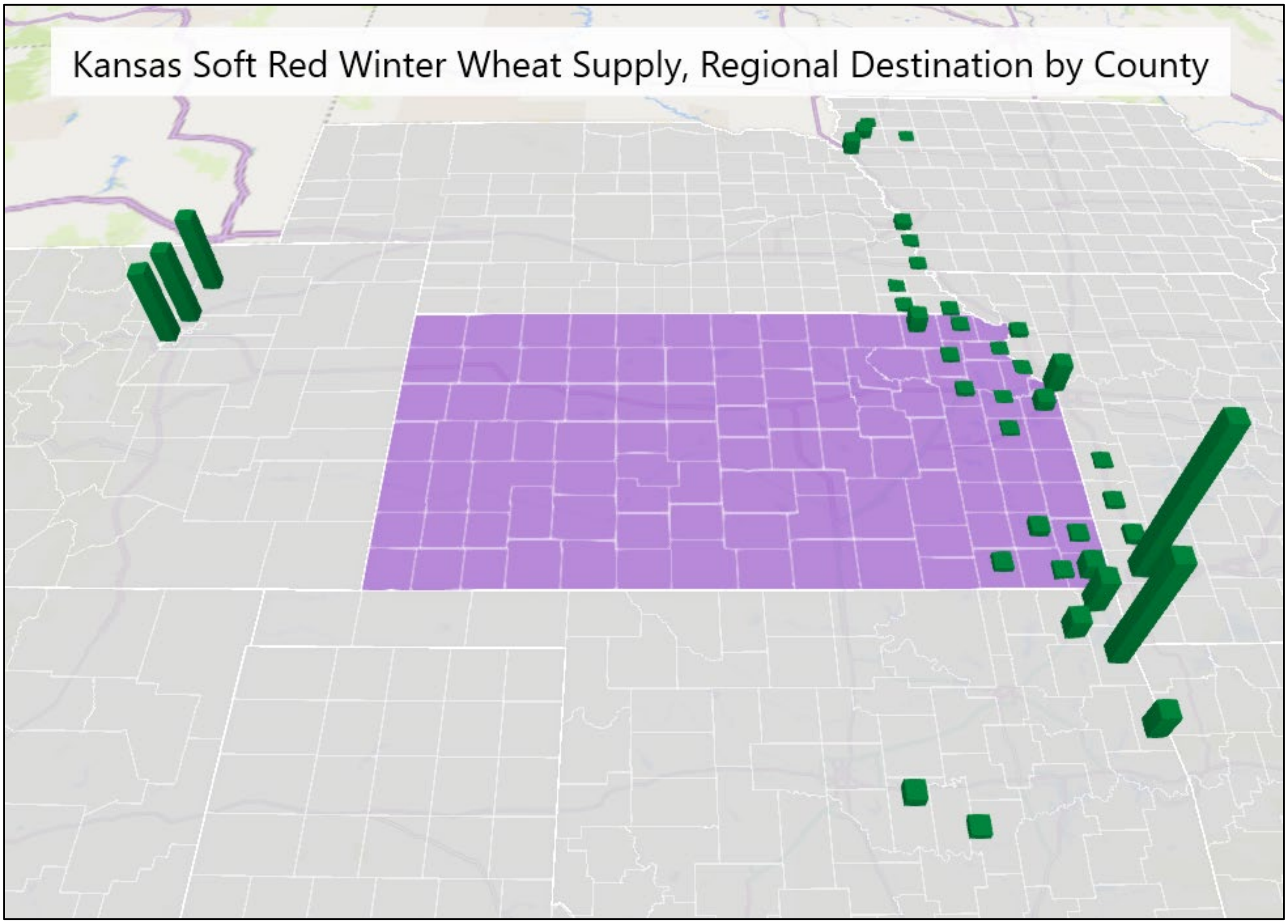
Table 5. Summary of regional soft red winter (SRW) wheat movement (1,000 bushels)

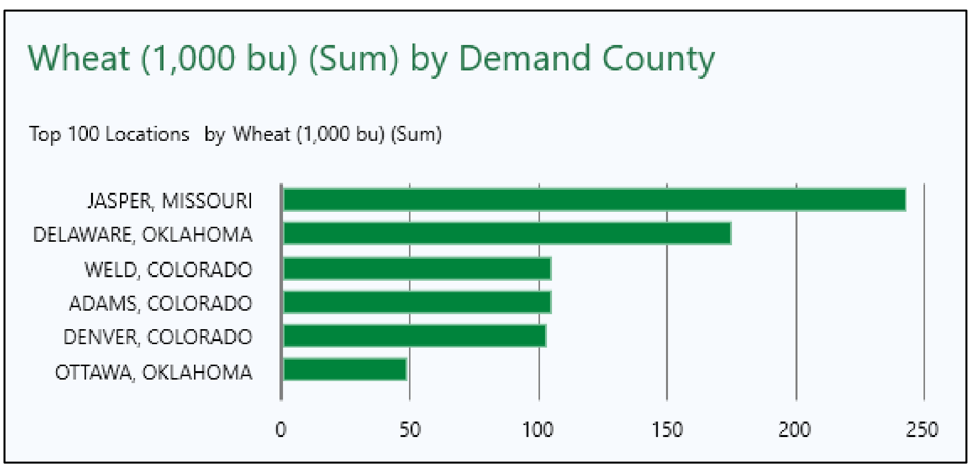
Summary of Regional Soft Red Winter Wheat Movement (1,000 bu.)

	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	146	-	-	-	-	604	20	-	-	834	2,388	498	4,490
CO	-	-	-	-	-	-	-	-	-	-	-	-	-
IA	-	-	-	-	-	-	-	-	-	-	-	-	-
IL	-	84	260	13,434	-	6,368	4,872	-	-	-	2,702	10,786	38,506
KS	-	316	36	-	156	-	270	28	-	320	-	598	1,724
LA	-	-	-	-	-	-	-	-	-	-	-	-	-
MO	70	1,004	612	332	670	758	9,254	50	-	740	6,436	4,304	24,230
NE	-	14	52	-	-	-	-	34	-	-	-	28	128
NM	-	-	-	-	-	-	-	-	-	-	-	-	-
OK	-	-	-	-	4	-	30	-	-	1,330	-	178	1,542
TX	-	-	-	-	-	8	-	-	-	362	3,098	-	3,468
Out of Region	14	-	596	132	-	12,664	100	-	-	22	6,638		20,166
Total	230	1,418	1,556	13,898	830	20,402	14,546	112	-	3,608	21,262	16,392	94,254

Notes: Read down to see where a state gets its SRW wheat. Read across to see where a state's SRW wheat goes for feed, milling, or export.

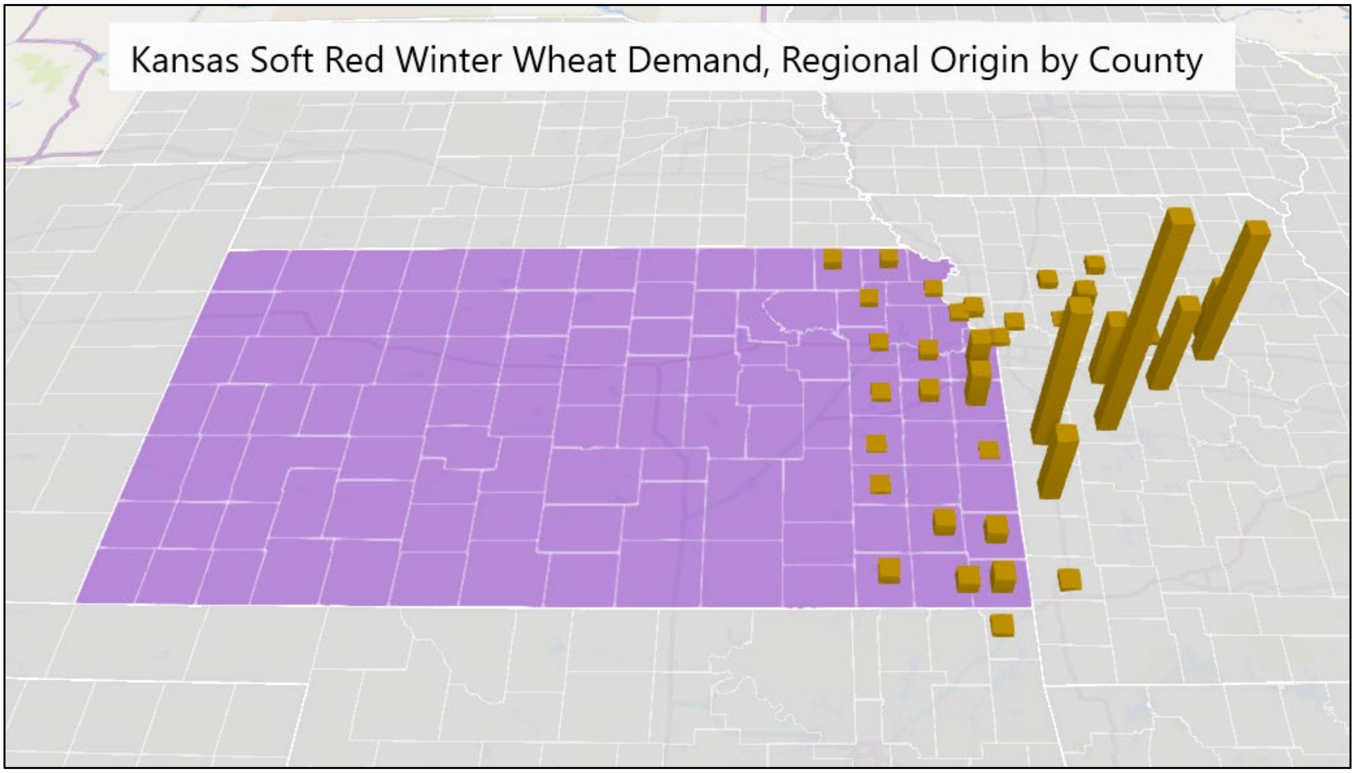
Figure 44. Kansas SRW wheat supply, regional destination by county

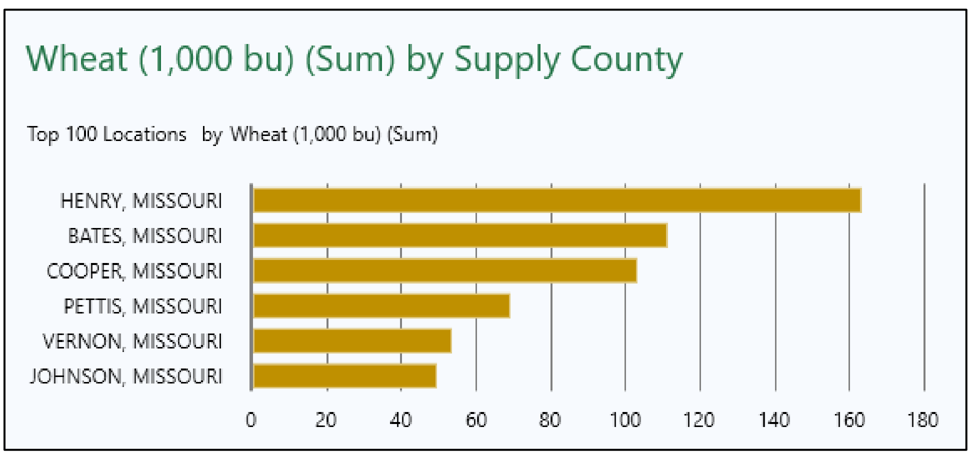




Kansas receives SRW wheat from Missouri (670,000 bu.) and Oklahoma (4,000 bu.). Figure 45 shows the counties that supply SRW to Kansas. They are mostly located in central and west-central Missouri.

Figure 45. Kansas SRW wheat demand, regional origin by county





2.4.3 White wheat flow

Most milling use designations that are published do not distinguish between HWW wheat, SWW wheat, HWS wheat, and SWS wheat. As noted in Figure 34 and Figure 35, 6.8 million bushels of HWW are produced in counties in western Kansas with a larger share of that production in counties in southwestern Kansas; the production of HWW in Kansas is more than sufficient to meet the milling needs of white wheat in Kansas (5.6 million bushels).

Of the 5.6 million bushels of white wheat used in Kansas, an estimated 3.5 million come from within Kansas. Colorado supplies 525,000 bushels of white wheat to Kansas and states outside the 11-state region supply 1.6 million bushels of white wheat to Kansas (Table 6).

Kansas supplies white wheat to Iowa (10,000 bu.), Illinois (50,000 bu.), Louisiana (690,000 bu.), Missouri 690,000 bu.), Nebraska (380,000 bu.), Oklahoma (2.0 million bu.), Texas (1.5 million bu.), and 220,000 bushels to states outside the 11-state region (Figure 47).

Table 6. Summary of regional white wheat movement (1,000 bushels)

Summary of Regional White Wheat Movement (1,000 bu.)

	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	-	-	-	-	-	-	-	-	-	-	-	-	-
CO	-	1,850	295	-	525	-	200	1,135	-	340	870	1,355	6,570
IA	-	-	-	-	-	-	-	-	-	-	-	-	-
IL	-	-	-	-	-	-	-	-	-	-	-	-	-
KS	-	-	10	50	3,480	690	690	380	-	1,980	1,480	220	8,980
LA	-	-	-	-	-	-	-	-	-	-	-	-	-
MO	-	-	-	-	-	-	-	-	-	-	-	-	-
NE	-	-	80	-	-	-	-	65	-	-	-	330	475
NM	-	-	-	-	-	-	-	-	-	-	-	-	-
OK	-	-	-	-	-	-	-	-	-	-	-	-	-
TX	-	-	-	-	-	-	-	-	-	-	-	-	-
Out of Region	-	-	890	4,220	1,610	-	1,175	485	-	2,500	2,110		12,990
Total	-	1,850	1,275	4,270	5,615	690	2,065	2,065	-	4,820	4,460	1,905	29,015

Notes: Read down to see where a state gets its white wheat. Read across to see where a state's white wheat goes for feed, milling, or export.

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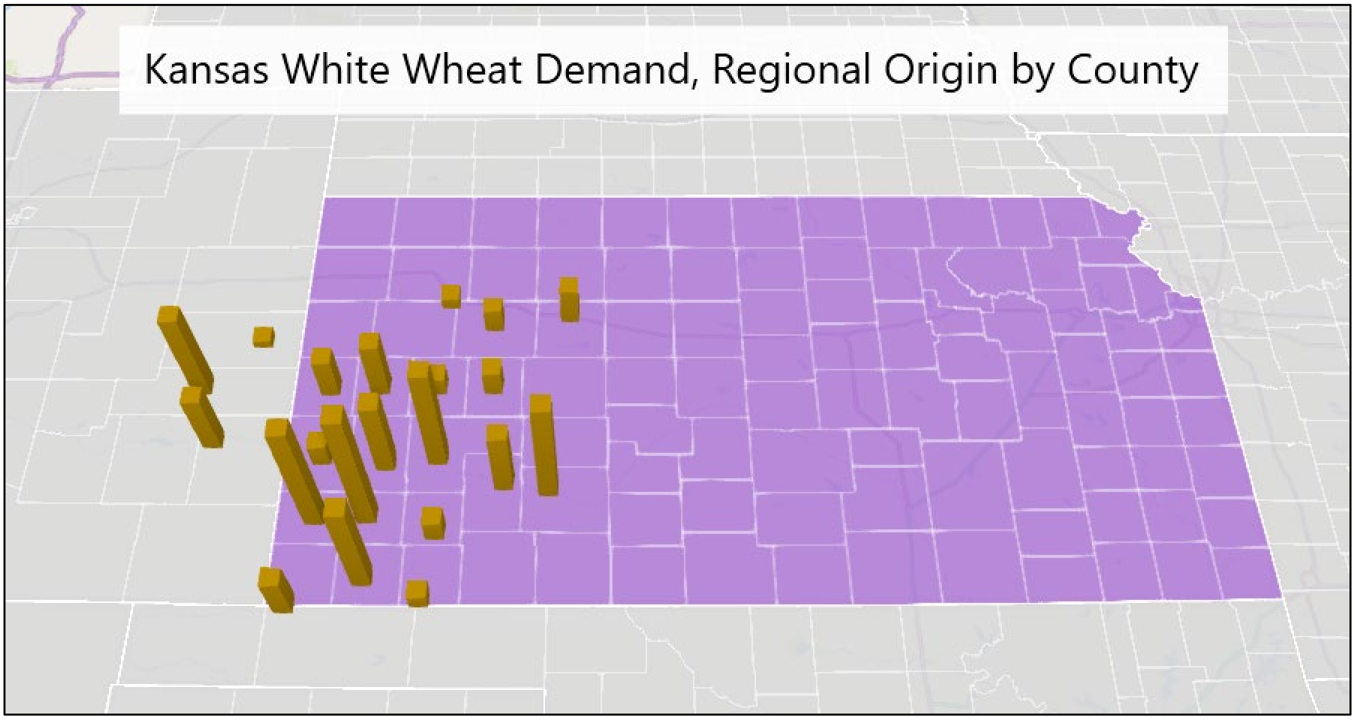
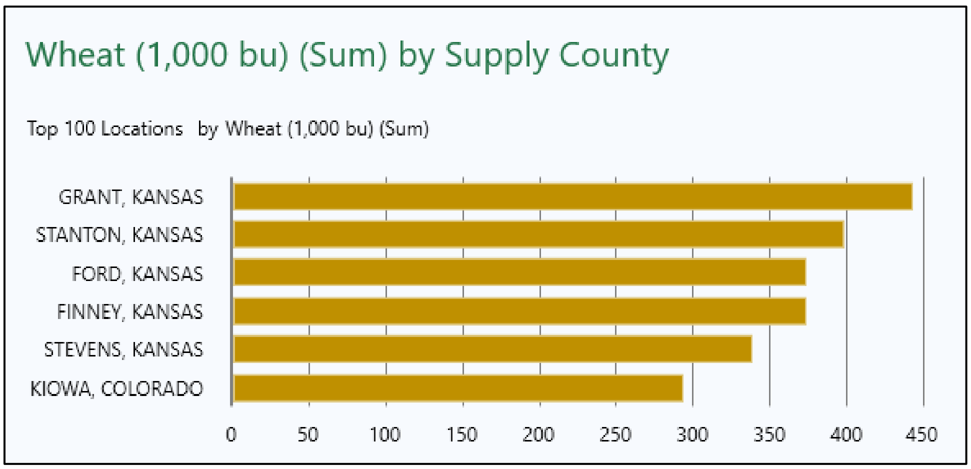
Kansas gets a significant portion of its white wheat from production that occurs in southwestern Kansas (Figure 46). Grant, Stanton, Ford, Finney, and Stevens counties in Kansas are the largest suppliers of white wheat to Kansas mills. Approximately 10 percent of the white wheat milled in Kansas originates from nearby counties in Colorado.

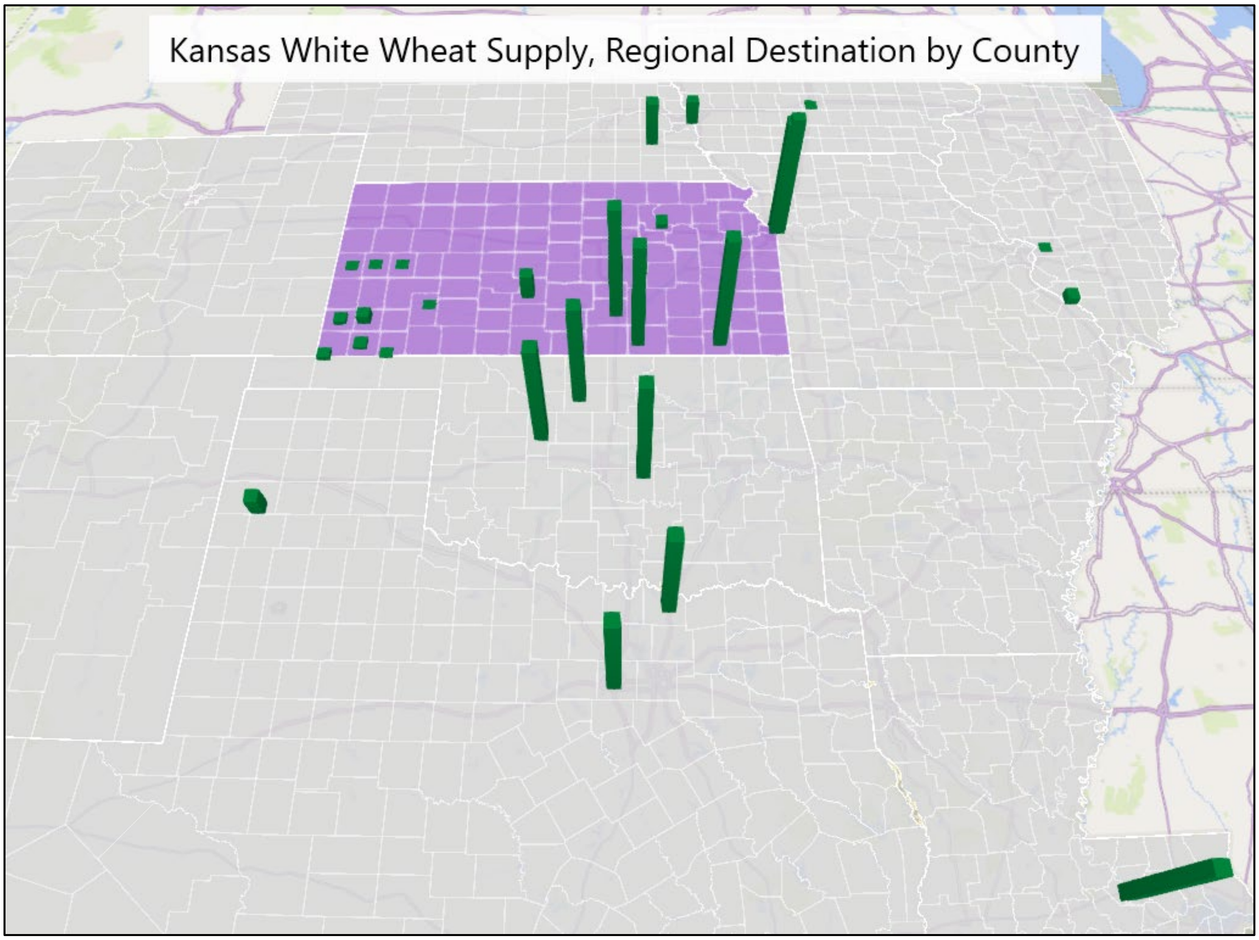
Figure 46. Kansas white wheat demand, regional origin by county

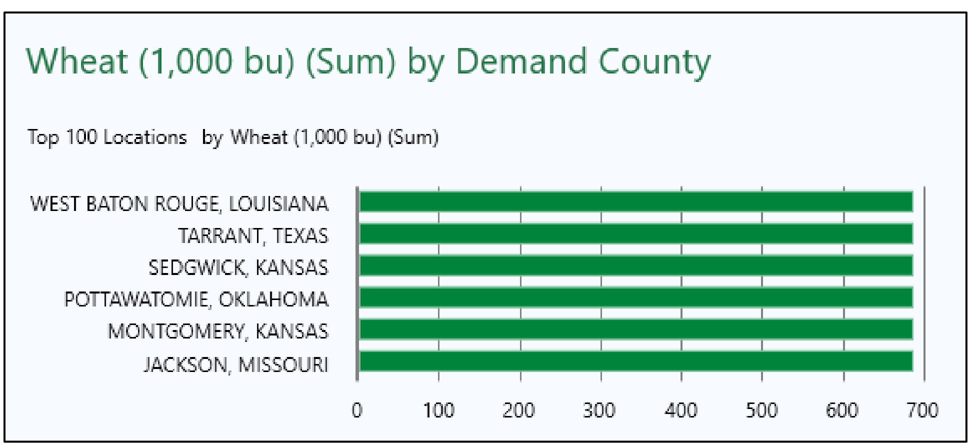




HWW from Kansas supplies all the HWW demand for the wheat mills in Montgomery County, Kansas; West Baton Rouge Parish in Louisiana; and Pottawatomie County, Oklahoma. HWW from Kansas provides about a third of the HWW demand in Sedgwick County, Kansas and Jackson County, Missouri and approximately 22% of the HWW used by the wheat mills in Tarrant County, Texas.

Figure 47. Kansas white wheat supply, regional destination by county[7]





[7] White wheat demand is estimated as a percentage of total mill capacity and Montgomery County, KS; West Baton Rouge, LA; and Pottawatomie, OK are the same at 688,000 bushels. Sedgwick, KS and Jackson, MO are larger mills, using an estimated 2,063,000 bushels of white wheat. KS white wheat is used up before they can get full supply, which is the same for the mill in Tarrant County, TX which used 3,094,000 bushels. This plant only gets 688,000 bushels from Kansas.

2.4.4 Hard red spring wheat flow

There is no HRS wheat grown within the 11-state region. All HRS wheat use within the 11-state region originates outside the 11-state region. Kansas receives 7.0 million bushels of wheat from states outside the 11-state region. HRS wheat is received from Minnesota (780,000 bu.), North Dakota (1.9 million bu.), and South Dakota (4.2 million bu.) (Table 7).

Table 7. Summary of regional hard red spring wheat movement (1,000 bushels)

Summary of Regional Hard Red Spring Wheat Movement (1,000 bu.)													
	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
ID	-	300	-	-	-	-	-	-	-	-	-	40,900	41,200
MN	-	-	3,240	5,720	780	2,580	3,640	360	-	-	960	60,000	77,280
MT	-	4,520	-	-	-	-	-	-	-	-	40	127,520	132,080
ND	-	2,120	1,080	11,800	1,940	25,380	7,700	3,480	-	320	14,900	204,900	273,620
SD	-	2,560	800	1,480	4,240	680	820	2,240	-	1,200	4,680	13,860	32,560
WA	-	-	-	-	-	-	-	-	-	-	-	36,060	36,060
Out of Region	-	-	-	-	-	-	-	-	-	-	-		-
Total	-	9,500	5,120	19,000	6,960	28,640	12,160	6,080	-	1,520	20,580	483,240	592,800
Notes: Read down to see where a state gets its HRS wheat. Read across to see where a state's HRS wheat goes for milling or export.													

2.4.5 Durum wheat flow

There is no durum wheat grown within the 11-state region. All durum wheat use within the 11-state region originates outside the 11-state region. Kansas receives 280,000 bushels of durum wheat from North Dakota (Table 8).

Table 8. Summary of regional durum wheat movement (1,000 bushels)

Summary of Regional Durum Wheat Movement (1,000 bu.)													
	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AZ	-	-	-	-	-	380	-	-	-	-	370	4,260	5,010
CA	-	-	-	-	-	-	-	-	-	-	-	1,670	1,670
ID	-	-	-	-	-	-	-	-	-	-	-	790	790
MN	-	-	2,100	-	-	1,390	2,010	-	-	-	1,500	5,860	12,860
MT	-	-	-	-	-	-	5,420	-	-	-	-	25,440	30,860
ND	-	-	6,250	-	280	4,180	12,040	-	-	-	930	36,850	60,530
TX	-	-	-	-	-	170	-	-	-	-	260	170	600
Out of Region	-	-	-	-	-	-	-	-	-	-	-		-
Total	-	-	8,350	-	280	6,120	19,470	-	-	-	3,060	75,040	112,320
Notes: Read down to see where a state gets its durum wheat. Read across to see where a state's durum wheat goes for milling or export.													

3 Dynamic commodity flow: value added processing

3.1 Value-added feed and pet food flows

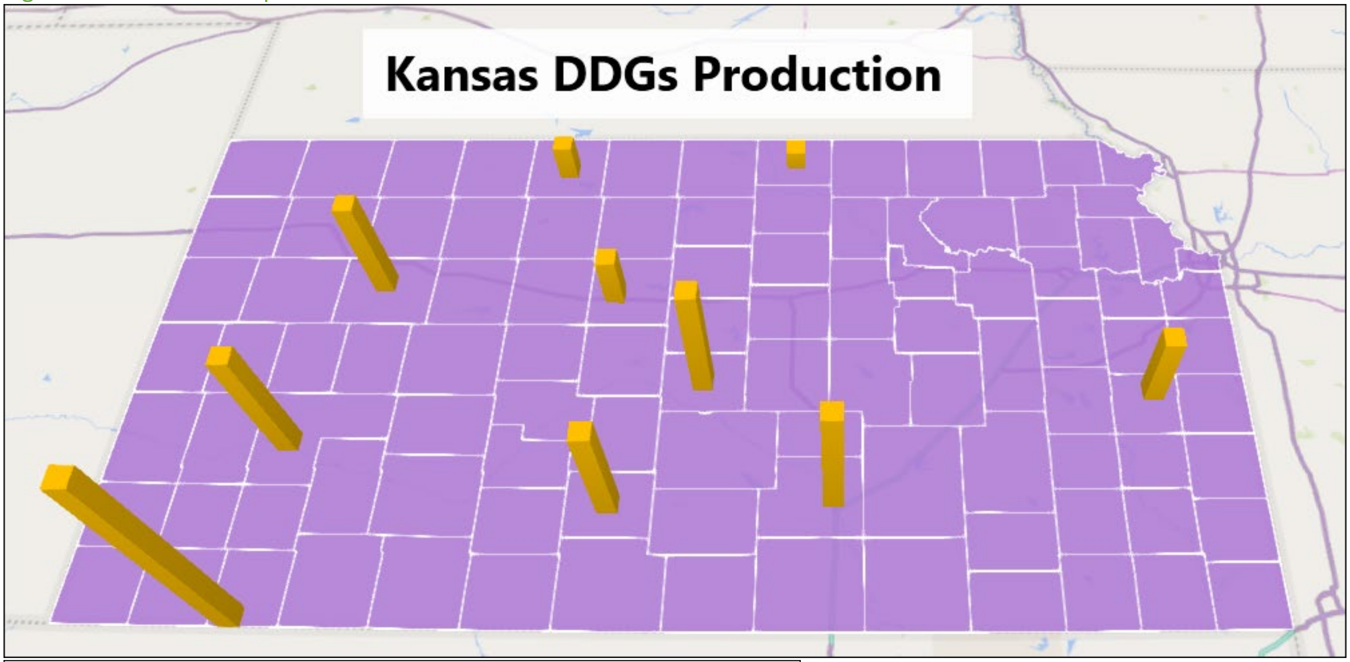
In this dynamic commodity flow analysis, feed demand for livestock and demand for feed ingredients for pet food manufacturing are considered together since both livestock feed and pet foods are processed at feed mill facilities. Figure 48 shows the number of pet food manufacturers for each Kansas county. There are 40 pet food manufacturers located in 22 counties. Johnson, Nemaha, Shawnee, and Wyandotte counties in Kansas each have 4 pet food manufacturers. Barton, Brown, Cherokee, Douglas, Lyon, and Washington counties in Kansas each have 2 pet food manufacturers. Twelve other counties in Kansas have one pet food manufacturer. Kansas pet food manufacturers range from some of the largest pet food manufacturers in the country to some relatively small pet food manufacturers.

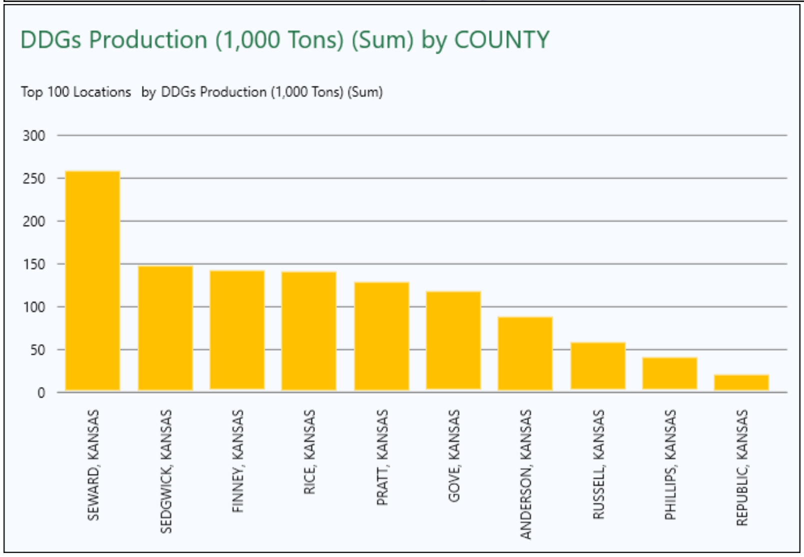
Figure 48. Kansas pet food production

3.1.1 Dried distillers grains (DDGs)

DDGs production occurs at dry mill ethanol plants that use corn and grain sorghum as feedstocks for ethanol production. Kansas is estimated to have produced 1,149,000 tons of DDG in 2020 (Figure 49).[8]

Figure 49. Kansas DDGs production



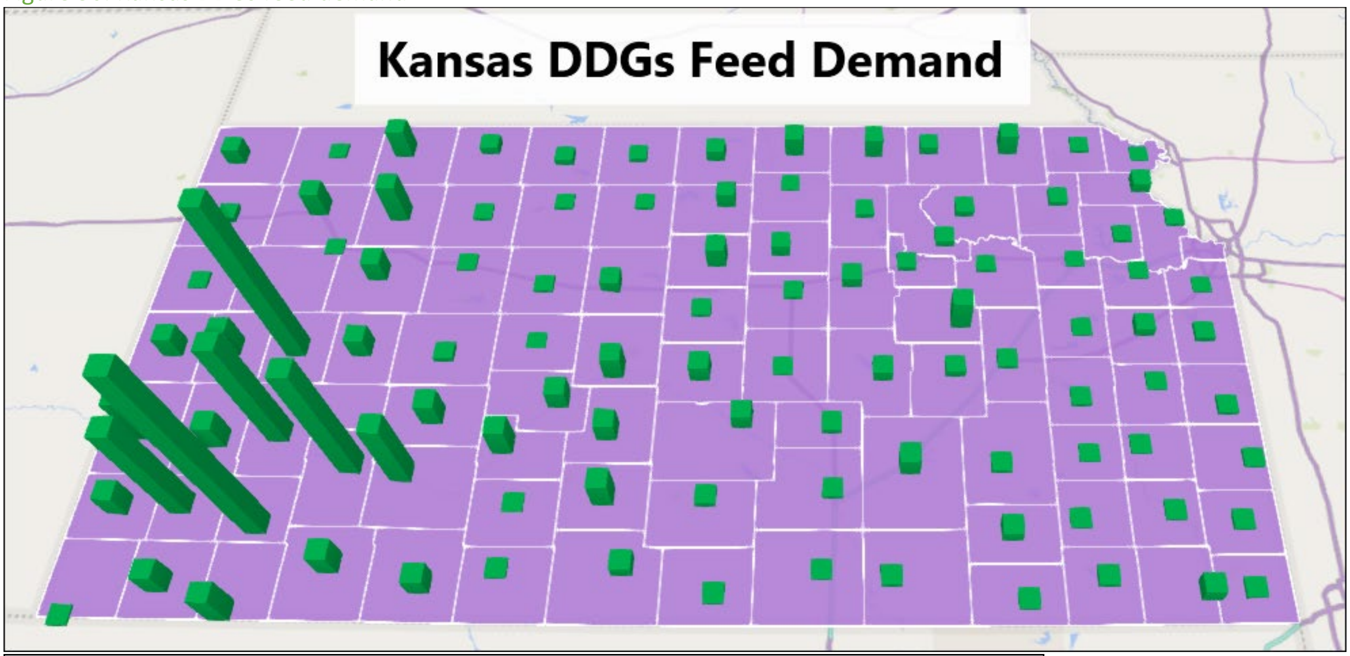


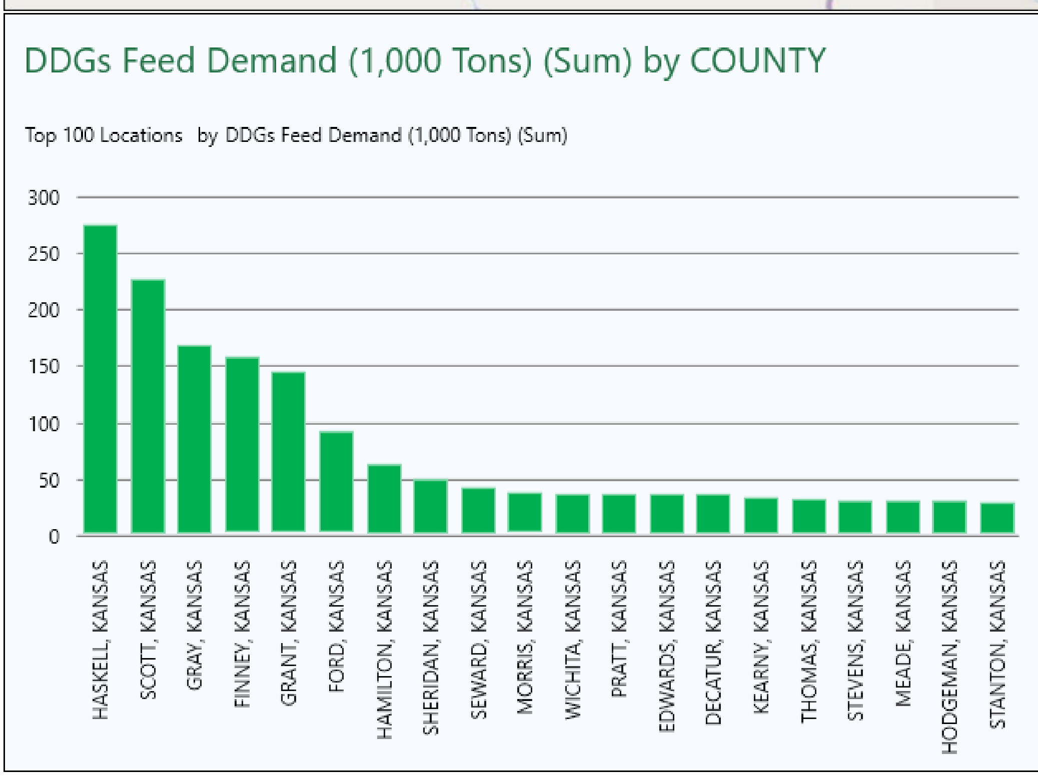
[8] There are 12 facilities producing ethanol in Kansas. One uses beverage waste as the feedstock, another uses a combination of wheat starch (from 8 million bushels of wheat) and either grain sorghum or corn for the balance of its production. There are 10 facilities that use corn and/or grain sorghum as the feedstocks for ethanol production. The 11 plants that produce DDG are located in 10 counties (2 plants in Finney County).

In 2020, it is estimated that 2.4 million tons of DDGs were used for production of feed and pet foods in Kansas (Figure 50). The largest amounts of DDGs are used in cattle-on-feed rations (1.90 million tons), but DDGs are also used for feeding beef cows and in calf feed rations (217,879 tons), dairy cows (197,088 tons), hogs 99,187 tons), sheep and goats (450 tons), and 363 tons in pet food manufacturing.

Haskell county has the largest DDGs consumption in Kansas (278,000 tons), followed by Scott (229,000 tons), Gray (170,000 tons), Finney (160,000 tons), Grant (147,000 tons), and Ford (93,000 tons) counties.

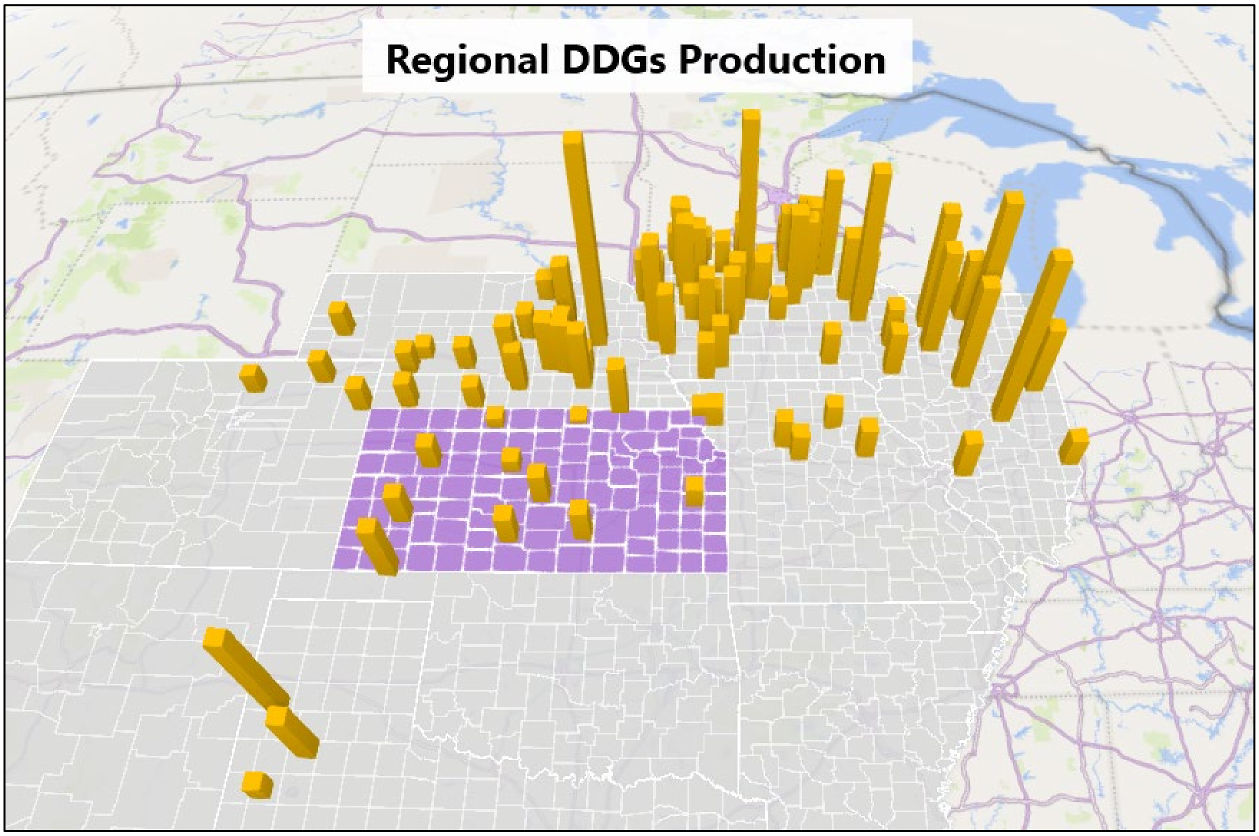
Figure 50. Kansas DDGs feed demand

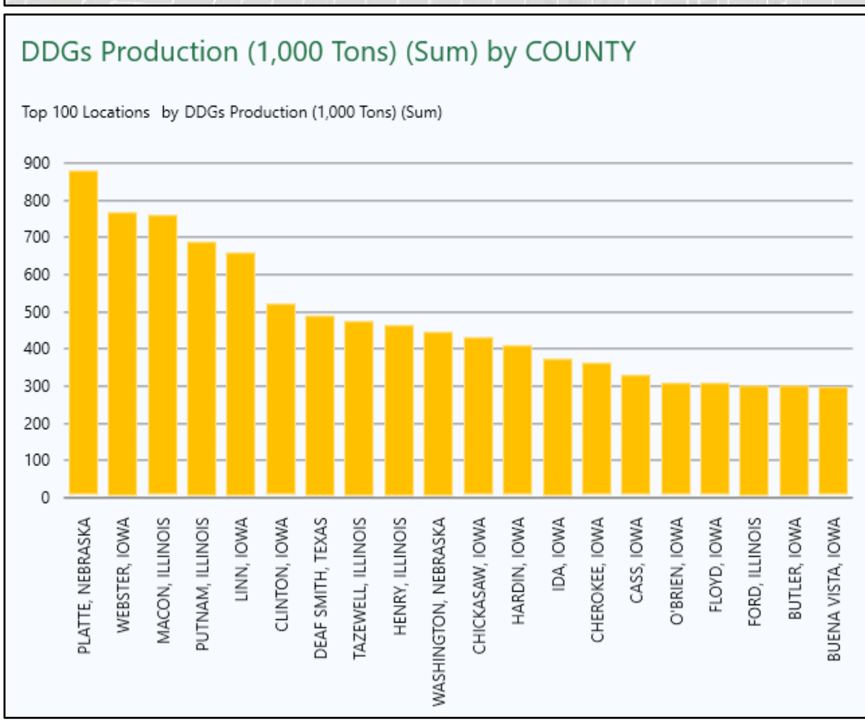




Within the 11-state region, there were 20.4 million tons of DDGs produced in 2020. Within the region, the largest state of production is Iowa with 46 percent of regional DDGs production. This is followed by Nebraska (23%), Illinois (17%), Kansas (5%), Texas (4%), Missouri (3%), and Colorado (2%) (Figure 51).

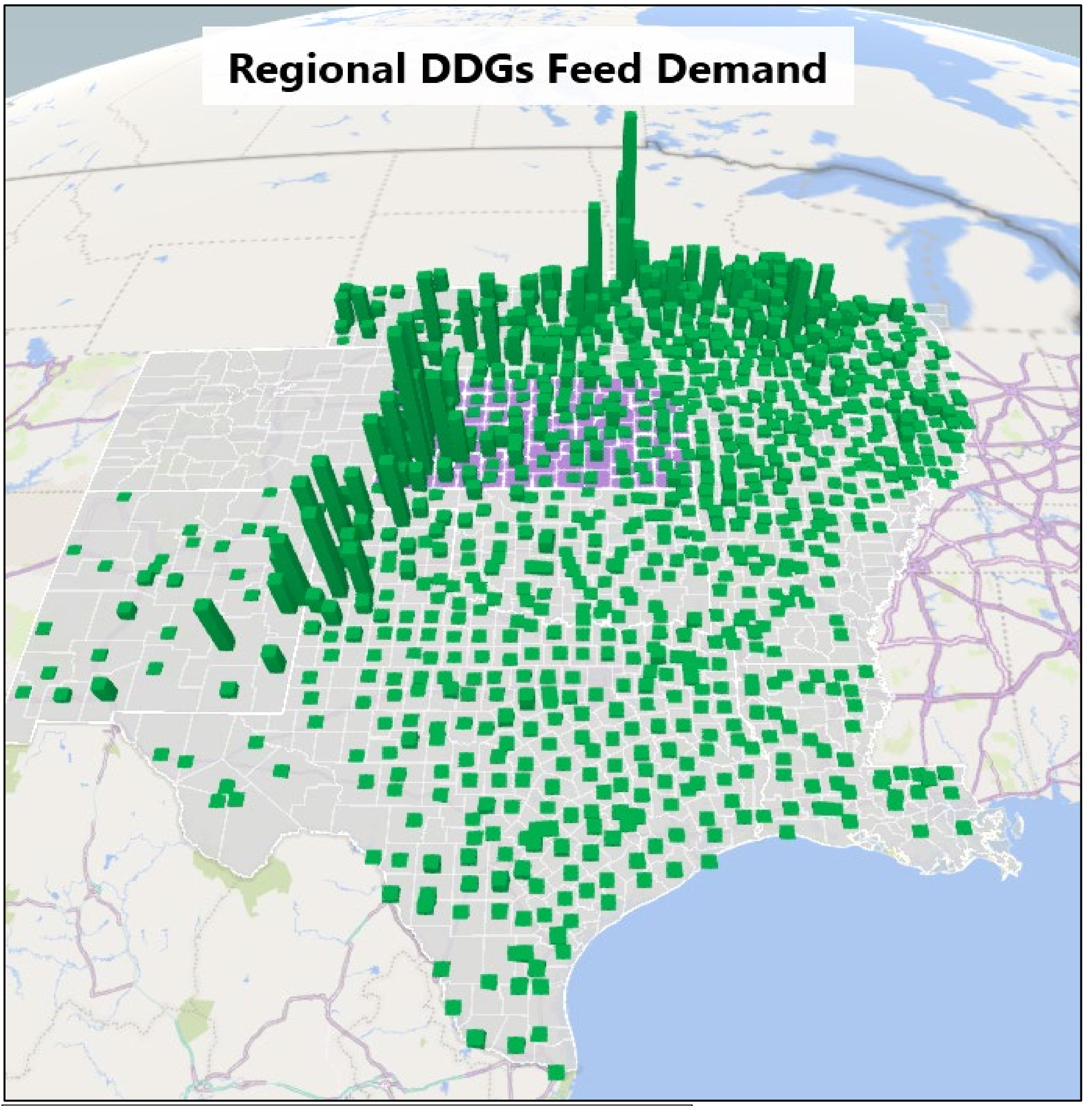
Figure 51. Regional DDGs production

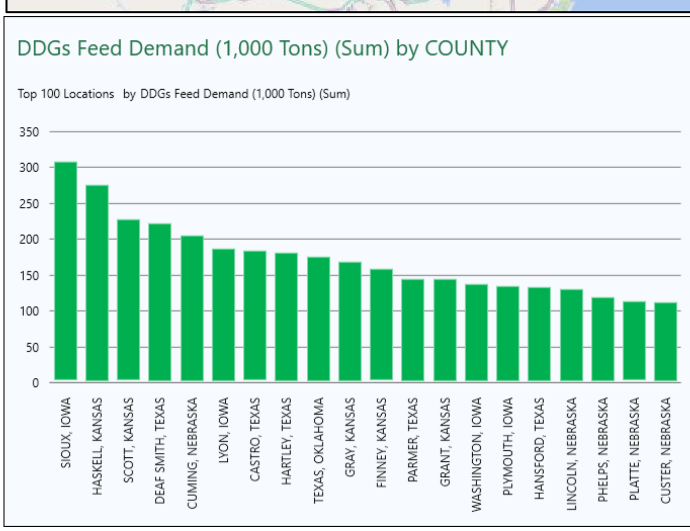




In the 11-state region, there were 13.6 million tons of DDGs used in livestock feed and pet food production. DDGs make up 12.3% of the 7-major feed ingredients used in the 11-state region. Kansas accounts for 17.8 percent of the regional DDGs consumption with DDGs making up 20.5% of Kansas feed ingredient use. Kansas has net inflows of 1.2 million tons of DDGs from other states (Figure 52).

Figure 52. Regional DDGs feed demand





3.1.1.1 DDGs flow

While Kansas produces 1.1 million tons of DDGs, it is a consumer of 2.4 million, with 1.8 million tons shipped in from other states (Table 9). In 2020, Kansas received DDGs from Colorado (20,000 tons), Iowa (591,000 tons), Missouri (58,000 tons), Nebraska (991,000 tons), and from states outside the region (140,000 tons), all according to DIS estimates. Figure 53 shows the regional counties that supply DDGs to Kansas.

Kansas sends DDGs to Arkansas (7,000 tons), Louisiana (2,000 tons), Missouri (10,000 tons), Nebraska (9,000 tons), New Mexico (4,000 tons), Oklahoma (234,000 tons), Texas (266,000 tons), and to states outside the region (3,000 tons). Figure 54 shows where DDGs produced in Kansas go within the 11-state region. Kansas is a significant supplier of DDGs to the eastern halves of Oklahoma and Texas. Figure 55 shows the distribution of DDGs from Kansas counties with ethanol production to counties within the region.

Table 9. Summary of regional DDG movement (tons)

Summary of Regional DDG Movement (1,000 tons)

	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	-	-	-	-	-	-	-	-	-	-	-	-	-
CO	-	-	-	-	20	-	-	30	18	3	29	213	312
IA	-	-	3,131	119	591	13	41	264	91	125	2,208	2,923	9,506
IL	-	-	34	498	-	2,410	39	-	-	-	-	424	3,405
KS	7	-	-	-	615	2	10	9	4	234	266	3	1,149
LA	-	-	-	-	-	-	-	-	-	-	-	-	-
MO	73	-	-	10	58	22	429	4	-	34	34	-	665
NE	-	-	90	-	991	-	-	2,216	194	125	773	299	4,687
NM	-	-	-	-	-	-	-	-	-	-	-	-	-
OK	-	-	-	-	-	-	-	-	-	-	-	-	-
TX	-	-	-	-	-	-	-	-	130	56	616	45	847
Out of Region	57	-	262	46	140	323	28	159	46	24	451	-	1,536
Total	137	-	3,518	673	2,414	2,770	545	2,682	484	601	4,376	3,861	22,107

Notes: Read down to see where a state gets its DDGs. Read across to see where a state's DDGs go for feed or export.

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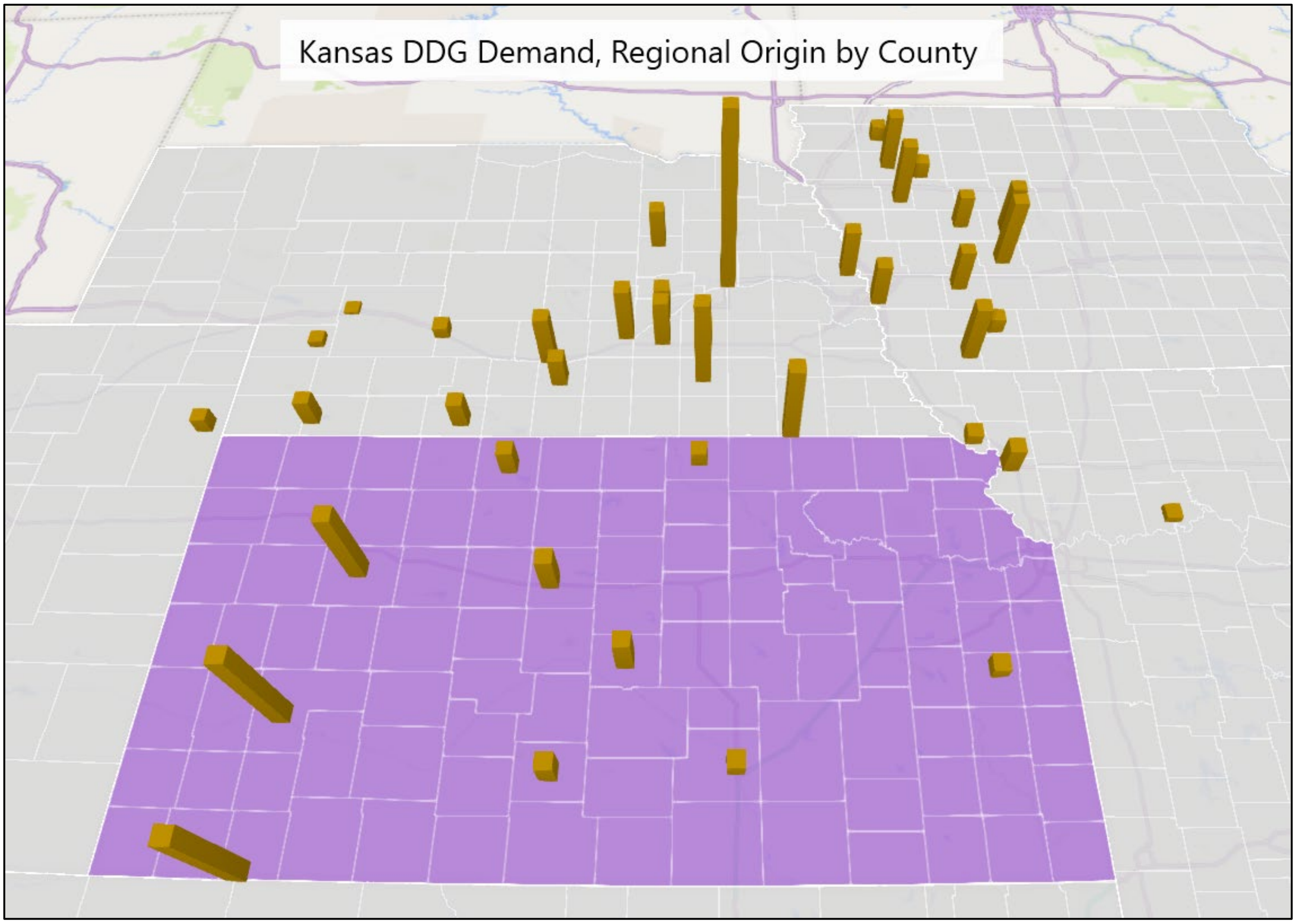
Figure 53. Kansas DDG demand, regional origin by county



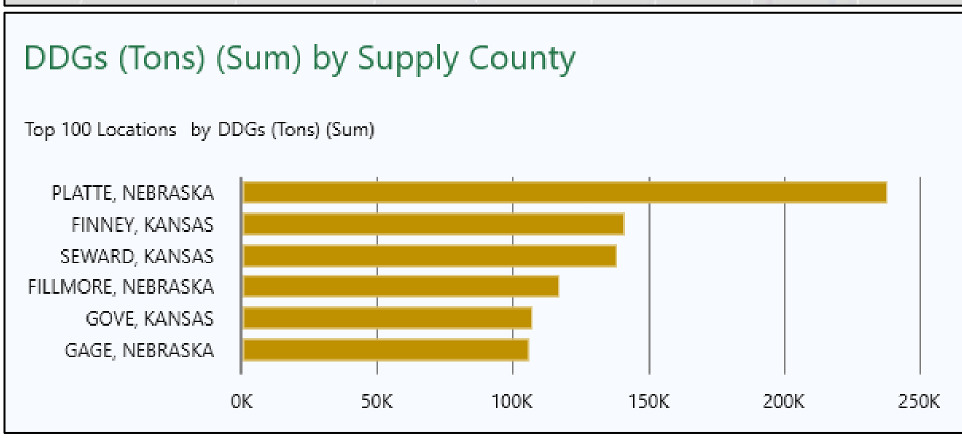
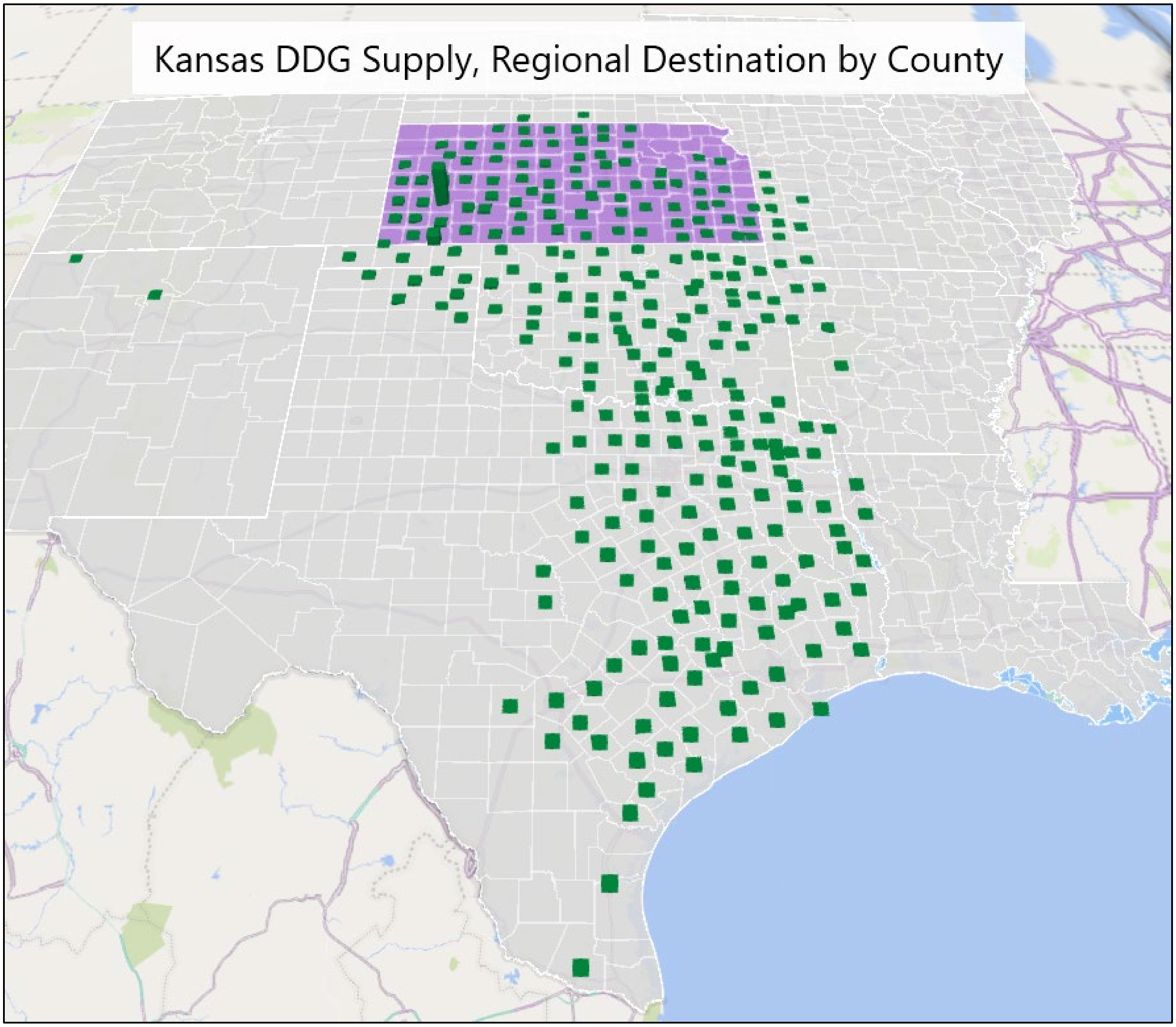


Figure 54. Kansas DDG supply, regional destination by county



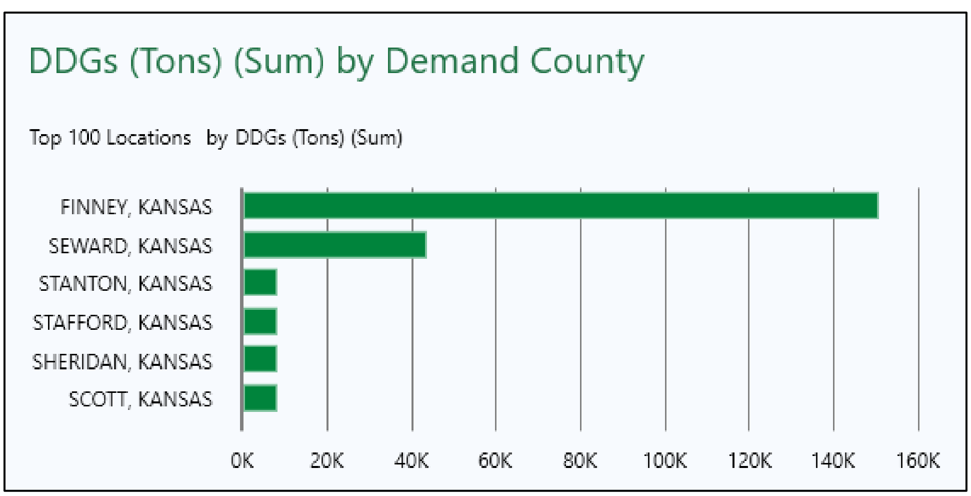
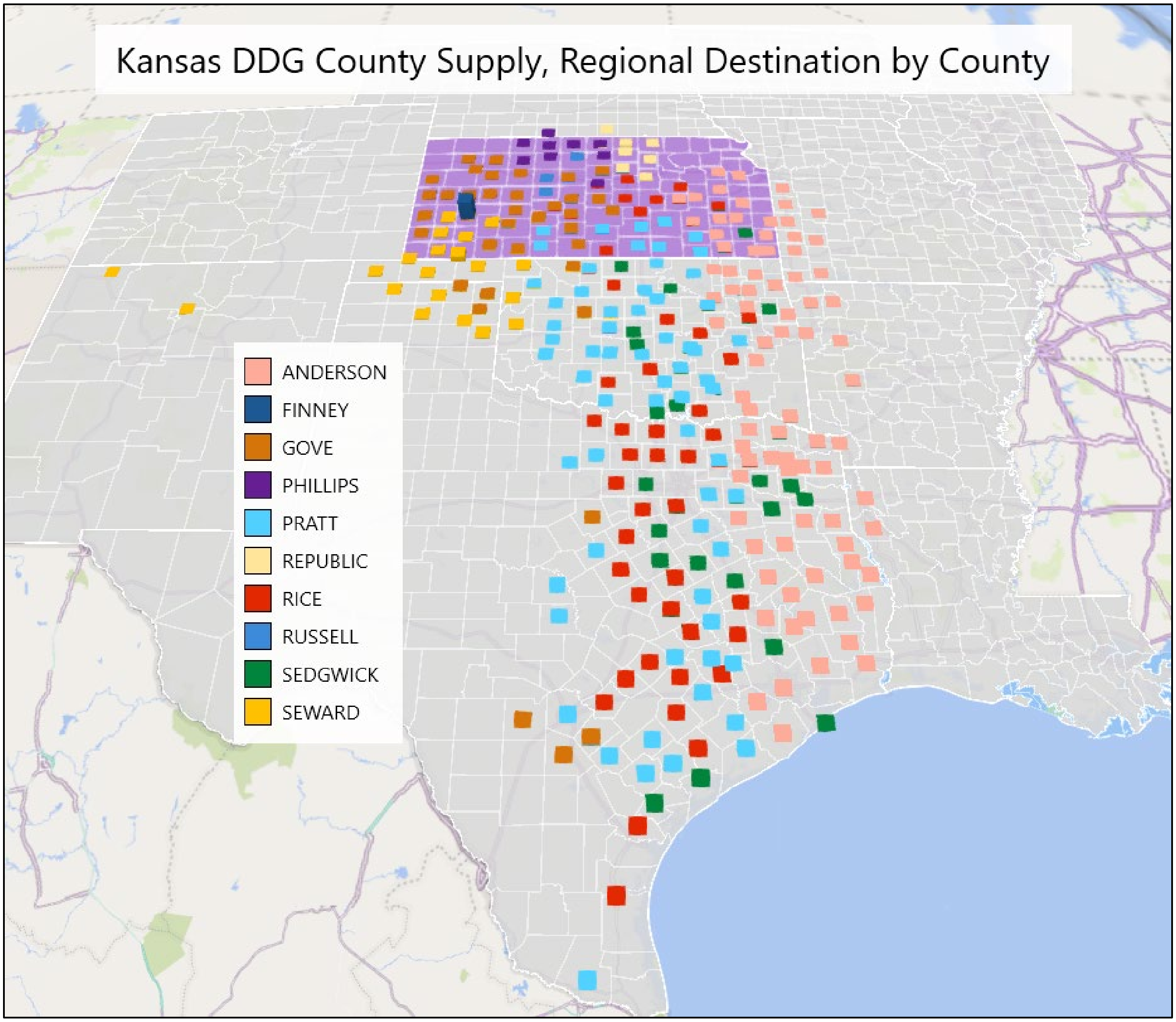


Figure 55 shows where DDGs produced by the ethanol plants in each of the Kansas counties are used. The DDGs from plants in Anderson, Pratt, Rice, and Sedgwick counties tend to be used locally, but also flow south to counties in Missouri, Arkansas, Oklahoma, and Texas. DDGs from ethanol facilities in Finney, Gove, Phillips, and Republic counties tend to be used within a few counties of the production facility. Feedlot demand for DDGs produced in Seward County tend to be used by feedlots within 100 miles of the production facility.

Figure 55. Kansas DDG county supply, regional destination by county

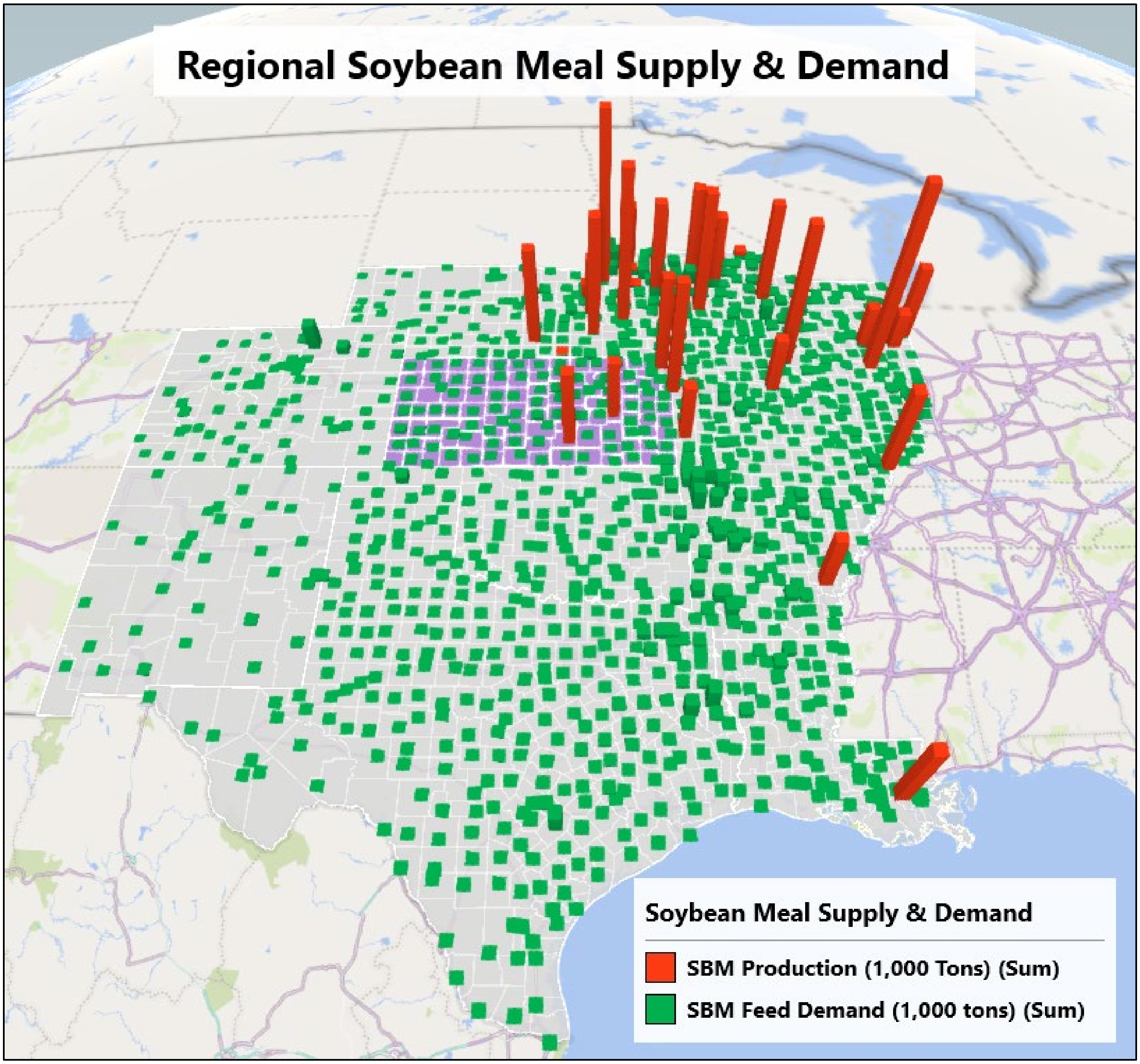


3.1.2 Soybean meal

Kansas produced an estimated 1.5 million tons of soybean meal and uses 331,000 tons of soybean meal in 2020. The largest users of soybean meal in Kansas are pet food manufacturers. Soybean meal accounts for 2.8% of Kansas feed ingredient use.

Regionally, there were 25.4 million tons of soybean meal produced in 2020. Total feed demand for soybean meal in the 11-state region is 12.9 million tons. Another 7.6 million tons are exported through export ports in the region (Figure 56).

Figure 56. Regional soybean meal supply and demand



3.1.2.1 Soybean meal flow

Kansas receives soybean meal from Missouri (59,000 tons) and Nebraska (67,000 tons) (Table 10). Kansas sends soybean meal to Arkansas (5,000 tons), Colorado (46,000 tons), Missouri (46,000 tons), New Mexico (117,000 tons), Oklahoma (268,000 tons), Texas (529,000 tons), and to states outside the region (249,000 tons) (Figure 58).

Table 10. Summary of regional soybean meal movement

Summary of Regional Soybean Meal Movement (1,000 tons)

	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	338	-	-	-	-	86	-	-	-	17	185	2	628
CO	-	-	-	-	-	-	-	-	-	-	-	-	-
IA	496	53	2,837	83	-	2,370	136	21	-	48	2,165	1,730	9,939
IL	453	-	97	441	-	2,999	223	-	-	-	14	1,775	6,002
KS	5	46	-	-	205	-	46	-	117	268	529	249	1,465
LA	15	-	-	-	-	135	-	-	-	-	418	392	960
MO	1,394	-	16	21	59	116	946	7	-	371	451	3	3,384
NE	36	462	35	-	67	-	8	467	-	50	483	1,391	2,999
NM	-	-	-	-	-	-	-	-	-	-	-	-	-
OK	-	-	-	-	-	-	-	-	-	-	-	-	-
TX	-	-	-	-	-	-	-	-	-	-	-	-	-
Out of Region	35	-	351	97	-	109	9	-	7	-	-		608
Total	2,772	561	3,336	642	331	5,815	1,368	495	124	754	4,245	5,542	25,985

Notes: Read down to see where a state gets its soybean meal. Read across to see where a state's soybean meal goes for feed or export.

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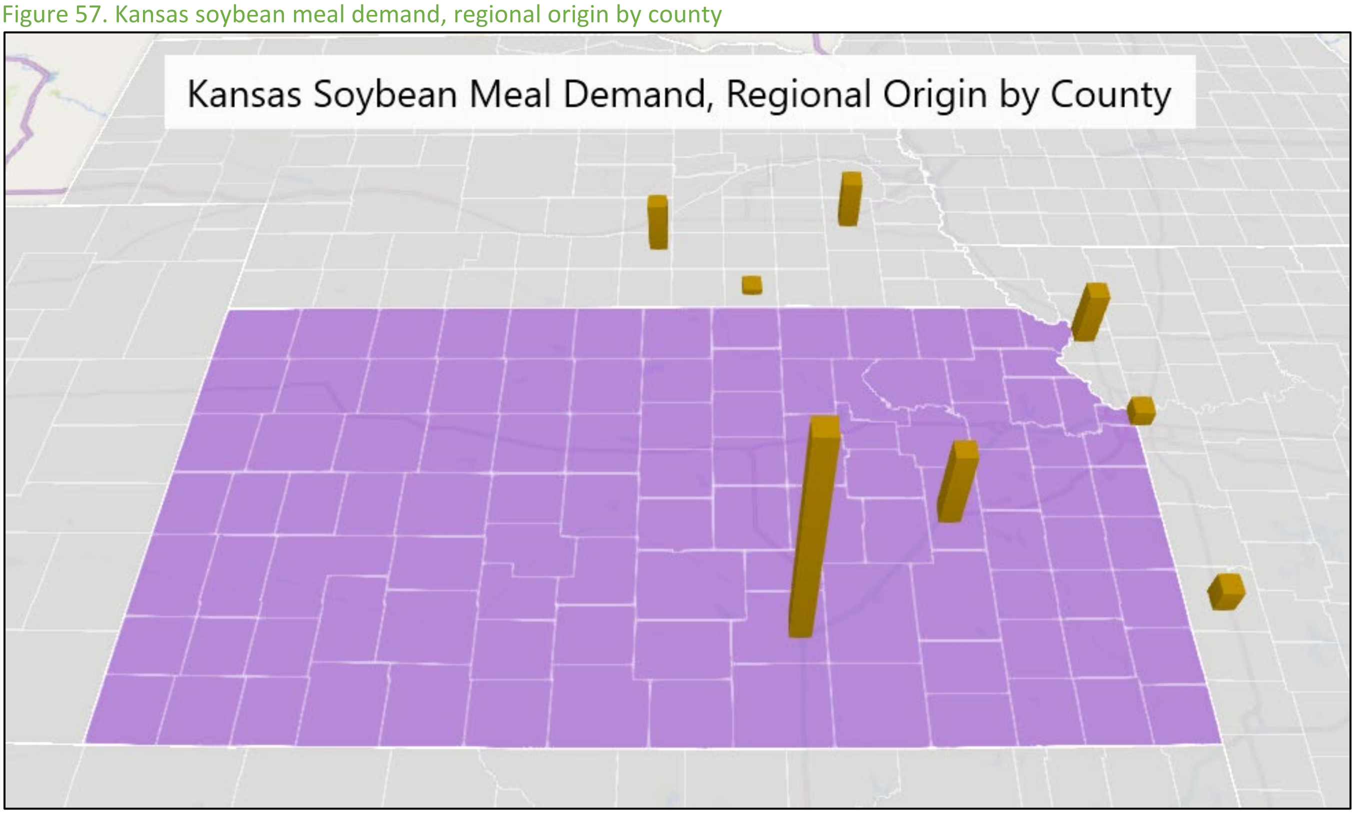
Figure 57. Kansas soybean meal demand, regional origin by county



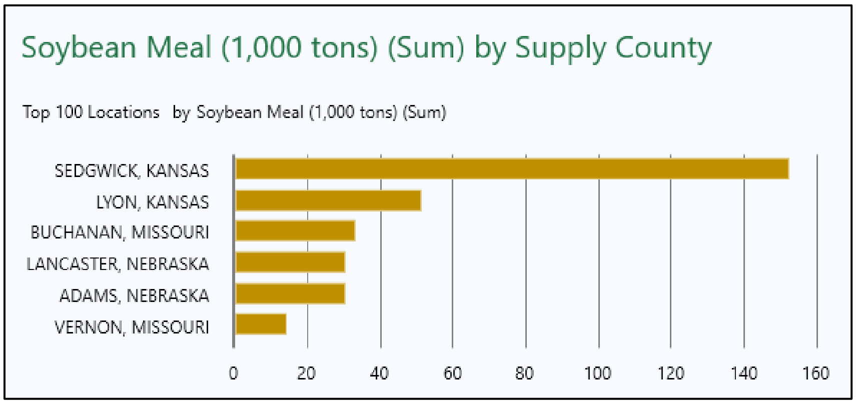
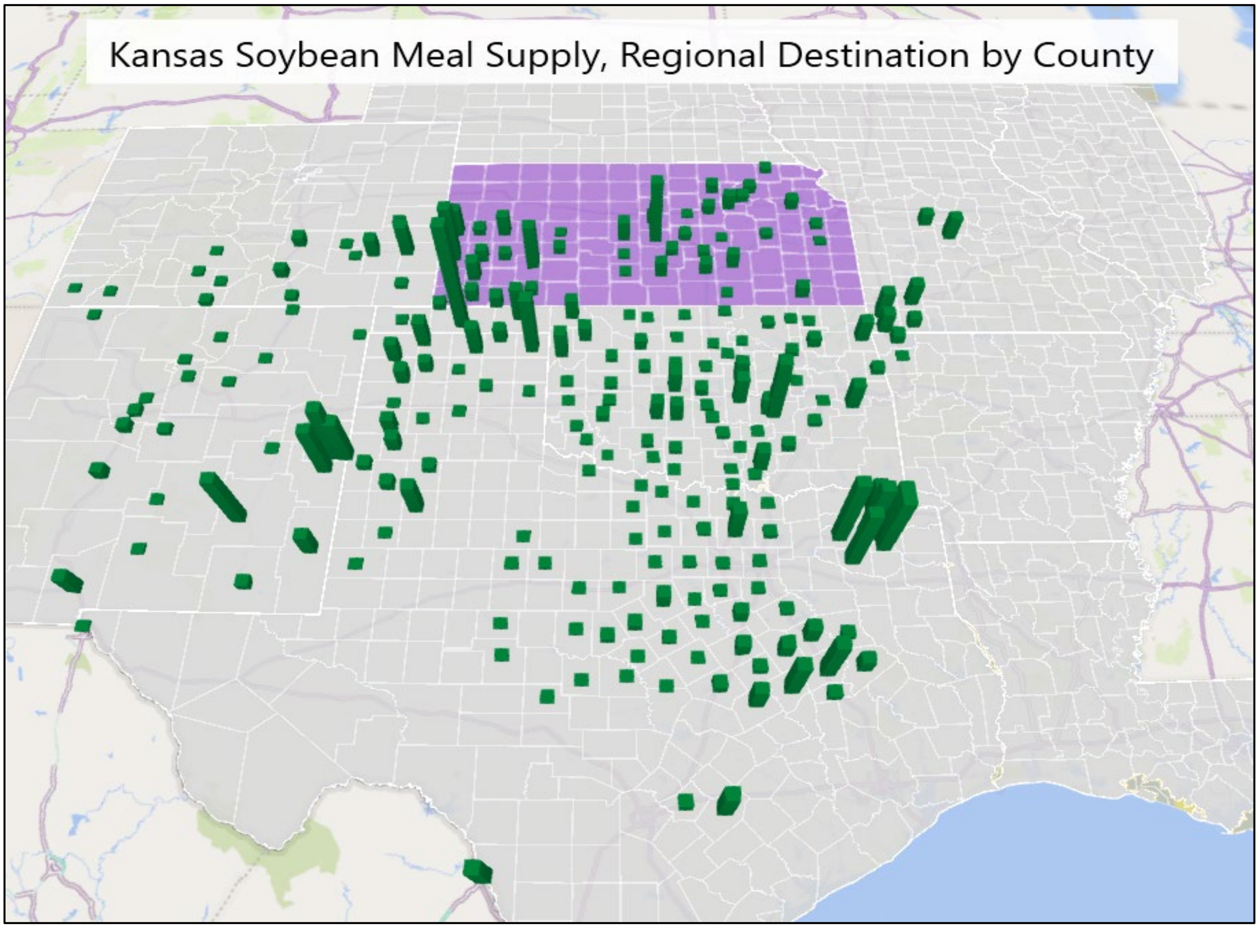


Figure 58. Kansas soybean meal supply, regional destination by county



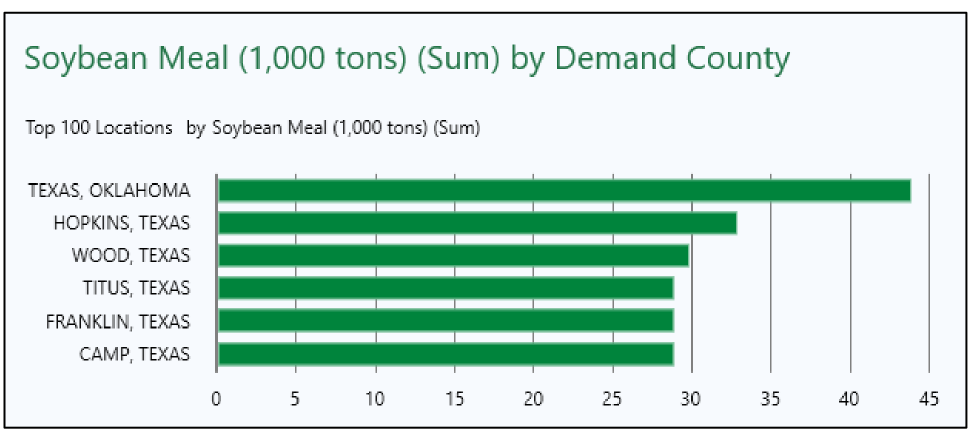
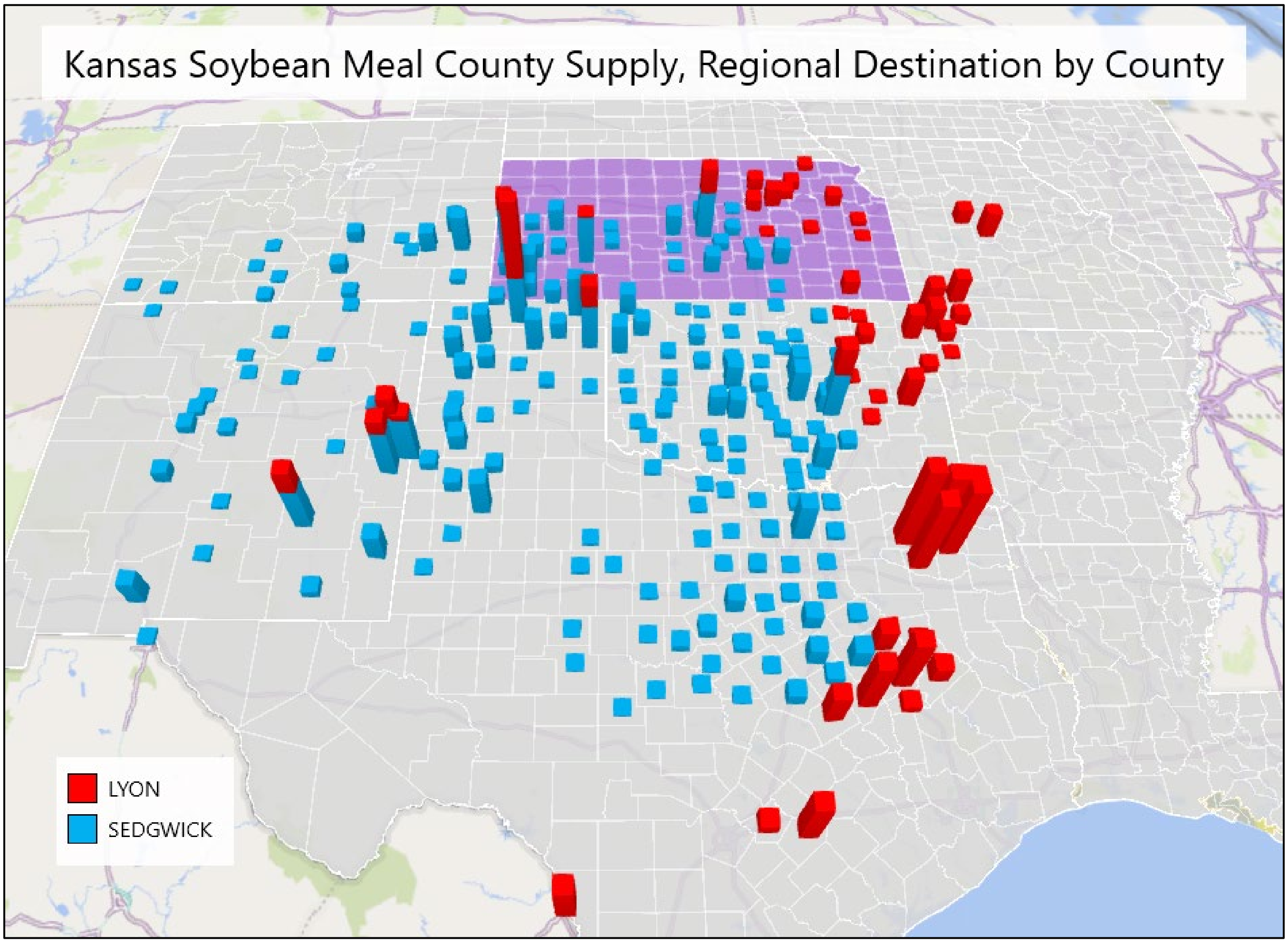


Figure 59 shows where soybean meal produced by the two soybean processing plants in Kansas is used. Both plants send significant tonnage of soybean meal south into Oklahoma and Texas. The facility in Lyon County, KS is also a supplier of soybean meal to southwest Missouri, northwest Arkansas, northeast Oklahoma, and eastern Texas.

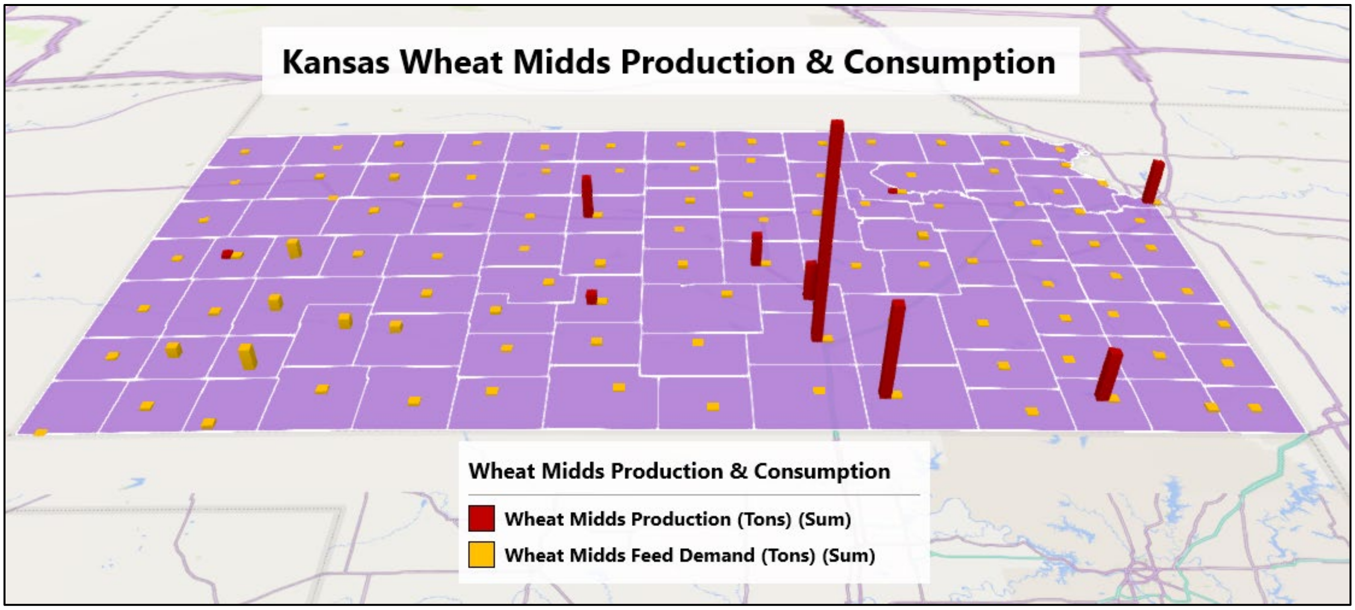
Figure 59. Kansas soybean meal county supply, regional destination by county



3.1.3 Wheat millfeeds (midds)[9]

Kansas produced an estimated 478,950 metric-tons of wheat midds in 2020. Wheat midds production occurs in 12 wheat mills located in 10 counties within Kansas. Kansas used 394,200 tons of wheat midds. Wheat midds are used extensively across Kansas by feed mills, feedlots, and pet food manufacturers. Wheat midds make up 3.3% of Kansas feed ingredient use (Figure 60).

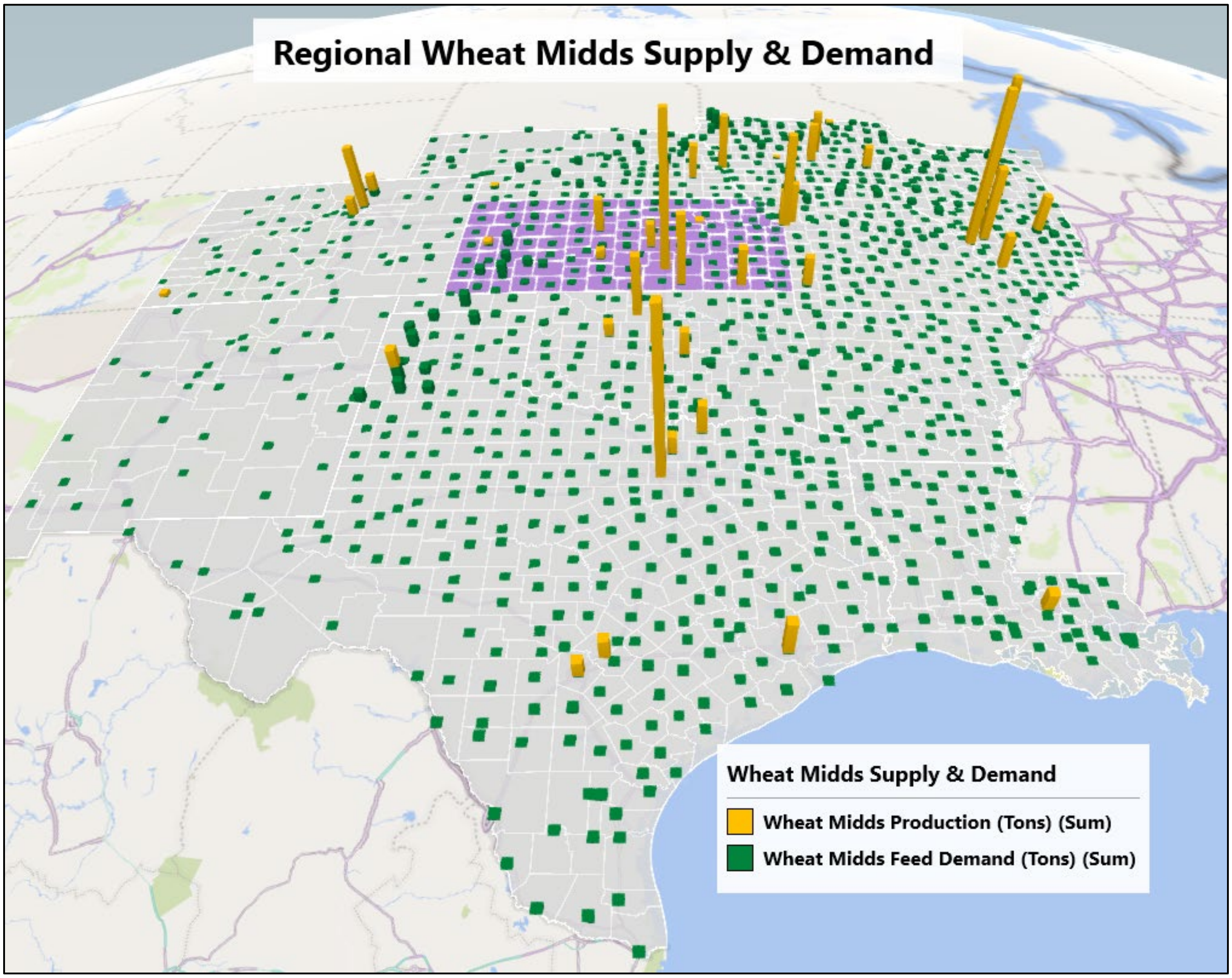
Figure 60. Kansas wheat midds production and consumption



[9] During the wheat milling process, about 70 to 75% of the grain becomes flour, and the remaining 25 to 30% is available as wheat by-products largely destined for livestock consumption. These by-products commonly are referred to as wheat millfeed, wheat mill run or wheat middlings with little regard for the various mill streams and proportions that are combined and ultimately constitute the by-product's final composition. Source: Wheat Middlings: Composition, Feeding Value and Storage Guidelines, Kansas State Research and Extension. For the purposes of this report, these by-products of the wheat milling process are referred to as wheat midds. Wheat midds are a good source of protein, fiber, phosphorus, and other nutrients. They are used to produce foods like pasta, breakfast cereals, puddings, and couscous for humans, as well as ingredients in livestock rations and pet food products.

Regional wheat midds supply occurs at 49 wheat mills located in 9 of the 11 states in the region (Figure 61). Kansas has the most wheat mills with 12, followed by Texas (9), Illinois (6), Colorado (5), Iowa (5), Missouri (5), Nebraska (4), Oklahoma (3), and Louisiana (1). Arkansas and New Mexico do not have any commercial wheat mills. In 2020, the region produced 2,150,800 tons of wheat midds and used 3,488,200 tons of wheat midds. Wheat midds are used in a variety of rations such as fed cattle rations, beef calf starter rations, and sow rations, with minor use by other species such as dairy, sheep and goats, horses, and poultry. Across the 11-state region, wheat midds account for 3.2% of the seven major feed ingredients.

Figure 61. Regional wheat midds supply and demand



3.1.3.1 Wheat midds flow

Kansas receives wheat midds from Colorado (7,100 tons), Illinois (2,400 tons), Missouri (34,400 tons), Nebraska (4,500 tons), Oklahoma (1,200 tons), Texas (200 tons), and from states outside the region (135,900 tons) (Table 11).

Table 11. Summary of regional wheat midds movement

Summary of Regional Wheat Midds Movement (100 tons)

	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	-	-	-	-	-	-	-	-	-	-	-	-	-
CO	-	597	-	-	71	-	-	299	136	8	-	186	1,296
IA	-	-	1,039	26	-	-	132	94	-	-	-	24	1,316
IL	79	1	422	1,932	24	-	591	32	-	9	2	201	3,293
KS	114	213	29	-	2,088	-	316	871	6	648	505	-	4,788
LA	14	-	-	-	-	140	-	-	-	-	-	88	242
MO	388	11	391	391	344	-	2,213	143	-	152	31	13	4,077
NE	-	-	191	-	45	-	4	801	-	-	-	110	1,152
NM	-	-	-	-	-	-	-	-	-	-	-	-	-
OK	28	-	-	-	12	-	-	-	22	867	349	-	1,278
TX	172	2	-	-	2	267	-	-	115	283	3,219	7	4,066
Out of Region	139	388	4,387	854	1,359	31	685	2,461	149	781	2,770	-	14,004
Total	933	1,212	6,459	3,204	3,945	437	3,942	4,700	426	2,748	6,876	629	35,513

Notes: Read down to see where a state gets its wheat midds. Read across to see where a state's wheat midds go for feed or export.

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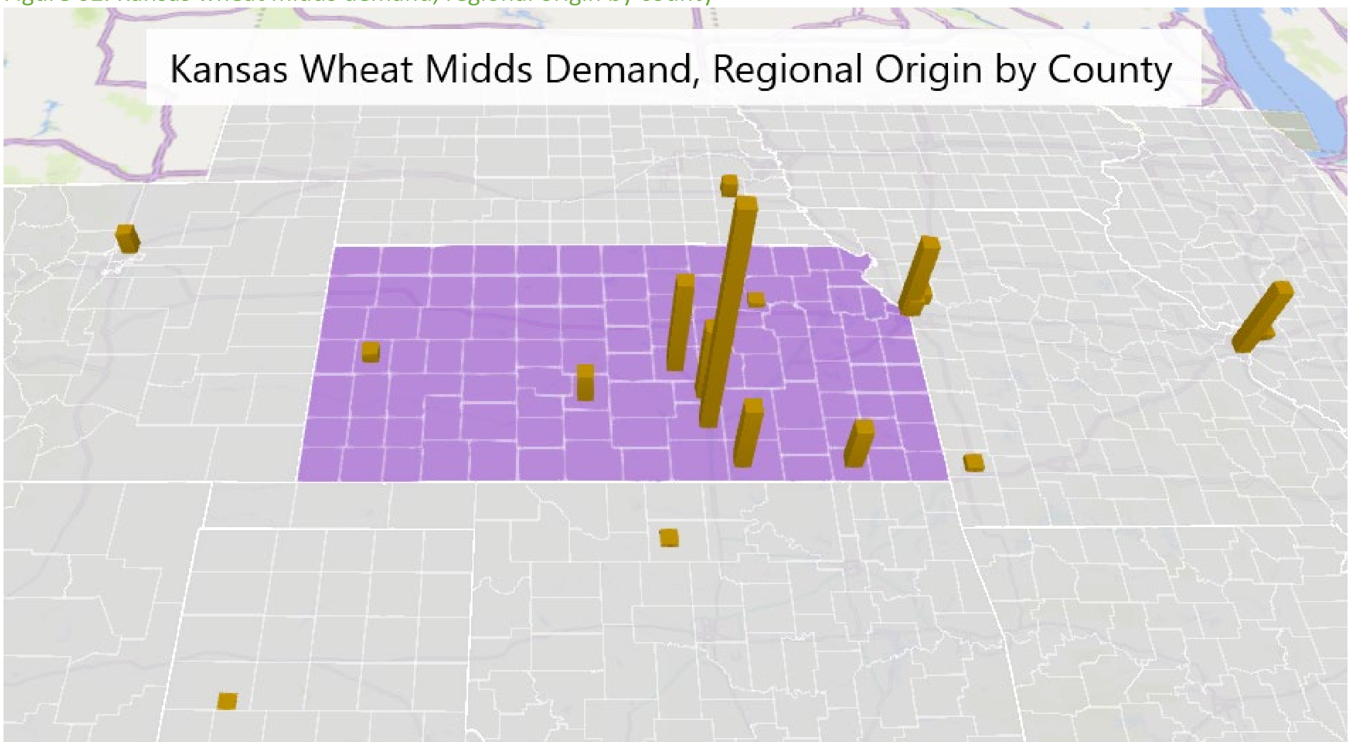
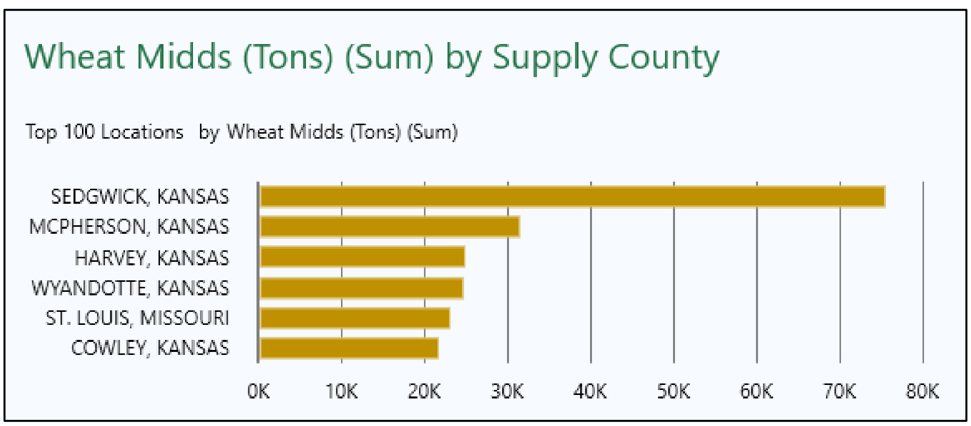
The wheat mill in Sedgwick County, Kansas, is the largest supplier of wheat midds (75,800 tons) for Kansas. Kansas receives wheat midds from all its own mills as well as from mills of large metropolitan areas, including St. Louis, Missouri and Denver, Colorado (Figure 62).

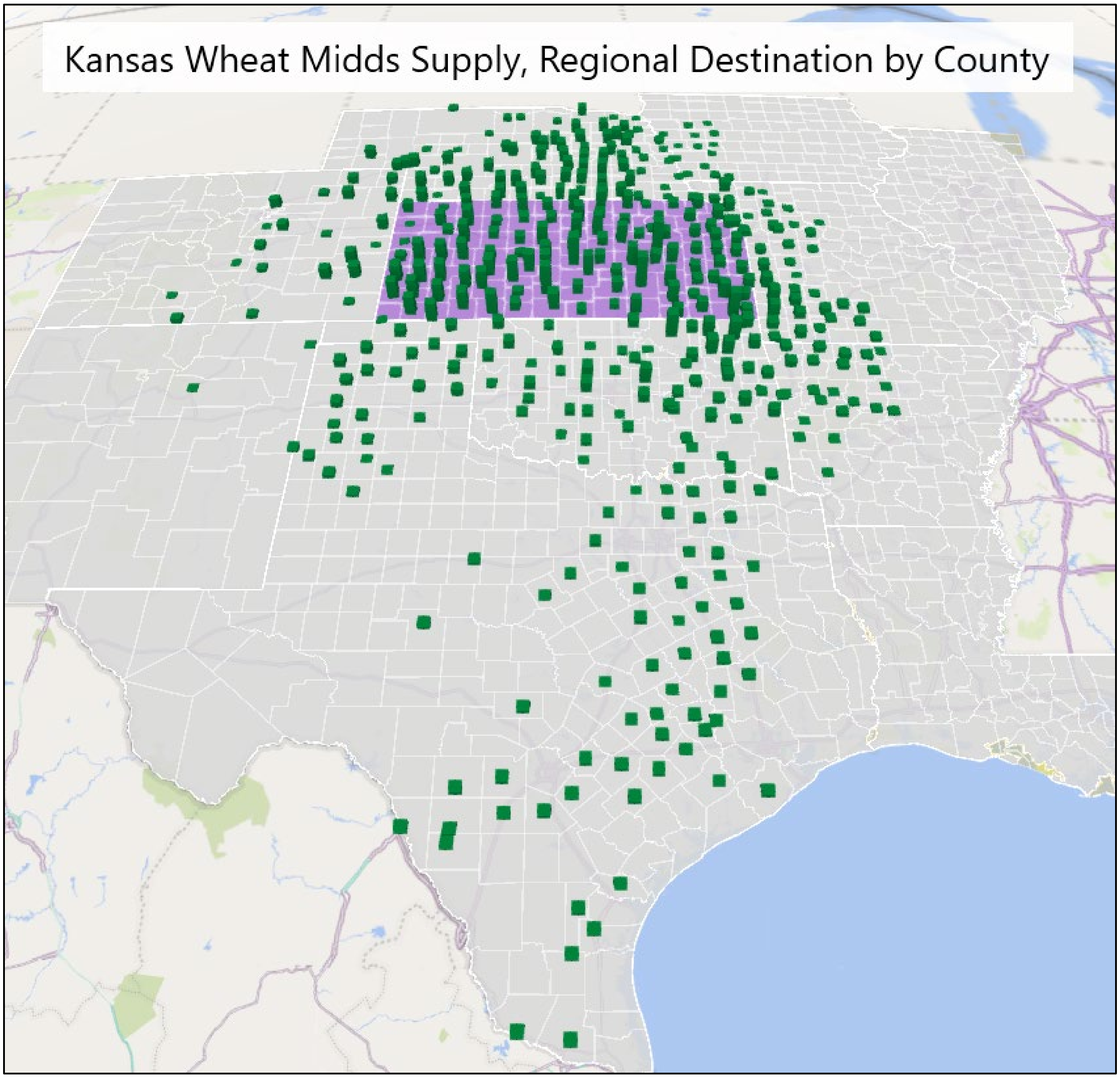
Figure 62. Kansas wheat midds demand, regional origin by county

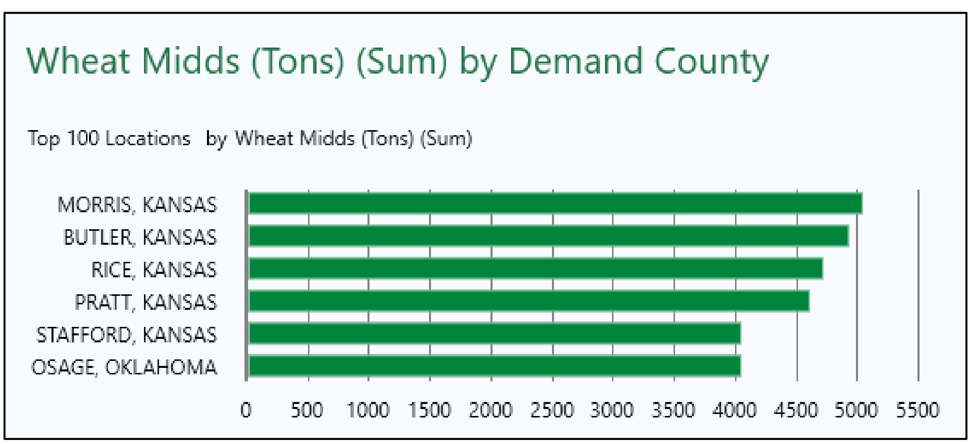




Except for Illinois and Louisiana, Kansas wheat midds go to every state in the region; Kansas sends wheat midds to Arkansas (11,400 tons), Colorado (21,300 tons), Iowa (2,900 tons), Missouri (3,600 tons), Nebraska (87,100 tons), New Mexico (600 tons), Oklahoma (64,800 tons), and Texas (50,500 tons) (Table 11 and Figure 63).

Figure 63. Kansas wheat midds supply, regional destination by county

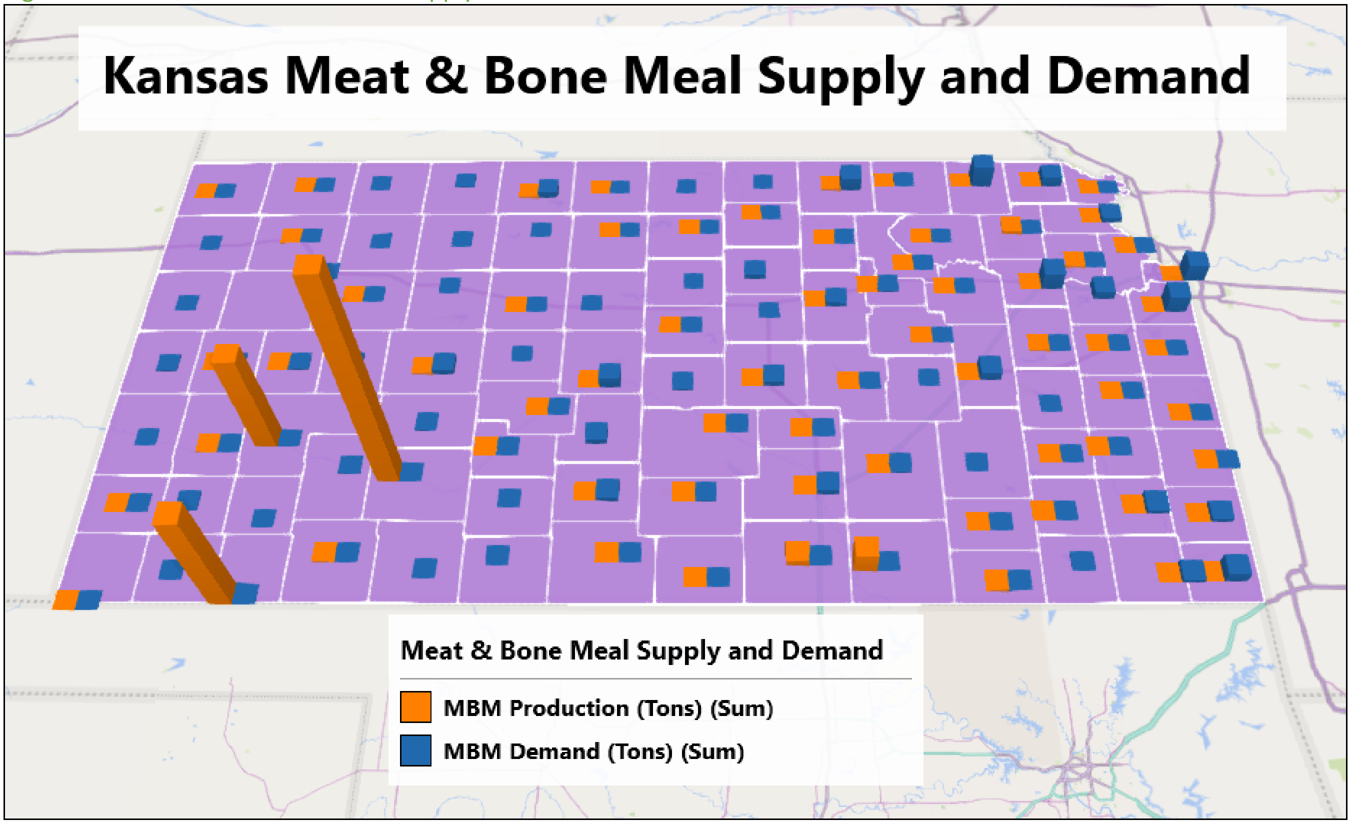


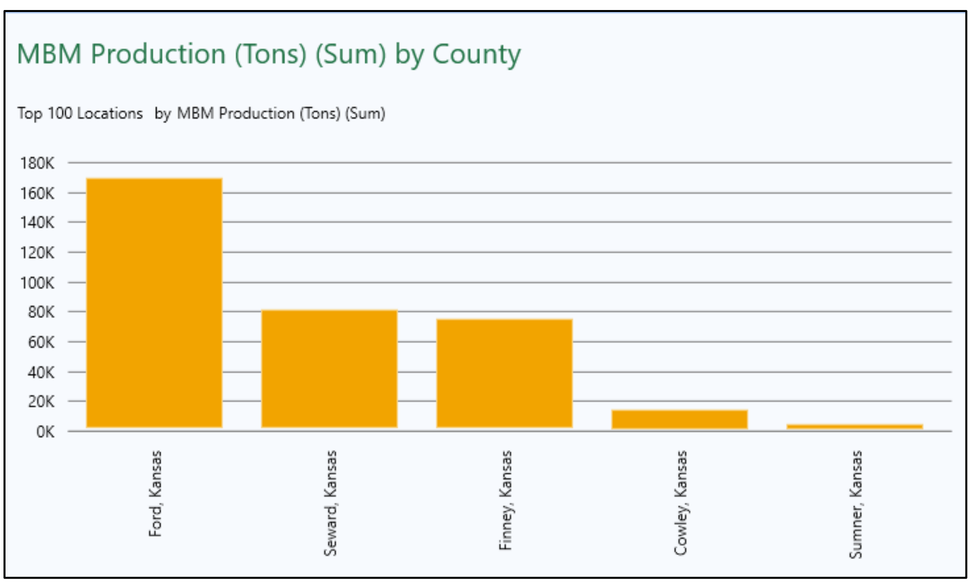


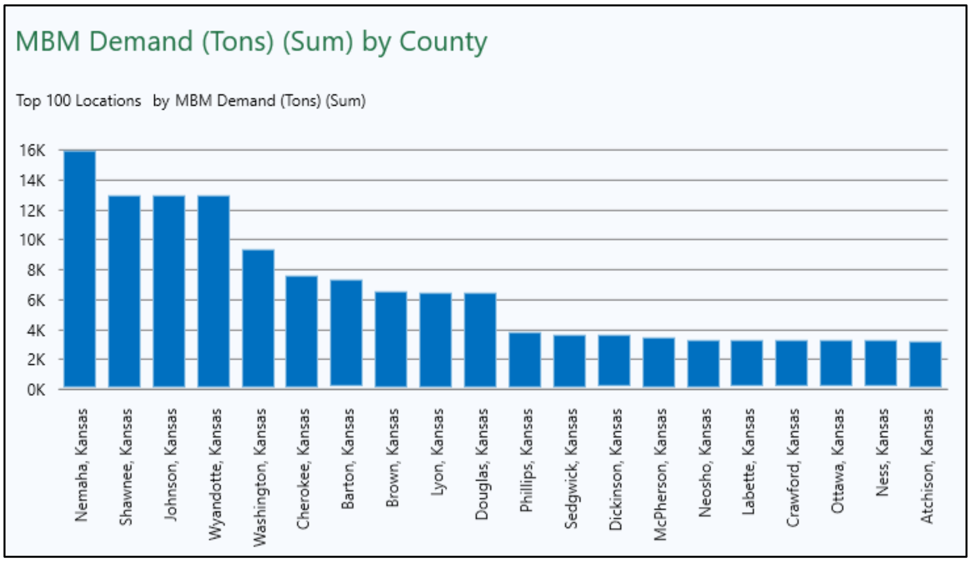
3.1.4 Meat & bone meal

Kansas meat and bone meal production is dominated by the large cattle slaughter facilities in the southwest region of the state. Pet food manufacturing makes up most of Kansas meat and bone meal demand. Meat and bone meal accounts for 1.3% of Kansas feed ingredient use (Figure 64).

Figure 64. Kansas meat & bone meal supply and demand

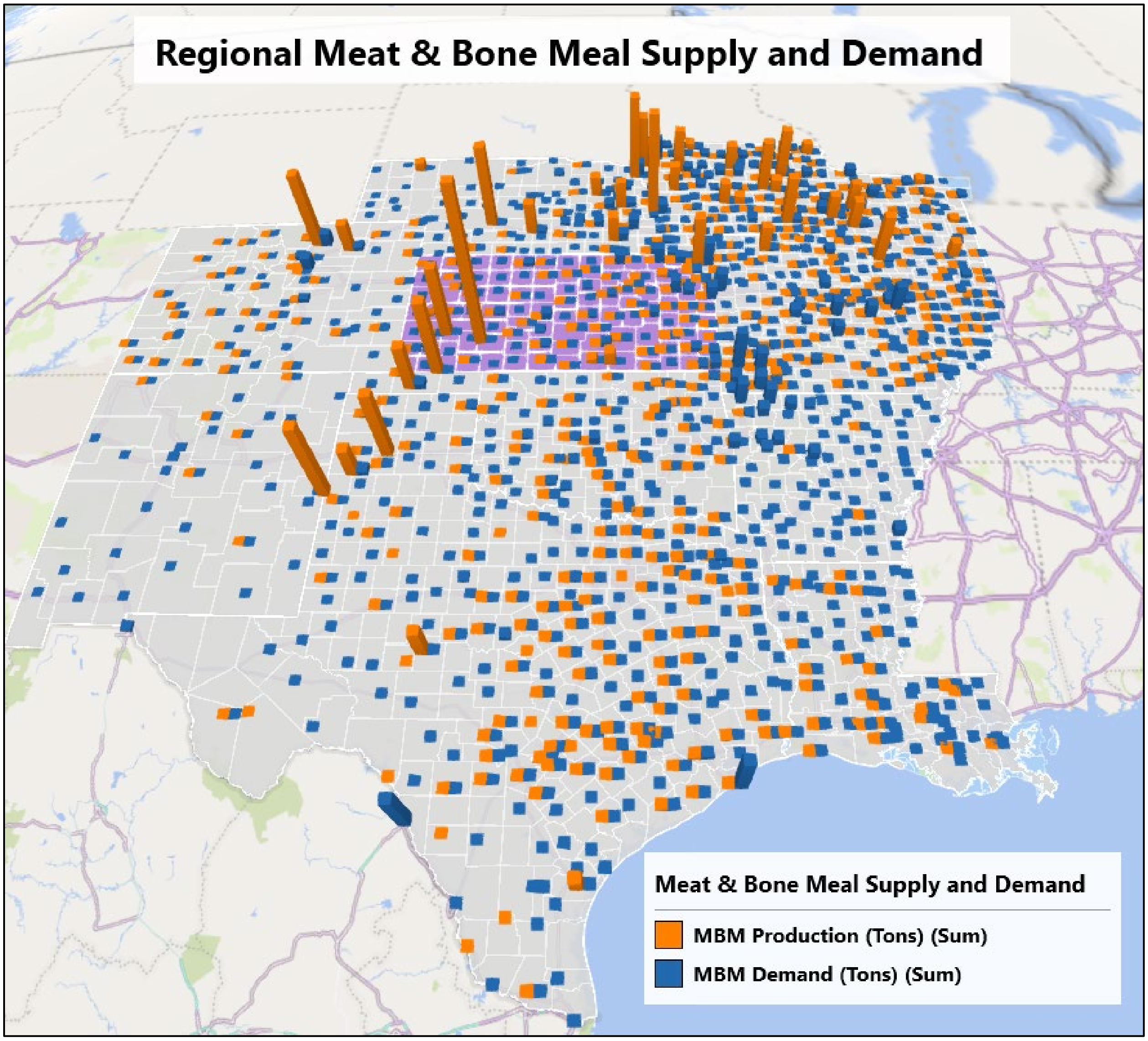


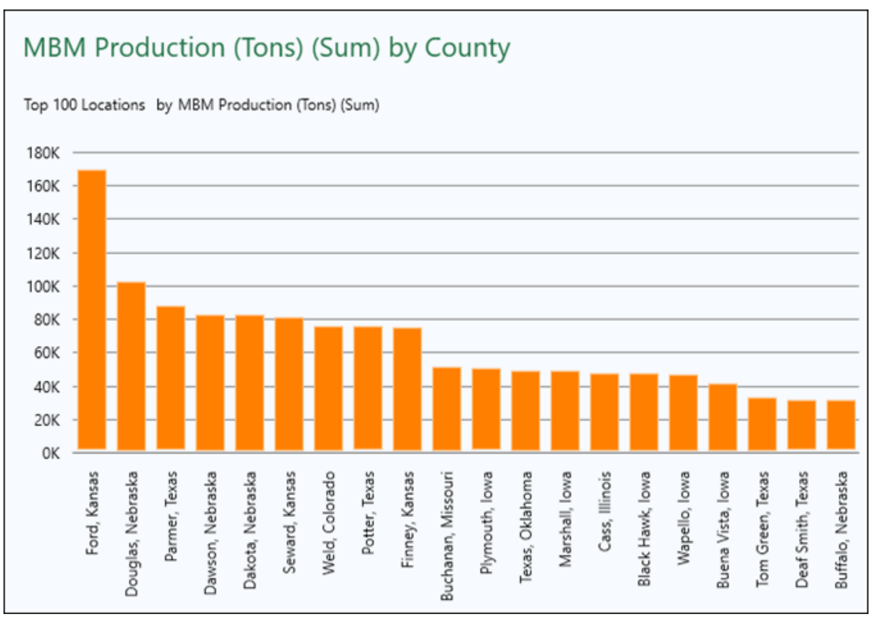


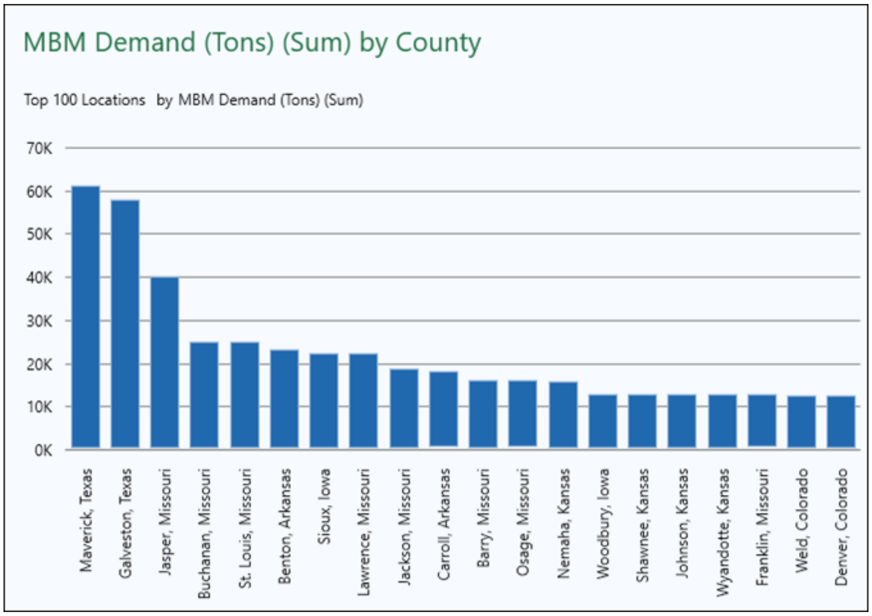


In the 11-state region, Iowa, Nebraska, and Kansas are the largest producers of meat and bone meal, while Missouri, Iowa, and Texas are the largest consumers. Pet food manufacturing is the largest user of meat and bone meal in the region, followed by hogs and turkeys. Meat and bone meal accounts for 1.1% of feed ingredient use in the 11-state region (Figure 65).

Figure 65. Regional Meat & Bone Meal Supply and Demand







3.1.4.1 Meat & bone meal flow

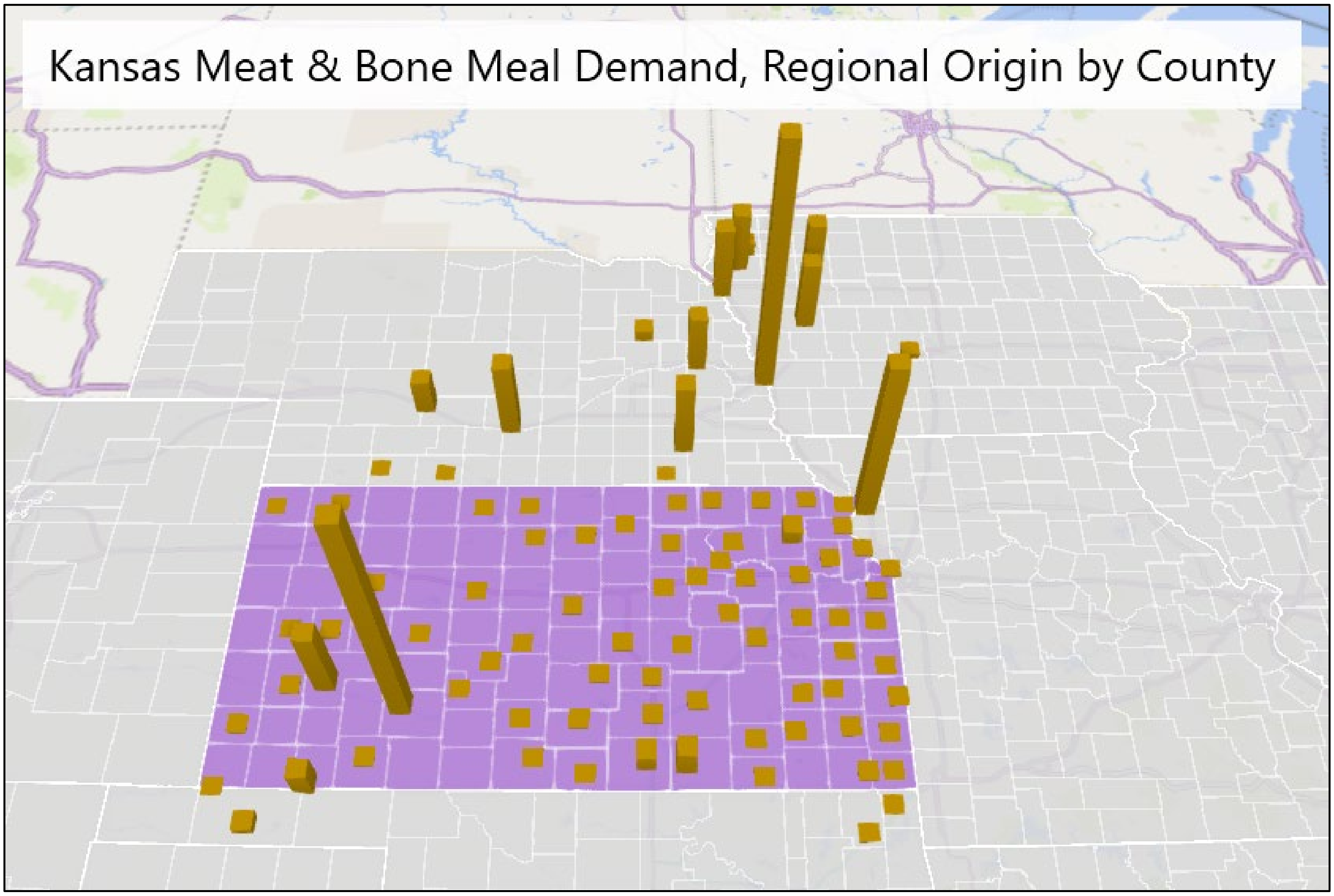
Kansas produced an estimated 357,580 tons of meat and bone meal in 2020. Of this amount, Kansas used 52,160 tons (15%). Inside the region, Kansas sent meat and bone meal to Arkansas (40,620 tons), Colorado (700 tons), Missouri (88,000 tons), Nebraska (760 tons), Oklahoma (21,580 tons), and Texas (10,360 tons). Kansas sent 40% of its production (143,400 tons) out of the region, all of which went to the Pacific coast for export. Kansas received meat and bone meal from Iowa (22,120 tons), Missouri (18,500 tons), Nebraska (62,840 tons), Oklahoma (860 tons), and from states outside of the region (380 tons).

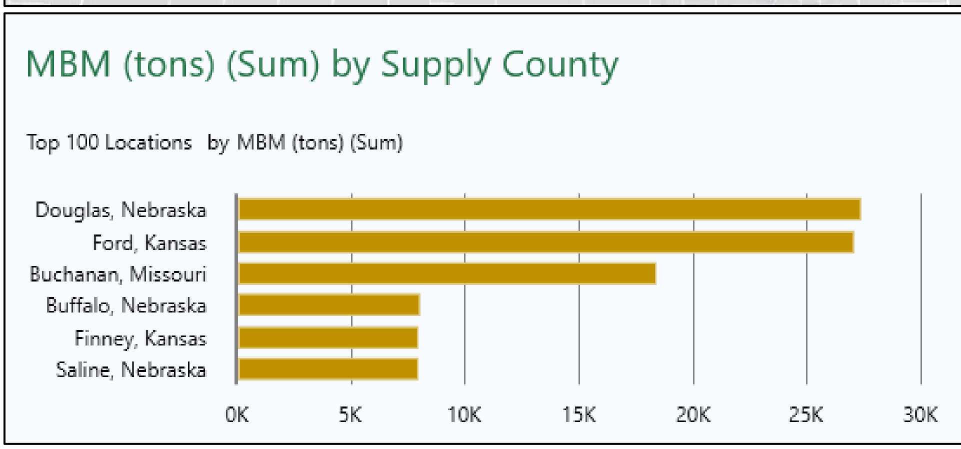
Table 12. Summary of regional meat & bone meal movement

Summary of Regional Meat & Bone Meal Movement (tons)													
	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	460	-	-	-	-	-	-	-	-	20	-	-	480
CO	-	38,540	-	-	-	-	-	300	2,220	-	-	76,120	117,180
IA	21,900	-	182,320	9,100	22,120	-	55,900	6,640	-	-	-	98,620	396,600
IL	2,100	-	17,220	60,120	-	-	15,760	-	-	-	-	57,160	152,360
KS	40,620	700	-	-	52,160	-	88,000	760	-	21,580	10,360	143,400	357,580
LA	20	-	-	-	-	480	-	-	-	-	-	40	540
MO	17,360	-	2,240	260	18,500	-	43,320	1,960	-	2,540	-	180	86,360
NE	-	3,740	15,920	520	62,840	-	56,120	96,080	-	-	-	148,540	383,760
NM	-	-	-	-	-	-	-	-	460	-	20	-	480
OK	9,440	-	-	-	860	-	15,980	-	-	8,060	13,900	7,400	55,640
TX	32,040	-	-	-	-	1,020	-	-	1,880	25,400	167,560	57,040	284,940
Out of Region	1,320	80	23,520	4,200	380	80	5,500	1,500	200	-	-		36,780
Total	125,260	43,060	241,220	74,200	156,860	1,580	280,580	107,240	4,760	57,600	191,840	531,460	1,872,700
Notes: Read down to see where a state gets its meat & bone meal. Read across to see where a state's meat & bone meal goes for feed or export.													Decision Innovation Solutions

The largest supplier of meat and bone meal to Kansas is Douglas County, Nebraska, followed closely by Ford County, Kansas. The hog slaughter facility in Buchanan County, Missouri, is also a major source of meat and bone meal for Kansas (Figure 66). While Finney and Seward counties are also large producers of meat and bone meal in Kansas, a large portion of their production is destined for out of state demand according to the commodity flow analysis.

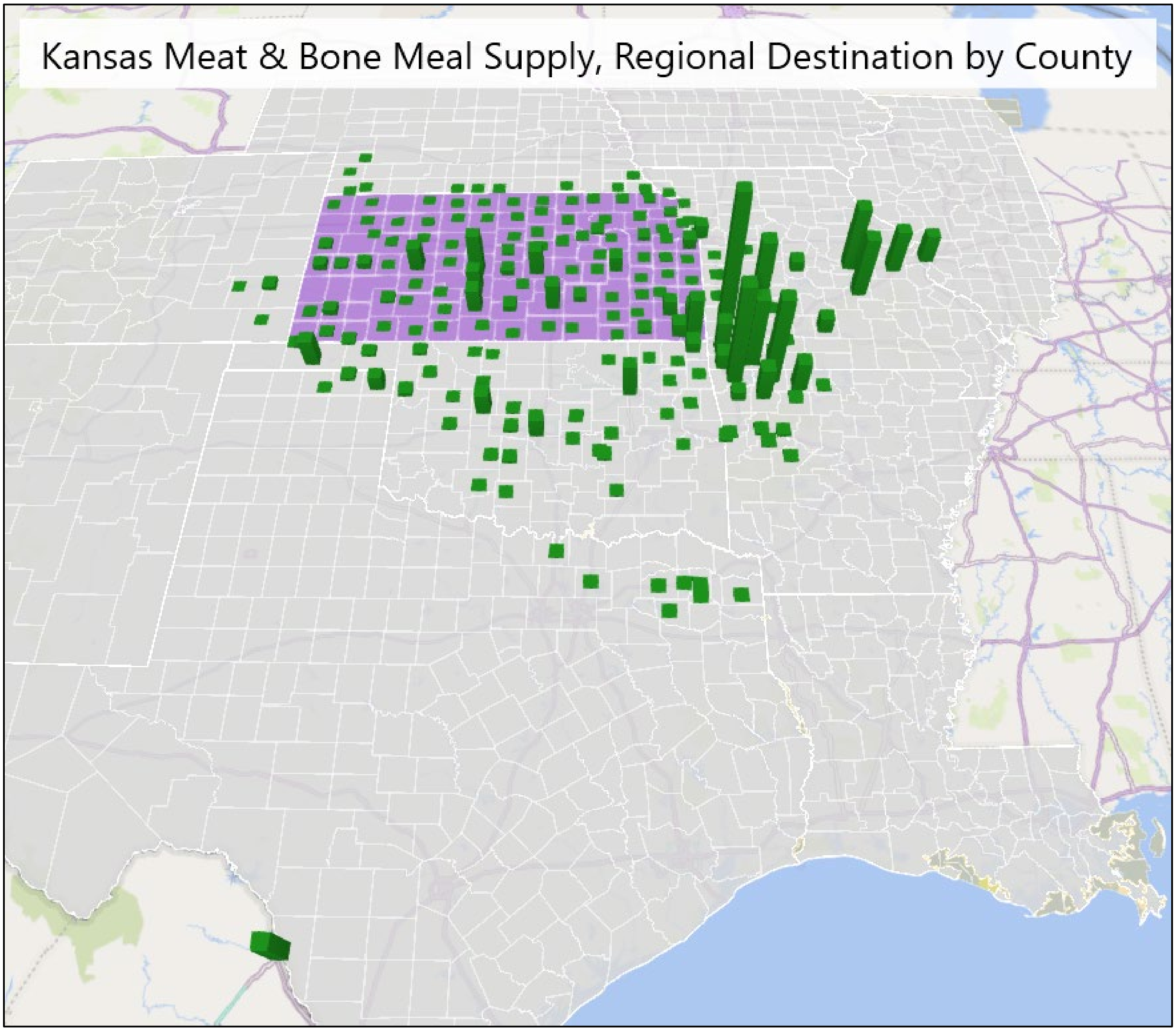
Figure 66. Kansas MBM demand, regional origin by county





Inside the 11-state region, Kansas meat and bone meal production is largely used by pet food manufacturing in Kansas and Missouri as well as poultry production in southwestern Missouri and northwestern Arkansas (Figure 67).

Figure 67. Kansas MBM supply, regional destination by county



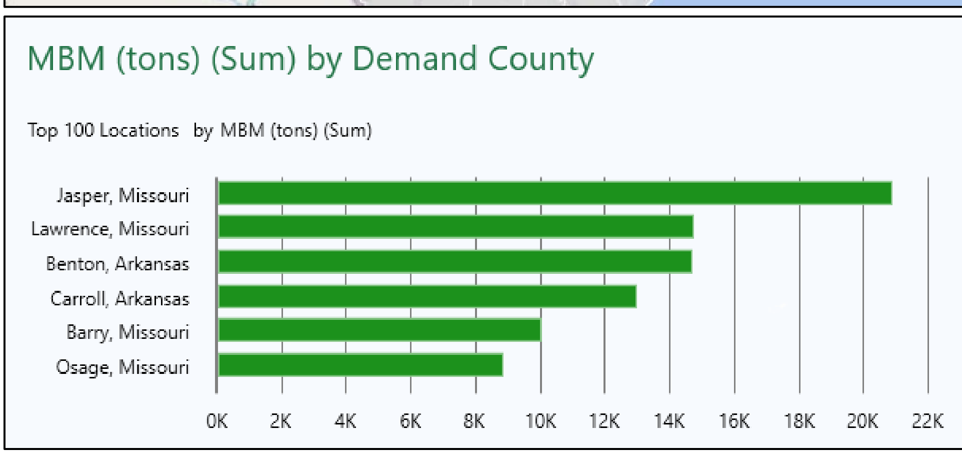
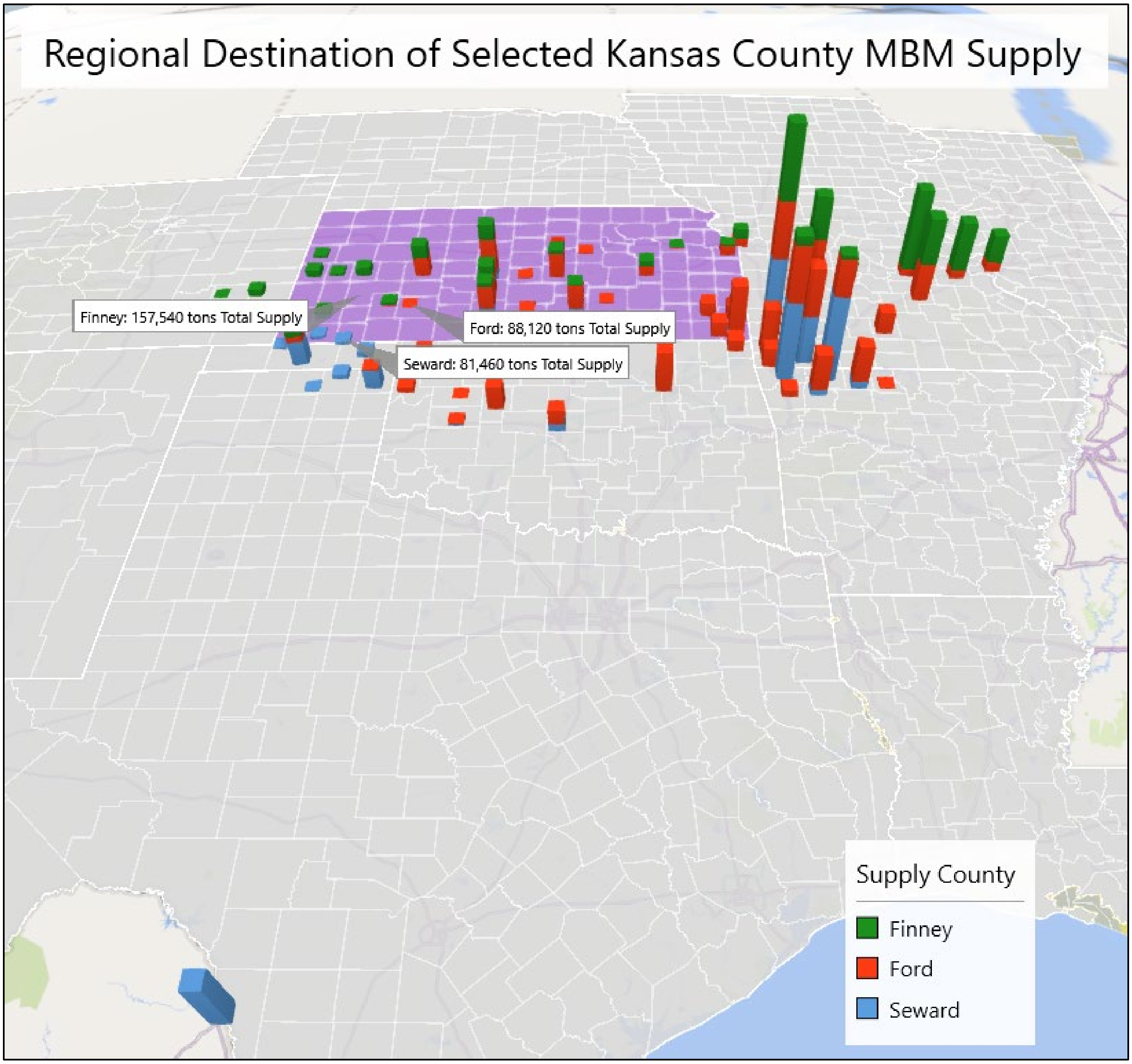


Figure 68 shows the destination counties for the three counties with the highest level of meat and bone meal production in Kansas. The largest demand points within the region are for broiler and turkey production in Arkansas and Missouri, pet food production in Kansas and Missouri as well as for export by rail to Mexico.

Figure 68. Regional destination of selected Kansas county MBM supply

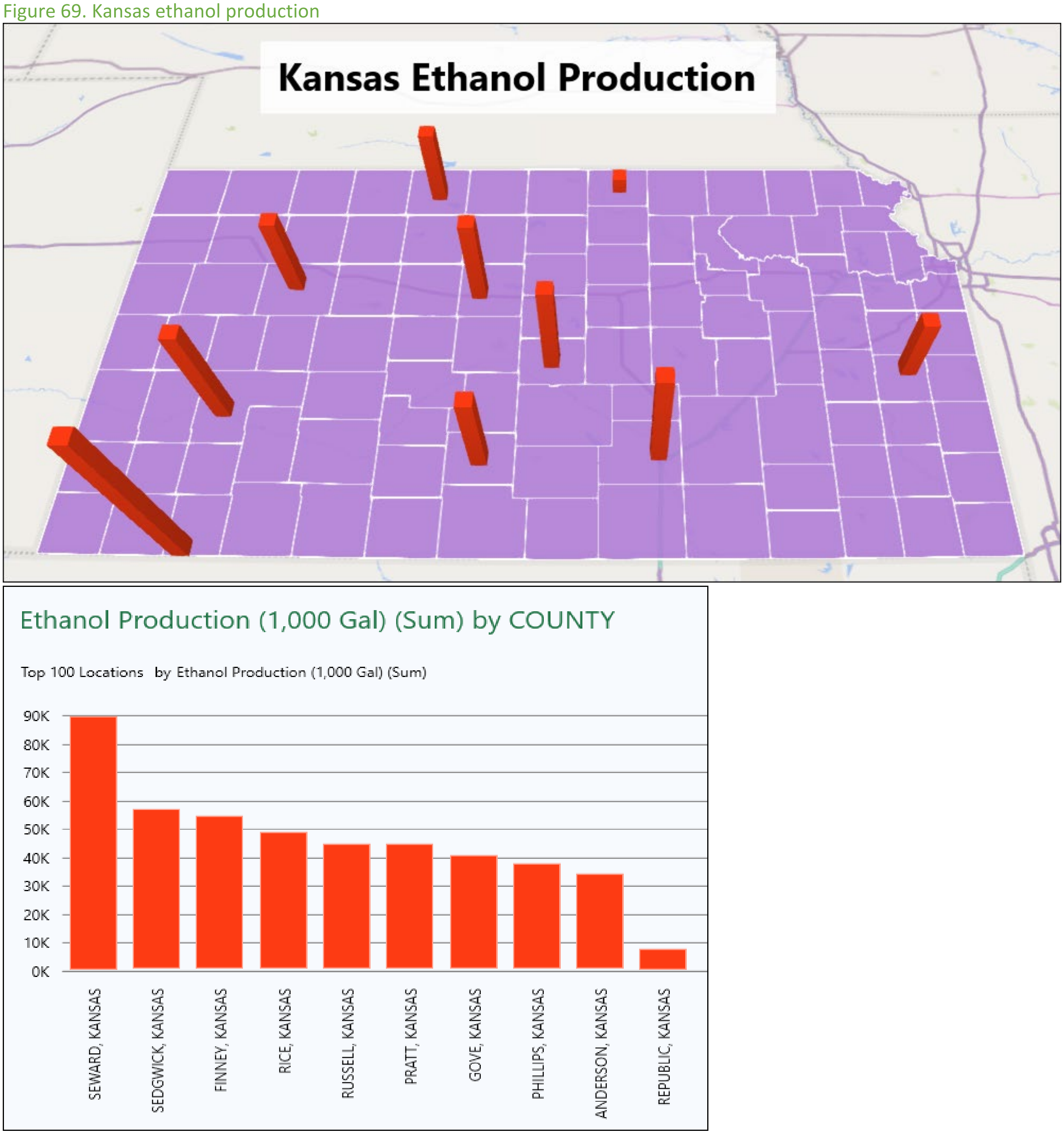


3.2 Biofuels

3.2.1 Ethanol

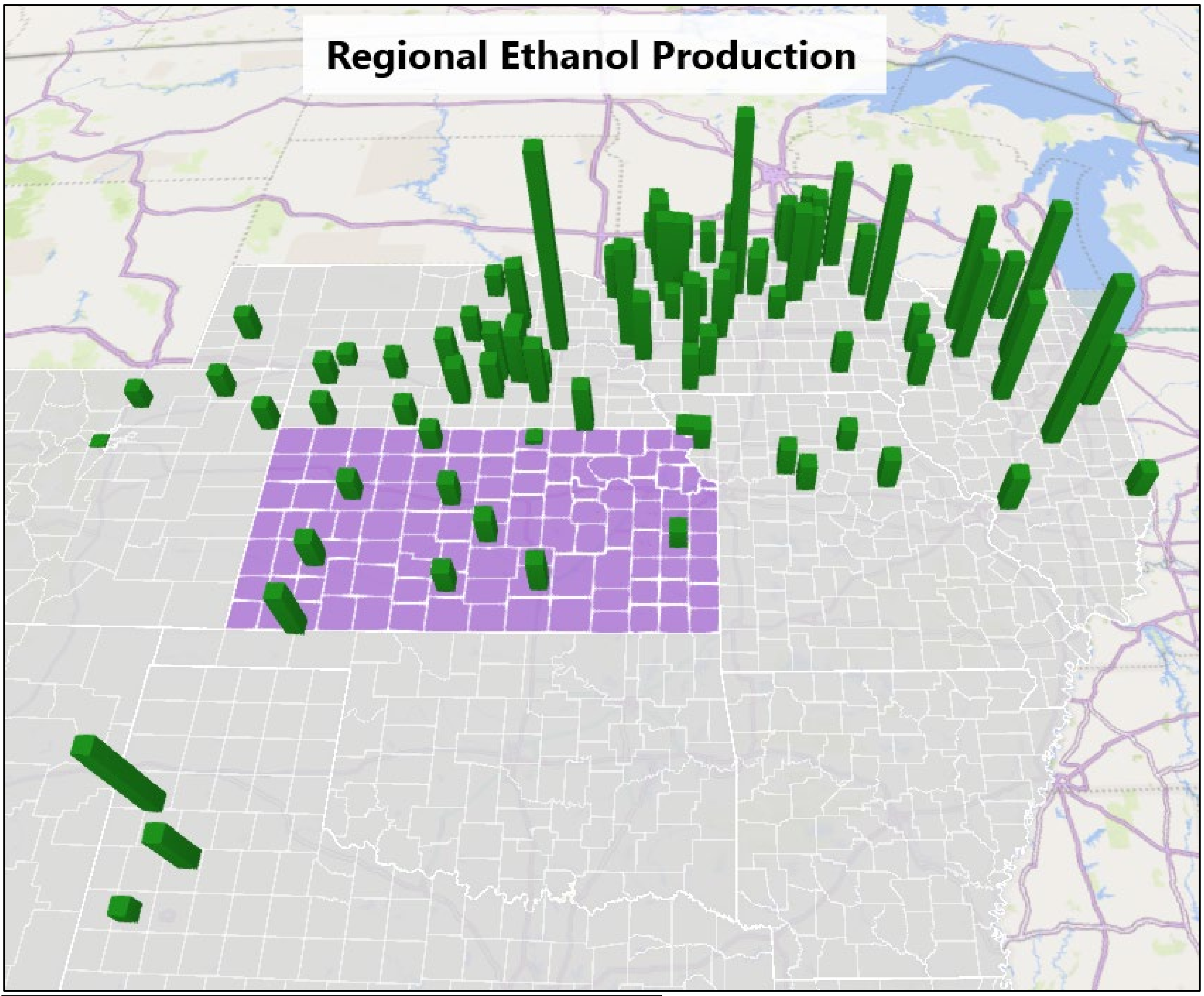
Kansas has 11 facilities in 10 counties that produce fuel-grade ethanol from corn, grain sorghum and wheat starch (Figure 69). The combined nameplate capacity of these plants is 559 million gallons per year of ethanol production. In 2020, it is estimated that Kansas produced 457 million gallons of ethanol. Operating capacity utilization was negatively affected by COVID-19 disruptions that temporarily reduced gasoline consumption and thus ethanol blending.

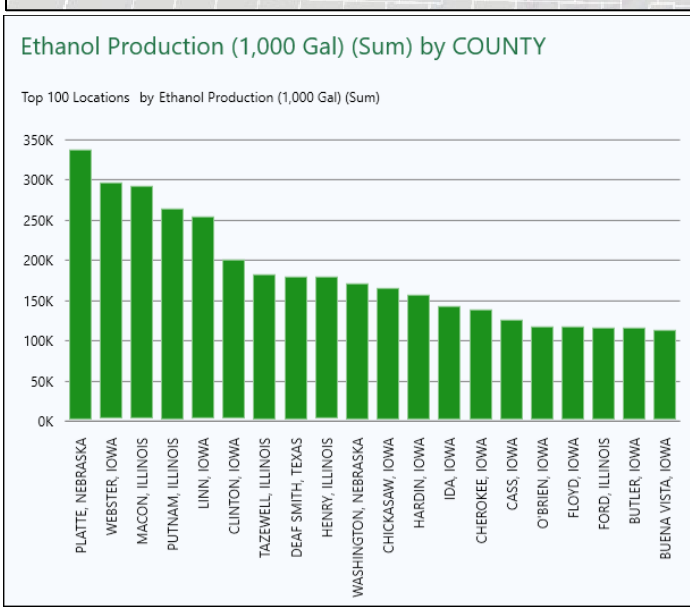
Figure 69. Kansas ethanol production



The 11-state region has 102 ethanol plants with nameplate capacity of 9.68 billion gallons of ethanol production per year (Figure 70). In 2020, it is estimated that these facilities produced 7.98 billion gallons of ethanol (82.4% capacity utilization) and accounted for 5.7 percent of regional ethanol production.

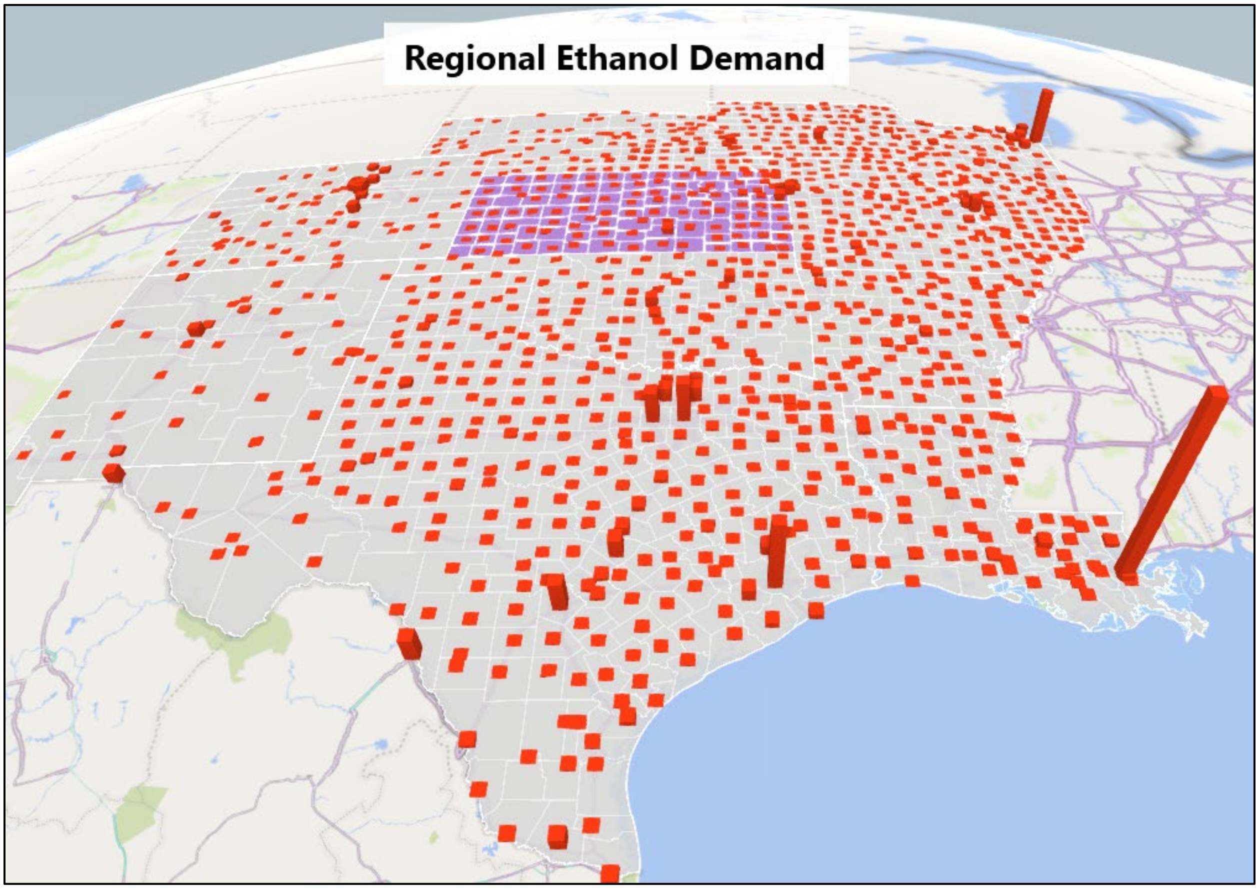
Figure 70. Regional ethanol production

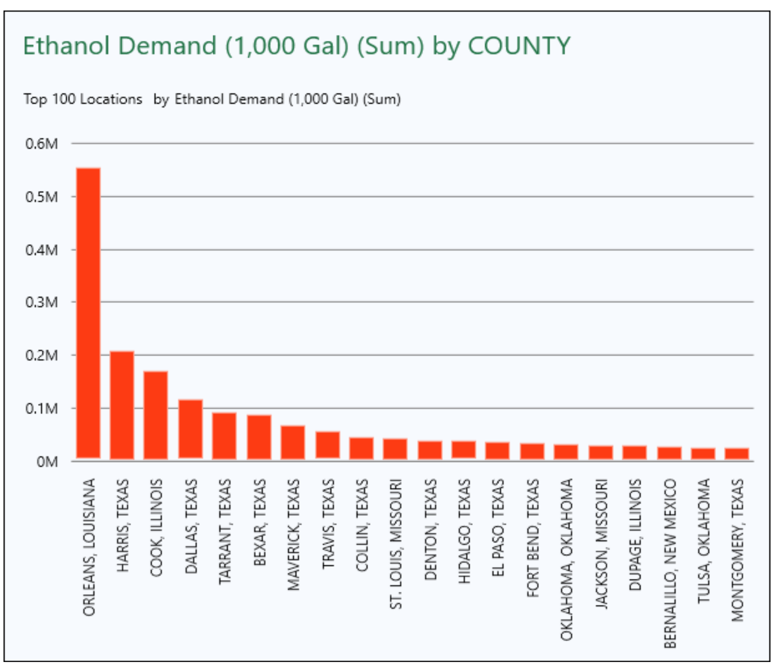




Regionally, the largest single points of ethanol demand are at the export ports in Louisiana and Texas. The large metropolitan areas such as Chicago, Dallas-Fort Worth, Houston, San Antonio, Kansas City, St. Louis, and Denver also show up as significant demand points. While most of the ethanol in rural areas goes through bulk blending terminals, often in major metropolitan areas, the actual consumption of ethanol is most often distributed across the region (Figure 71).

Figure 71. Regional ethanol demand





3.2.1.1 Ethanol flow

Kansas ethanol supplies a portion of Kansas ethanol demand but also is sent to 8 states south and west of Kansas as well as to Arkansas, Missouri, and Nebraska. Texas receives the most ethanol shipped out of Kansas. Within the 11-state region, that is followed by shipments to Oklahoma, Colorado, Arizona, New Mexico, Arkansas, and Missouri. Out-of-region shipments to western states are significant demand points for ethanol produced in Kansas. According to the commodity flow analysis, most ethanol used in Kansas is produced in Kansas, but some ethanol flows into the state from Colorado, Nebraska, Iowa, and Missouri (Table 13).

Table 13. Summary of regional ethanol movement

Summary of Regional Ethanol Movement (10,000 gallons)

	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	-	-	-	-	-	-	-	-	-	-	-	-	-
CO	-	8,460	-	-	30	-	-	40	30	-	-	3,750	12,310
IA	5,290	-	15,030	14,450	1,910	17,880	10,050	1,790	-	1,050	19,270	279,490	366,210
IL	1,020	-	750	16,600	-	3,570	5,640	-	-	-	-	103,680	131,260
KS	580	3,930	-	-	5,030	60	580	70	2,020	9,340	17,080	7,650	46,340
LA	-	-	-	-	-	-	-	-	-	-	-	-	-
MO	4,640	-	70	220	2,240	4,370	10,170	100	-	920	2,500	350	25,580
NE	170	9,180	360	870	2,100	2,150	650	5,690	2,300	3,920	66,870	93,030	187,290
NM	-	-	-	-	-	-	-	-	-	-	-	-	-
OK	-	-	-	-	-	-	-	-	-	-	-	-	-
TX	-	150	-	-	-	-	-	-	4,770	1,440	21,920	2,780	31,060
Out of Region	1,950	-	440	10,900	-	46,890	830	50	-	-	9,980		71,040
Total	13,650	21,720	16,650	43,040	11,310	74,920	27,920	7,740	9,120	16,670	137,620	487,950	871,090

Notes: Read down to see where a state gets its ethanol. Read across to see where a state's ethanol goes for use or export.

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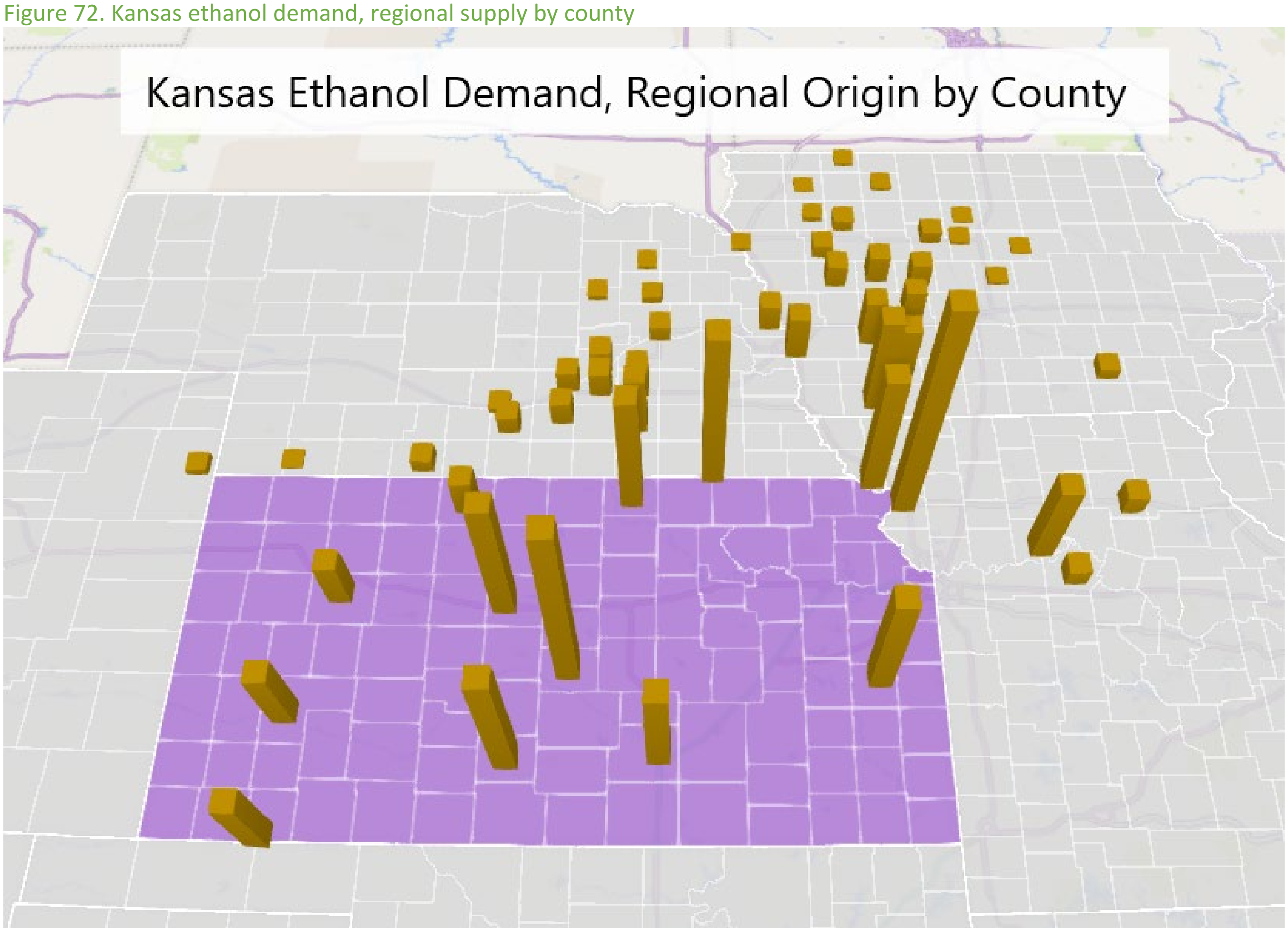
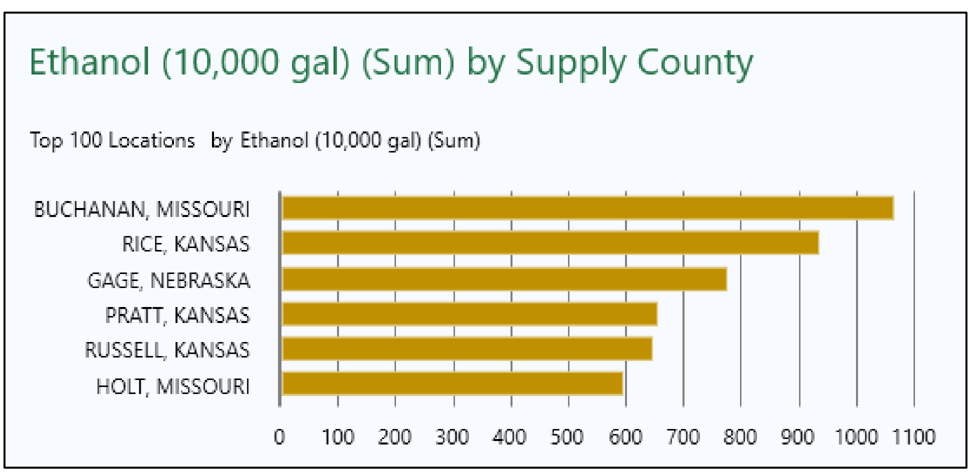
Even though a significant portion of ethanol produced in Kansas is shipped out of Kansas, market dynamics are such that Kansas receives ethanol from several ethanol plants outside of Kansas. The commodity flow model estimates that Kansas received some level of ethanol from 40 plants outside of Kansas in 2020. This occurs because the demand for ethanol is so strong south and west of Kansas that Kansas ethanol gets shipped there and then Kansas brings in ethanol from facilities that are north and east of Kansas (Figure 72).

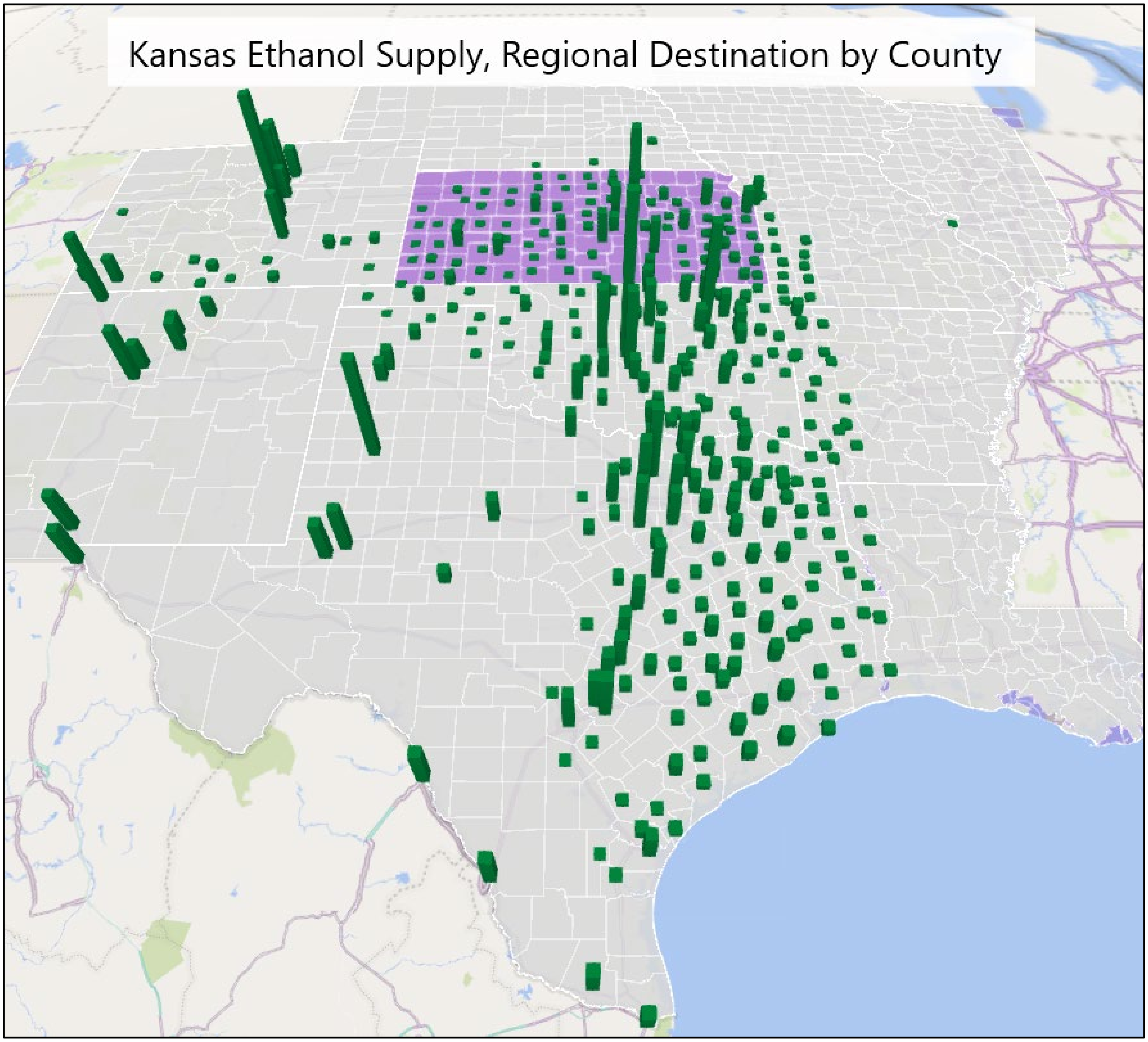
Figure 72. Kansas ethanol demand, regional supply by county





The strong demand for Kansas-produced ethanol by the major metropolitan areas south and west of Kansas is shown in Figure 73. The modeled flows of ethanol from Kansas ethanol production facilities (by facility) are shown in Figure 74.

Figure 73. Kansas ethanol supply, regional demand by county



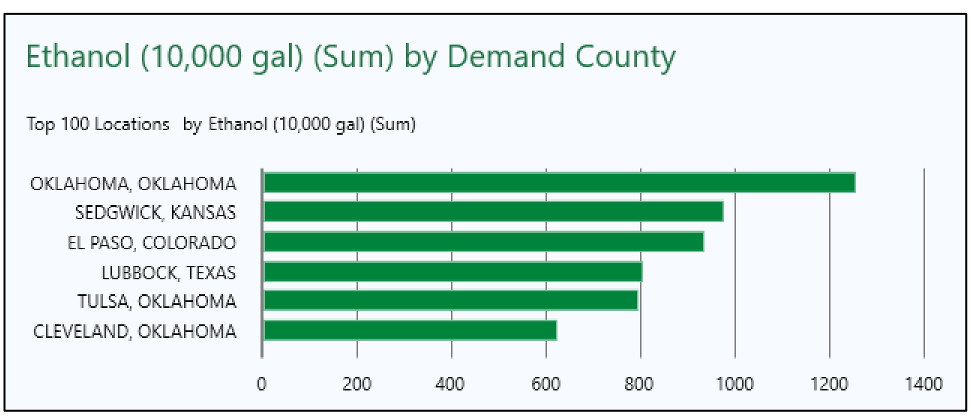
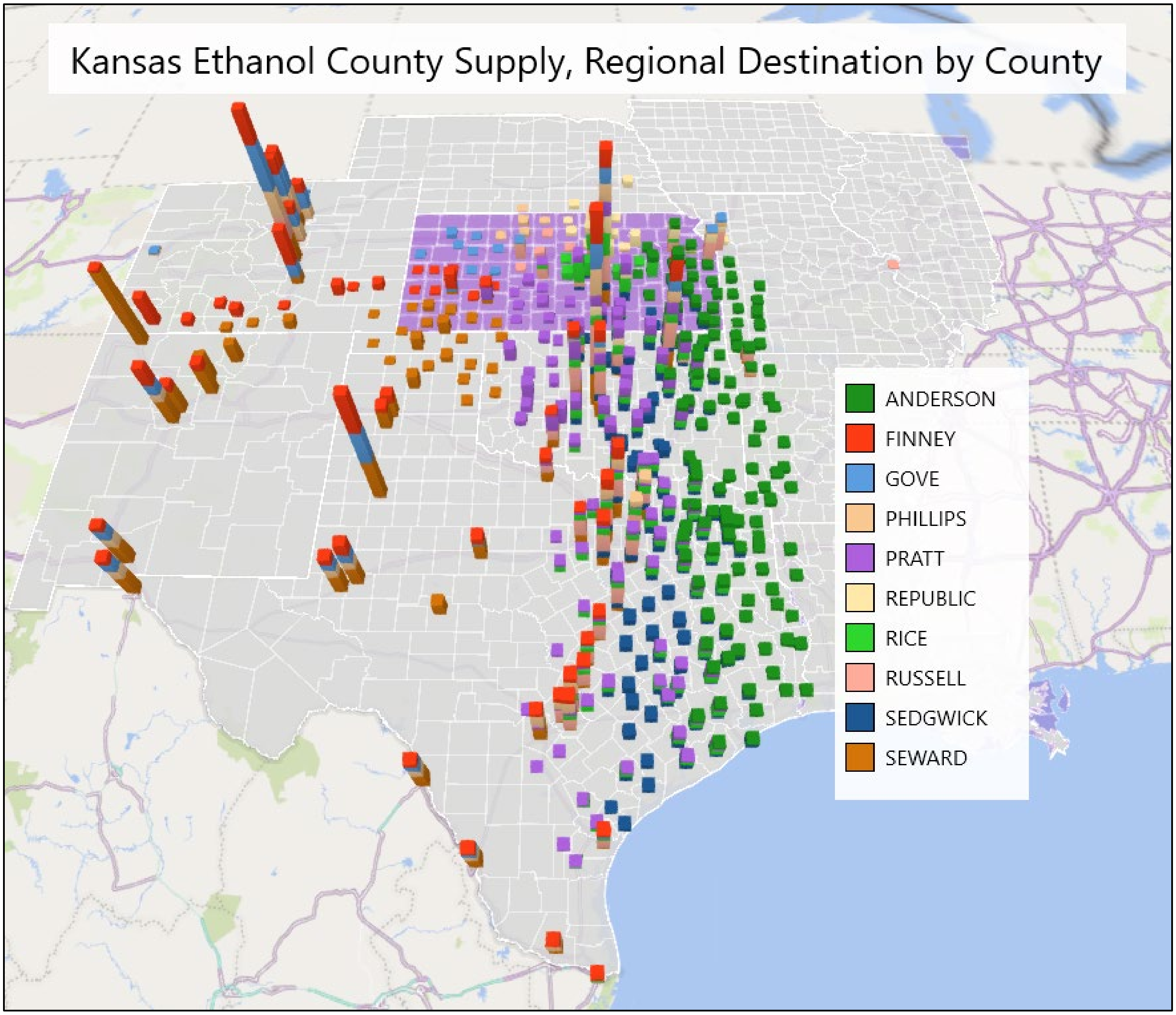


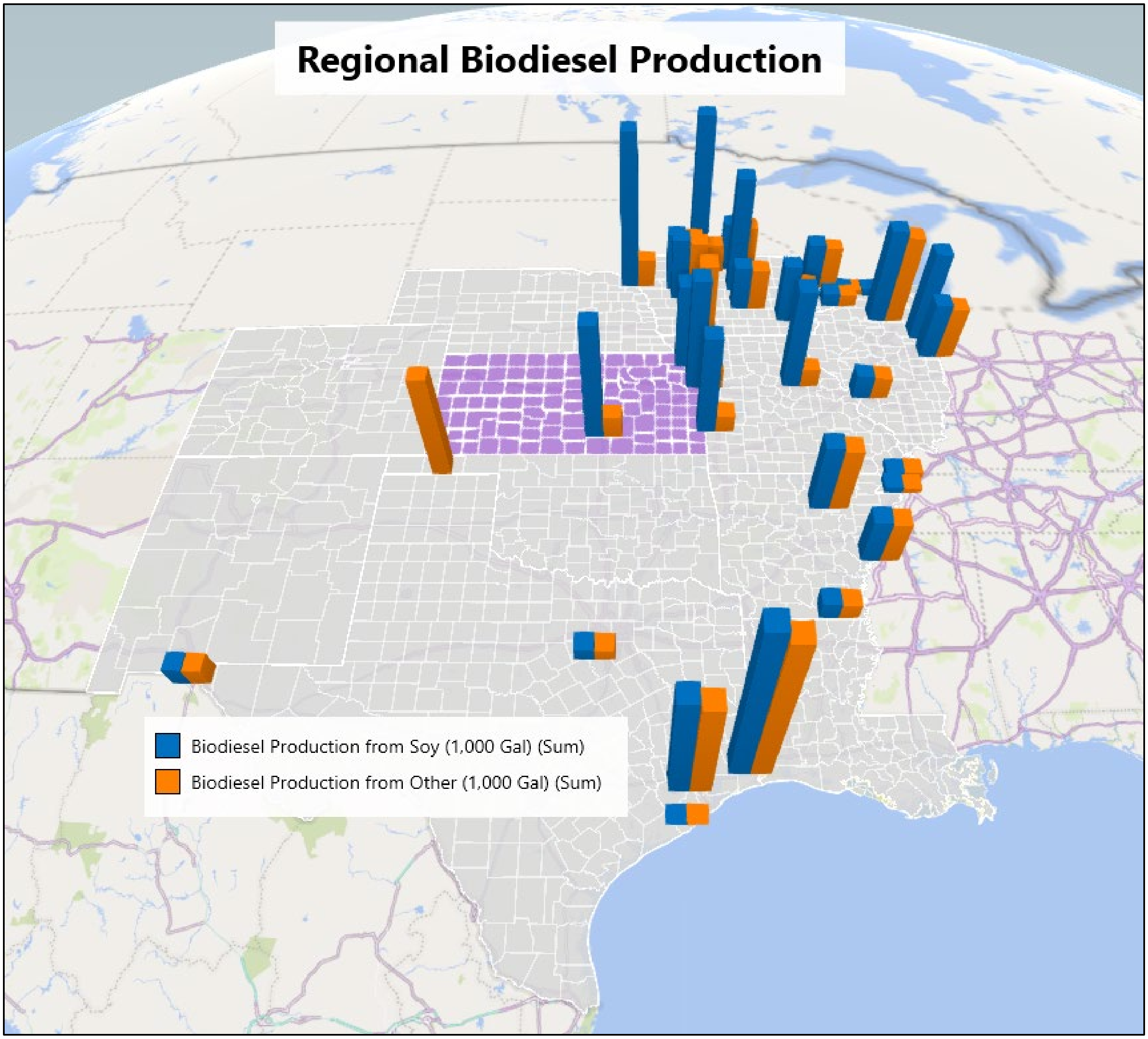
Figure 74. Kansas ethanol county supply, regional destination by county

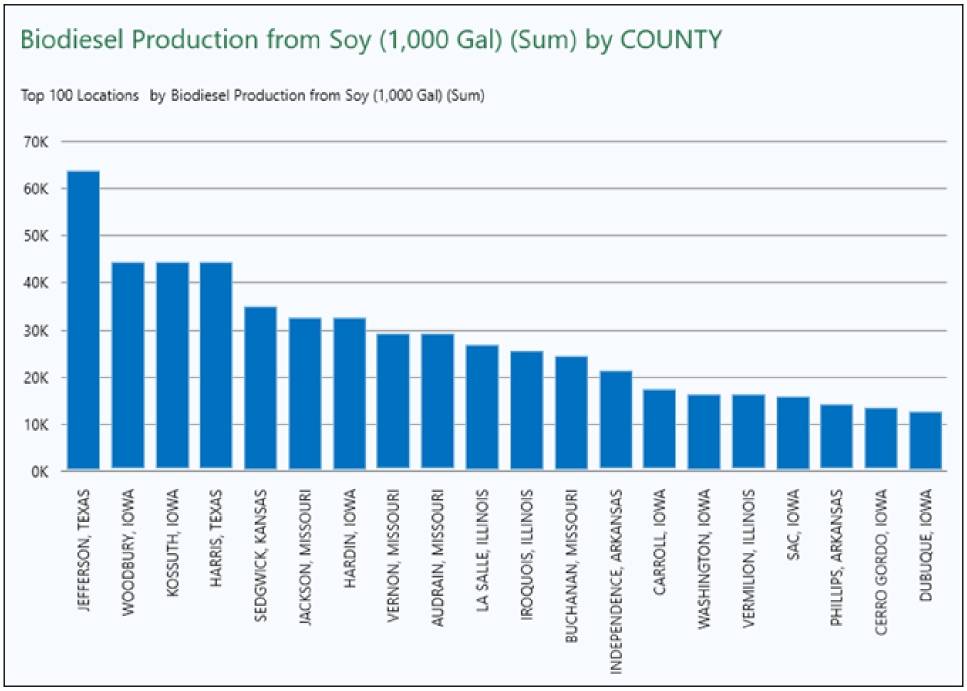


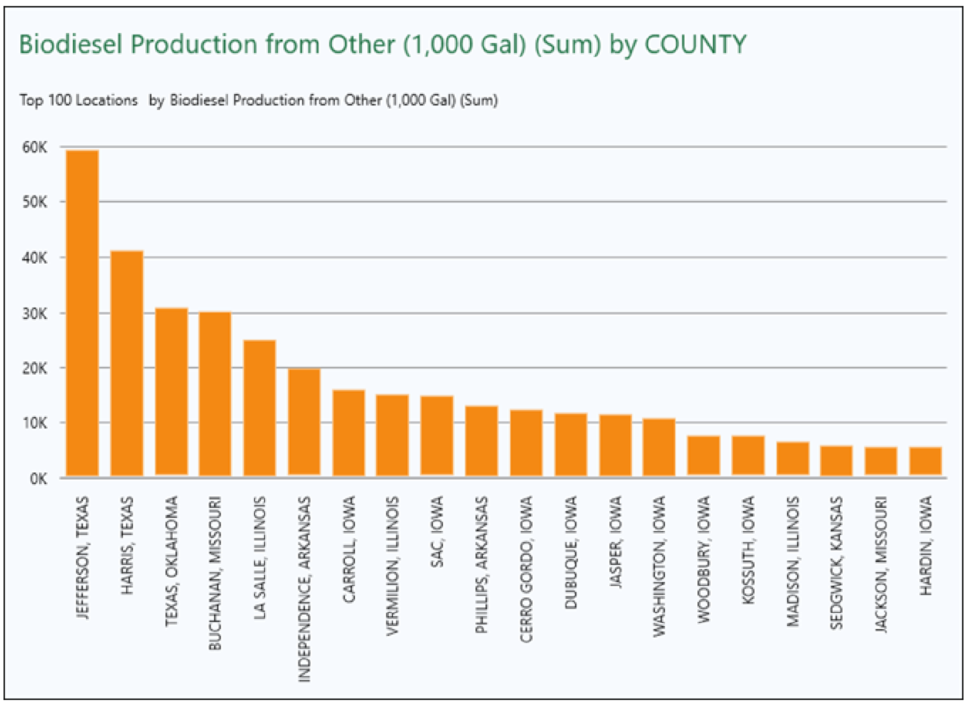
3.2.2 Biodiesel

Kansas has one biodiesel production facility with a nameplate capacity of 60 million gallons per year. In 2020, it is estimated that Kansas produced 41.2 million gallons of biodiesel. The 11-state region has 44 active biodiesel production facilities with a combined nameplate capacity of 1.47 billion gallons of biodiesel per year. In 2020, it is estimated that the 11-state region produced 1.02 billion gallons of biodiesel. Nationally, it is estimated that 60.8 percent of biodiesel uses soybean oil as a feedstock, 11 percent of the feedstock is corn oil and 9 percent is canola oil. Other feedstocks used in the production of biodiesel are animal fats (poultry fat and beef tallow, white grease from swine), and recycled feedstocks (yellow grease). Figure 75 shows the biodiesel plants that are in the 11-state region and an estimate of the split at each plant for feedstock between soybean oil and other feedstocks.

Figure 75. Regional biodiesel production

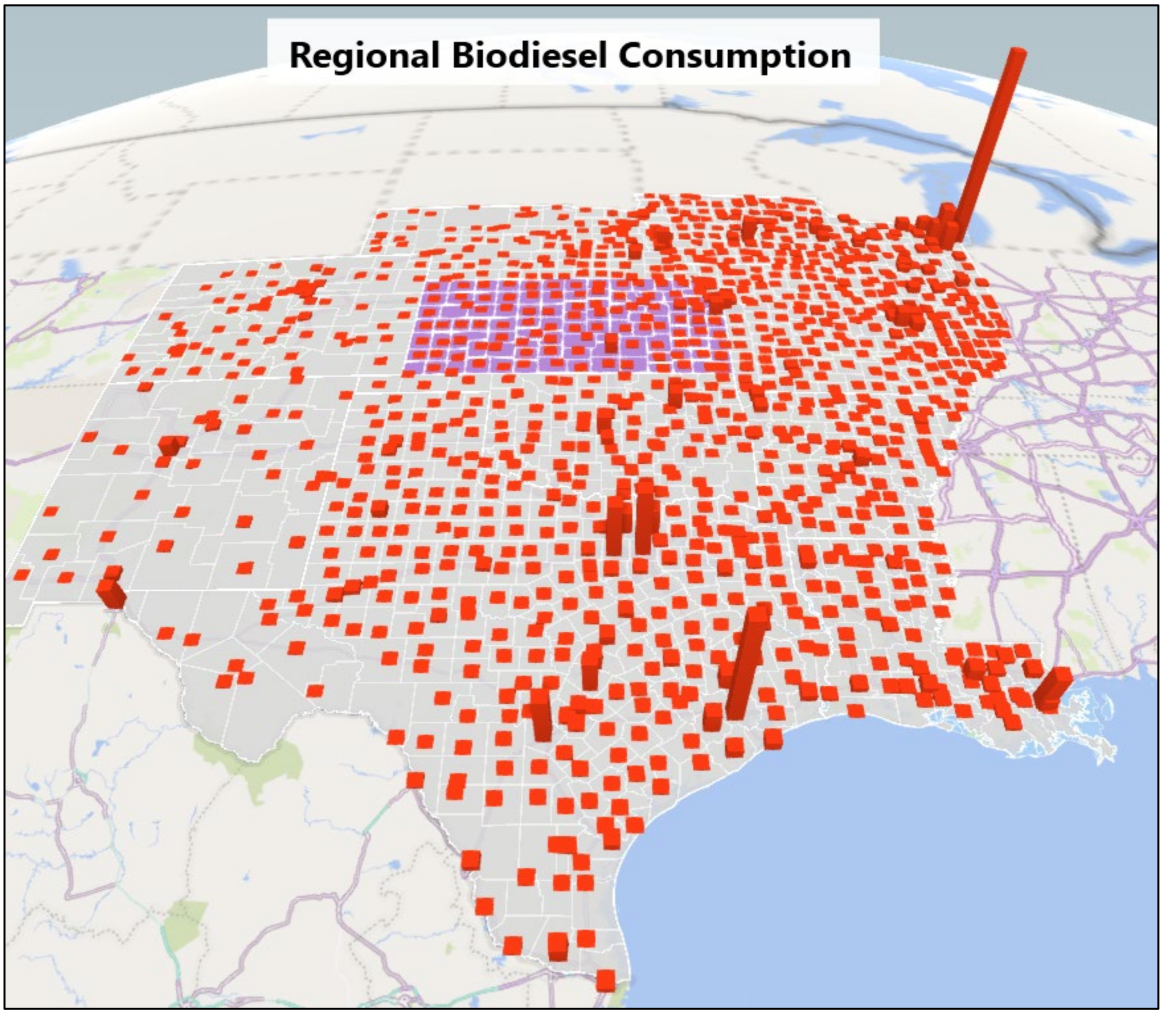


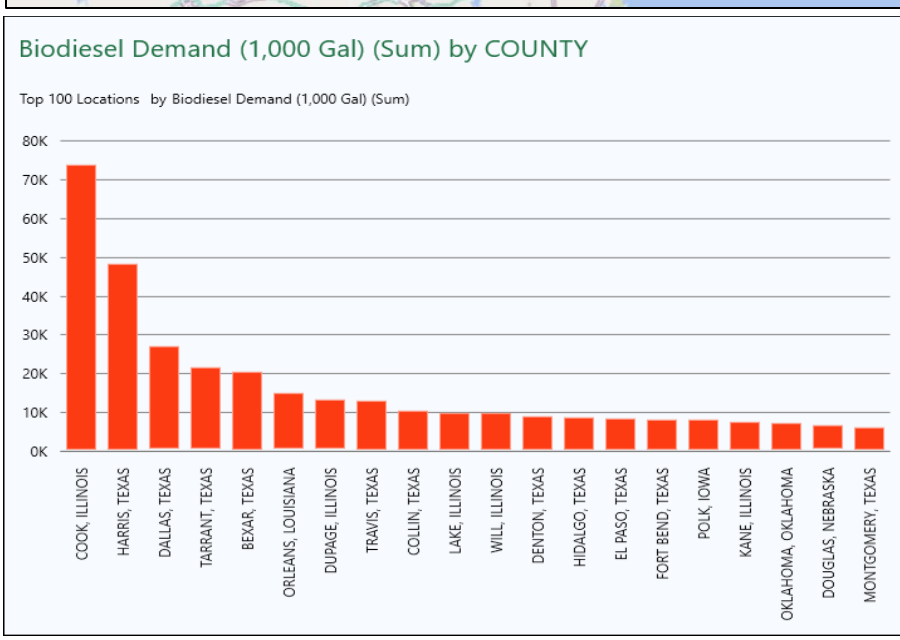

Biodiesel Production from Soy (1,000 Gal) (Sum) by COUNTY
Top 100 Locations by Biodiesel Production from Soy (1,000 Gal) (Sum)
70K
60K
50K
40K
30K
20K
10K
0K
JEFFERSON, TEXAS
WOODBURY, IOWA
KOSSUTH, IOWA
HARRIS, TEXAS
SEDGWICK, KANSAS
JACKSON, MISSOURI
HARDIN, IOWA
VERNON, MISSOURI
AUDRAIN, MISSOURI
LA SALLE, ILLINOIS
IROQUOIS, ILLINOIS
BUCHANAN, MISSOURI
INDEPENDENCE, ARKANSAS
CARROLL, IOWA
WASHINGTON, IOWA
VERMILION, ILLINOIS
SAC, IOWA
PHILLIPS, ARKANSAS
CERRO GORDO, IOWA
DUBUQUE, IOWA


Biodiesel Production from Other (1,000 Gal) (Sum) by COUNTY
Top 100 Locations by Biodiesel Production from Other (1,000 Gal) (Sum)
60K
50K
40K
30K
20K
10K
0K
JEFFERSON, TEXAS
HARRIS, TEXAS
TEXAS, OKLAHOMA
BUCHANAN, MISSOURI
LA SALLE, ILLINOIS
INDEPENDENCE, ARKANSAS
CARROLL, IOWA
VERMILION, ILLINOIS
SAC, IOWA
PHILLIPS, ARKANSAS
CERRO GORDO, IOWA
DUBUQUE, IOWA
JASPER, IOWA
WASHINGTON, IOWA
WOODBURY, IOWA
KOSSUTH, IOWA
MADISON, ILLINOIS
SEDGWICK, KANSAS
JACKSON, MISSOURI
HARDIN, IOWA

Biodiesel consumption within the 11-state region is very extensively distributed, but also has relatively high points of demand at all the major metropolitan areas (Figure 76). Chicago, Houston, and the Dallas-Fort Worth metropolitan area are the largest single points of demand. Small amounts of biodiesel are exported through Maverick County, Texas, and New Orleans.

Figure 76. Regional biodiesel consumption





3.2.2.1 Biodiesel flow

Kansas biodiesel production satisfies a significant portion of demand in Kansas, but also sends biodiesel to Nebraska (980,000 gal.), New Mexico (1.1 million gal.), Oklahoma (19.9 million gal.), Texas (8.5 million gal.), and to states outside of the region (2.6 million gal.). Kansas receives biodiesel from Missouri (15.9 million gal.) and Oklahoma (1.2 million gal.) (Table 14).

Table 14. Summary of regional biodiesel movement

Summary of Regional Biodiesel Movement (10,000 gallons)

	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	2,138	-	-	-	-	516	162	-	6	352	1,366	3,358	7,898
CO	-	-	-	-	-	-	-	-	-	-	-	-	-
IA	-	-	4,890	7,778	-	-	76	1,784	-	-	262	16,872	31,662
IL	-	-	108	7,334	-	-	352	-	-	-	-	5,600	13,394
KS	-	-	-	-	808	-	-	98	114	1,994	846	260	4,120
LA	-	-	-	-	-	2,016	-	-	-	-	-	3,556	5,572
MO	766	-	76	1,692	1,586	-	3,112	262	214	1,062	1,902	6,224	16,896
NE	-	-	-	-	-	-	-	-	-	-	-	-	-
NM	-	-	-	-	-	-	-	-	-	-	-	-	-
OK	-	678	-	-	122	-	-	58	548	148	1,230	306	3,090
TX	-	-	-	-	-	1,202	-	-	662	158	20,920	16	22,958
Out of Region	334	-	302	1,424	-	2,570	76	66	-	-	3,258		8,030
Total	3,238	678	5,376	18,228	2,516	6,304	3,778	2,268	1,544	3,714	29,784	36,176	113,620

Notes: Read down to see where a state gets its biodiesel. Read across to see where a state's biodiesel goes for use.

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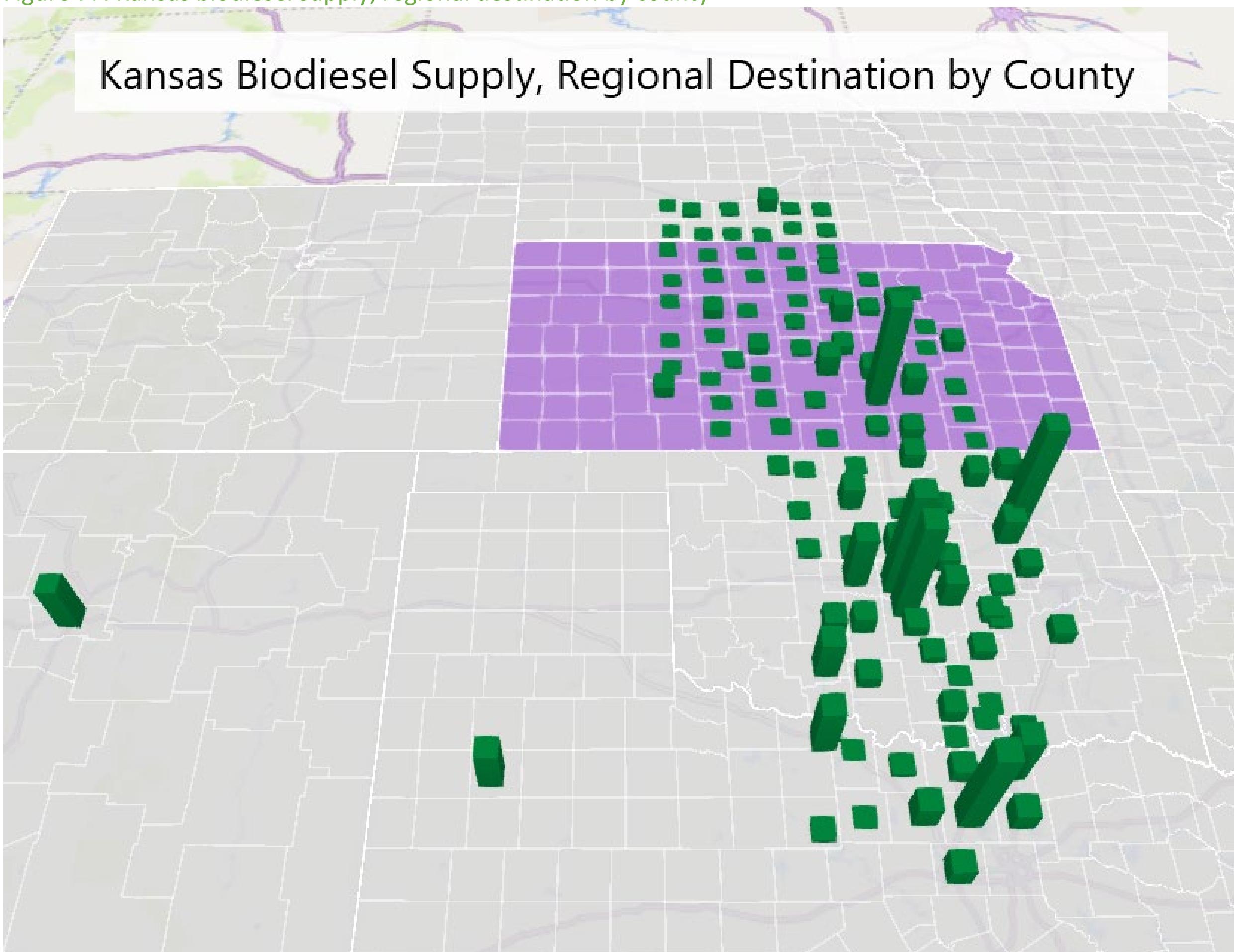
The biodiesel plant in Sedgwick County, Kansas, supplies biodiesel to central Kansas, south-central Nebraska, central Oklahoma, and north-central Texas, as well as supplying some biodiesel to major metropolitan areas further south and west (Figure 77).

Figure 77. Kansas biodiesel supply, regional destination by county



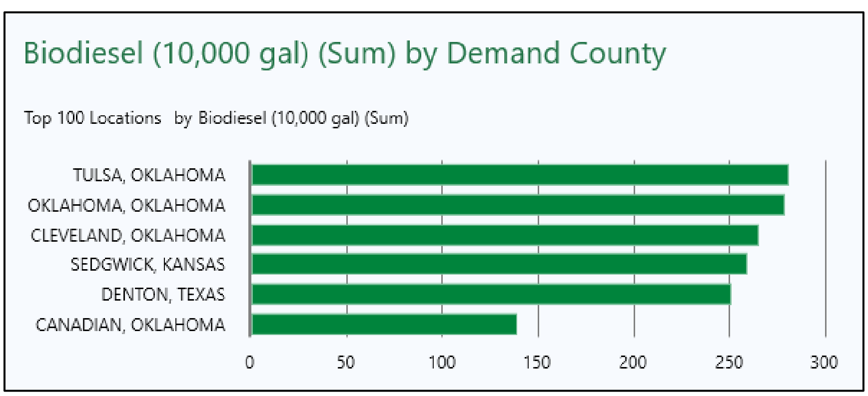
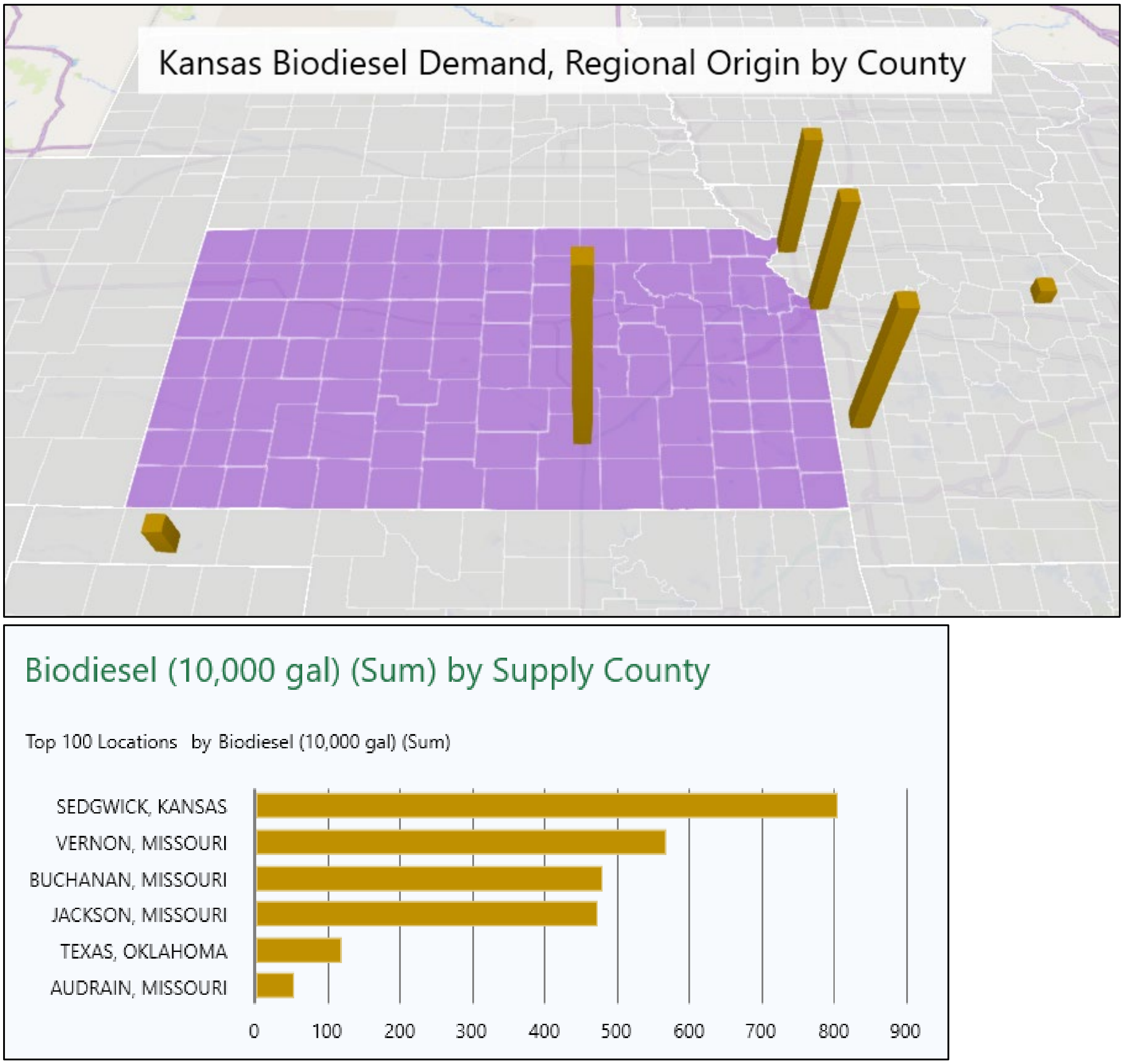


Figure 78 shows the counties supplying Kansas biodiesel demand. While central Kansas is supplied by the Sedgwick County plant, western Kansas receives its biodiesel from the facility in Texas County, Oklahoma. Counties in eastern Kansas receive their biodiesel largely from the three plants on the Missouri side of the Kansas-Missouri border in Vernon, Buchanan, and Jackson counties.

Figure 78. Kansas biodiesel demand, regional origin by county



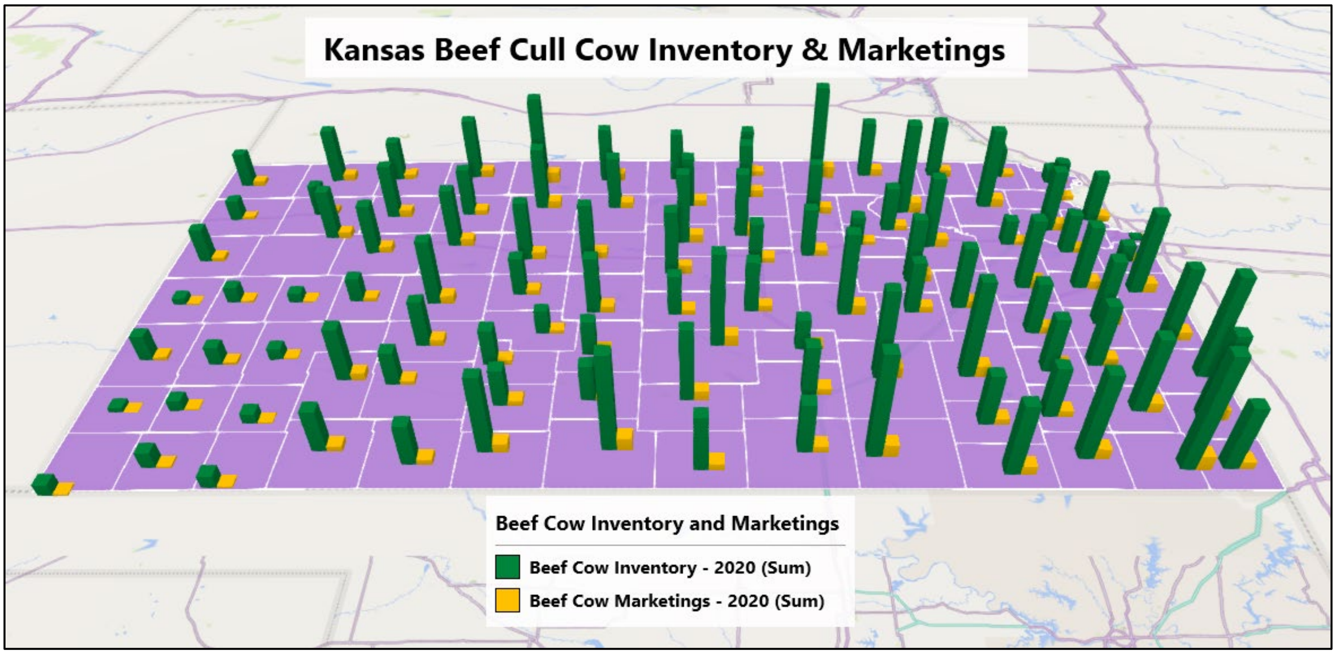
3.3 Livestock and poultry

The commodity flow analysis for cattle separated the flows into (cull) cow slaughter and fed cattle slaughter.

3.3.1 Beef & dairy cows

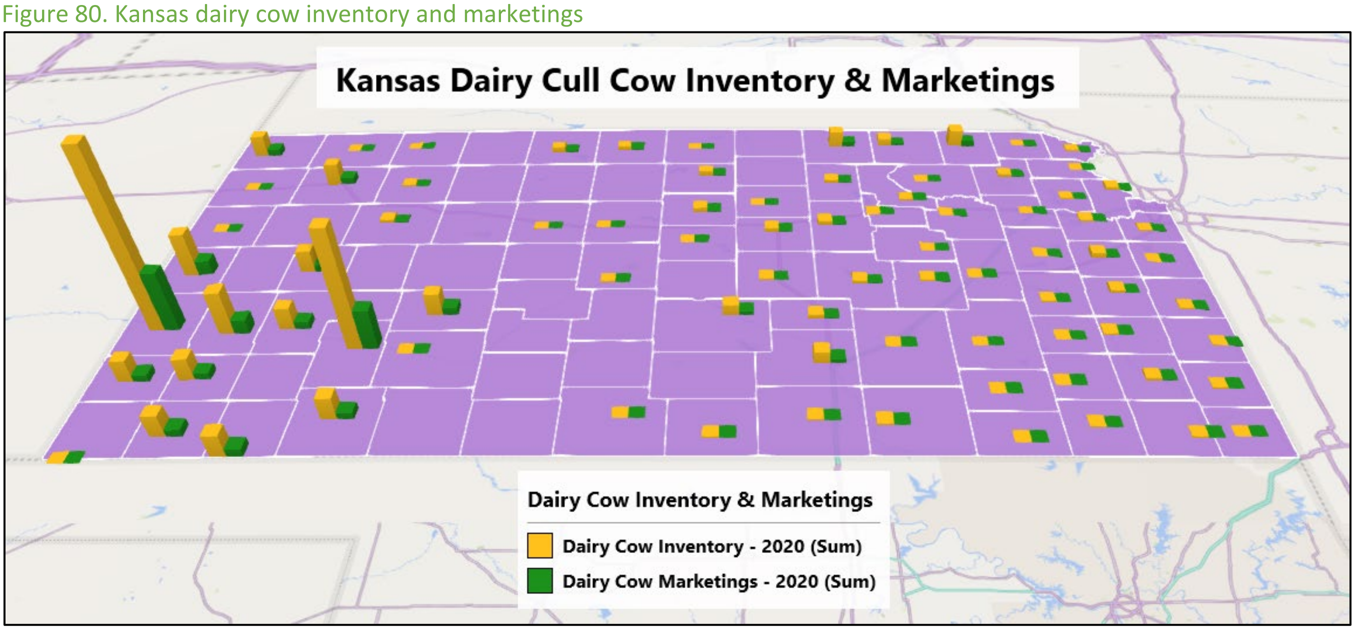
Cull cow slaughter flows at the county level were calculated from beef and dairy cow inventories and using a national-average cull rate for beef cows and dairy cows. In 2020, Kansas had 1.44 million beef cows. It is estimated that there were 174,340 beef cows that moved from Kansas farms to all cow slaughter facilities in 2020 (Figure 79).

Figure 79. Kansas beef cow inventory and marketings



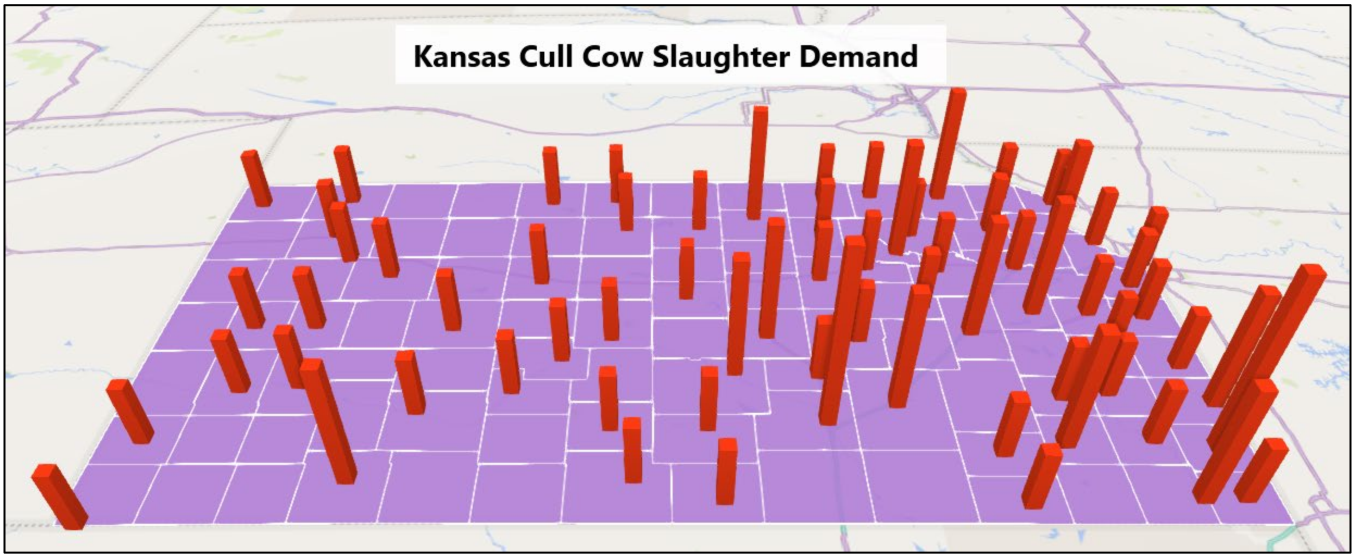
Kansas had a dairy cow inventory of 167,000 head in 2020. It is estimated that 54,760 dairy cows were sent to cow slaughter facilities in 2020 (Figure 80).

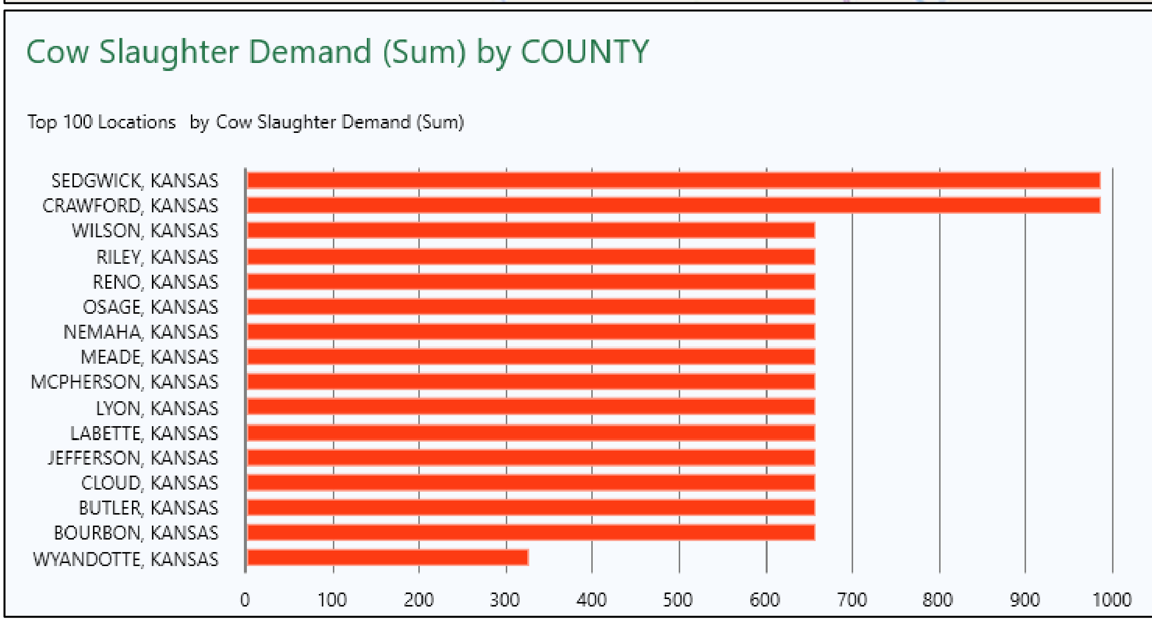
Figure 80. Kansas dairy cow inventory and marketings



Kansas has no large-scale cow slaughter facilities. It does have 88 small, local slaughter facilities that can process both cows and fed cattle, depending on local supply and demand. It is estimated that these local facilities process 27,300 cows per year, or 11.9 percent of its slaughter cow supply (Figure 81).

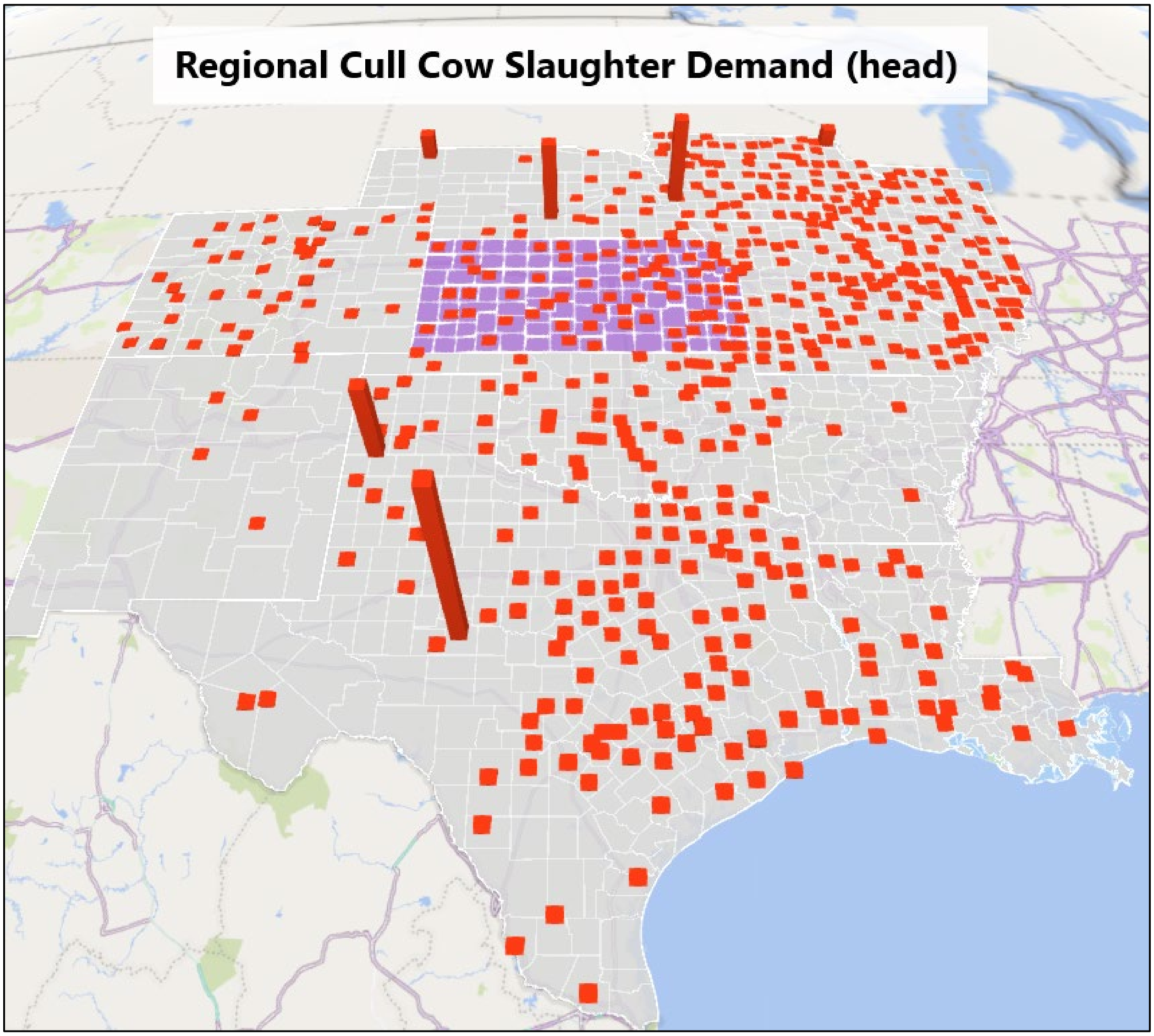
Figure 81. Kansas cow slaughter demand

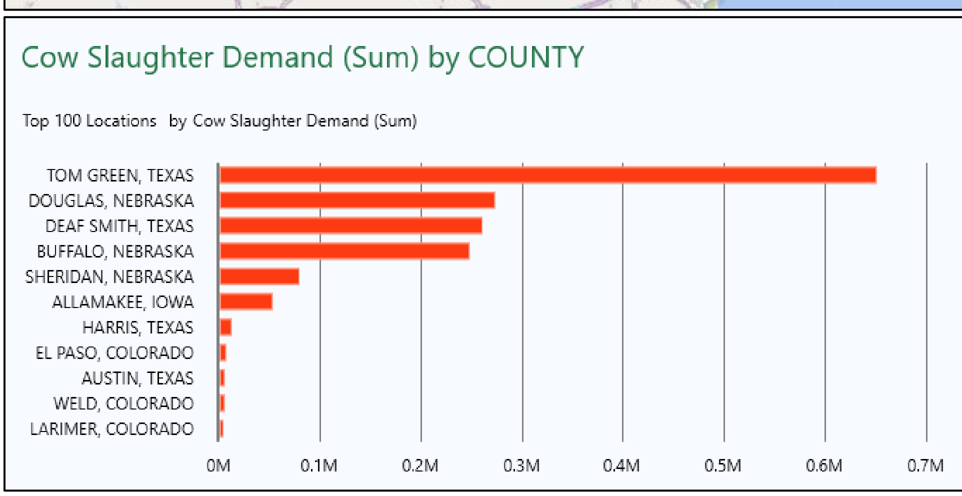




In the 11-state region, it is estimated that 2.27 million cows were slaughtered in 2020. This represents 32 percent of national slaughter cow processing capacity. In the 11-state area, there are 6 large facilities that process slaughter cows (Figure 82). Some of these facilities may process a mix of cows and fed cattle depending on market conditions, but these are primarily cow-slaughter facilities.

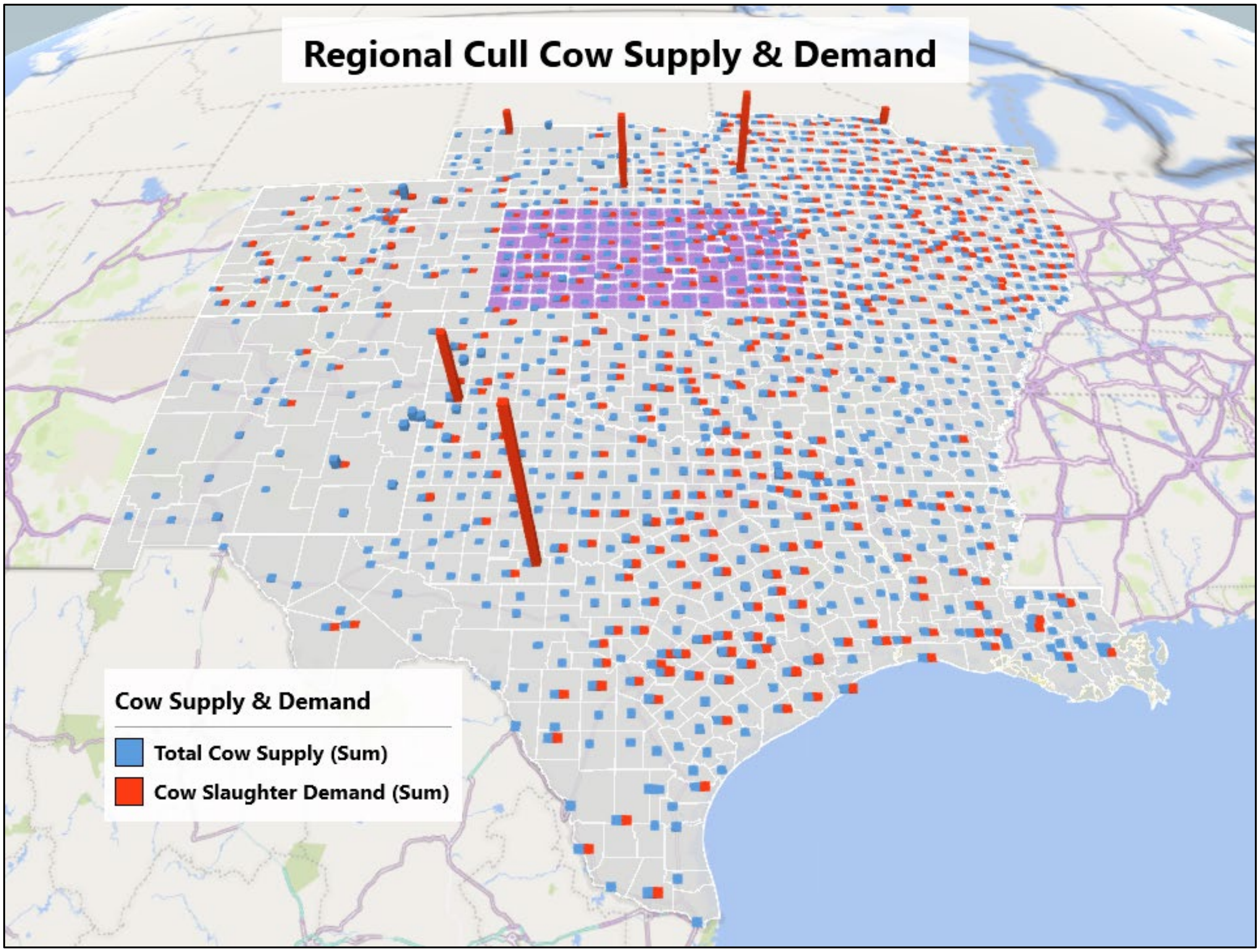
Figure 82. Regional cow slaughter demand





In the 11-state region, there were an estimated 2,244,900 beef and dairy cows that are shipped to slaughter facilities in 2020 (Figure 83). Within the region, there were an estimated 2,271,000 cows slaughtered.

Figure 83. Regional cow supply and demand



3.3.1.1 Beef & dairy cow flow

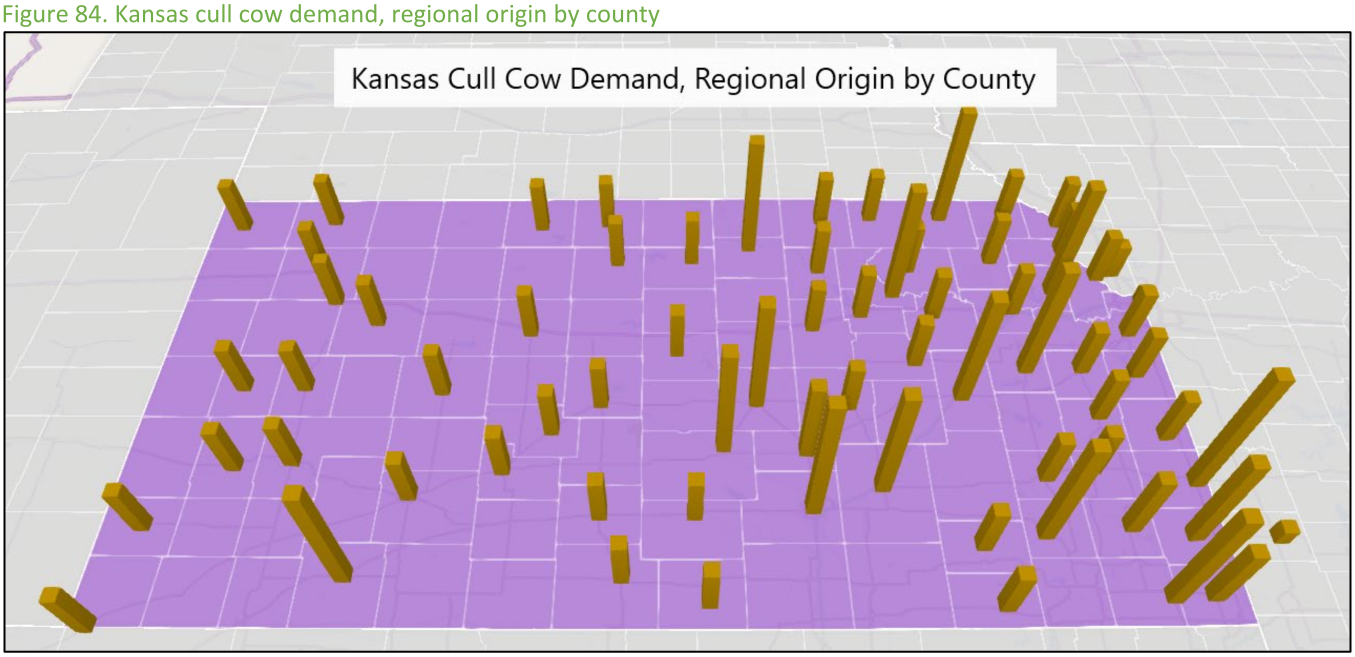
Kansas beef and dairy cull clow slaughter is almost entirely supplied by Kansas cows (27,000 head). Kansas sends cows for slaughter to Nebraska (162,700), Texas (21,000), Missouri (500), Oklahoma (200), and to states outside of the region (17,700) (Table 15).

Table 15. Summary of regional cull cow movement

Summary of Regional Cull Cow Movement (100 head)													
	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	46	-	-	-	-	-	11	-	-	-	517	546	1,120
CO	-	988	-	-	-	-	-	272	-	-	49	242	1,551
IA	-	-	677	20	-	-	1	550	-	-	-	555	1,803
IL	-	-	2	654	-	-	22	-	-	-	-	54	732
KS	-	-	-	-	270	-	5	1,627	-	2	210	177	2,291
LA	-	-	-	-	-	42	-	-	-	-	513	27	582
MO	-	-	1	33	3	-	1,001	772	-	-	1	959	2,770
NE	-	6	-	-	-	-	-	2,079	-	-	-	426	2,511
NM	-	74	-	-	-	-	-	-	47	-	1,215	327	1,663
OK	1	-	-	-	-	-	1	224	-	292	2,038	125	2,681
TX	-	-	-	-	-	-	-	-	-	-	7,426	-	7,426
Out of Region	-	32	269	155	-	-	4	760	-	-	92		1,312
Total	47	1,100	949	862	273	42	1,045	6,284	47	294	12,061	3,438	26,442
Notes: Read down to see where a state gets its cows. Read across to see where a state's cows go for slaughter.													

The small, local slaughter facilities that process cull cows obtain their supply almost entirely from within Kansas. A small number of cows are brought in from Jasper County, Missouri (Figure 84).

Figure 84. Kansas cull cow demand, regional origin by county



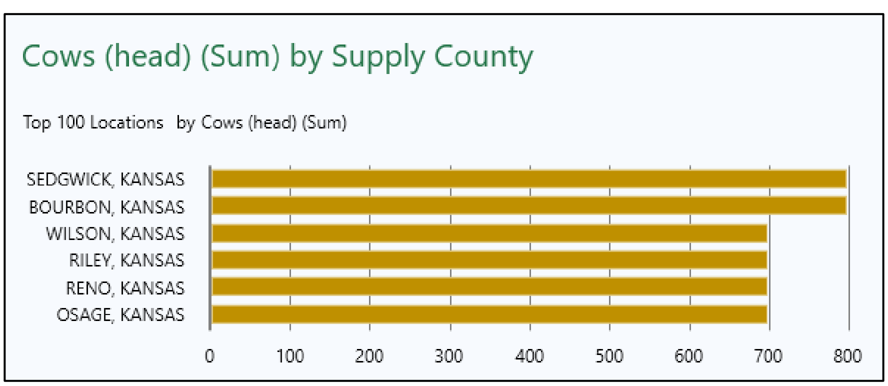
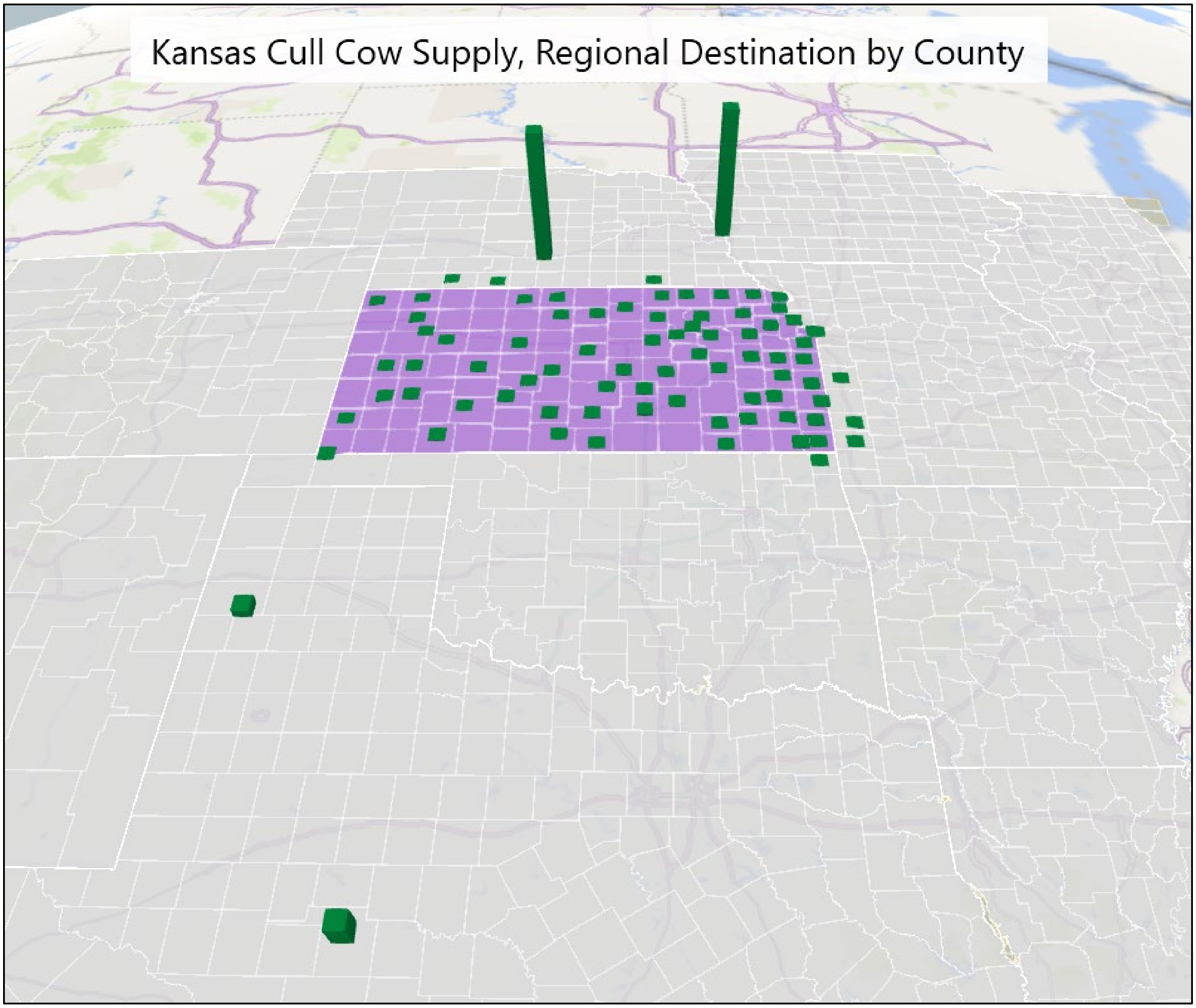
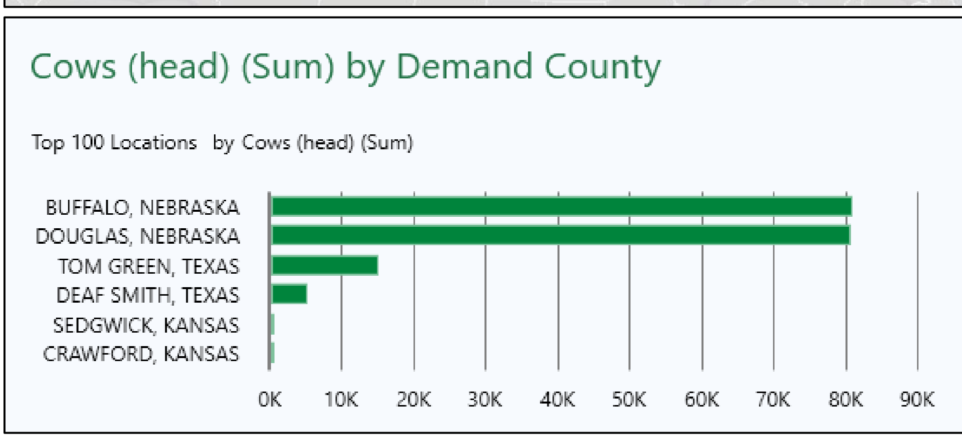


Figure 85 shows where Kansas counties send their cull cows for slaughter. Kansas sends most (71%) of its cows to Nebraska, primarily to processing facilities in Buffalo and Douglas Counties.

Figure 85. Kansas cull cow supply, regional destination by county

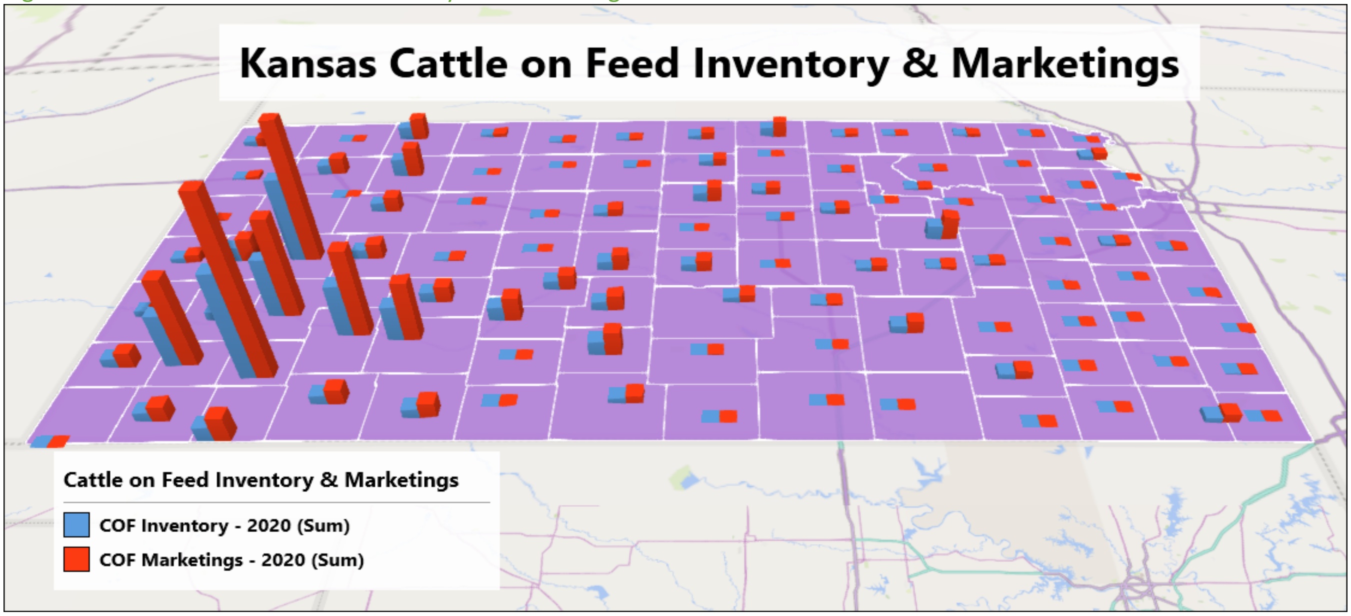




3.3.2 Fed cattle

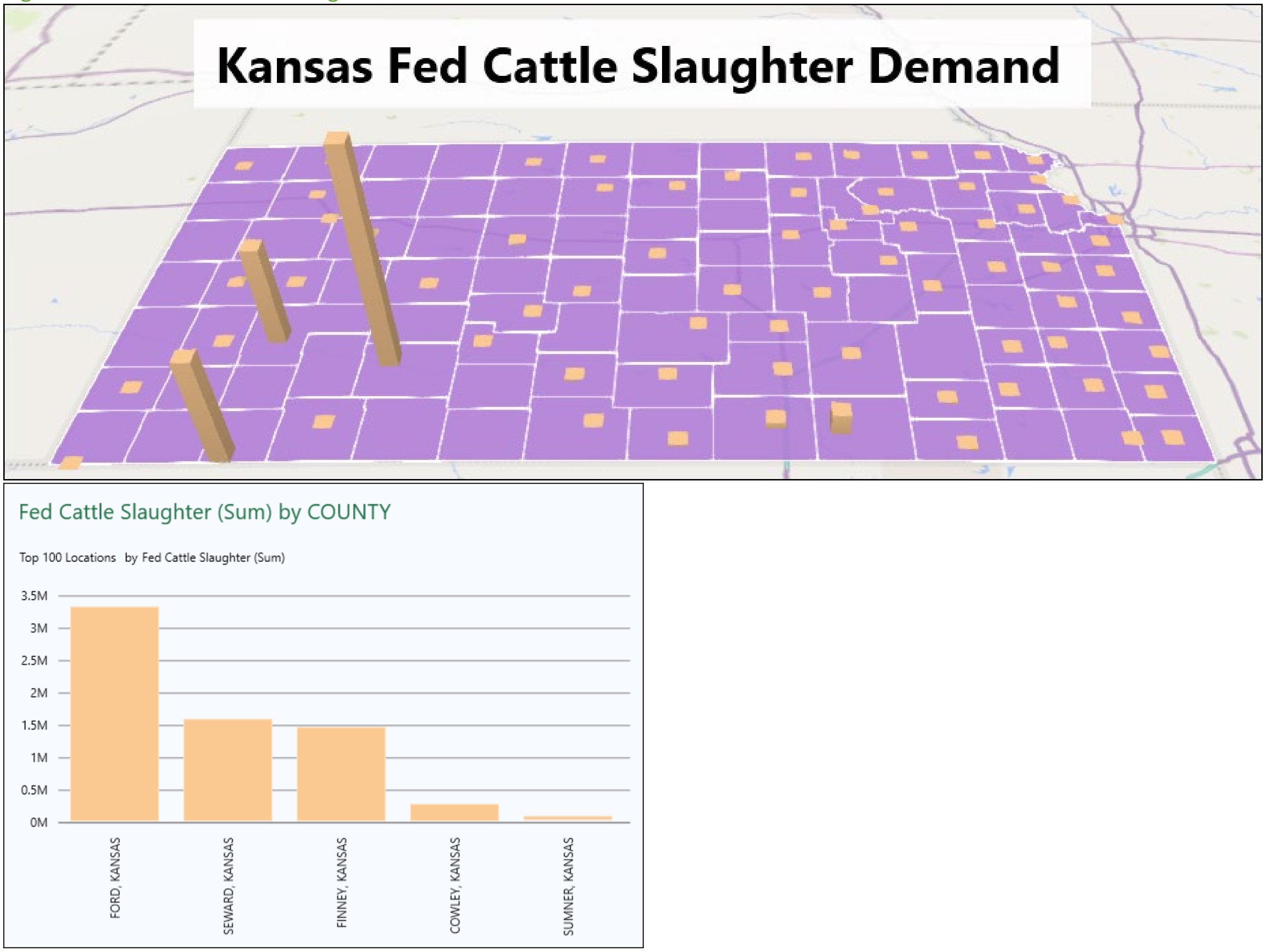
In 2020, Kansas had an inventory of 2.58 million head of cattle on feed. It is estimated that they produced 4.37 million fed cattle marketings (Figure 86).

Figure 86. Kansas cattle on feed inventory and marketings



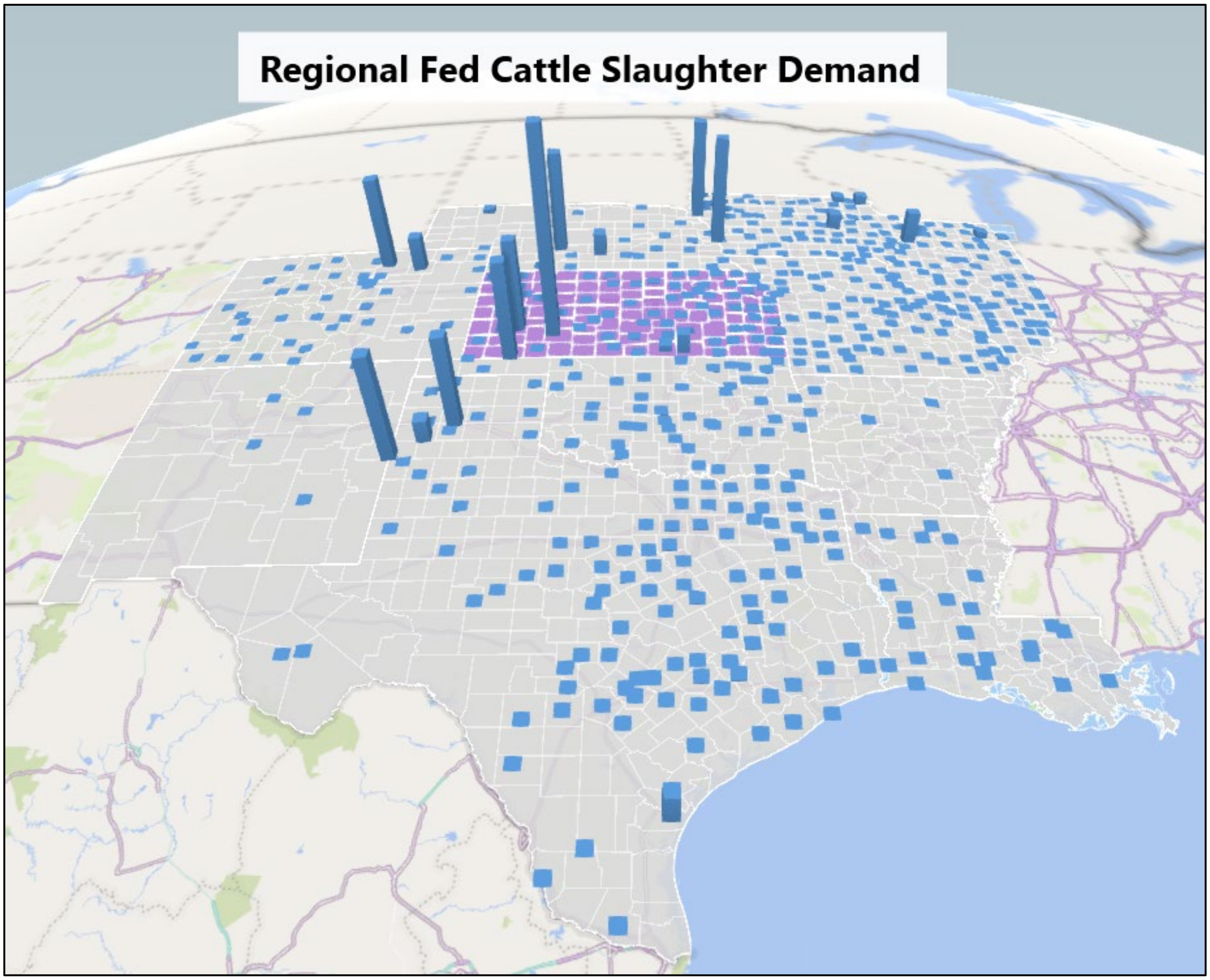
It is further estimated that Kansas processed 6.47 million head of fed cattle in 2020. Kansas has four very large fed cattle slaughter facilities, two mid-sized facilities along with a number of small and very small facilities that process fed cattle. Many of the small and very small facilities handle both fed cattle and cows (Figure 87).

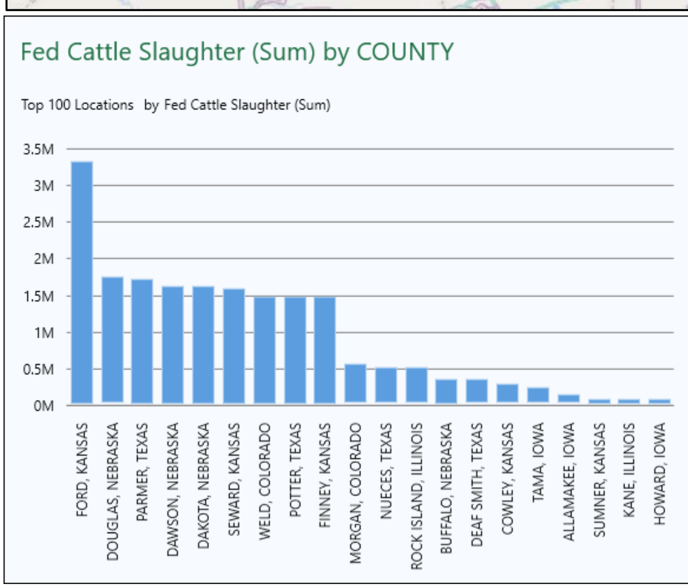
Figure 87. Kansas fed cattle slaughter demand



In the 11-state region, there are 9 large, fed cattle processing facilities, 10 mid-sized facilities that process fed cattle, 6 small commercial facilities that process fed cattle, and 769 very small, local facilities that process fed cattle. Average daily capacity of all these facilities is estimated at 82,377 head of fed cattle. Total annual slaughter capacity within the region is 20.6 million head of fed cattle which is 76 percent of national fed cattle slaughter (Figure 88).

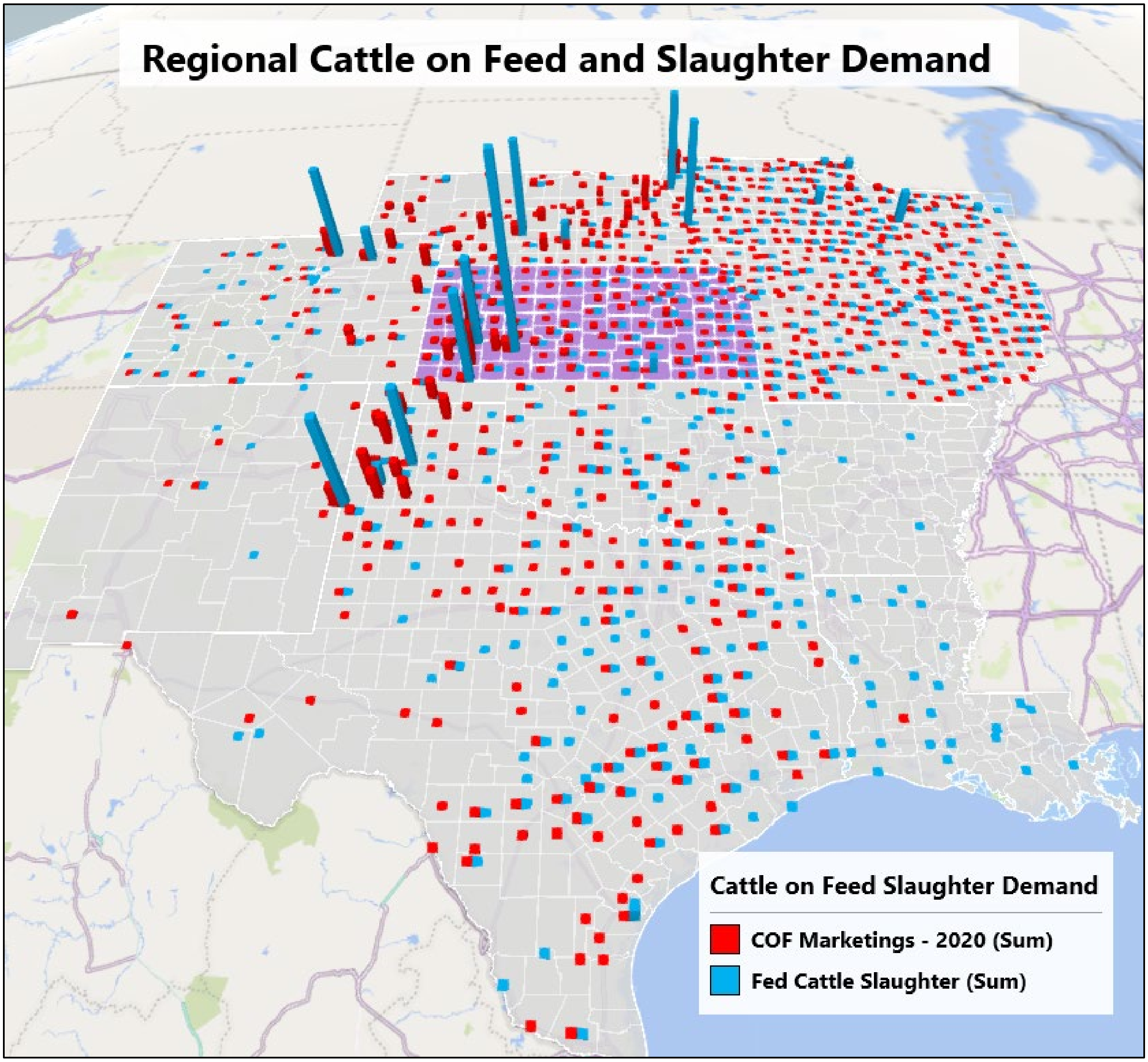
Figure 88. Regional fed cattle slaughter demand





In the 11-state region, there were 18.6 million fed cattle marketed. Fed cattle from within the region are sufficient to satisfy about 90 percent of fed cattle processing within the region (Figure 89).

Figure 89. Regional cattle on feed marketings and slaughter demand



3.3.2.1 Fed cattle flow

Kansas slaughters 6.47 million cattle per year. Of these, 64% originate from Kansas feedlots. Fed cattle are sent to Kansas for slaughter from Colorado (260,300 head), Iowa (48,800 head), Illinois (60,700 head), Missouri (56,000 head), Nebraska (100,600 head), New Mexico (62,600 head), Oklahoma (526,600 head), Texas (733,300 head), and 496,100 head from outside the 11-state region (Table 16). Figure 90 shows the origins of fed cattle that are slaughtered in Kansas. Kansas sends fed cattle for slaughter to Colorado (20,300 head), Nebraska (225,600 head) and Oklahoma (1,800 head) (Table 16). Figure 91 shows where Kansas-produced fed cattle are slaughtered.

Table 16. Summary of regional fed cattle movement

Summary of Regional Fed Cattle Movement (100 head)													
	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	-	-	-	-	-	-	-	-	-	-	-	-	-
CO	-	16,171	-	-	2,603	-	-	-	1	-	-	185	18,960
IA	-	-	5,632	3,011	488	-	-	12,464	-	-	-	246	21,841
IL	-	-	10	3,230	607	-	13	-	-	-	-	202	4,062
KS	-	203	-	-	41,200	-	-	2,256	-	18	-	-	43,677
LA	-	-	-	-	-	7	-	-	-	-	-	-	7
MO	25	-	16	445	560	-	652	155	-	1	-	12	1,866
NE	-	4,552	-	-	1,006	-	-	38,146	-	-	-	313	44,017
NM	-	2	-	-	626	-	-	-	39	-	358	-	1,025
OK	15	-	-	-	5,266	3	-	-	-	244	229	-	5,757
TX	-	-	-	-	7,333	25	-	-	2	13	43,070	2	50,445
Out of Region	-	1,010	418	46	4,961	6	-	2,207	-	-	-		8,648
Total	40	21,938	6,076	6,732	64,650	41	665	55,228	42	276	43,657	960	200,305

Notes: Read down to see where a state gets its fed cattle. Read across to see where a state's fed cattle go for slaughter.

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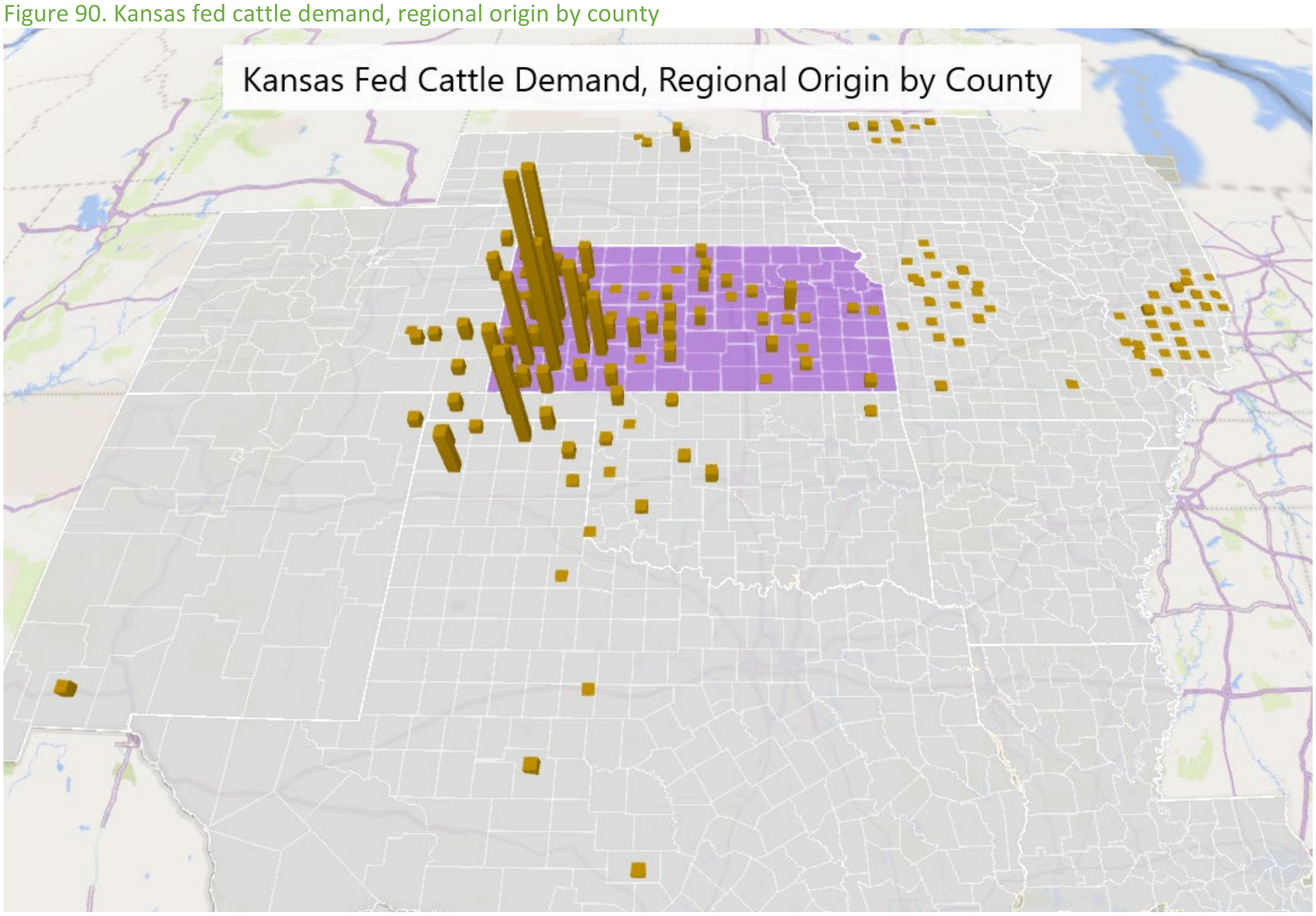
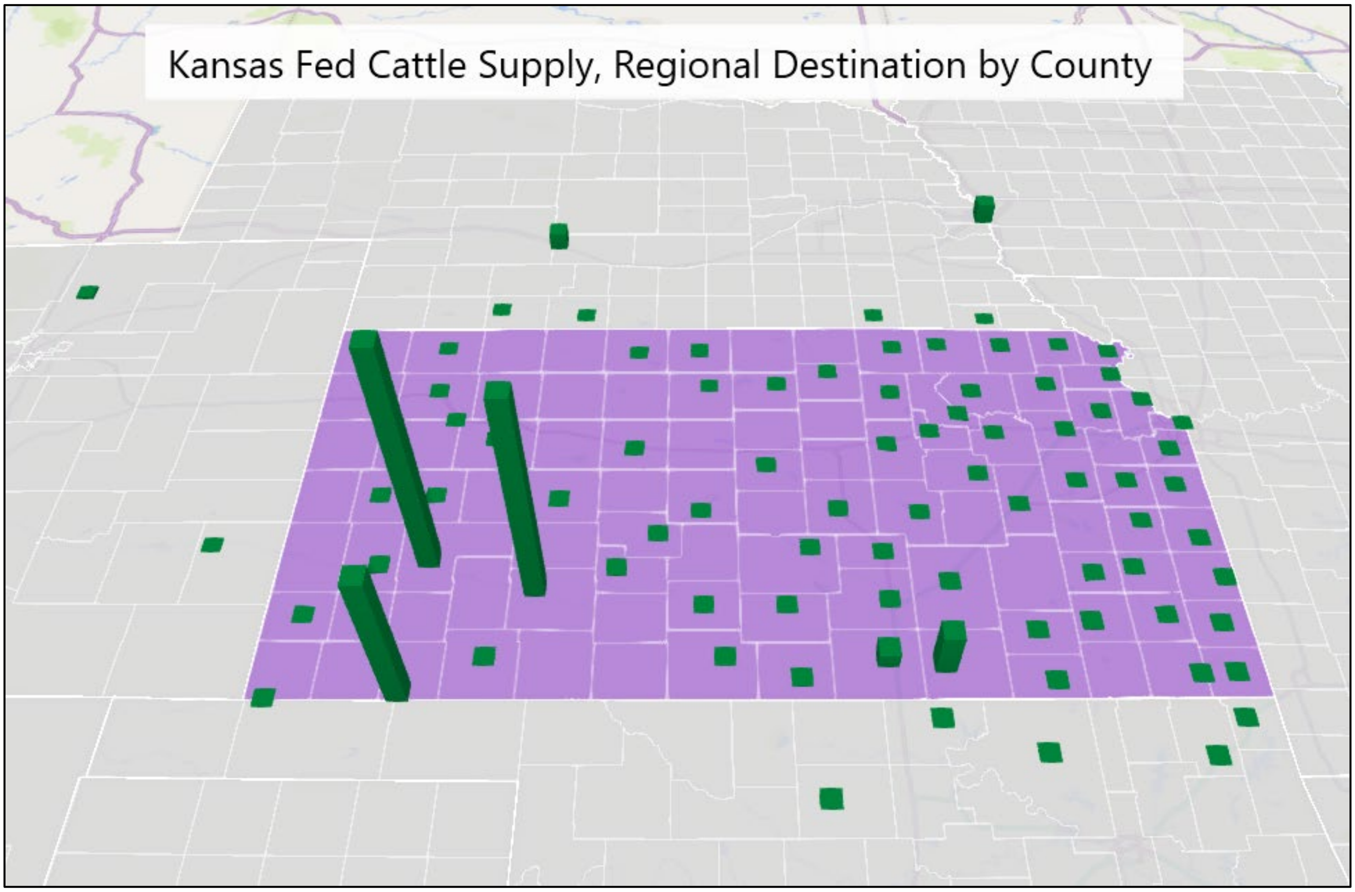
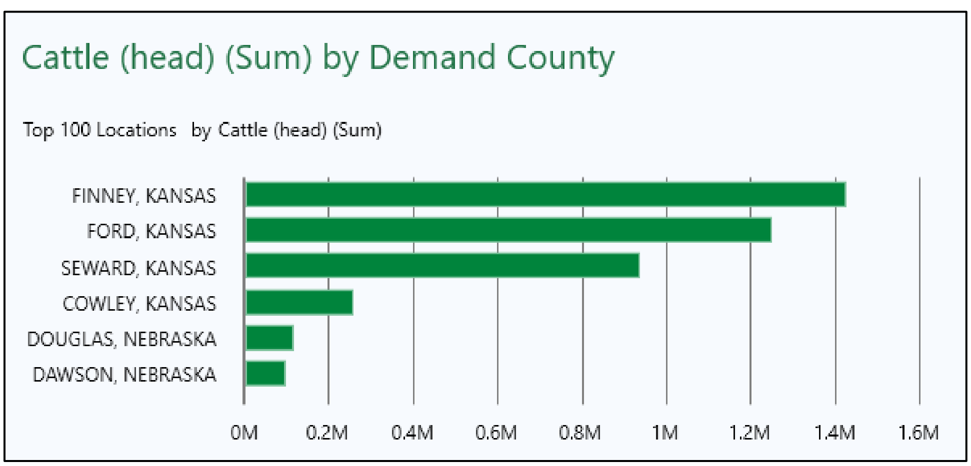
Figure 90. Kansas fed cattle demand, regional origin by county



As shown in Figure 91, Finney (1.43 million head) and Ford (1.32 million head) counties draw the most fed cattle from within Kansas for processing. Ford County has two large processing facilities. The plant in Seward (884,000 head) county draws 55 percent of the cattle processed there from within Kansas. While only 54,600 of the cattle processed in Finney County come from out-of-state feedlots, more than 700,000 head processed in Seward County and more than 1.5 million head (53%) processed in Ford County are estimated to come from out-of-state feedlots.

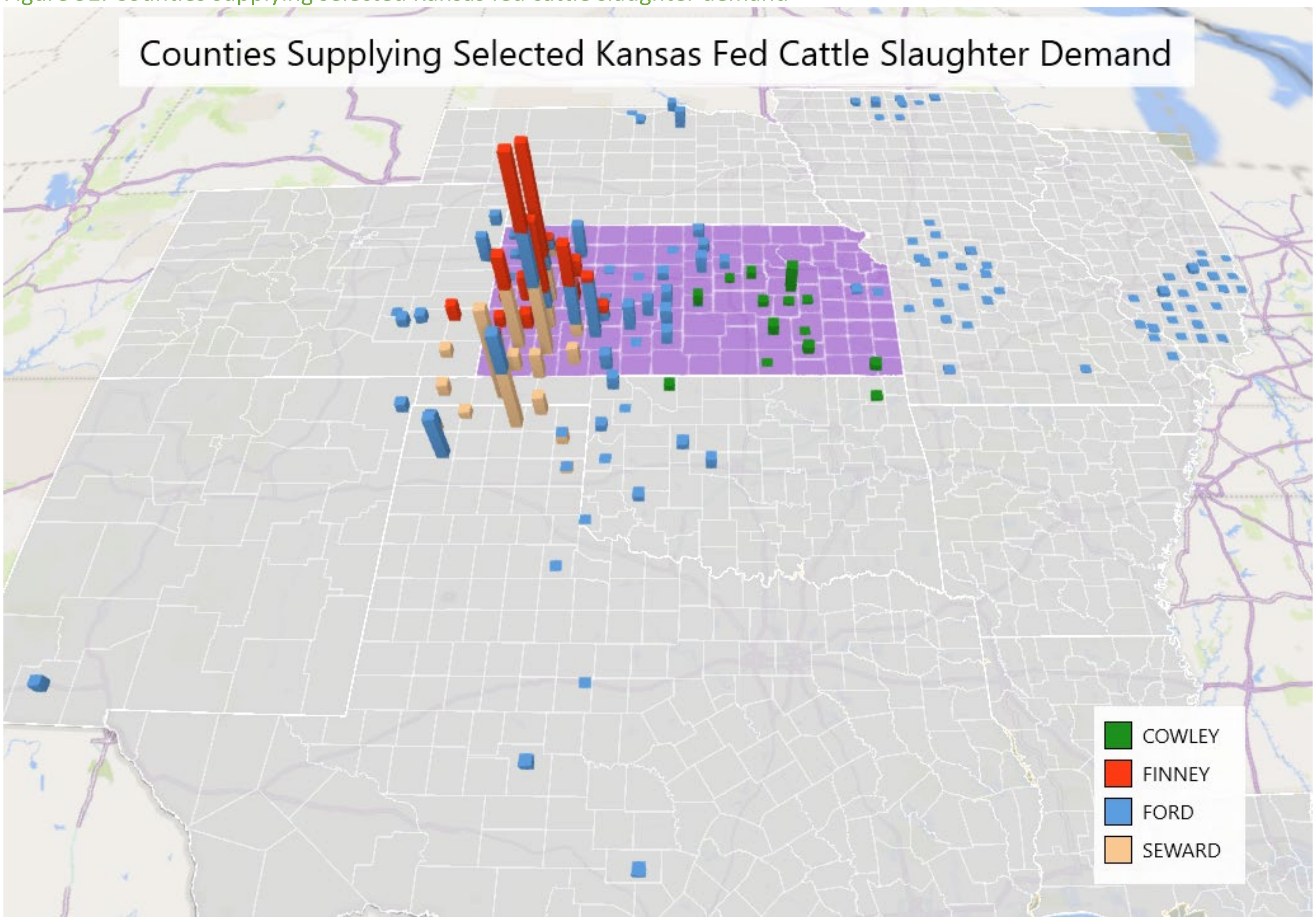
Figure 91. Kansas fed cattle supply, regional destination by county

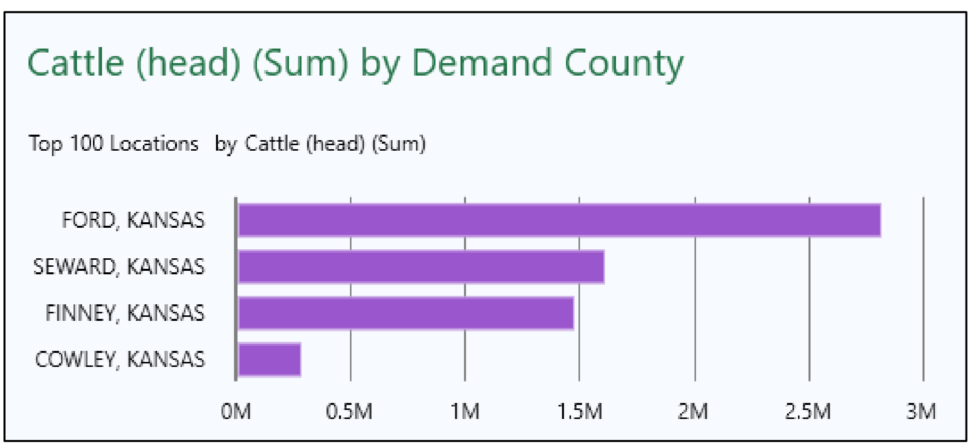




As seen in Figure 92, the fed cattle processing plants in Cowley and Finney Counties procure most of their cattle supply from within Kansas. The plants in Ford County and Seward County procure significant portions of their cattle supplies from outside Kansas with feedlots in Oklahoma and Texas being major suppliers. According to the dynamic flow analysis, there are pockets of fed cattle in Missouri, Illinois, Iowa and elsewhere that are in excess of the local demand and not needed to supply demand to closer fed cattle slaughter facilities. These cattle are needed by Kansas fed cattle slaughter facilities to meet their annual demand.

Figure 92. Counties supplying selected Kansas fed cattle slaughter demand

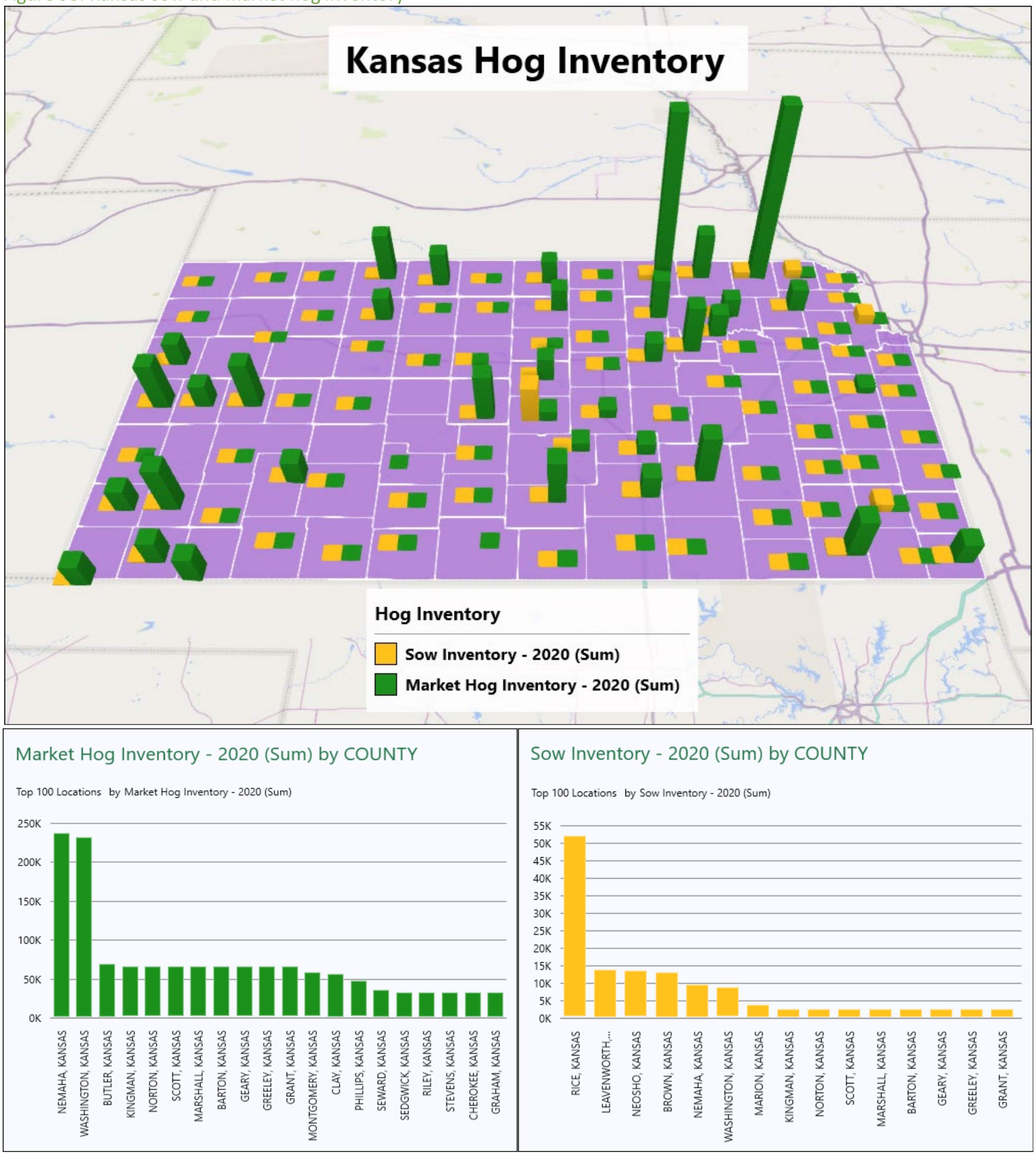




3.3.3 Hogs

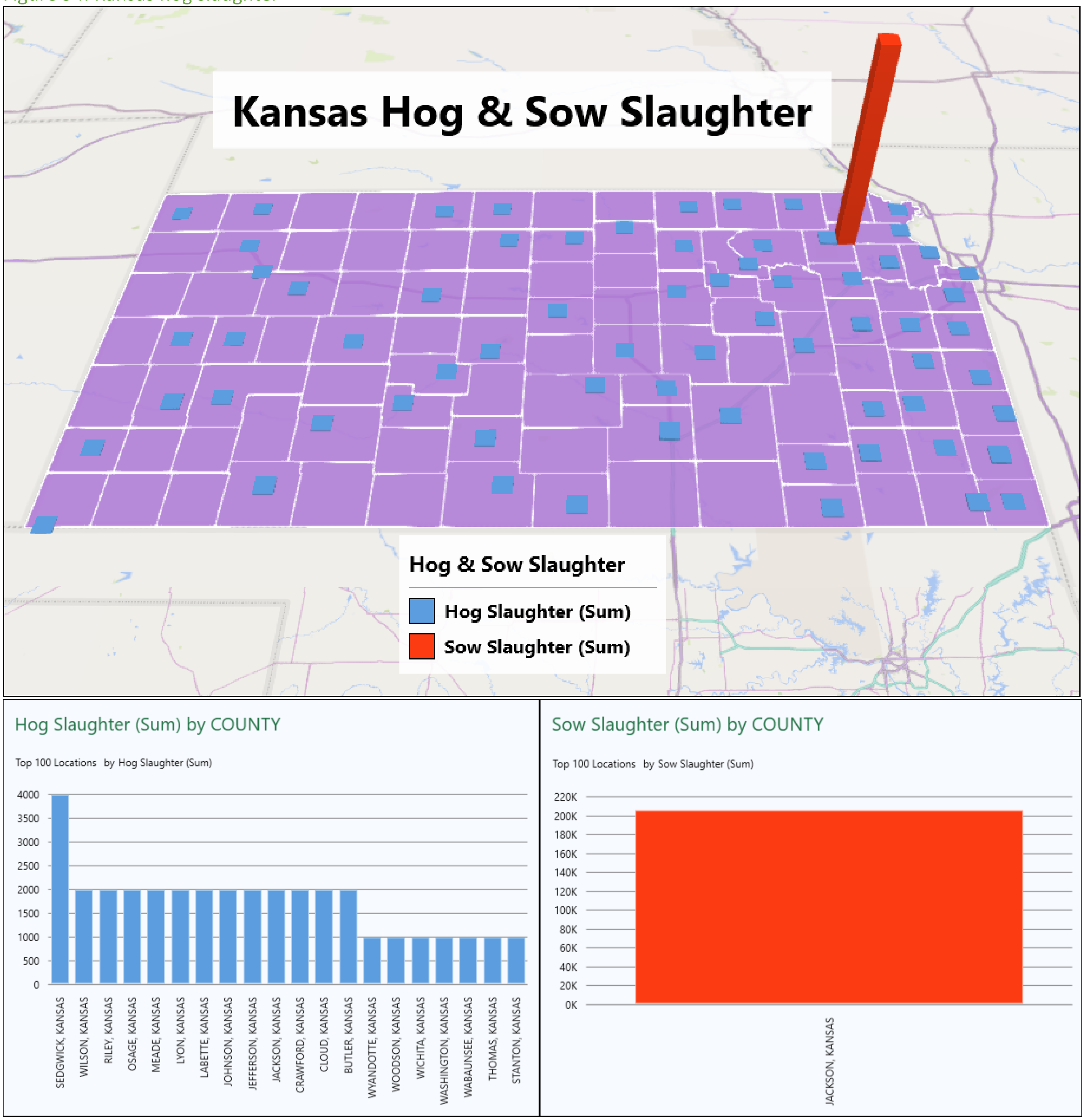
According to the 2017 USDA Census of Agriculture, there is some level of hog production in 97 of Kansas' 105 counties. Kansas sow inventory in 2020 was estimated to be 170,000 head. Kansas market hog inventory was estimated to be 1.88 million head. It was estimated that Kansas marketed 98,400 sows and 3.38 million market hogs in 2020 (Figure 93).

Figure 93. Kansas sow and market hog inventory



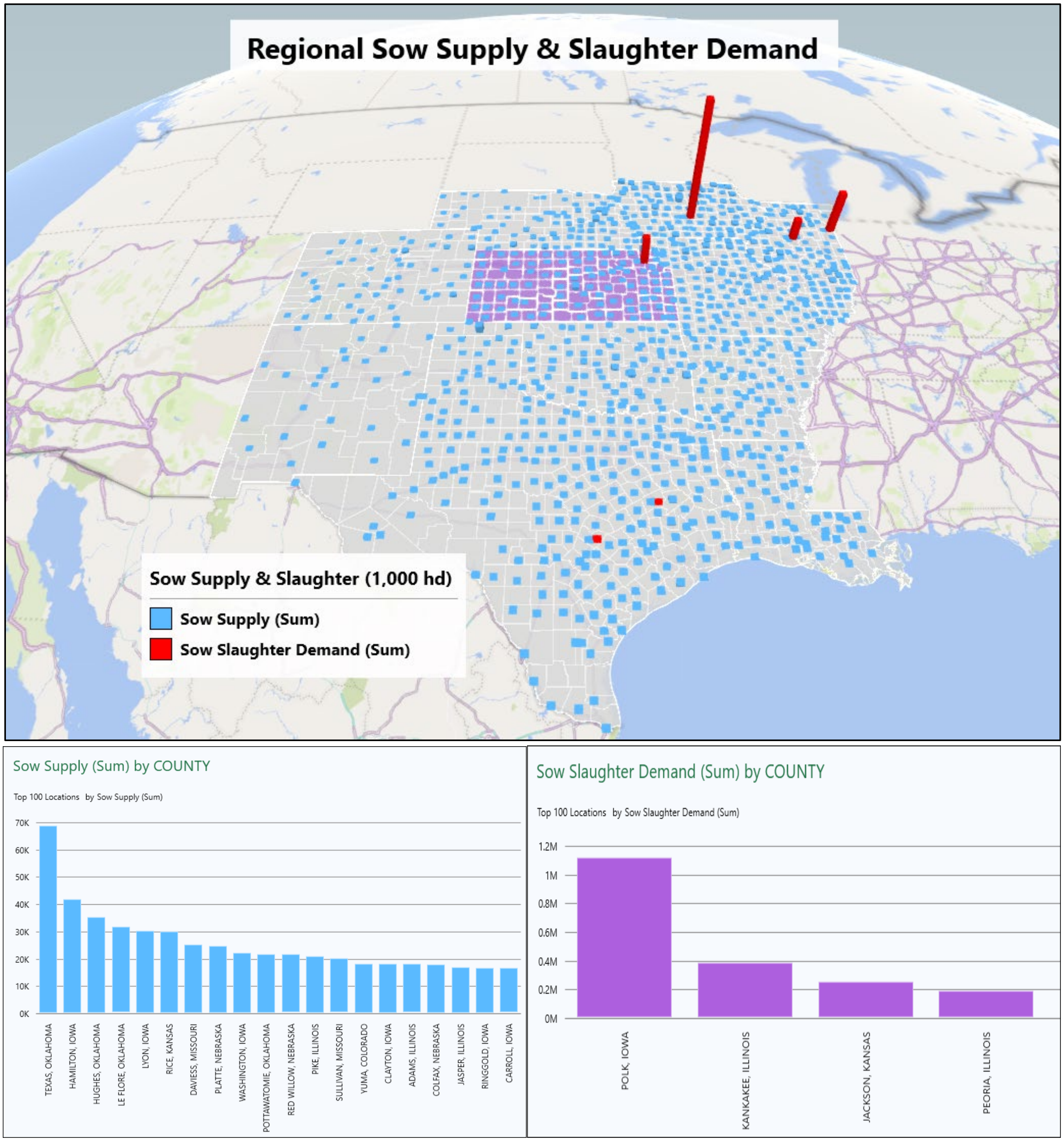
Kansas has one mid-sized sow slaughter facility with estimated daily processing capacity of 1,000 sows and/or boars per day (estimated annual capacity of 260,000 sows and/or boars) and 83 very small, local facilities that are estimated to process 83,000 hogs annually (Figure 94).

Figure 94. Kansas hog slaughter



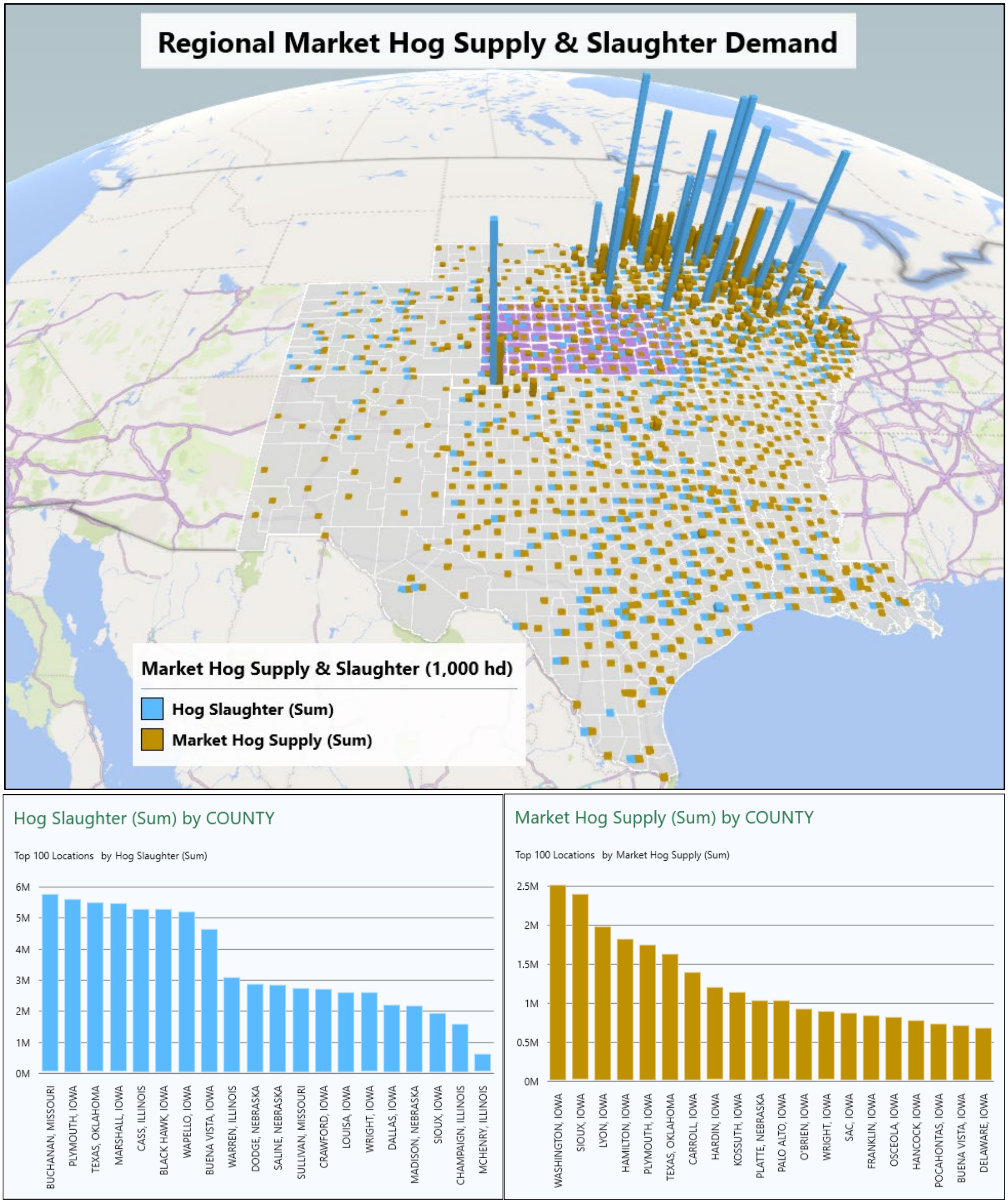
Within the 11-state region, there is one large scale sow slaughter facility in Des Moines, IA, 3 mid-sized sow slaughter facilities, two are in Illinois and one in Kansas, and two small facilities in Texas. In 2020, an estimated 1.56 million head of sows and boars were processed within the regional facilities. There was an estimated 1.97 million sows and boars shipped to slaughter facilities from within the region (Figure 95).

Figure 95. Regional sow supply and slaughter demand



In 2020, an estimated 74.3 million market hogs were processed through slaughter hog facilities within the 11-state region. There were an estimated 71.9 million market hogs produced in the region. Kansas hog production accounts for 4.7 percent of regional market hog supply. Kansas accounts for 0.1 percent of regional market hog slaughter (Figure 96).

Figure 96. Regional market hog supply and slaughter demand



3.3.3.1 Hog flow

Approximately 2 percent of Kansas market hogs are processed in very small, local facilities in Kansas and in some counties in neighboring states that slaughter hogs. The largest percentage of Kansas hogs (40%) are processed at the facility in Saline County, Nebraska. The slaughter facility in Buchanan County, Missouri processes 23 percent of Kansas market hogs and the facility in Texas County, Oklahoma processes 35 percent of Kansas market hogs (Figure 97).

Table 17. Summary of regional hog movement

Summary of Regional Hog Movement (100 head)

	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	70	-	33	79	-	6	1,065	-	-	236	1	-	1,490
CO	-	194	-	-	8	-	360	27	7	7,930	-	1	8,527
IA	-	-	353,477	14,886	-	-	6,782	6,024	-	-	-	43,546	424,715
IL	-	-	4,813	78,324	-	-	22	-	-	-	-	4,478	87,637
KS	-	-	-	-	765	-	7,839	13,505	-	11,654	-	-	33,763
LA	-	-	-	-	-	54	-	-	-	-	2	13	69
MO	-	-	9,489	7,972	39	-	41,764	-	-	-	-	-	59,264
NE	-	-	2,606	634	15	-	1,682	52,523	-	292	-	79	57,831
NM	-	1	-	-	-	-	-	-	10	-	1	-	12
OK	-	-	-	-	3	-	3,657	-	-	25,152	192	-	29,004
TX	-	-	-	-	-	1	55	-	6	13,991	2,794	-	16,847
Out of Region	-	1	25,020	19,164	-	1	23,804	8,247	4	-	-		76,241
Total	70	196	395,438	121,059	830	62	87,030	80,326	27	59,255	2,990	48,117	795,400

Notes: Read down to see where a state gets its hogs. Read across to see where a state's hogs go for slaughter.

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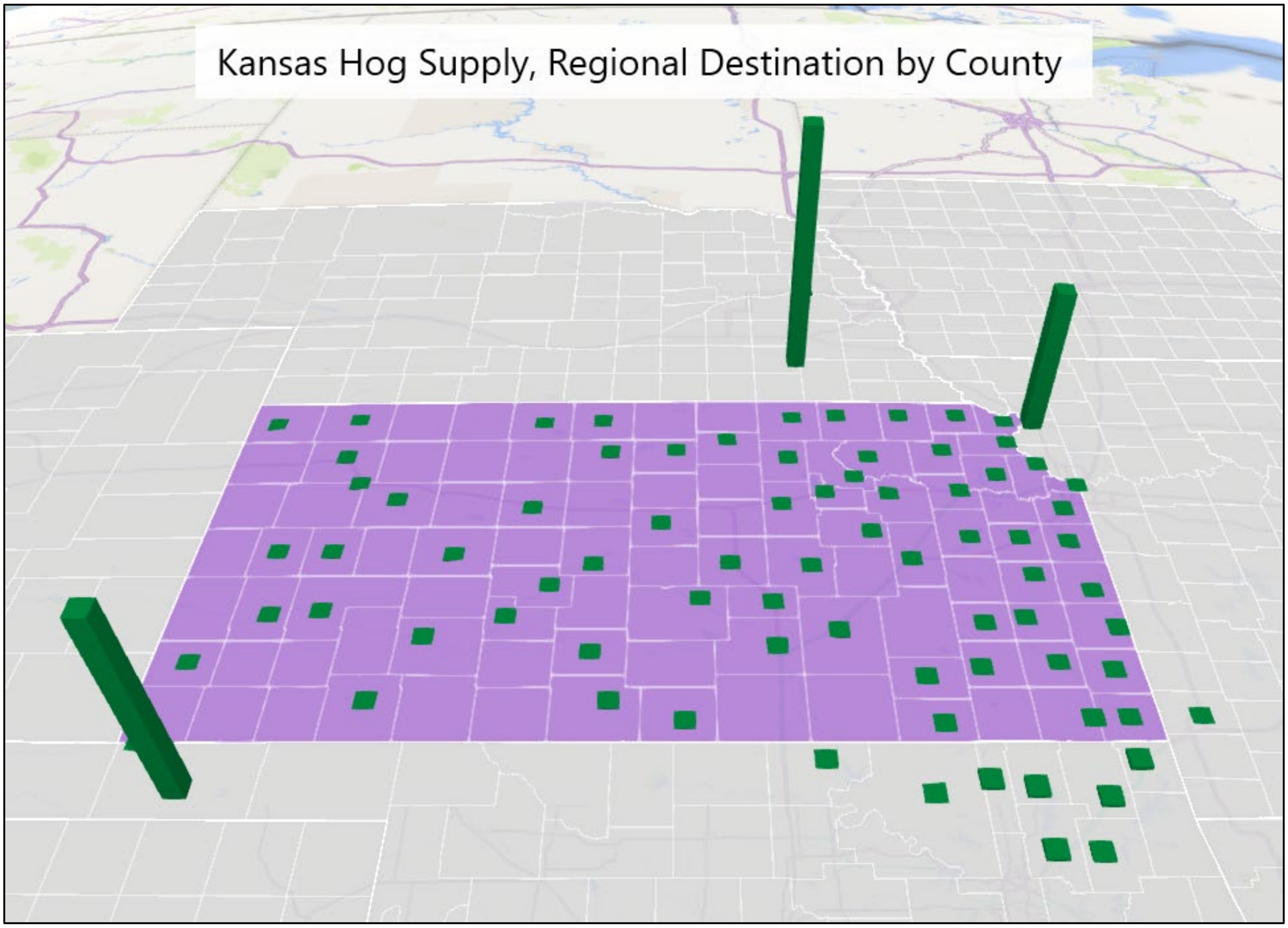
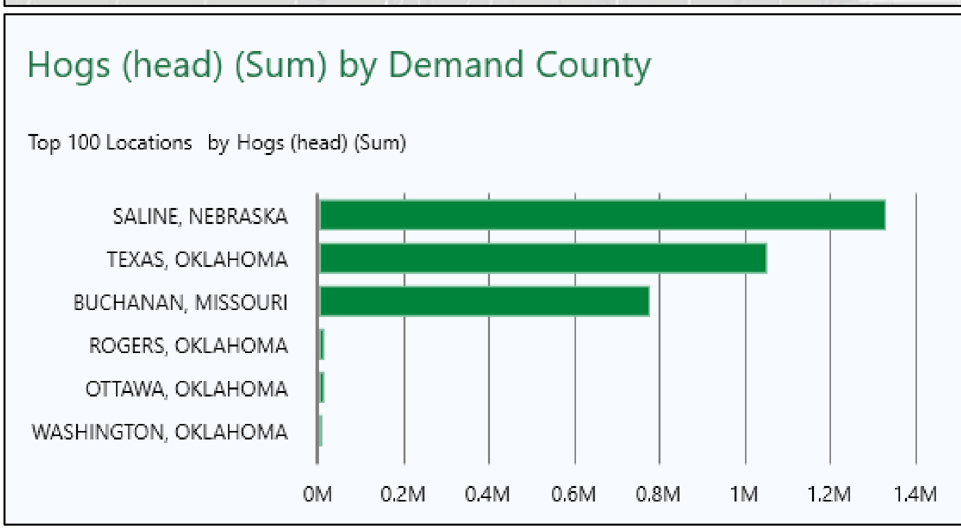
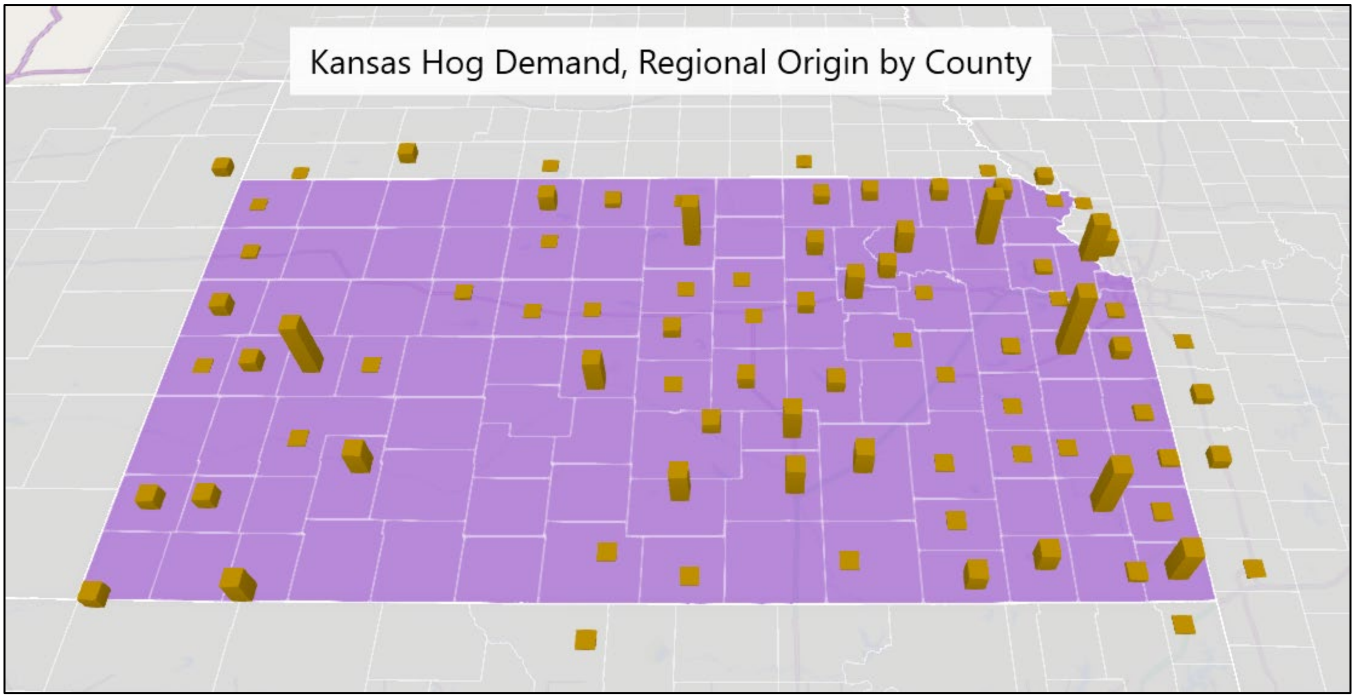
Figure 97. Kansas hog supply, regional destination by county

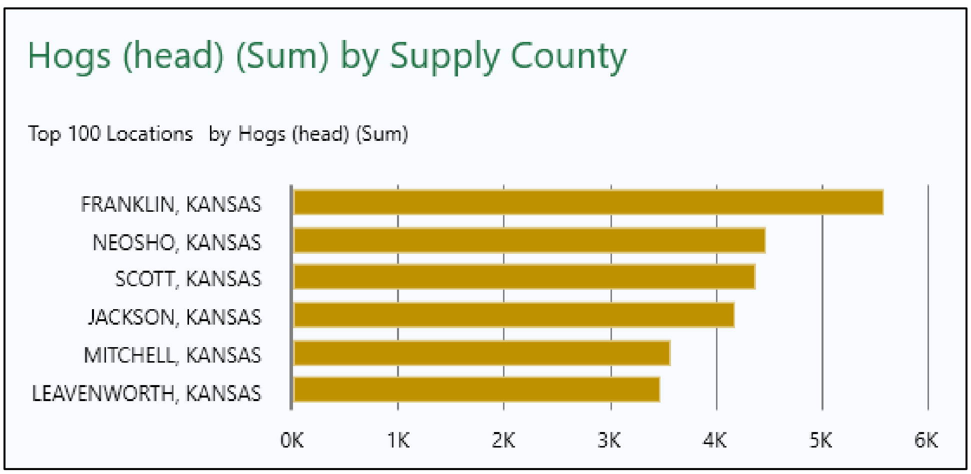




The very small, local processors in Kansas that process hogs can procure nearly all their hogs from within Kansas, and often from within the county in which the facility is located (Figure 98).

Figure 98. Kansas hog demand, regional origin by county



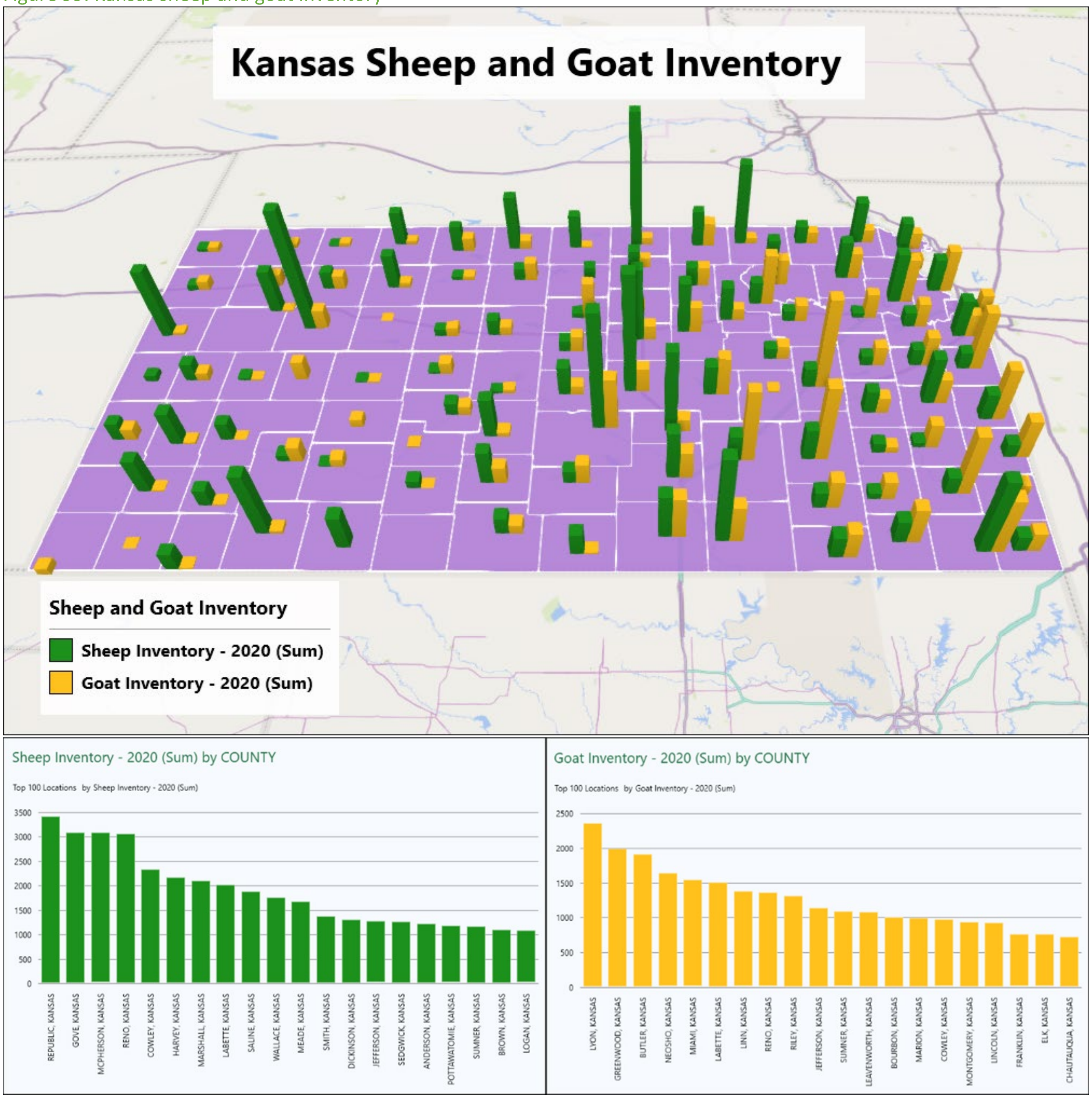


3.3.4 Sheep and goat

The inventory of sheep in Kansas in 2020 was estimated to be 73,000 head. From this supply, it is estimated that 31,560 head were marketed. The goat inventory in Kansas in 2020 is estimated to be 48,240 head. Marketings of goats from Kansas in 2020 were estimated to be 12,245 head (Figure 99).

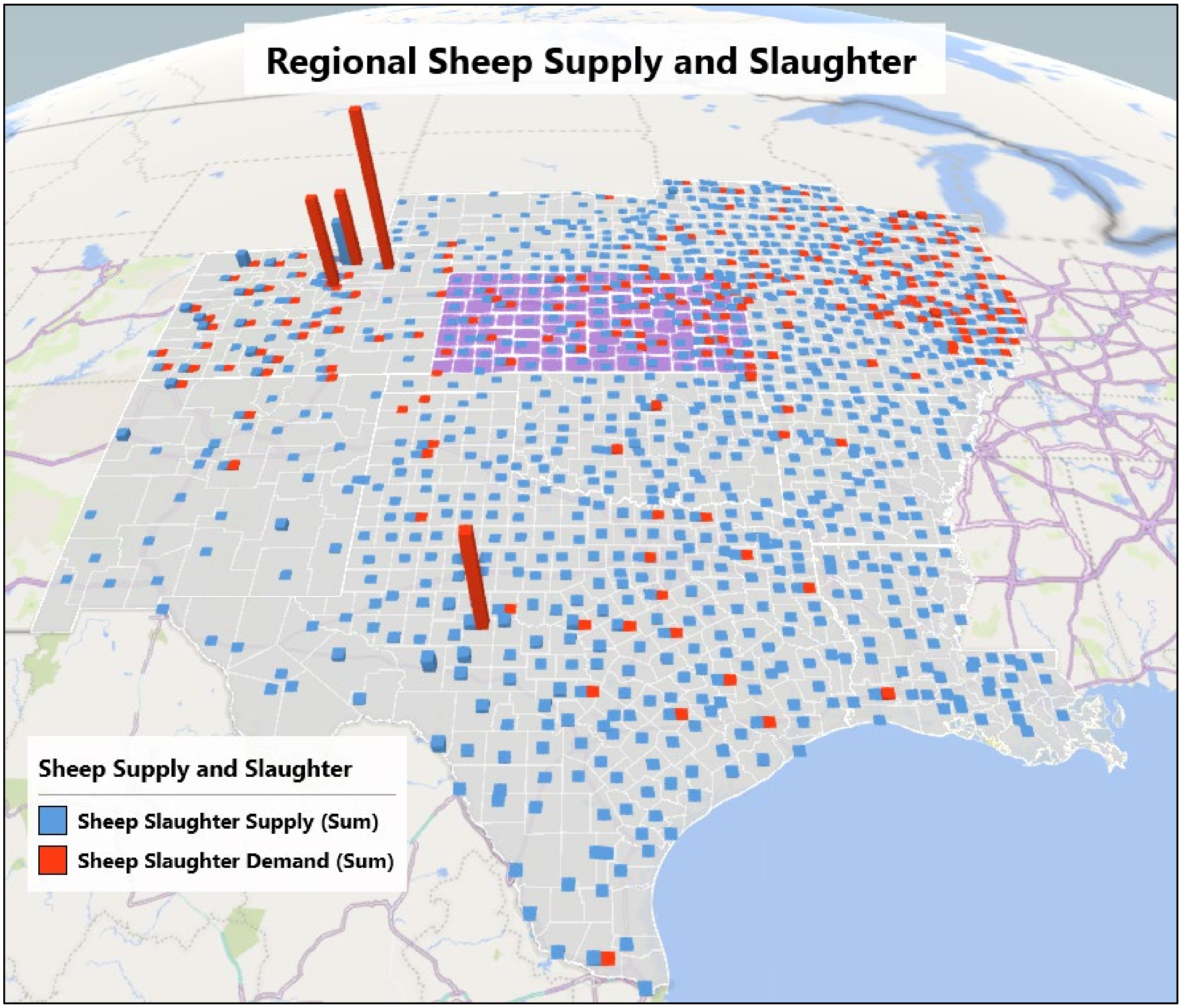
The top five counties for sheep production in Kansas are Republic, Gove, McPherson, Reno, and Cowley. The top five counties for goat production in Kansas are Lyon, Greenwood, Butler, Neosho, and Miami.

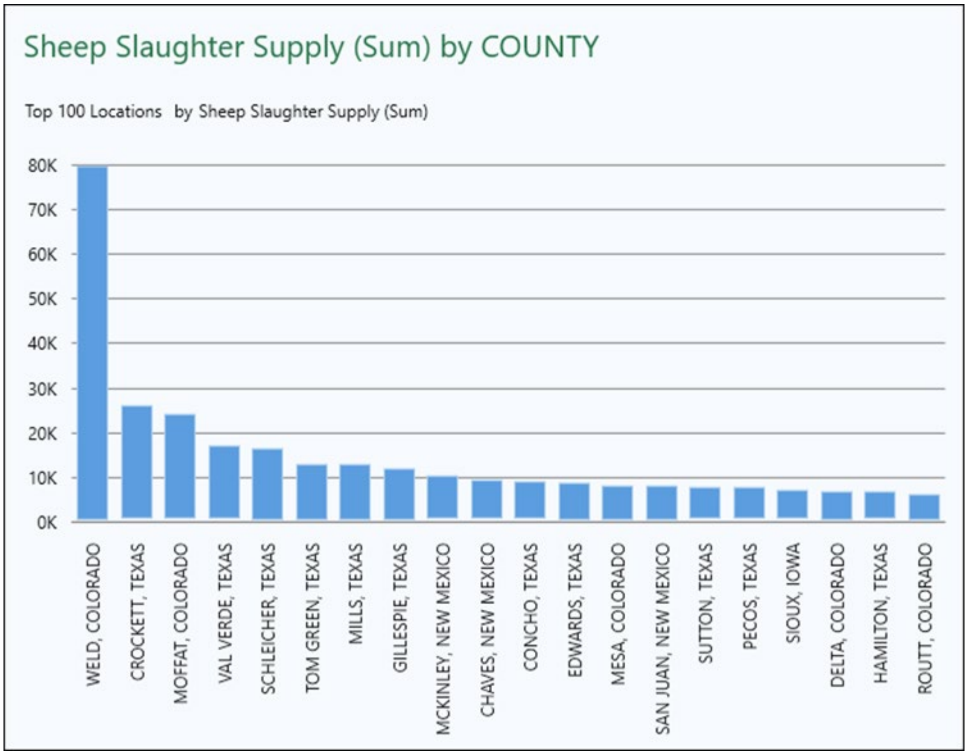
Figure 99. Kansas sheep and goat inventory



Regionally, sheep slaughter is concentrated into several large facilities in Colorado and one in Texas (Figure 100). Kansas has no large sheep or goat processor in the state. Sheep, lamb and goat processing that is done in Kansas is done by local, small state-inspected facilities or exempt slaughter facilities. Regionally, the largest goat supply is in Texas (Figure 101). As noted in Table 18, the large sheep processors in Colorado secure more than 70% of their supplies from outside the region.

Figure 100. Regional sheep supply and slaughter demand




Sheep Slaughter Supply (Sum) by COUNTY
Top 100 Locations by Sheep Slaughter Supply (Sum)
80K
70K
60K
50K
40K
30K
20K
10K
0K
WELD, COLORADO
CROCKETT, TEXAS
MOFFAT, COLORADO
VAL VERDE, TEXAS
SCHLEICHER, TEXAS
TOM GREEN, TEXAS
MILLS, TEXAS
GILLESPIE, TEXAS
MCKINLEY, NEW MEXICO
CHAVES, NEW MEXICO
CONCHO, TEXAS
EDWARDS, TEXAS
MESA, COLORADO
SAN JUAN, NEW MEXICO
SUTTON, TEXAS
PECOS, TEXAS
SIOUX, IOWA
DELTA, COLORADO
HAMILTON, TEXAS
ROUTT, COLORADO

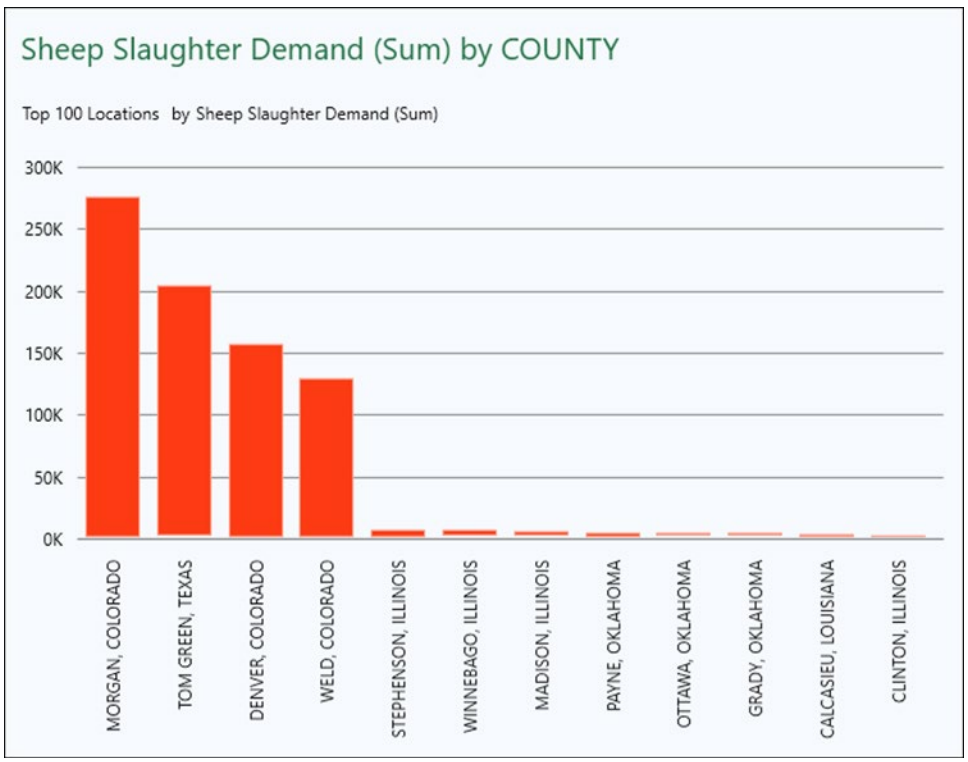
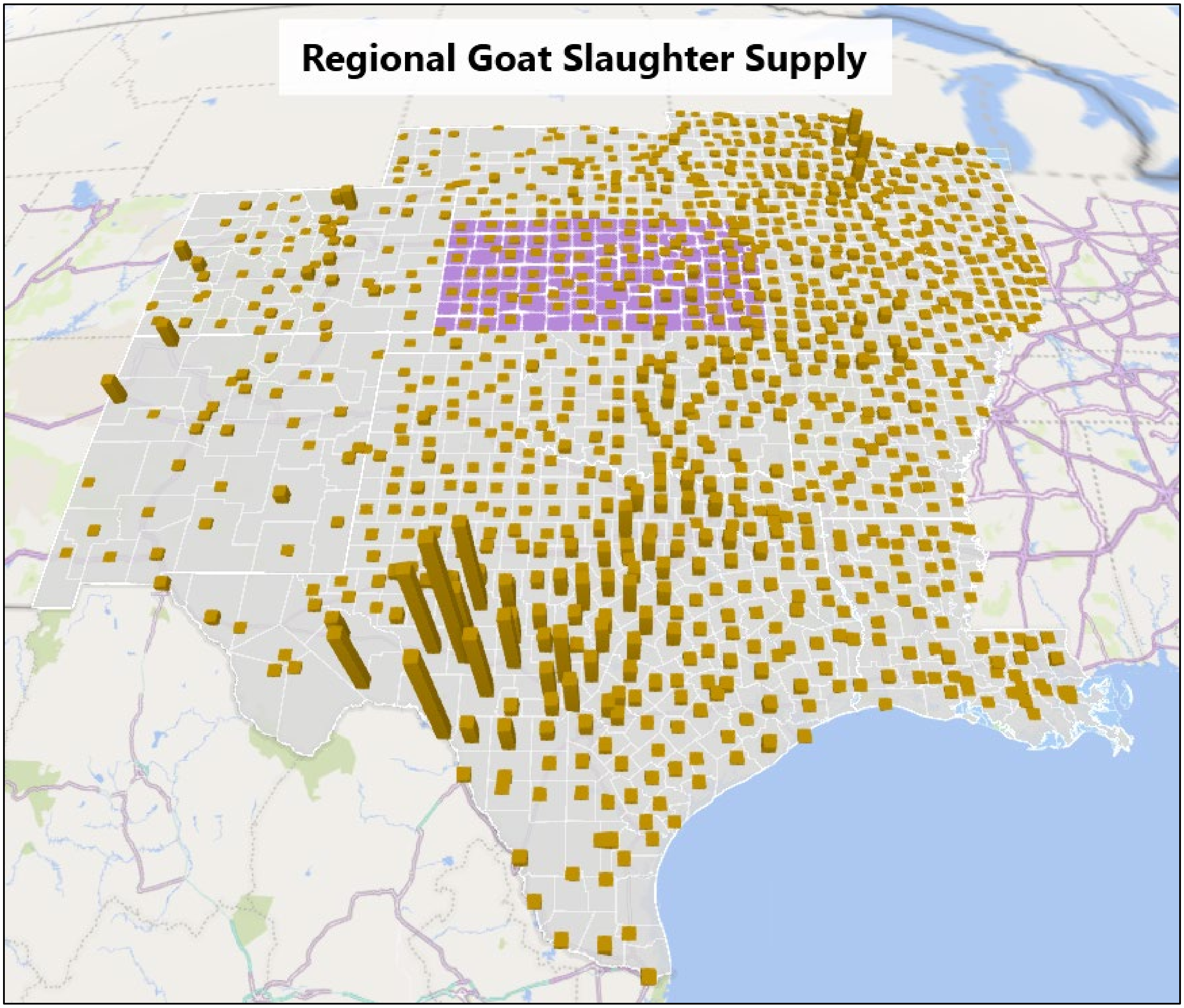
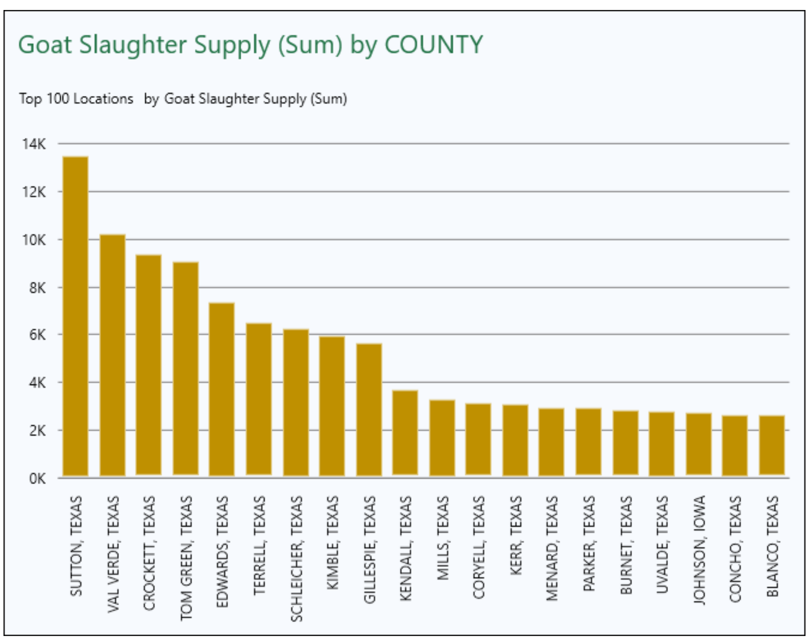

Sheep Slaughter Demand (Sum) by COUNTY
Top 100 Locations by Sheep Slaughter Demand (Sum)
300K
250K
200K
150K
100K
50K
0K
MORGAN, COLORADO
TOM GREEN, TEXAS
DENVER, COLORADO
WELD, COLORADO
STEPHENSON, ILLINOIS
WINNEBAGO, ILLINOIS
MADISON, ILLINOIS
PAYNE, OKLAHOMA
OTTAWA, OKLAHOMA
GRADY, OKLAHOMA
CALCASIEU, LOUISIANA
CLINTON, ILLINOIS

Figure 101. Regional goat slaughter supply





3.3.4.1 Sheep flow

Table 18 shows the summary of state-to-state sheep movement. Of the estimated 31,900 sheep raised in Kansas, 4,800 (15%) remain in Kansas to be slaughtered at small, local processing facilities. Kansas sends sheep to Colorado (1%), Illinois (9%), Oklahoma (2%), and to eastern states outside of the region (72%). Kansas brings in a small number of sheep from Missouri and Oklahoma. Figure 102 shows the counties supplying Kansas sheep demand.

Table 18. Summary of regional sheep movement

Summary of Regional Sheep Movement (head)

	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	600	-	-	-	-	-	-	-	-	300	-	4,200	5,100
CO	-	101,800	-	-	-	-	-	-	400	-	500	81,000	183,700
IA	-	-	2,000	7,800	-	-	-	-	-	-	-	55,300	65,100
IL	-	-	-	21,500	-	-	200	-	-	-	-	1,800	23,500
KS	-	300	-	3,000	4,800	-	-	-	-	700	-	23,100	31,900
LA	-	-	-	-	-	400	-	-	-	-	-	2,100	2,500
MO	-	-	-	8,600	200	-	10,500	-	-	1,600	-	22,200	43,100
NE	-	300	-	1,500	-	-	-	600	-	-	-	31,800	34,200
NM	-	33,800	-	-	-	-	-	-	5,800	-	-	1,500	41,100
OK	-	-	-	400	100	-	-	-	-	12,500	300	9,000	22,300
TX	-	30,400	-	-	-	4,300	-	-	-	200	214,400	68,400	317,700
Out of Region	-	419,200	-	8,600	-	-	-	-	-	-	-	-	427,800
Total	600	585,800	2,000	51,400	5,100	4,700	10,700	600	6,200	15,300	215,200	232,000	1,198,000

Notes: Read down to see where a state gets its sheep. Read across to see where a state's sheep go for slaughter.

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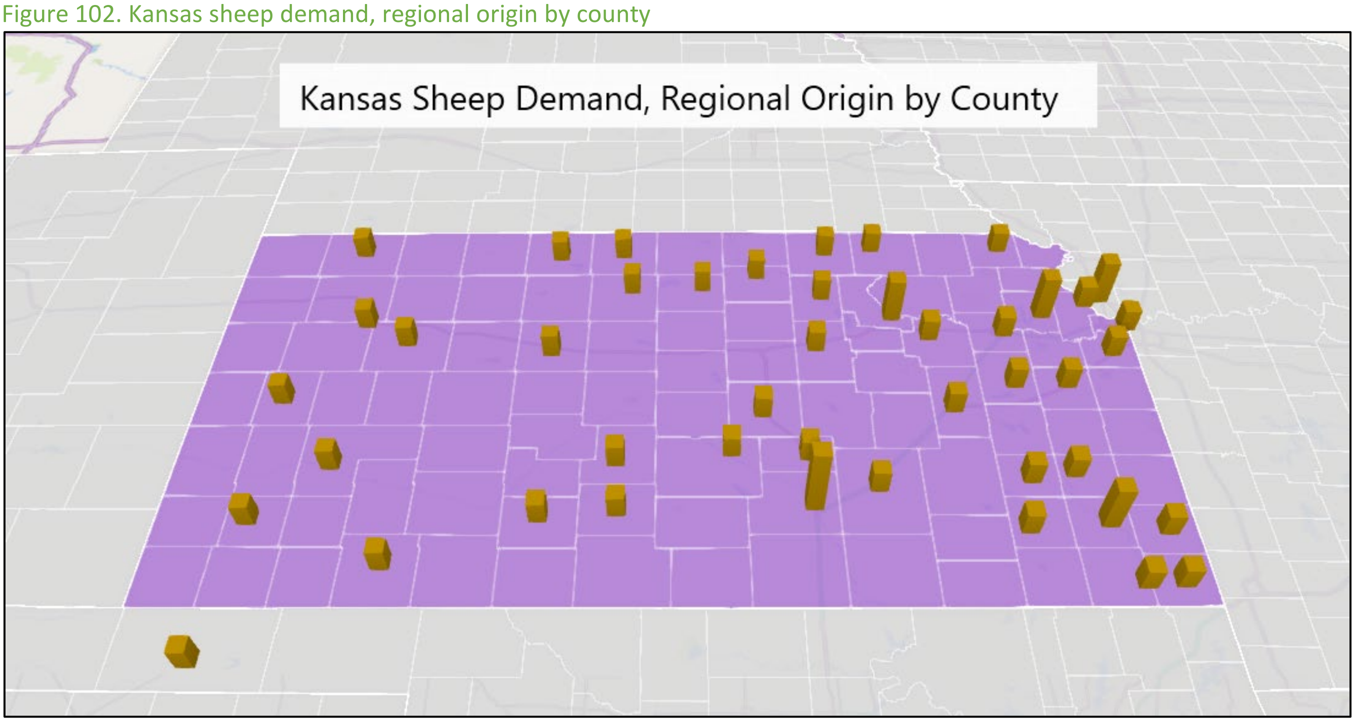
Figure 102. Kansas sheep demand, regional origin by county



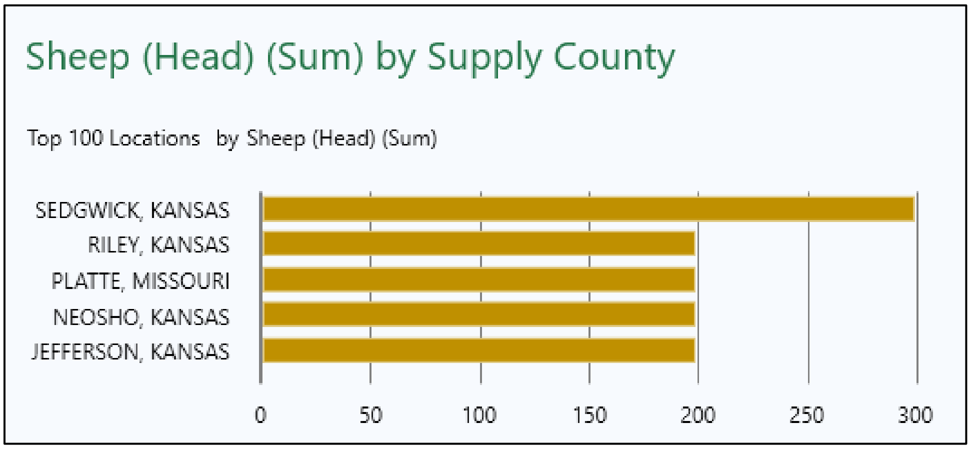
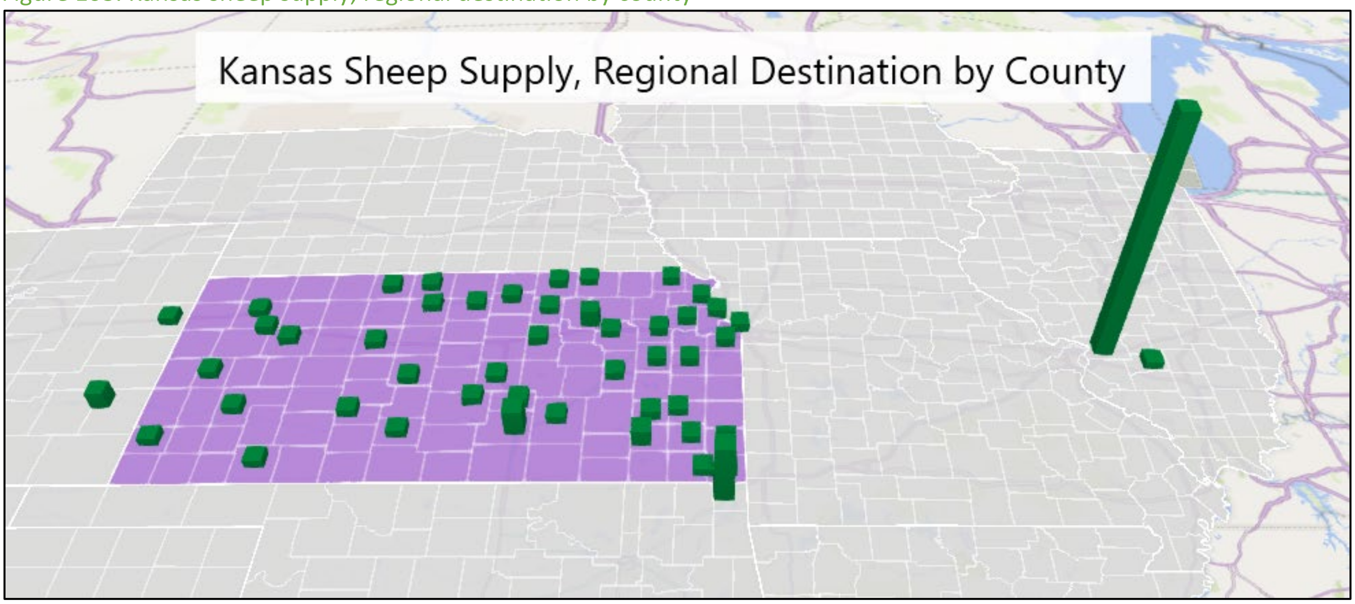
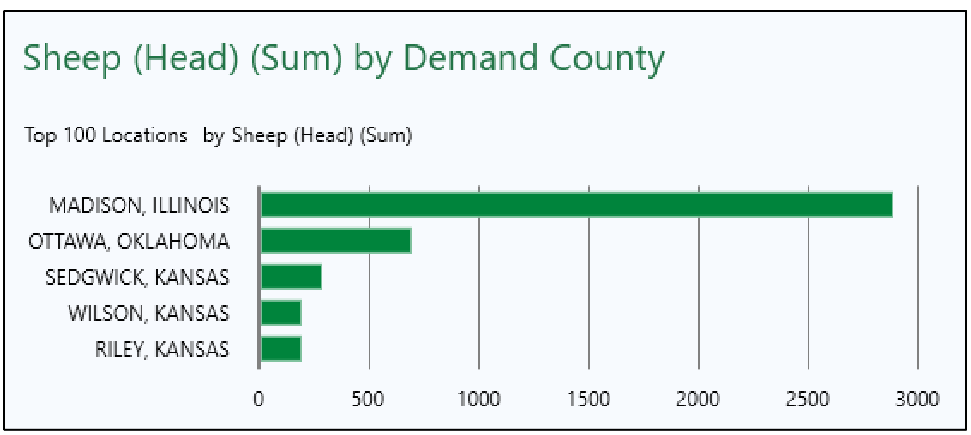


Figure 103 shows the counties receiving sheep from Kansas. The largest destination for Kansas sheep in the region is Madison County, Illinois.

Figure 103. Kansas sheep supply, regional destination by county

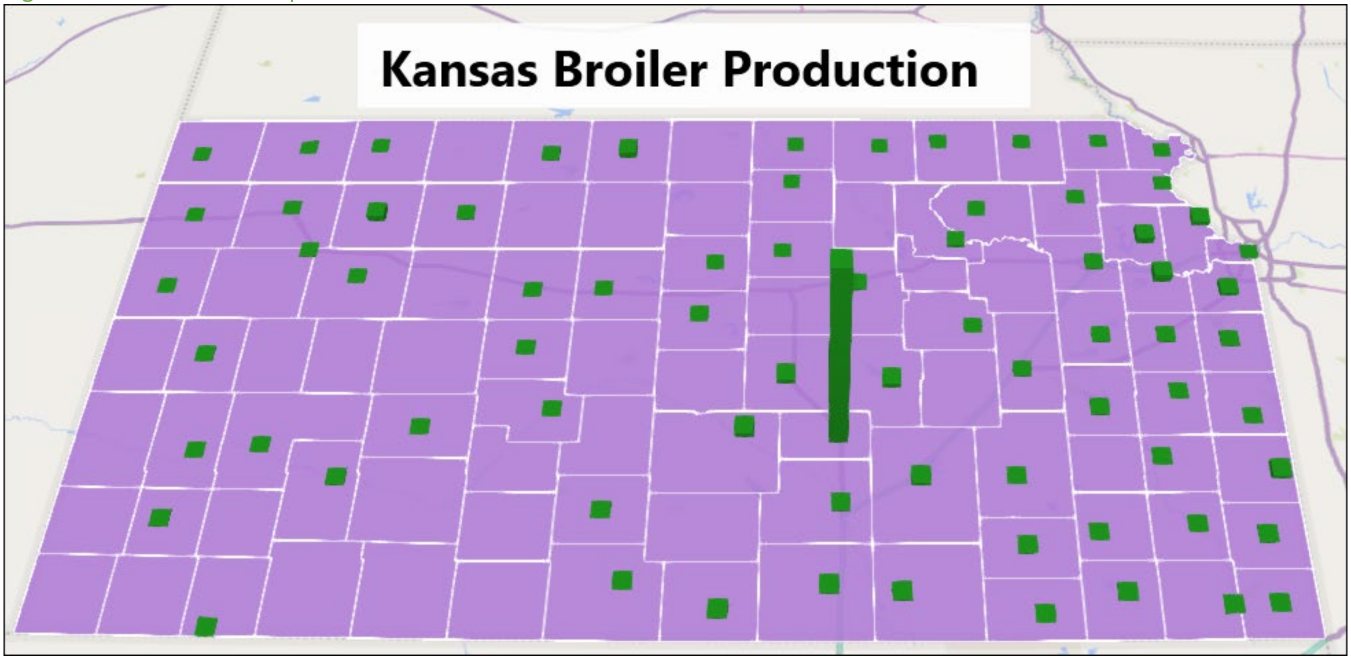


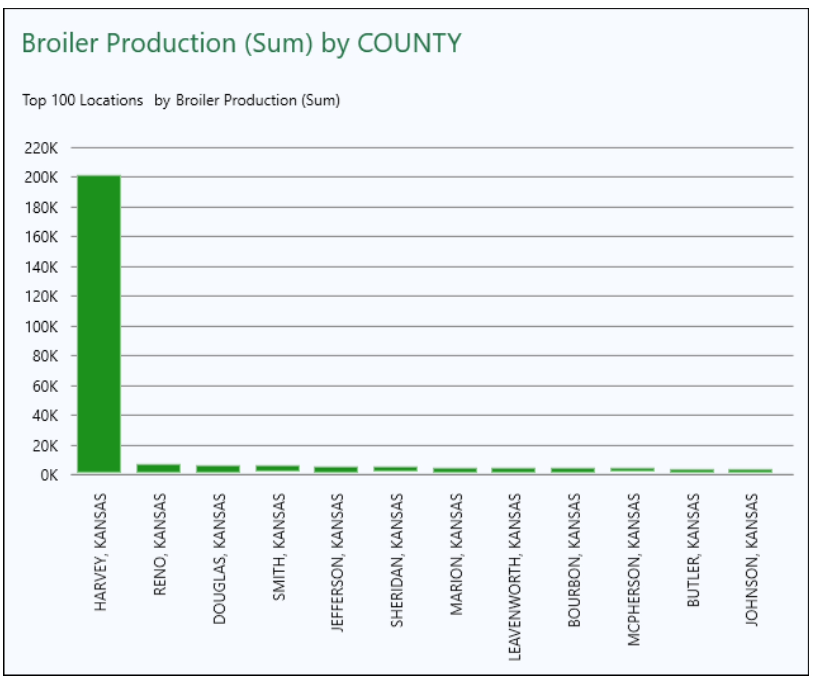


3.3.5 Broilers

An estimated 260,000 broiler chickens were produced in Kansas in 2020. In the 2017 COA, Kansas had 214 farms with broiler inventory and all but 2 had less than 2,000 head. As shown in Figure 104, this production is heavily concentrated in Harvey County which had 67% of broiler inventories in Kansas.

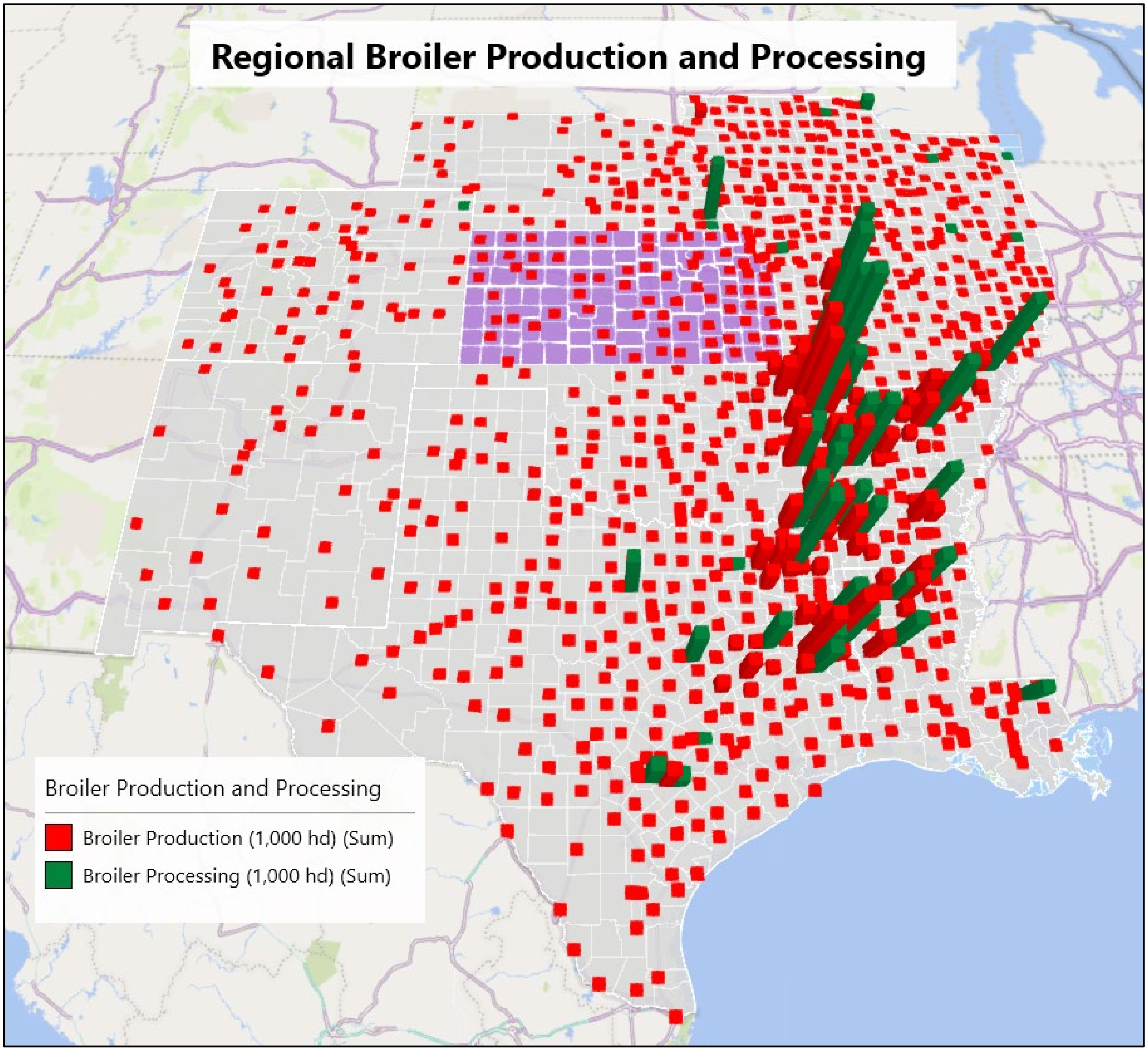
Figure 104. Kansas broiler production

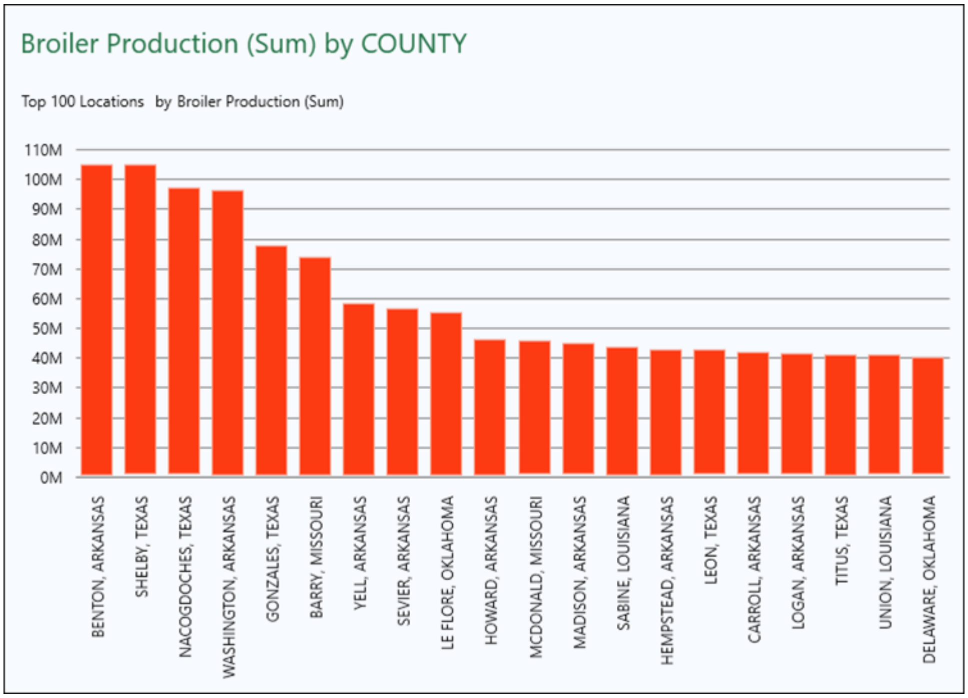


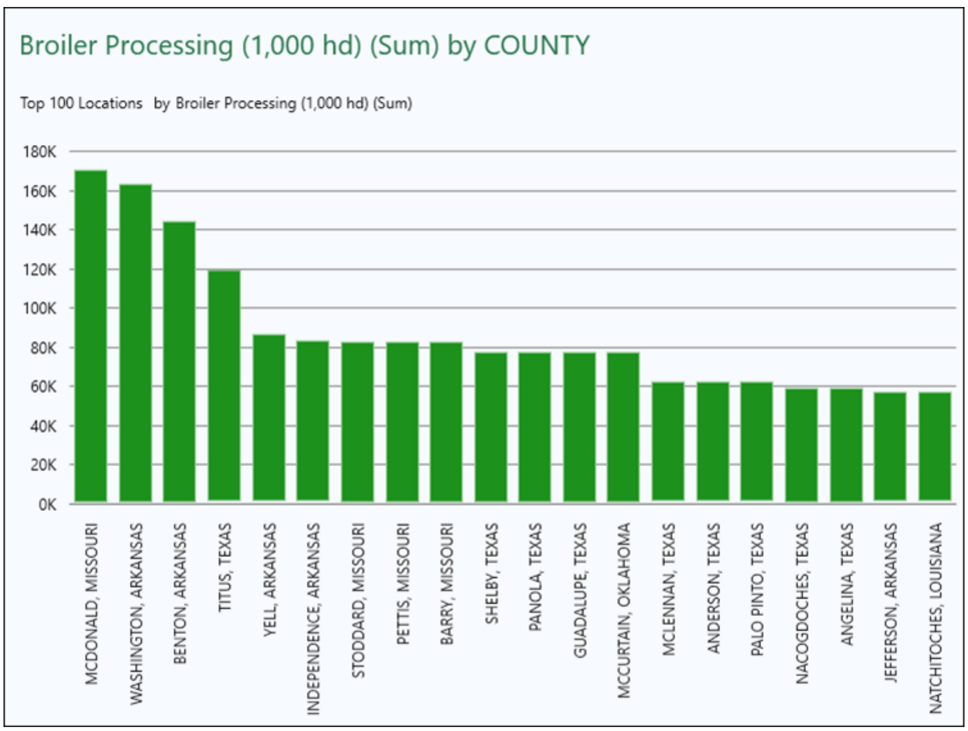


An estimated 20,000 broilers are processed in Kansas annually by small, local processors. Within the 11-state region, an estimated 2.5 billion broilers are processed each year. The states handling the largest portion of processing in the region are Arkansas (991 million), Texas (705 million), and Missouri (421 million) (Figure 105).

Figure 105. Regional broiler production and processing







3.3.5.1 Broiler flow

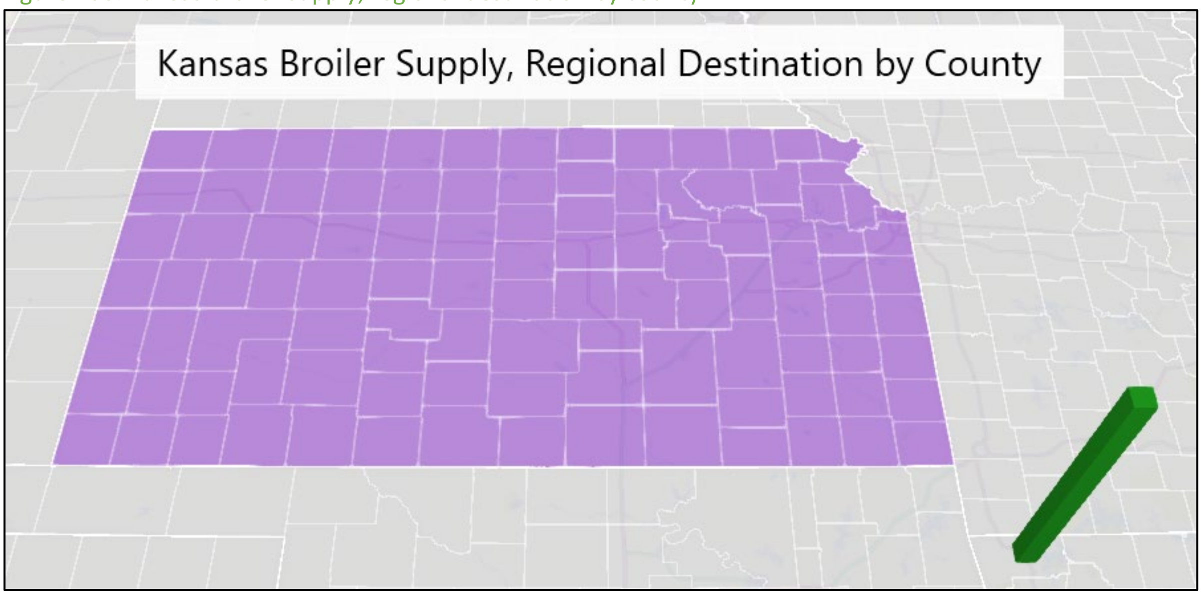
Kansas has no commercial scale broiler processing. The 20,000 head that are estimated to be processed in Kansas is all done at small, local state inspected or exempt facilities. According to the flow analysis, broilers produced commercially in Kansas are likely drawn to the slaughter facility in northwest Arkansas (see Table 19 and Figure 106).

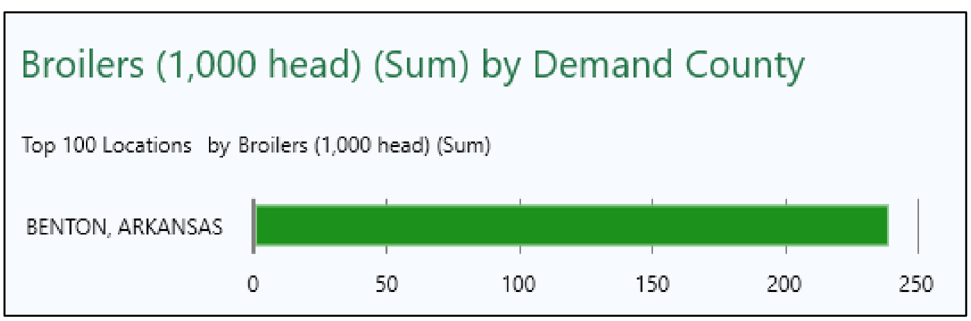
Table 19. Summary of regional broiler movement

Summary of Regional Broiler Movement (1,000 head)													
	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	862,640	-	-	-	-	2,880	113,900	15,000	-	38,140	1,000	14,000	1,047,560
CO	-	580	-	-	-	-	-	-	-	-	-	-	580
IA	-	-	3,320	620	-	-	-	15,680	-	-	-	1,540	21,160
IL	-	-	-	1,010	-	-	-	-	-	-	-	-	1,010
KS	240	-	-	-	20	-	-	-	-	-	-	-	260
LA	-	-	-	-	-	143,300	-	-	-	-	29,000	18,000	190,300
MO	38,290	-	-	660	-	-	243,340	6,150	-	-	-	3,000	291,440
NE	-	430	-	-	-	-	-	6,660	-	-	-	100	7,190
NM	-	-	-	-	-	-	-	-	-	-	-	-	-
OK	89,930	-	-	-	-	-	30,760	3,000	-	79,540	-	-	203,230
TX	1,000	-	-	-	-	3,000	1,000	10,000	-	13,000	673,340	-	701,340
Out of Region	-	-	7,000	1,510	-	28,210	32,000	-	-	-	-		68,720
Total	992,100	1,010	10,320	3,800	20	177,390	421,000	56,490	-	130,680	703,340	36,640	2,532,790

Notes: Read down to see where a state gets its broilers. Read across to see where a state's broilers go for slaughter.

Figure 106. Kansas broiler supply, regional destination by county

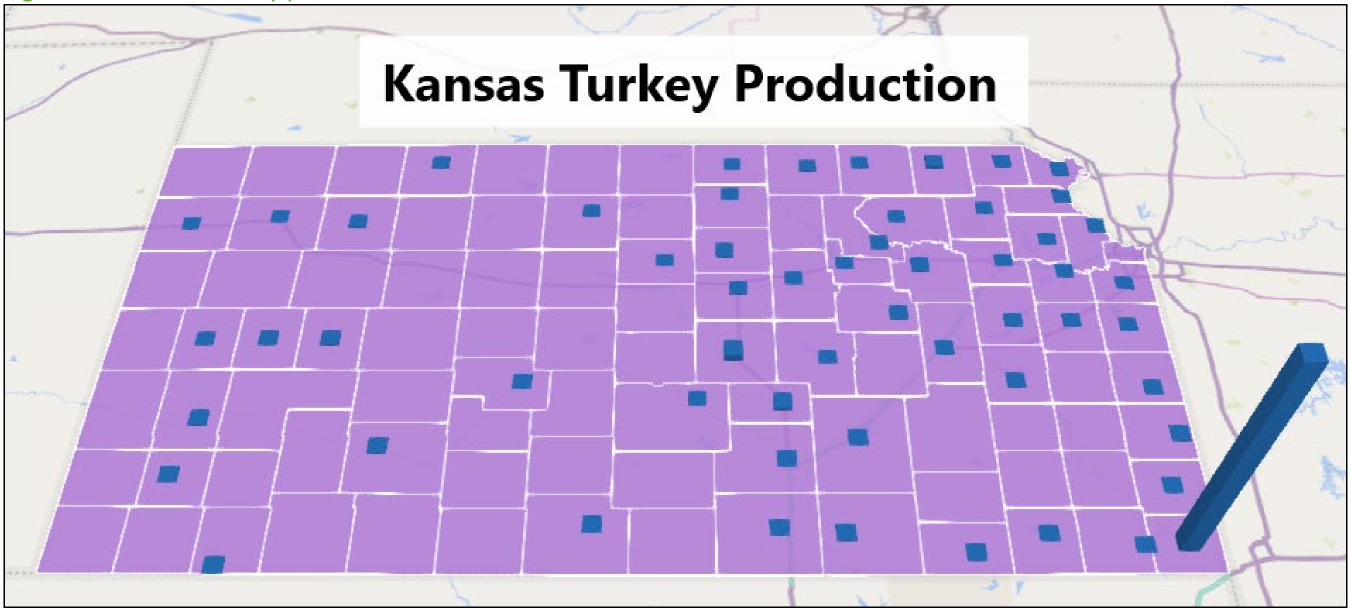


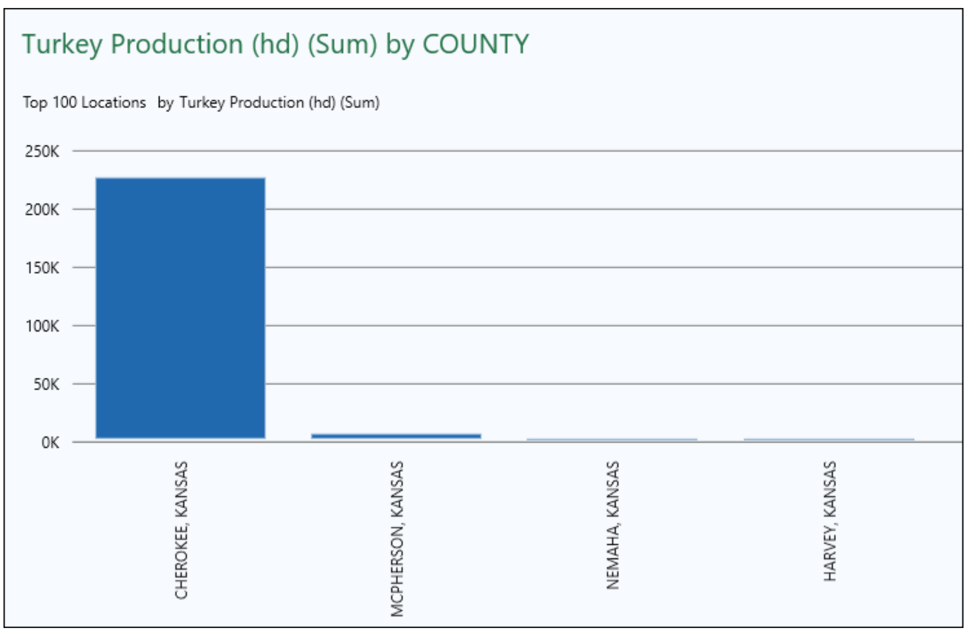


3.3.6 Turkeys

Kansas produced an estimated 264,000 turkeys in 2020. In the 2017 COA, Kansas had 280 farms with turkey inventory and 77 farms listed with sales of turkeys. This production is heavily concentrated in Cherokee County in southeast Kansas which in 2017 had 86% of the turkey inventory and 89% of turkeys sold in Kansas, as shown in Figure 107.

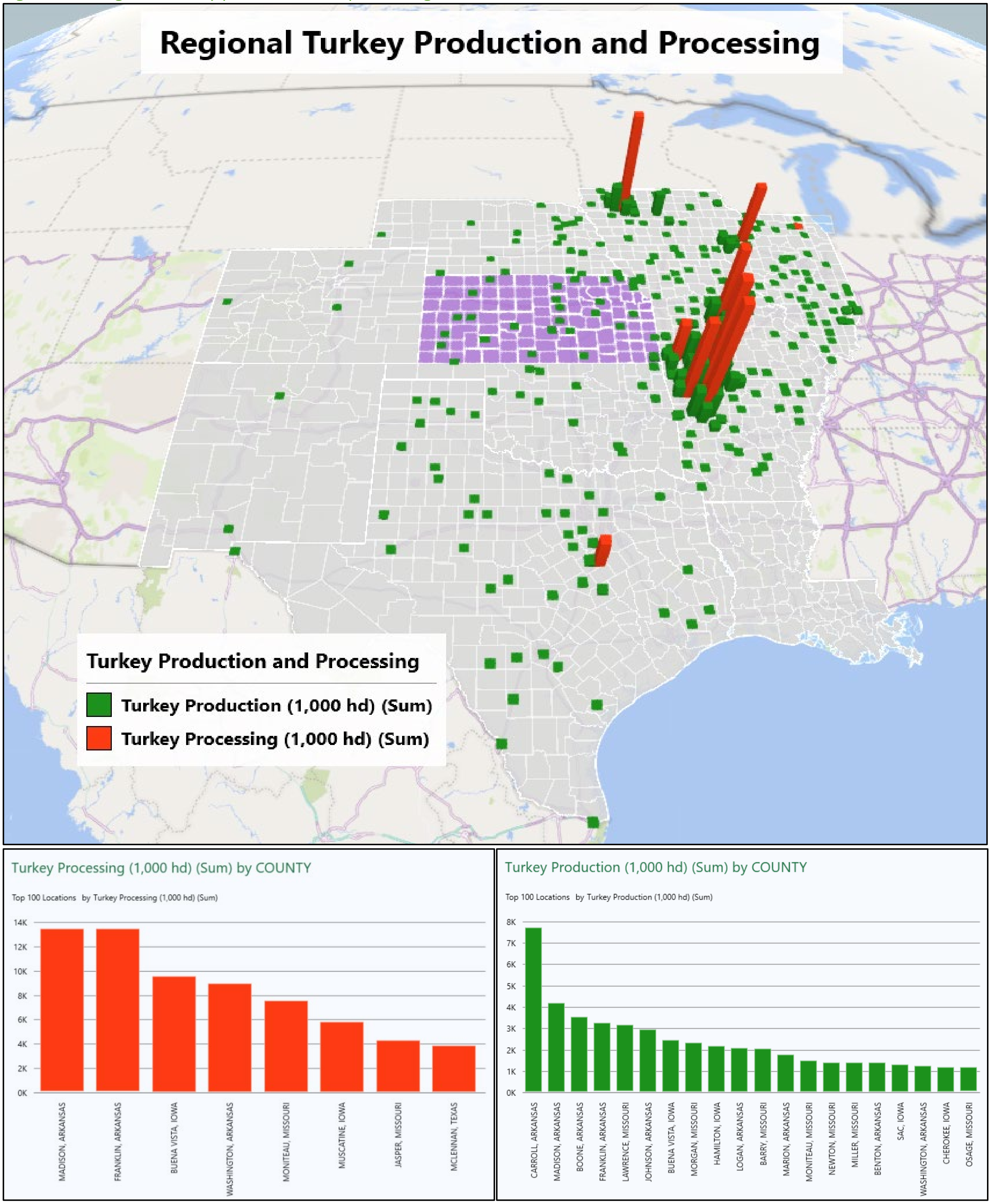
Figure 107. Kansas turkey production





In the 11-state region, turkey processing is largely located in Arkansas (35.8 million head), Iowa (15.4 million head), and Missouri (10.6 million head); turkey production is typically located in close proximity to a large processing facility. The closest turkey slaughter facility to Kansas is in Jasper County, Missouri (Figure 108).

Figure 108. Regional turkey production and processing



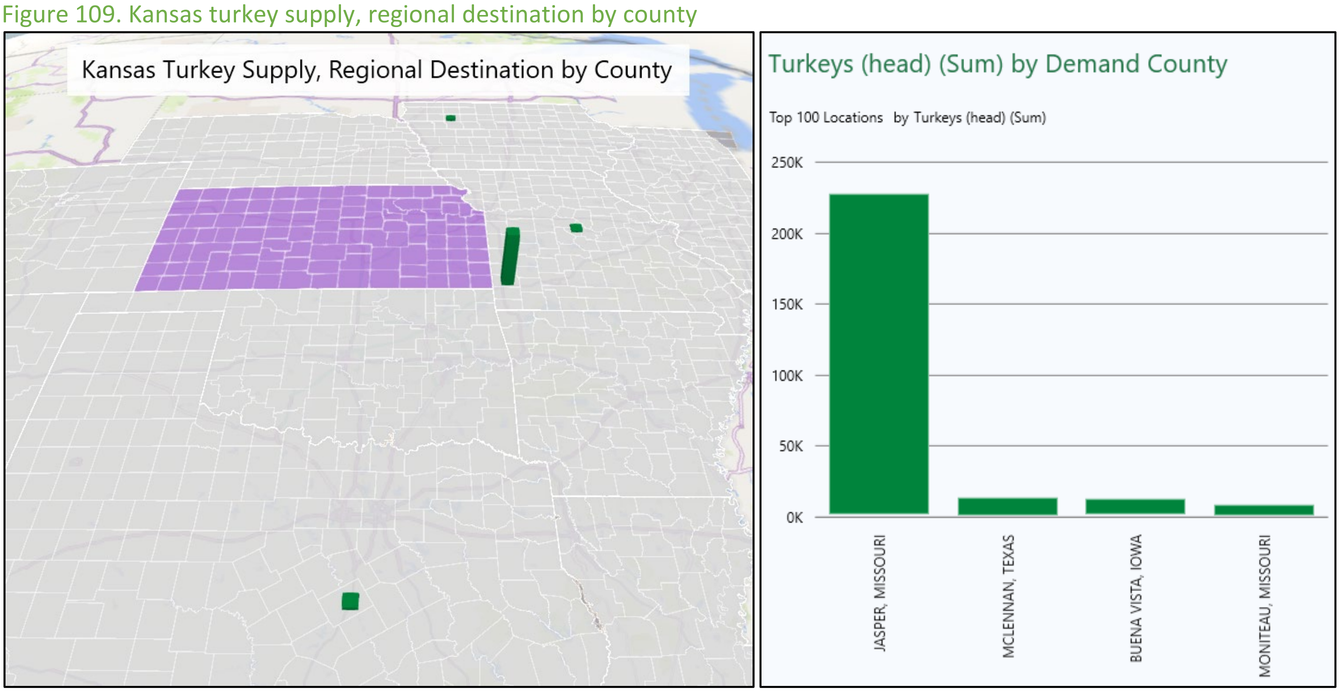
3.3.6.1 Turkey flow

As there is no commercial turkey slaughter in Kansas, all commercial turkey production in Kansas ultimately leaves the state for slaughter. The largest portion of Kansas turkeys (90%) are processed in Missouri, with nearly all going to the facility in Jasper County. The remaining supply goes to either Texas or Iowa for slaughter (Table 20 and Figure 109). There is some very small-scale slaughter/processing of turkeys within Kansas, but no specific data on location or capacity of such processors was found for this study[10].

Table 20. Summary of regional turkey movement

Summary of Regional Turkey Movement (1,000 head)													
	AR	CO	IA	IL	KS	LA	MO	NE	NM	OK	TX	Out of Region	Total
AR	19,941	-	2,737	-	-	-	5,342	-	-	-	1,213	1,768	31,001
CO	-	-	1	-	-	-	-	-	-	-	2	-	3
IA	-	-	11,253	-	-	-	12	-	-	-	-	427	11,692
IL	-	-	86	3	-	-	8	-	-	-	-	1,036	1,133
KS	-	-	13	-	-	-	237	-	-	-	14	-	264
LA	-	-	-	-	-	-	-	-	-	-	-	-	-
MO	581	-	25	-	-	-	16,383	-	-	-	-	2	16,991
NE	-	-	489	-	-	-	-	-	-	-	-	71	560
NM	-	-	-	-	-	-	-	-	-	-	11	-	11
OK	58	-	-	-	-	-	78	-	-	-	155	-	291
TX	-	-	-	-	-	-	-	-	-	-	1,802	-	1,802
Out of Region	4	-	2,372	2	-	-	4	-	-	-	1,106	-	3,488
Total	20,584	-	16,976	5	-	-	22,064	-	-	-	4,303	3,304	67,236
Notes: Read down to see where a state gets its turkeys. Read across to see where a state's turkeys go for slaughter. Decision Innovation Solutions													

Figure 109. Kansas turkey supply, regional destination by county

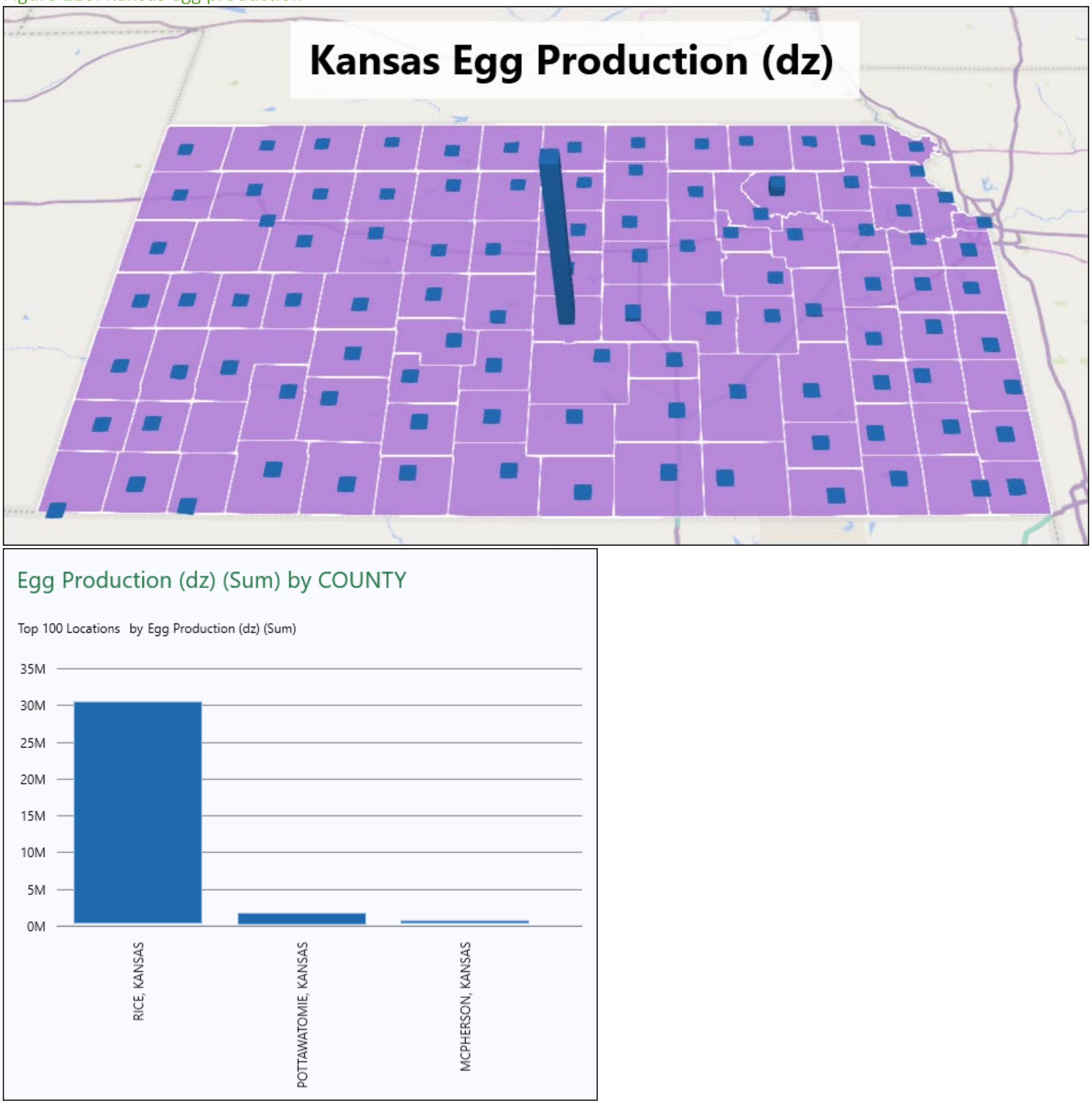


[10] A web search revealed 5 firms that advertise some level of custom processing or farm-raised processing of turkey, but no specific quantities were able to be determined.

3.3.7 Layers

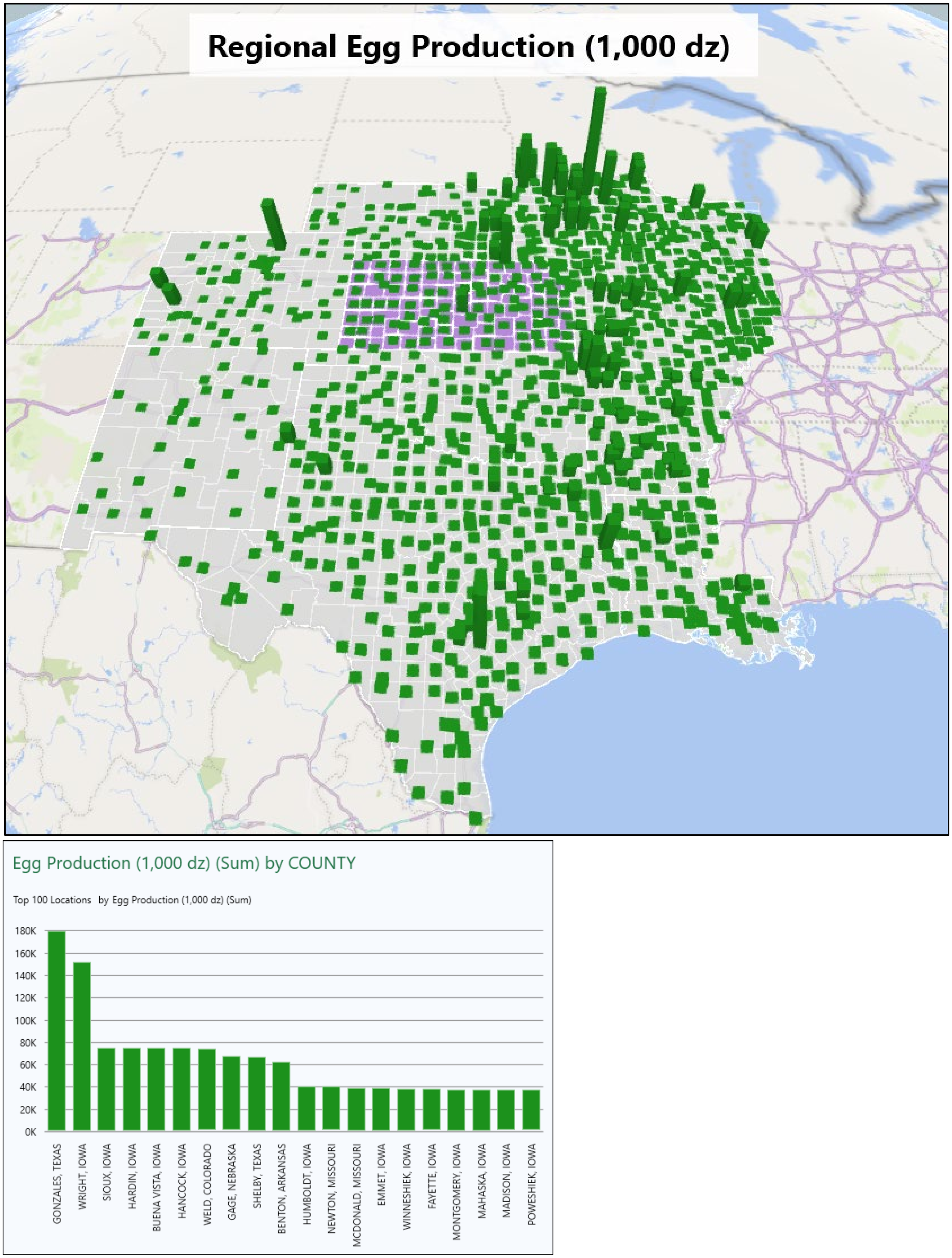
In 2020, Kansas had an estimated 1.5 million layers producing 35.7 million dozen eggs. Layers are included in this report because they contribute to overall feed demand. No analysis of egg demand or flow was conducted as a part of this project. Kansas has one county with significant egg production and small farm-flocks in all other counties in Kansas (Figure 110).

Figure 110. Kansas egg production



Regional egg production is greatest in Iowa (see Figure 111).

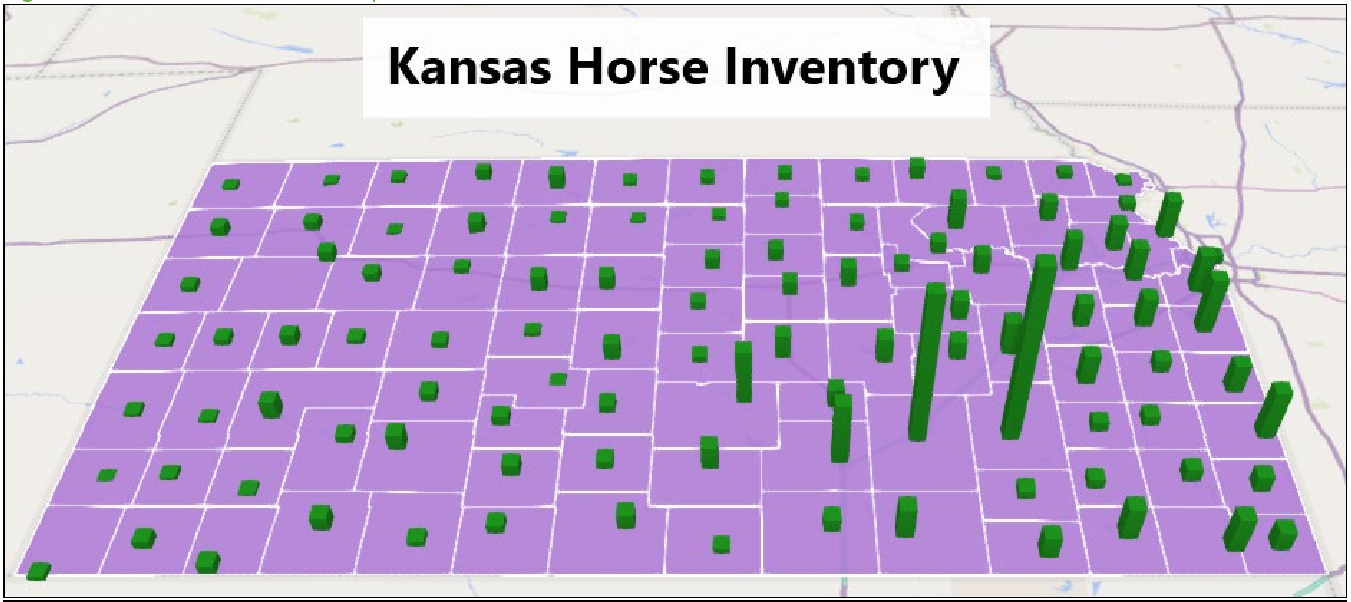
Figure 111. Regional egg production

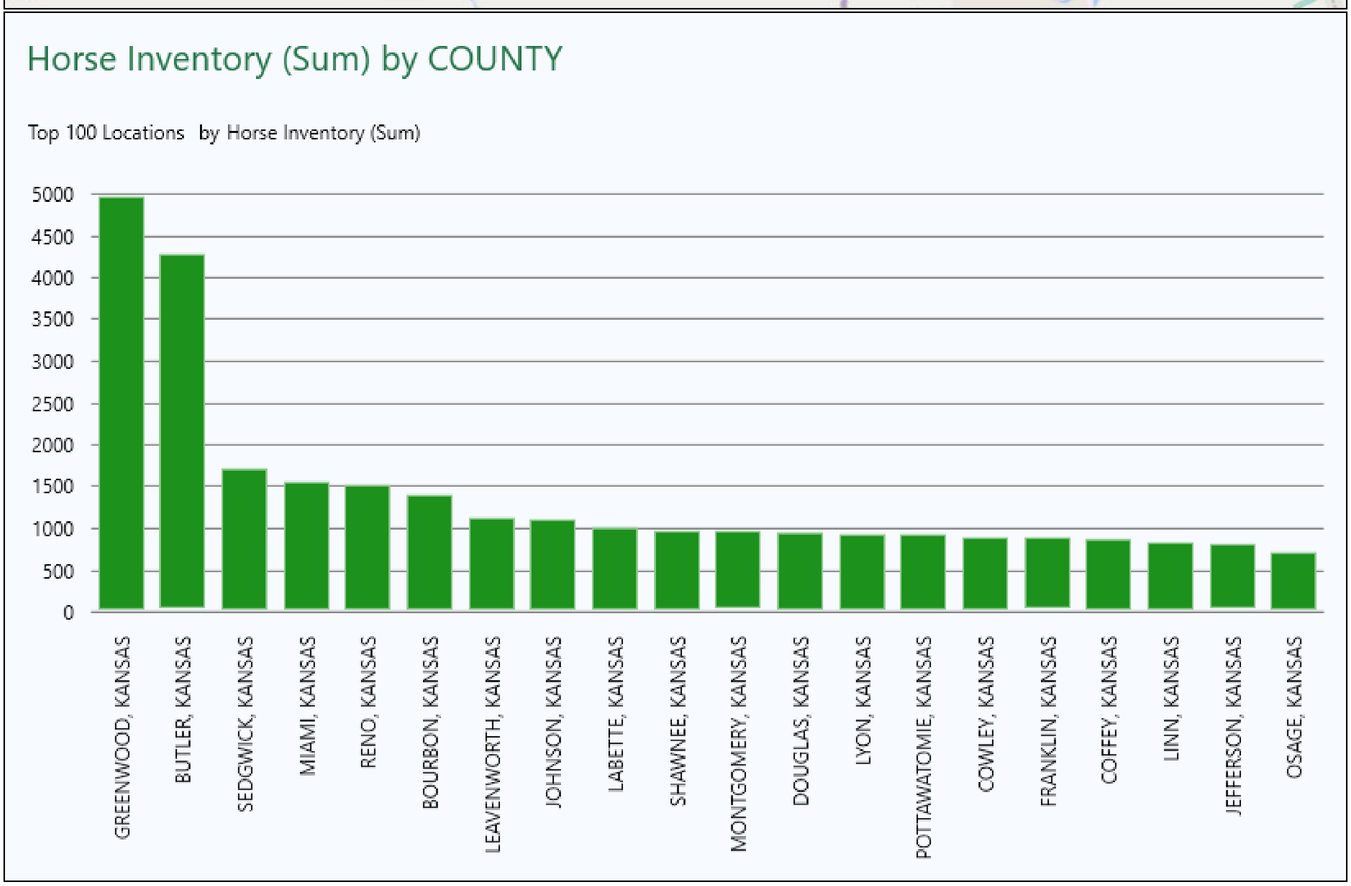


3.3.8 Horses

Kansas had an inventory of 53,400 horses according to the 2017 Census of Agriculture. Horse inventory is included in this report because it contributes to overall feed demand (Figure 112).

Figure 112. Kansas horse inventory



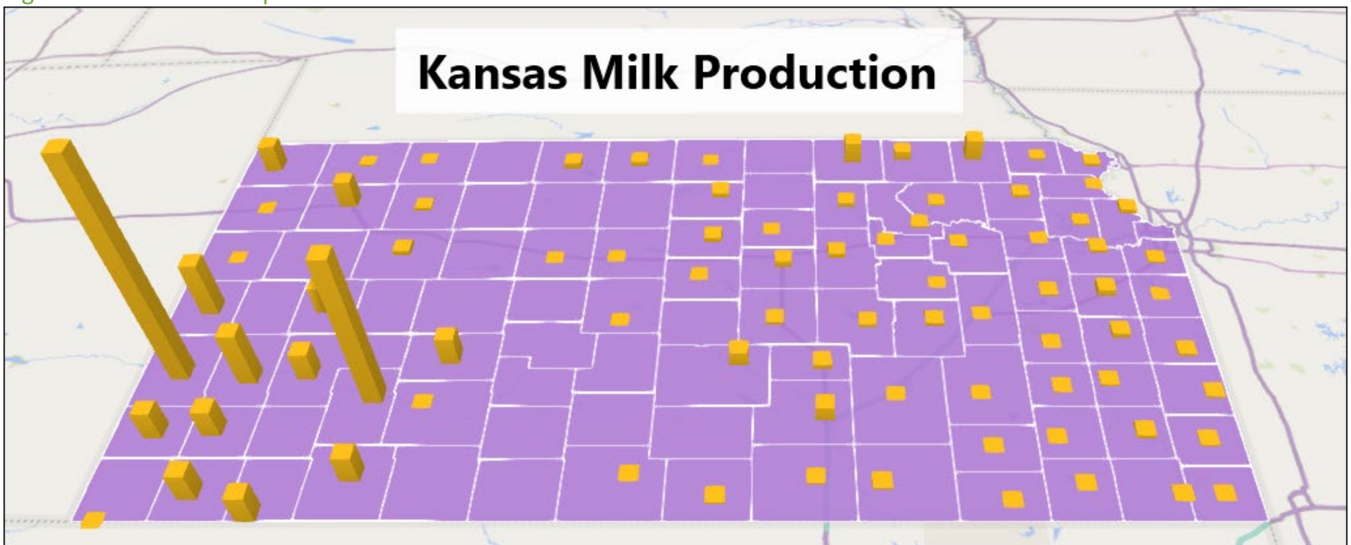


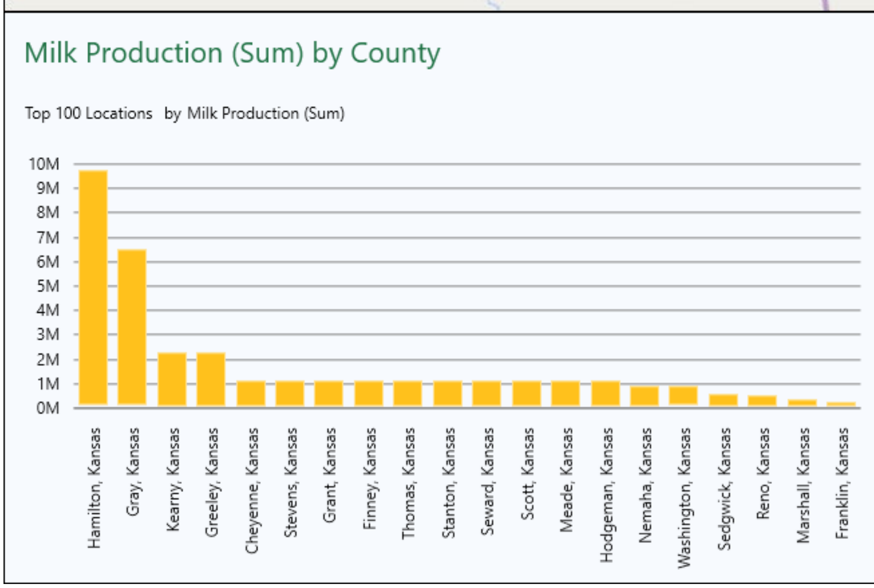
3.4 Milk

3.4.1 Milk supply and demand

Kansas produced 40.3 million hundredweights of milk in 2020. Milk production in Kansas is concentrated in southwestern Kansas (Figure 113). The leading counties for Kansas milk production are Hamilton, Gray, Greeley, Kearney, and Cheyenne.

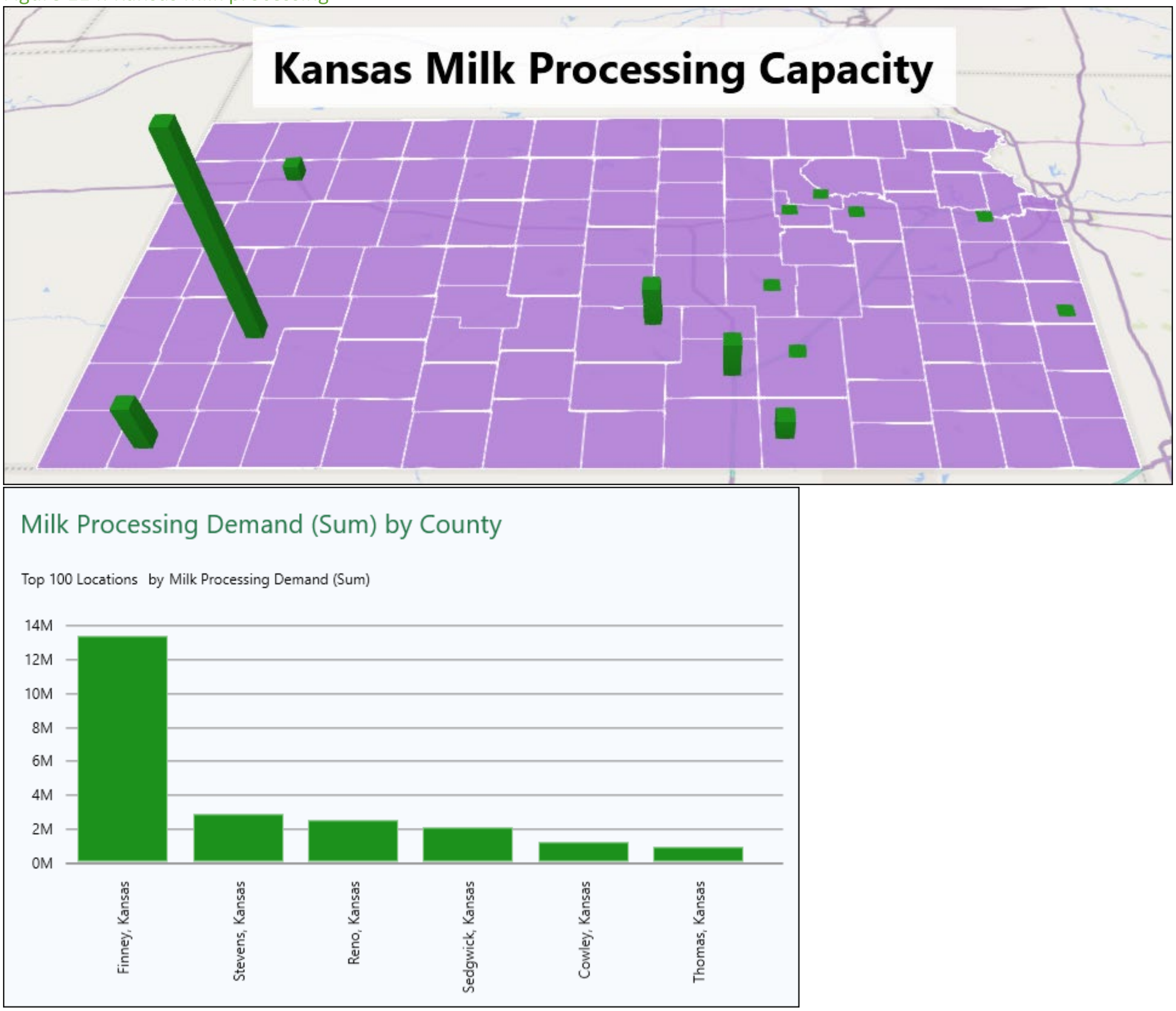
Figure 113. Kansas milk production





Kansas has 13 firms located in 13 counties receiving and/or processing 23.4 million hundredweight of milk. Seven of the processors are small processors and/or on-farm processors. There is one facility processing more than 13 million hundredweight of milk and 3 other facilities that process between 2 million to 3 million hundredweight of milk on an annual basis (Figure 114).

Figure 114. Kansas milk processing



The five largest milk processors all need to secure milk supplies from multiple counties (Figure 115 and Figure 116).

Figure 115. Kansas milk production and processing

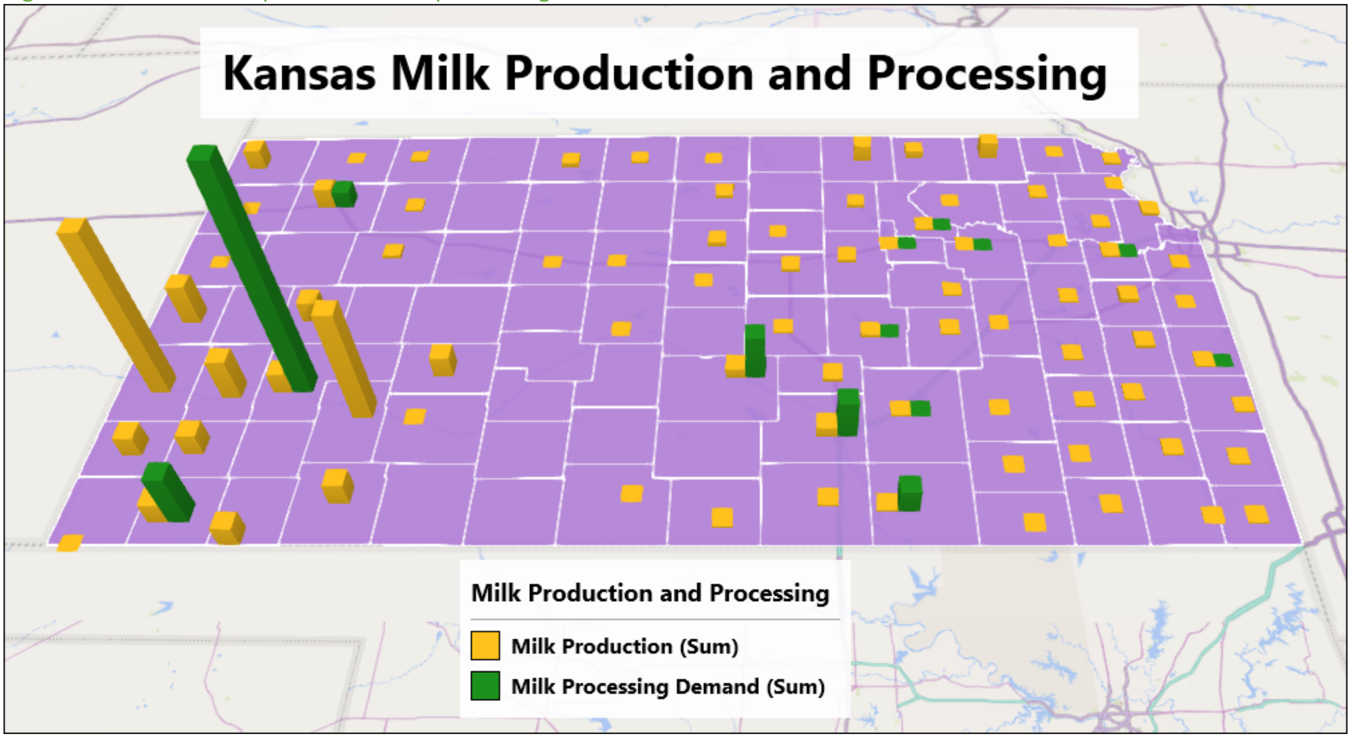
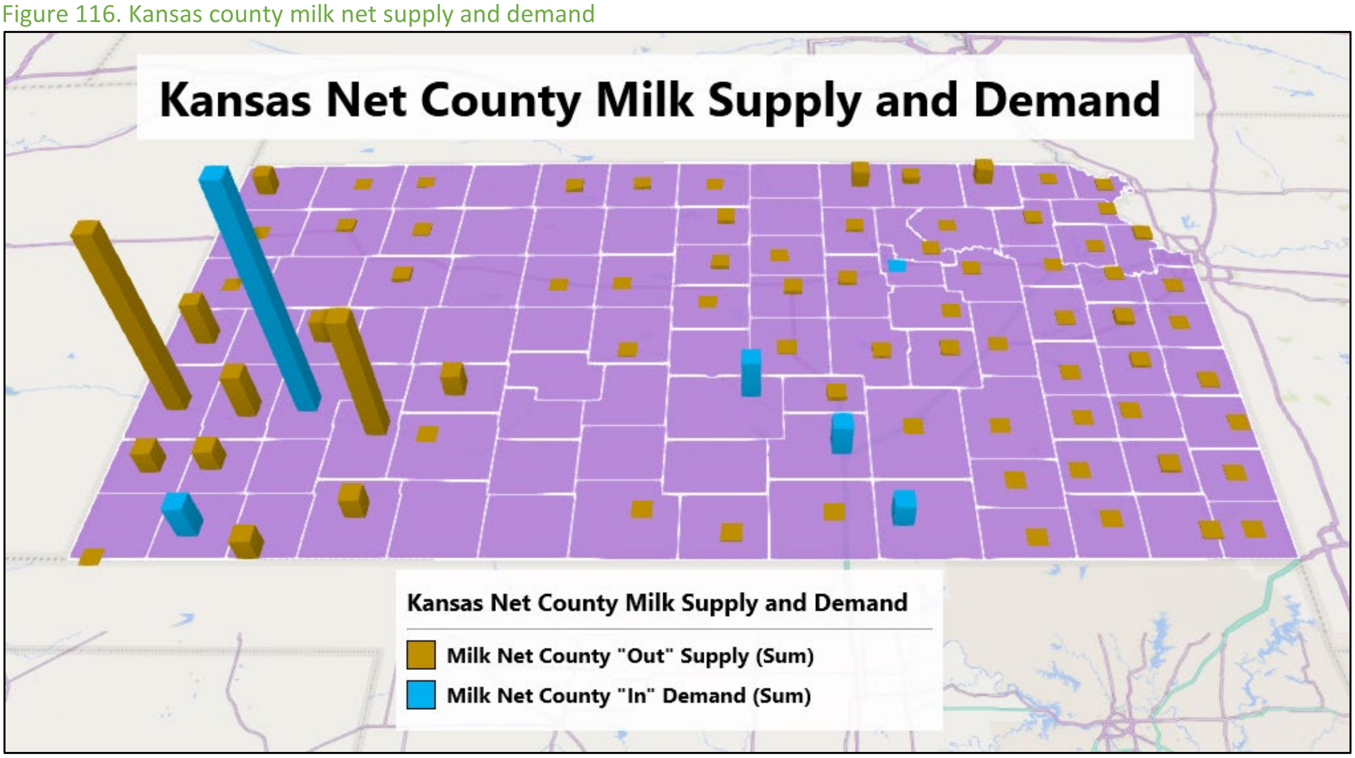
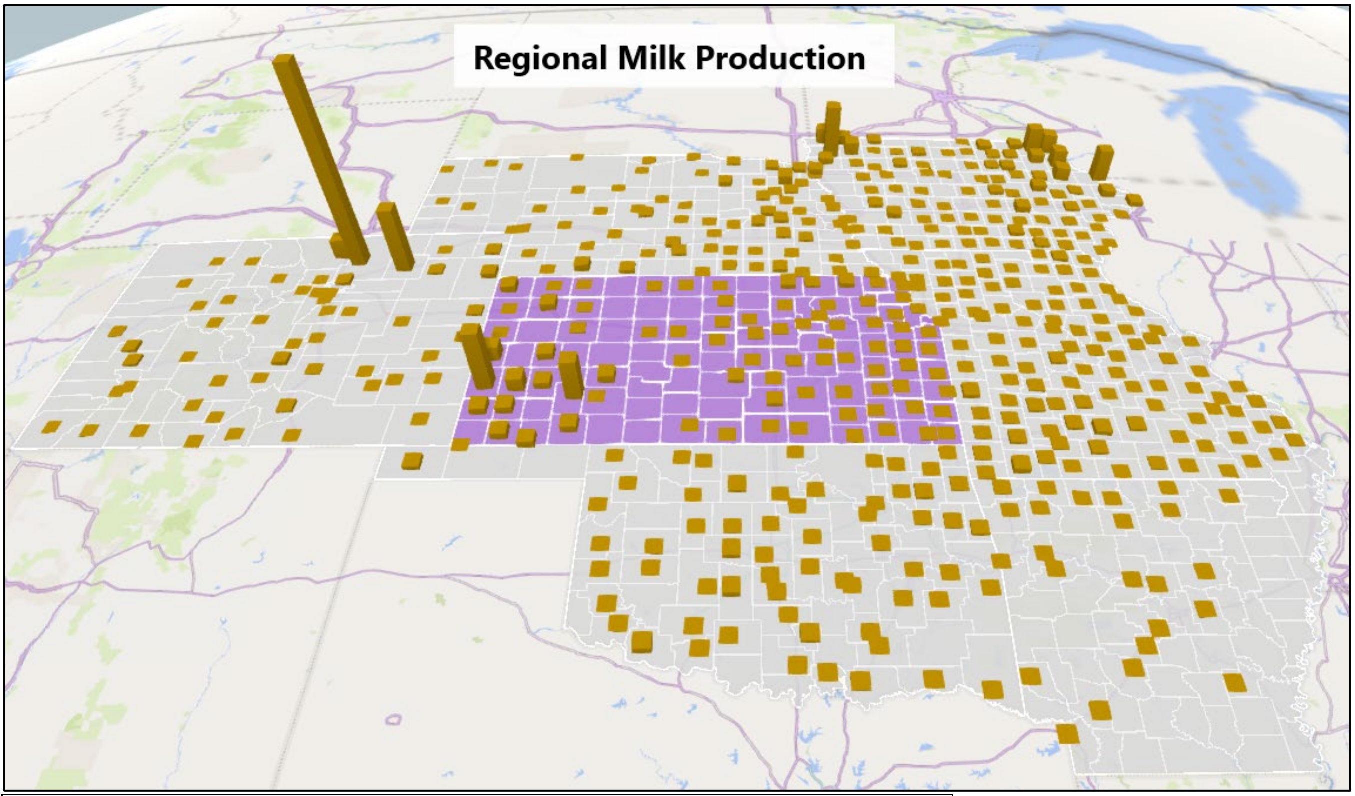


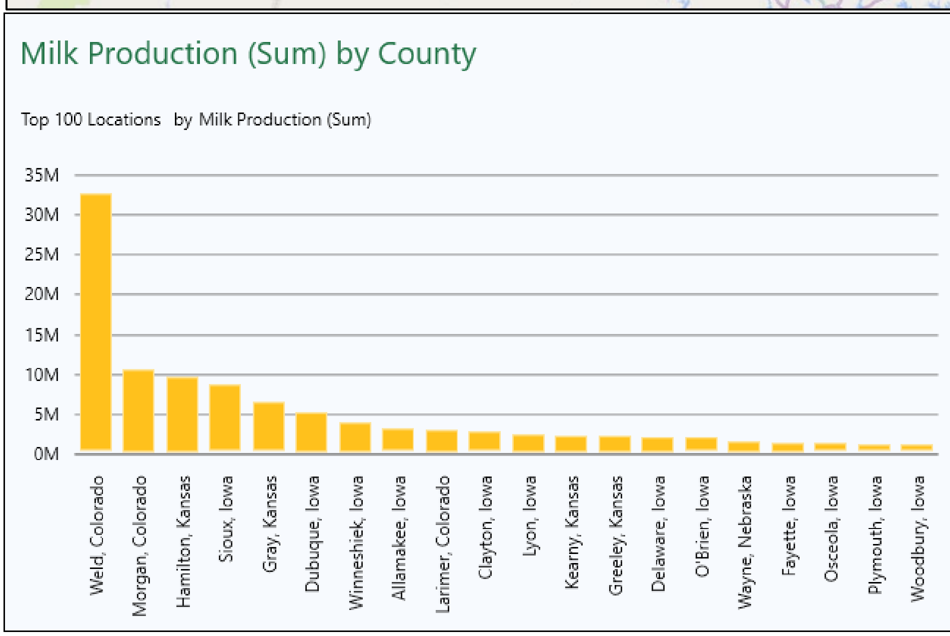
Figure 116. Kansas county milk net supply and demand



For milk, a 7-state region (AR, CO, IA, KS, MO, NE, OK) was used for the milk flow. Regionally, the states that produce the most milk are Iowa (53.7 million cwt), Colorado (51.5 million cwt), and Kansas (40.3 million cwt) (Figure 117). Milk flow was modeled from counties of production to counties with demand points. It does not follow the federal milk marketing orders.

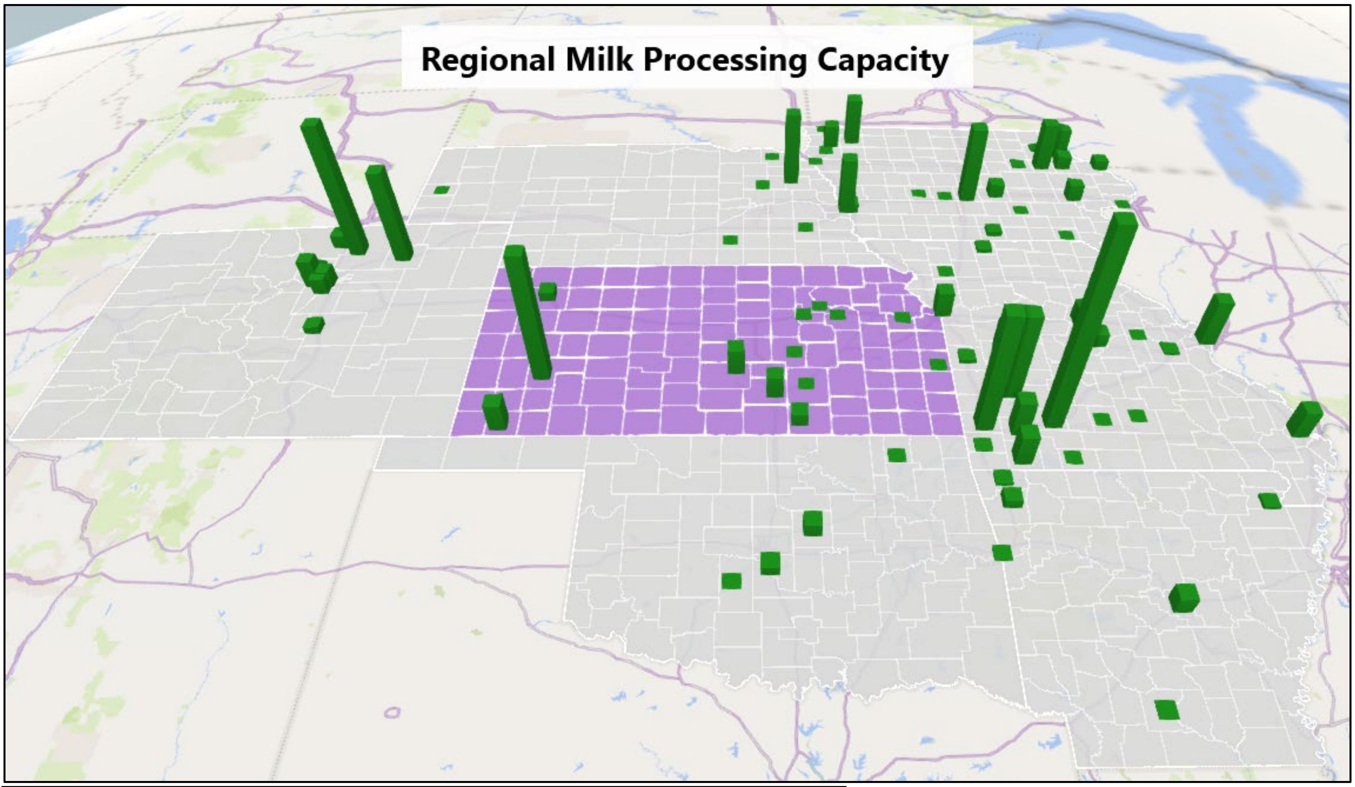
Figure 117. Regional milk production





Regionally, the top milk processing states are Missouri (74.2 million cwt), Colorado (33.1 million cwt), Iowa (31.1 million cwt), and Kansas (23.4 million cwt) (Figure 118 and Figure 119).

Figure 118. Regional milk processing



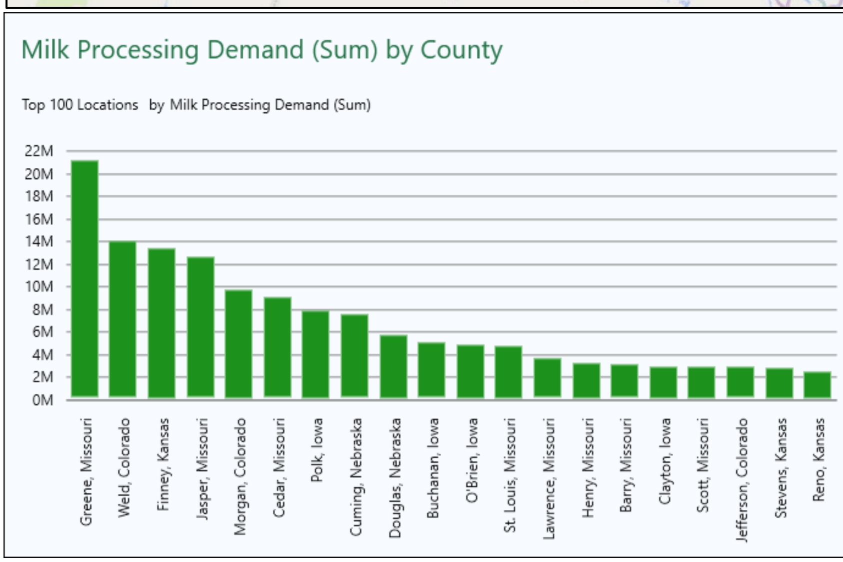
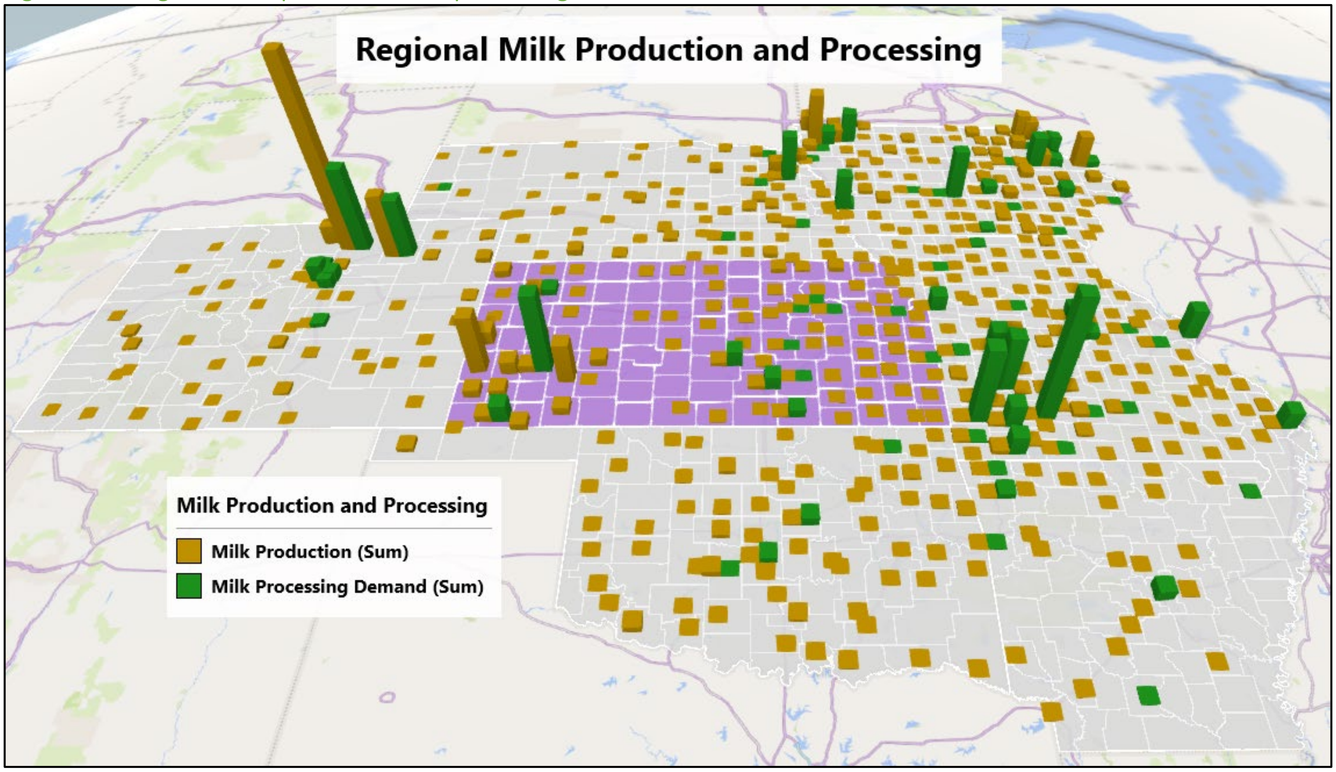
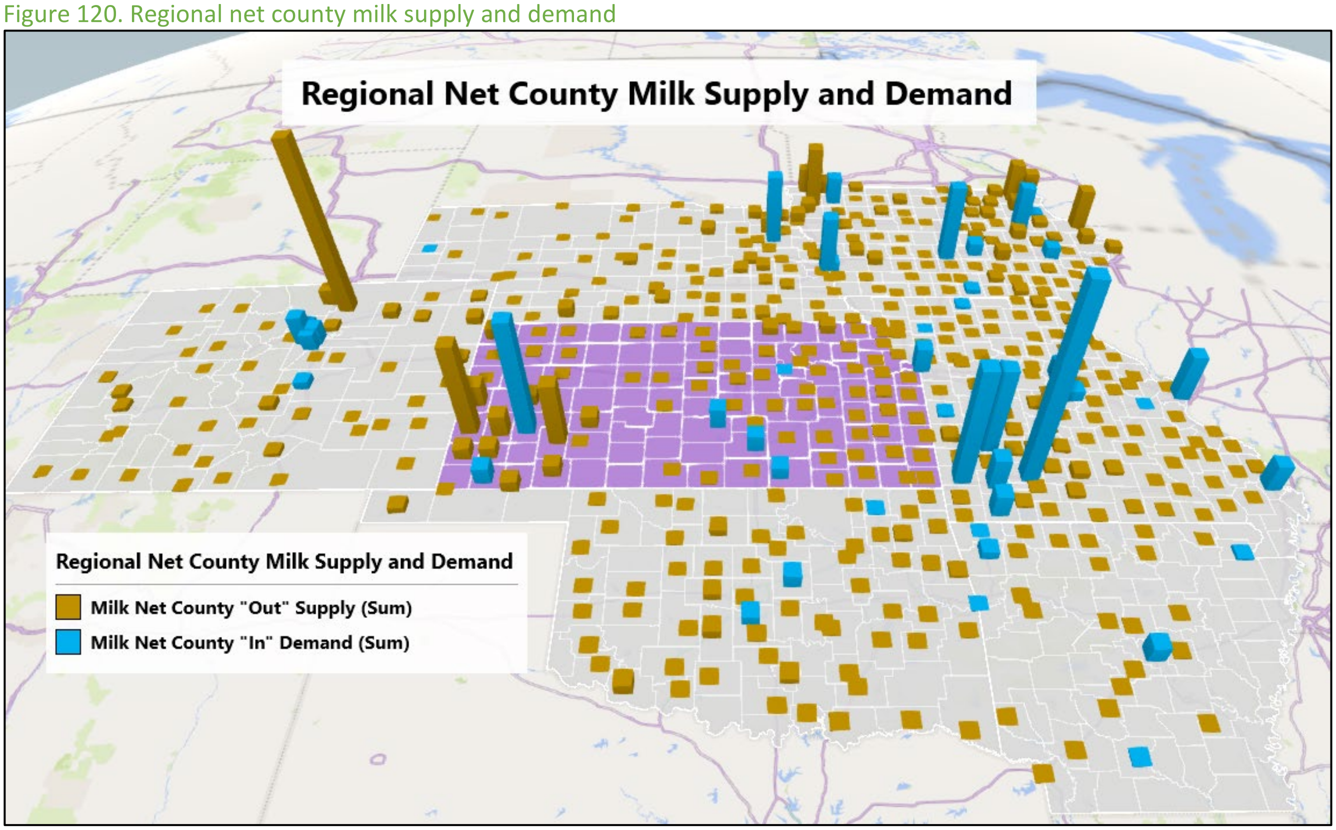


Figure 119. Regional milk production and processing



Areas within the region with net milk supply are in northeast Colorado, southwestern Kansas, and northeastern Iowa (Figure 120). Areas within the region with net milk demand are southwestern Missouri around Springfield, MO, the Kansas City metro area, the St. Louis, MO metro area, several areas in Iowa (Polk, Buchanan, O'Brien, Jasper, and Johnson counties), and two counties in Nebraska (Cuming and Douglas counties).

Figure 120. Regional net county milk supply and demand



3.4.1.1 Milk flow

Kansas supplies almost all (98%) of its own milk for processors. Kansas milk processors receive a small amount of milk from Oklahoma, Nebraska, and Colorado. A majority (57%) of the milk produced in Kansas is used for processing within Kansas, and the remaining supply is sent to Missouri (40%) and Colorado (3%), with very small amounts also being sent to Nebraska and Iowa[11] (Table 21).

Table 21. Summary of regional milk movement

Summary of Regional Milk Movement (cwt)

	AR	CO	IA	KS	MO	NE	OK	Total
AR	620,000	-	-	-	20,000	-	-	640,000
CO	-	30,542,000	4,378,000	4,000	-	232,000	-	35,156,000
IA	-	-	26,308,000	-	5,418,000	4,068,000	-	35,794,000
KS	-	1,254,000	2,000	22,864,000	16,054,000	2,000	-	40,176,000
MO	924,000	-	-	-	9,818,000	-	-	10,742,000
NE	-	58,000	386,000	178,000	2,732,000	9,638,000	-	12,992,000
OK	1,072,000	-	-	372,000	2,148,000	-	2,488,000	6,080,000
Total	2,616,000	31,854,000	31,074,000	23,418,000	36,190,000	13,940,000	2,488,000	141,580,000

Notes: Read down to see where a state gets its milk. Read across to see where a state's milk goes for processing.

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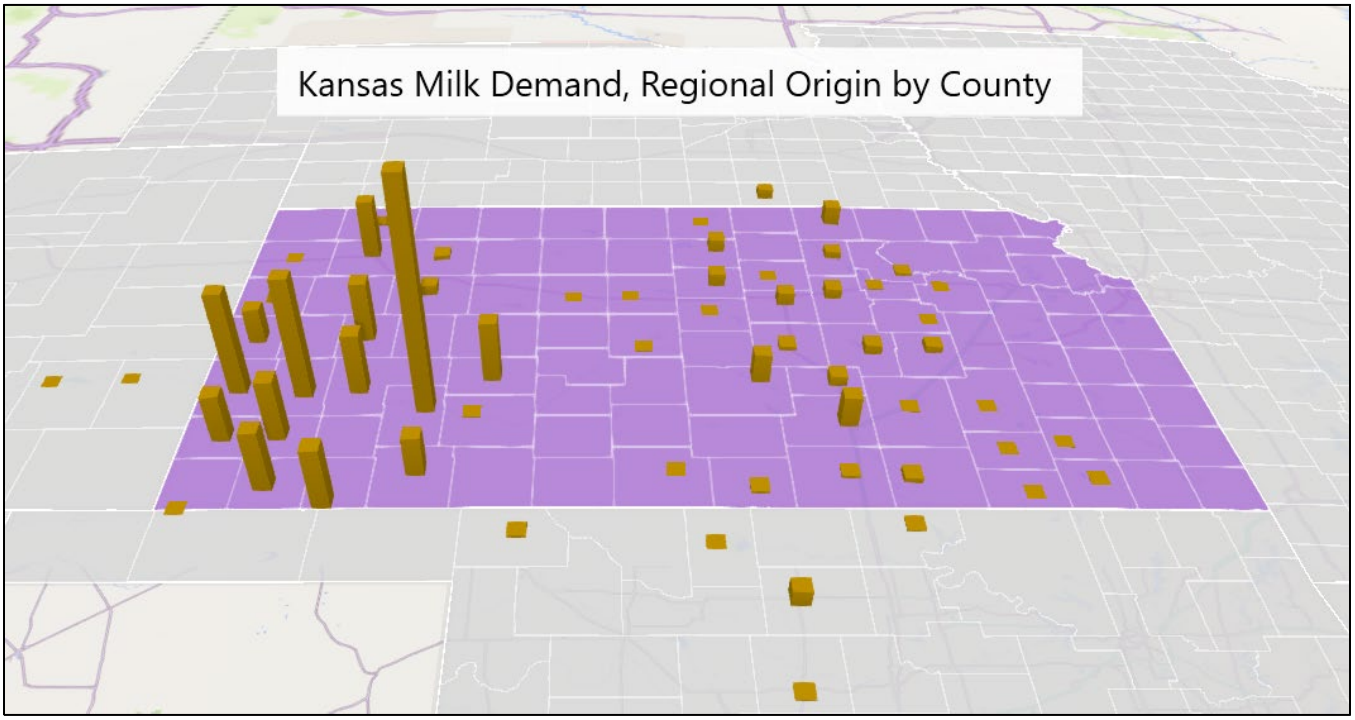
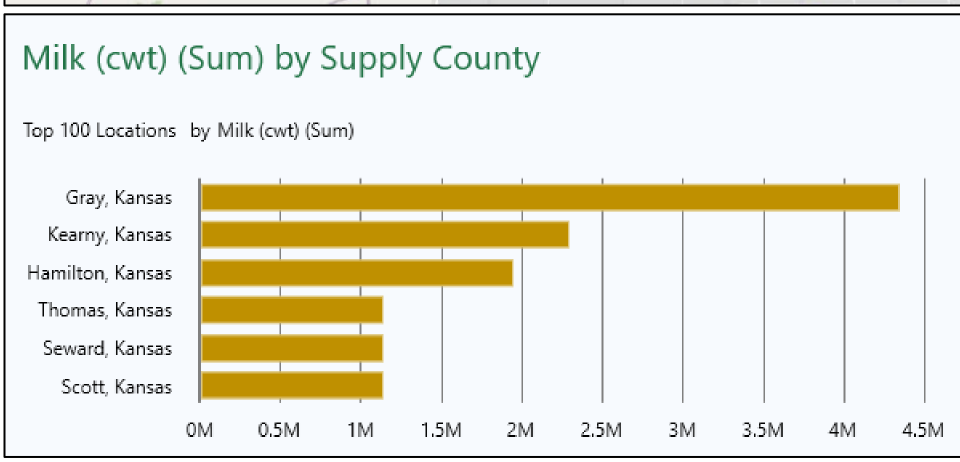
[11] Some specialty milk flows are beyond the scope of this study. For example, there are flows of organic milk from Texas to a processing facility in Wichita, Kansas that are not captured by this analysis. Likewise there are some flows of milk from Kansas to the cheese plant in Dalhart, Texas that were not captured by this flow analysis.

All the top milk supply counties for Kansas milk processing are in Kansas. While Hamilton County has the most outflow of milk, Gray County is the top supply county of milk for Kansas processors, followed by Kearny, Hamilton, Thomas, Seward, and Scott counties (Figure 121). As Figure 121 shows, Kansas milk demand is supplied from primarily Kansas counties with relatively small quantities being brought in from Nebraska, Colorado, and Oklahoma.

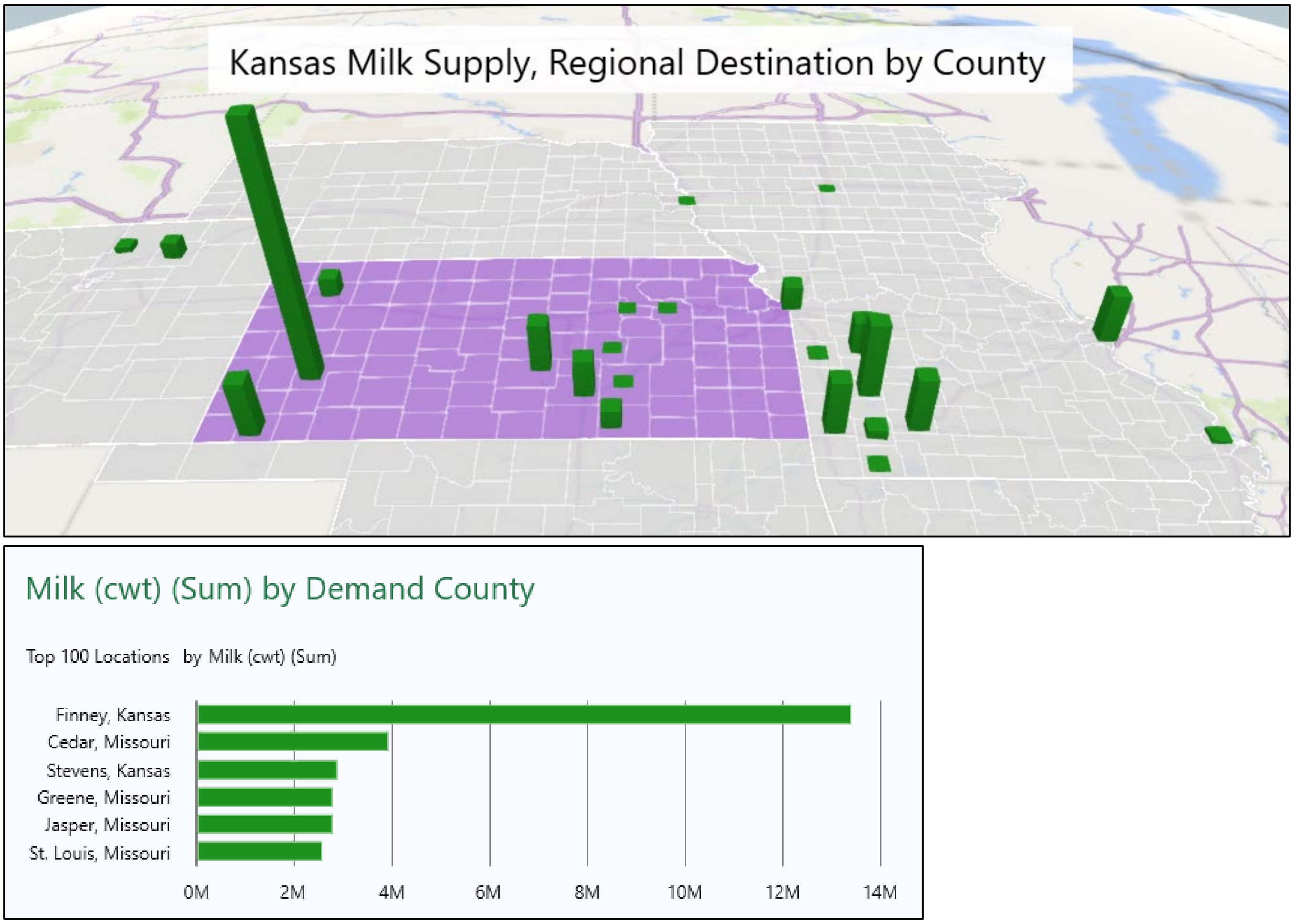
Figure 121. Kansas milk demand, regional origin by county





Most Kansas milk goes to the processing facilities in southwest and southcentral Kansas (Figure 122). A large portion also goes to processing in southwest Missouri as well as the Kansas City and St. Louis metropolitan areas.

Figure 122. Kansas milk supply, regional destination by county



3.5 Key takeaways from the flow studies

1. Kansas grain and oilseed production is increasing with the greatest increases in corn and soybean production (Figure 2).
2. Kansas has net outflows of all its major grains and feed ingredients, except distiller's dried grains (DDGs) (Figure 123).
3. The bulk of these outflows are to demand points within the 11-state region. The exception is HRW wheat for which 51% of outflows are outside the region (Figure 123.)

4. Finding ways to add more value to Kansas grains within Kansas is a way to increase revenues, decrease transportation costs, and reduce greenhouse gas emissions associated with long-distance transportation. Pathways for adding value to grains can include expanded livestock feeding and processing, increased biofuels production, and value-added grain processing such as protein extraction, synthetic amino acid production, and production of other grain-based nutritional derivatives.

5. Kansas has net outflows of biofuels with about 20% of biofuels moving outside the 11-state region (Figure 124). This implies that rail transport is an essential component of competitive biofuels production in Kansas. On a similar note, rail infrastructure is an essential part of moving the Kansas wheat crop to markets outside of Kansas and outside the 11-state region.

6. Kansas fed cattle processing firms draw a significant share of slaughter supply from outside the 11-state region. This suggests there may be an opportunity for more fed cattle feedlot production in Kansas; however, reducing the Kansas-based supply shortage of DDGs (they are currently importing a significant portion of DDGs needs) would help the competitiveness for more fed cattle feedlot production expansion.

7. While Kansas ships most of their hogs out of state for processing, there is substantial processing capacity just beyond the Kansas borders to the north, east and southwest. Expansion of hog production needs to consider the needs and flows of the individual processing plants just outside of Kansas.

8. Kansas ships a substantial amount of soybean meal to poultry producing areas in Oklahoma and Texas, and when the announced soybean processing facility in Montgomery County, Kansas begins operation, there will be more soybean meal available that could be the basis for more value-added production via broiler production in southeastern Kansas.

Figure 123. Kansas grains, oilseeds & feed- summary of net outflows

Kansas Grains, Oilseeds & Feed - Summary of Net Flows			
		Percent	Percent
Commodity	Net Outflow	Regional	Out of Region
Corn (1,000 Bu)	395,050	84.7%	15.3%
Grain Sorghum (1,000 Bu)	176,928	93.7%	6.3%
Soybeans (1,000 Bu)	145,640	94.8%	5.2%
HRW Wheat (1,000 Bu)	245,872	48.9%	51.1%
SRW Wheat (1,000 Bu)	894	99.3%	0.7%
HWW Wheat (1,000 Bu)	3,365	99.9%	0.1%
DDGs (1,000 tons)	(1,265)	88.9%	11.1%
SBM (1,000 tons)	1,134	78.0%	22.0%
Wheat Midds (1,000 tons)	85	100.0%	0.0%
MBM (1,000 tons)	201	94.8%	5.2%

Figure 124. Kansas biofuels—summary of net flows

Kansas Biofuels - Summary of Net Flows			
		Percent	Percent
Commodity	Net Outflow	Regional	Out of Region
Ethanol (Million gallons)	350	78.2%	21.8%
Biodiesel (Million gallons)	16	83.8%	16.2%

Figure 125. Kansas livestock—summary of net flows

Kansas Livestock - Summary of Net Flows			
		Percent	Percent
Commodity	Net Outflow	Regional	Out of Region
Cows (100 Head)	2,018	91.2%	8.8%
Fed Cattle (100 Head)	(20,973)	76.3%	23.7%
Market Hogs (100 Head)	32,933	100.0%	0.0%
Sheep (100 Head)	268	13.8%	86.2%
Milk (Cwts)	16,758,000	100.0%	0.0%

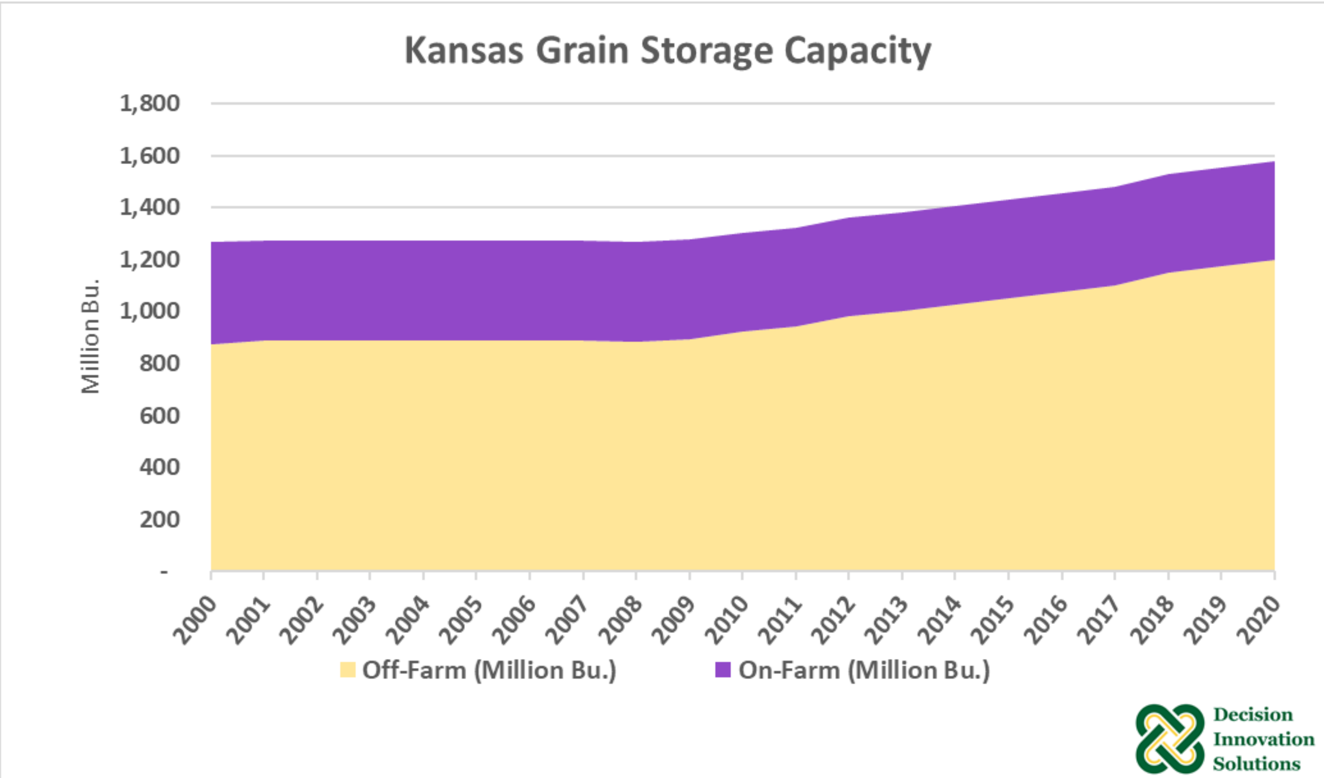
4 Markets and movement of commodities

4.1 Market types

4.1.1 Country elevators and shuttle loaders

According to USDA, commercial grain storage capacity in Kansas is 1.2 billion bushels and on-farm grain storage capacity is 380 million bushels. Total grain storage capacity in Kansas has grown 25 percent since 2000 (Figure 126).

Figure 126. Kansas grain storage capacity, 2000-2020



In 2020, Kansas harvested approximately 1.5 billion bushels of grain and oilseed crops. Approximately 19% of Kansas' total grain production is wheat and oats that are harvested in the summer months and 81% of the total grain and oilseed production is corn, grain sorghum, soybeans, and sunflowers harvested in the fall, September through November. USDA reports quarterly Kansas grain stocks in 2020 that ranged from 564 million bushels to 1.1 billion bushels with the low point occurring just before fall harvest.

Of the 1.5 billion bushels of grain and oilseed production, approximately 83% moves off the farm within the first quarter after harvest.[12] Roughly 58% of the crop is in off-farm commercial storage at the end of the calendar year and approximately 35% has been sent to its end use by the end of the calendar year. Wheat moves off-farm rather quickly with only 9% of the harvested crop in on-farm bins at the end of the first quarter after harvest. Off-farm wheat stocks prior to harvest were nearly equal to a year's worth of production and one quarter after harvest, off-farm wheat stocks in Kansas were 141% of the 2020 harvest.

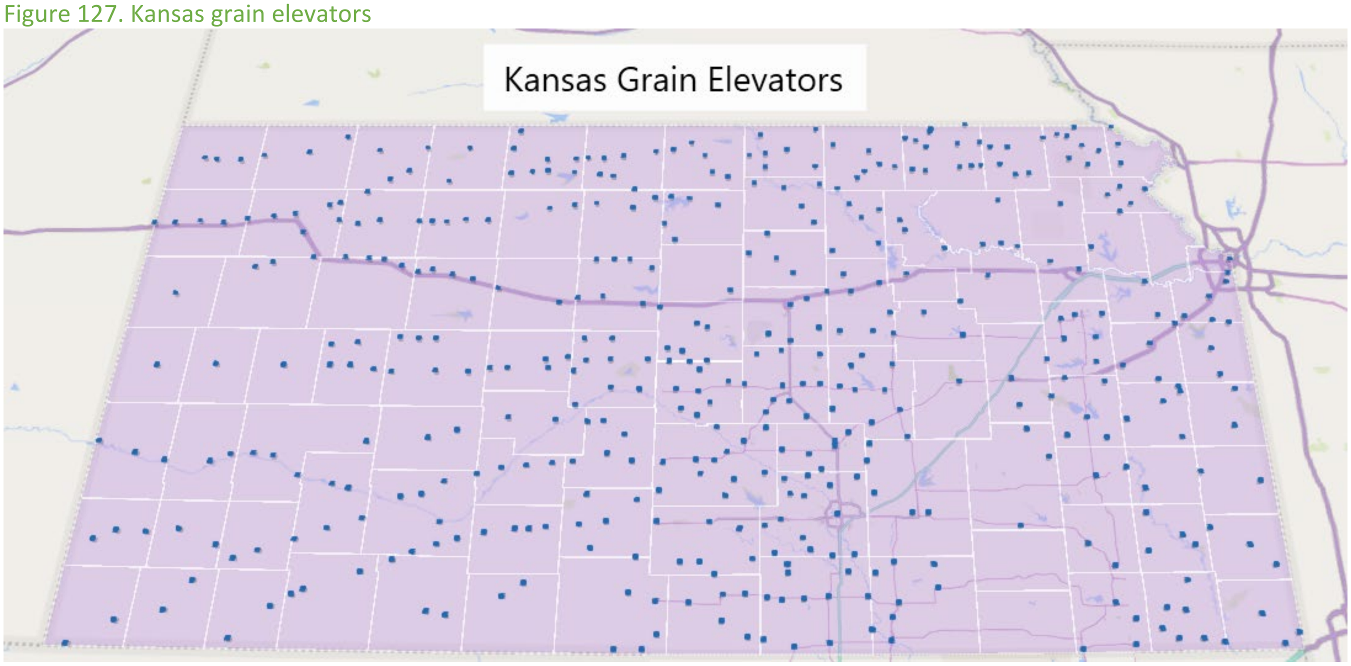
[12] Based on calculations comparing harvest quantities to subsequent USDA stocks in all position reports.

Corn stays on the farm longer than wheat. This is likely because more corn is fed on-farm than is wheat. Within three months after harvest, 20% of the corn harvest was in on-farm storage; 33% of the corn harvest was in off-farm storage, and 47% of corn had moved to end-users (including exports) in that time frame.

For soybeans, 17% of harvested bushels were in on-farm storage within three months after harvest, 43% were in off-farm storage and 40% had moved to end users (including exports).

There are 688 facilities in Kansas that handle commercial grain[13] with at least one elevator in 102 counties in Kansas (Figure 127).

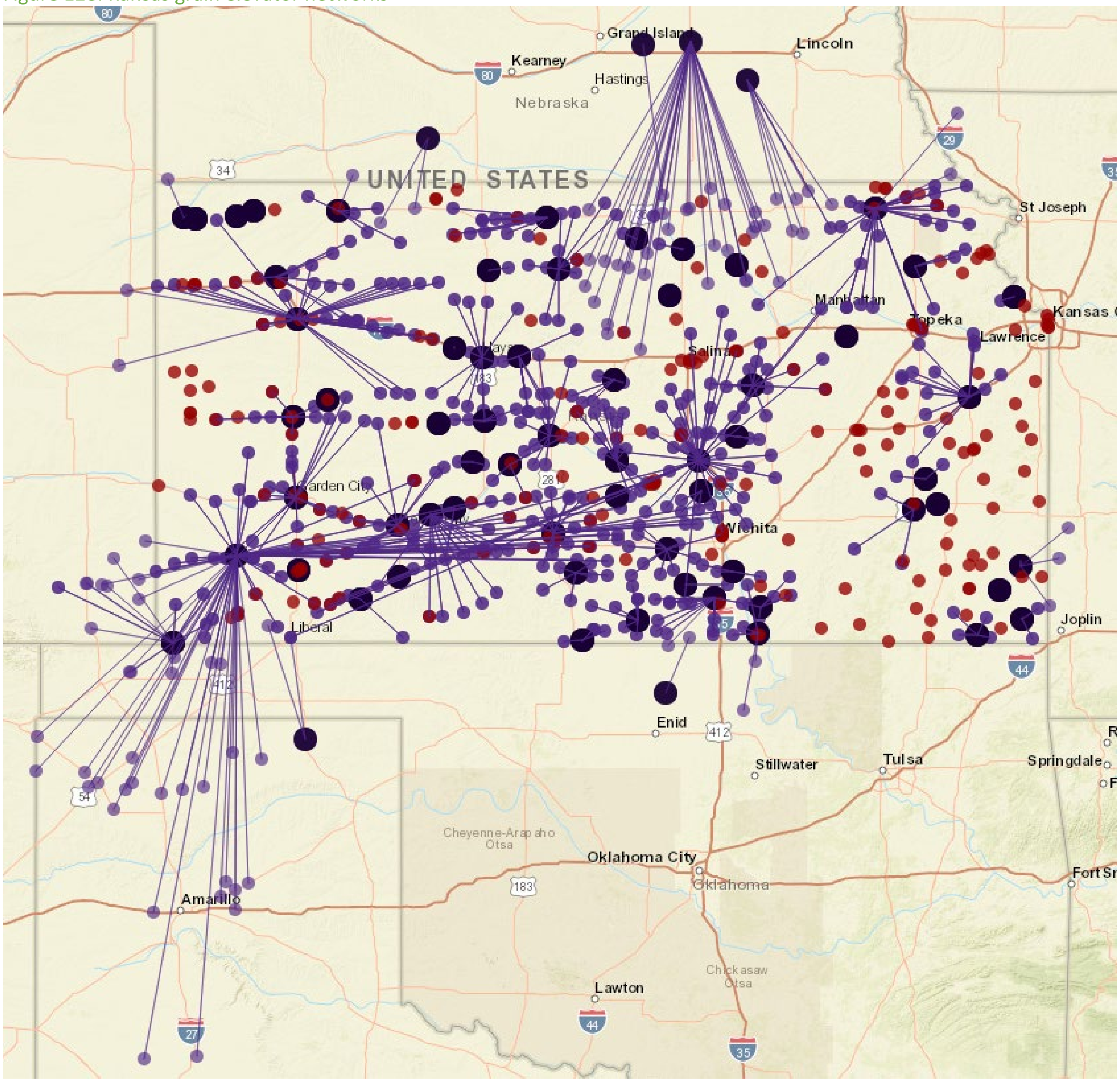
Figure 127. Kansas grain elevators



[13] These 688 facilities include grain elevators, feed mills, and rail and river loading facilities.

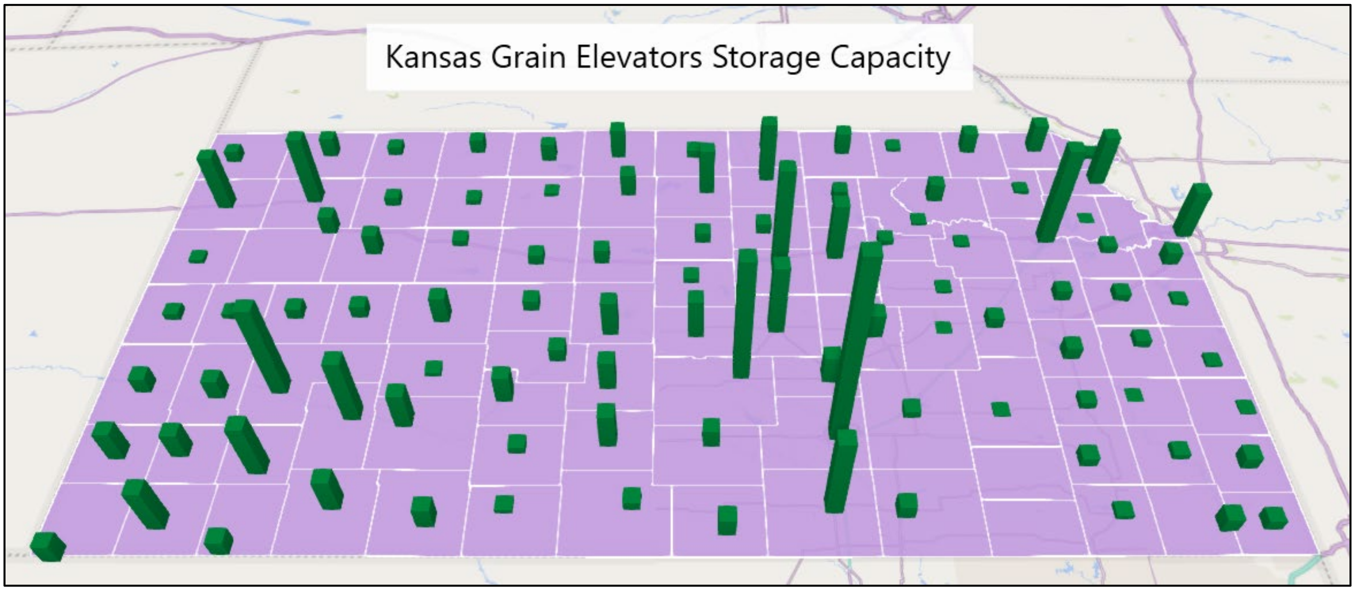
Kansas grain elevators are organized into networks. While many of the networks involve only Kansas-based grain handlers, some of the networks extend into neighboring states and in some cases the headquarters for a network can be outside of Kansas (Figure 128).[14] Kansas grain elevator storage capacity by county is illustrated in Figure 129.

Figure 128. Kansas grain elevator networks



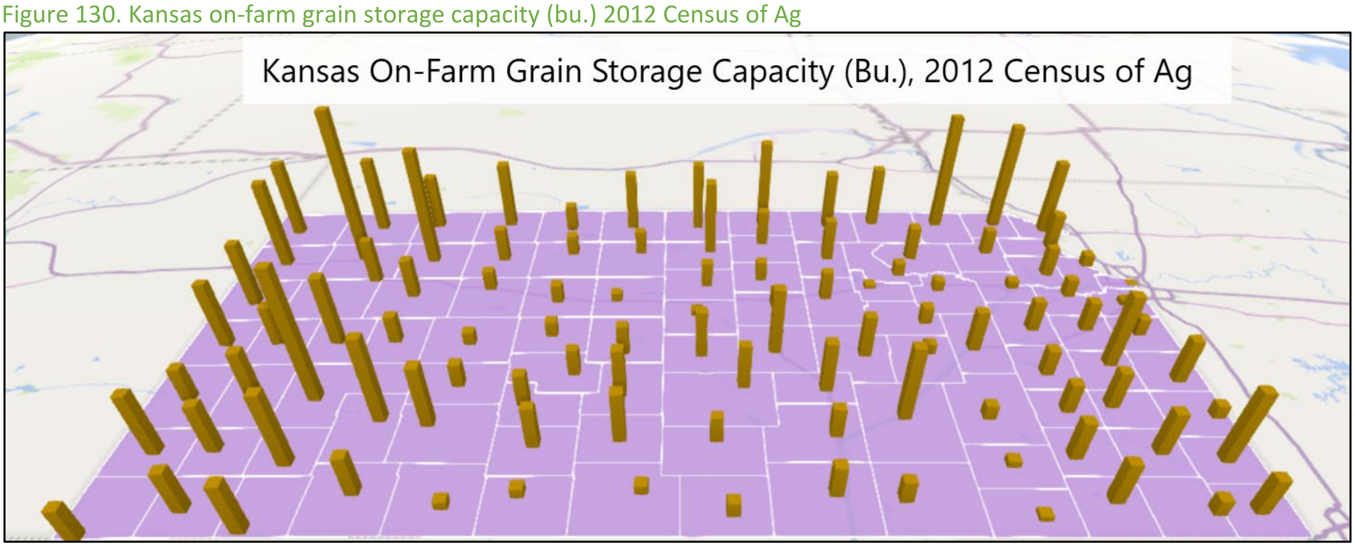
[14] See https://rpubs.com/ACCC/MapsDec2021 for an interactive map that allows for adding layer data such as railroads, terrain, etc.

Figure 129. Kansas grain elevator storage capacity, by county



In the 2012 USDA Census of Agriculture (COA), USDA reported that 10,921 farms in Kansas had a total of 332 million bushels of on-farm storage. No data regarding on-farm storage was included in the 2017 COA. USDA also reported that 79% of the on-farm storage was on farms classified as crop farms and 21% was on farms classified as livestock production farms (Figure 130).

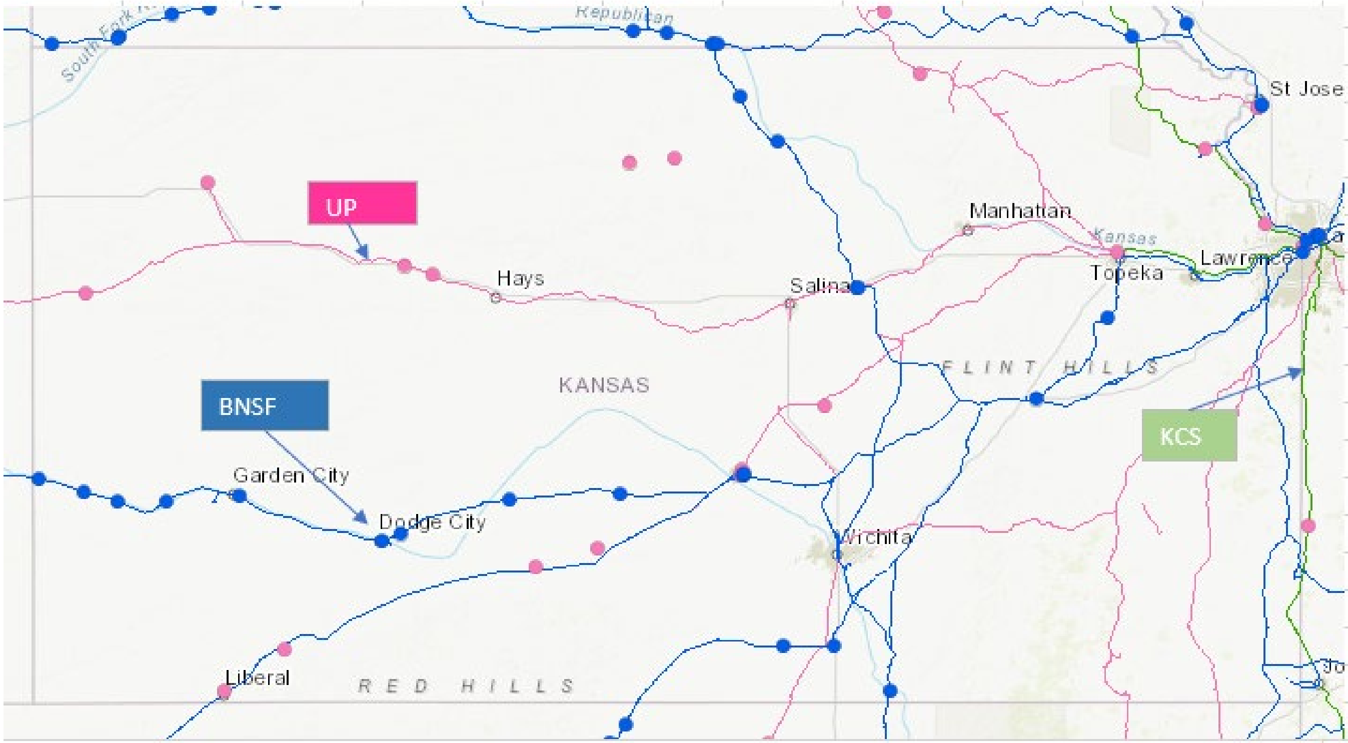
Figure 130. Kansas on-farm grain storage capacity (bu.) 2012 Census of Ag



4.1.2 Shuttle loading terminals

There are 49 rail shuttle loading terminals in or near Kansas with most of them on the Union Pacific (UP) or Burlington Northern Santa Fe (BNSF) railroad systems (Figure 131). A significant portion of the corn, soybeans, wheat, and grain sorghum being shipped out of Kansas will be drawn to these rail shuttle loading terminals either as a first point of delivery from the farm or as a secondary point of delivery from local grain elevators that do not have shuttle loading capabilities. A comprehensive assessment of these facilities is provided in Section 5.

Figure 131. Wheat shuttle loading terminals in and near Kansas



Source: U.S. Wheat Associates Interactive Map

4.1.3 End user direct delivery

Over the past two decades more markets have emerged that take direct delivery of commodities from producers. This is the case for most ethanol plants, corn wet mill plants, soybean processors, and for many wheat mills. In addition, in Kansas, many feedlots buy directly from farmers and take direct delivery of feed stuffs such as corn and grain sorghum.

Direct delivery of livestock to slaughter processing has become the norm, also. Nearly all cattle and hogs are delivered directly from the farm or feedlot to the processing facility. In years past, much of the livestock moved through stockyards or local collection points to be aggregated into semi-truck loads. Now most farms and feedlots can originate semi-truck loads of cattle or hogs destined for slaughter. A small portion of fed cattle and finished hogs move through sales barns or through local brokers/dealers. Feeder cattle are increasingly moving direct from farm to feedlot similar to farm-direct movements that are occurring in other commodities, however a significant volume still moves through sale barns and terminal markets.

The emergence of direct-delivery end-user markets has resulted in more commodities being moved by 5, 6, or 7 axle semi-trucks and less being moved by rail and via 2-axle straight trucks.

End-user direct delivery has also been facilitated by more commodity marketing through brokers who facilitate the transaction but do not take physical possession of the commodity. Some broker-dealers are associated with grain elevator networks, but some are independent of any physical facility and only facilitate the coordination of commodity flow from farms to end-users and facilitate the monetary exchanges, paperwork and compliance with applicable regulations.

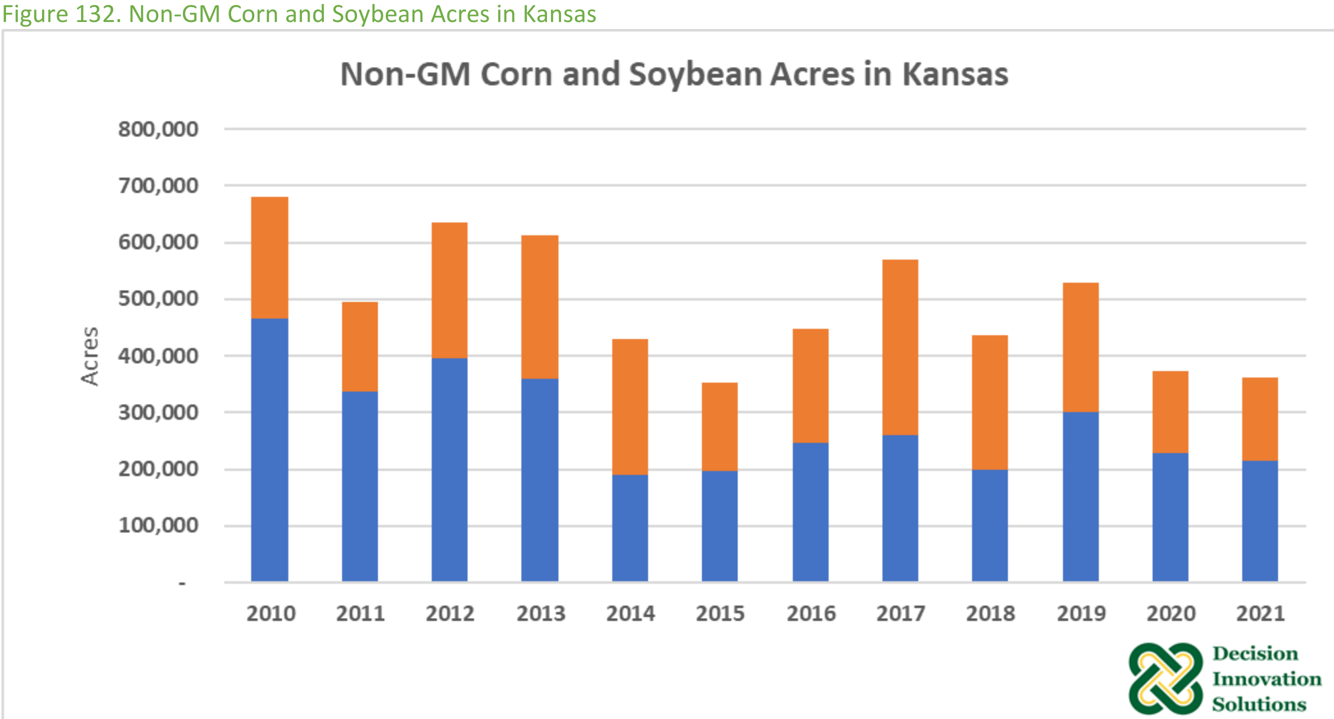
End-user direct delivery is also quite common for identity-preserved commodities in which there is a desire to not commingle the commodity at central collection points, but to maintain the identity of specific lots of the commodity throughout the marketing chain. This is quite common for organic production and for commodities with specific traits that the end-user seeks to preserve.

4.1.4 Identity Preserved Grains and Oilseeds

Commodity segregation and identity preservation are two aspects of commodity management that affect the use and management of storage facilities. Commodity segregation is the norm for Kansas commodities – Corn is kept separate from soybeans or wheat or canola or sunflower seeds, and even classes are segregated with hard white wheat being handled separately from hard red wheat or soft red wheat. Commodity segregation occurs at the farm level, at local and terminal elevators and within the grain processing and export systems. Commodity segregation does not mean, however that a facility or a grain storage facility needs to be dedicated to a single commodity. Grain bins can be thoroughly cleaned between crops and the same facility can be used to store wheat from July to September and then store corn or soybeans in the fall and winter. This is true at the farm level, the local elevator, at terminal elevators, and at processors and export facilities. However, handling multiple grains at a single facility can increase the cost of grain handling and reduce the overall grain handling operational capacity of a facility. For example, a farmer with a 50,000-bushel bin that was loaded with 25,000 bushels of wheat in July, but still has 10,000 bushels of wheat in it in October cannot be loaded with corn until it is completely emptied. If that farmer moves the wheat from his bin to a local or terminal elevator, it frees up the bin capacity of the farmer, but it may result in less than full utilization of bin capacity at the next level in the marketing chain.

Identity preservation is similar to commodity segregation, although it often includes keeping subsets of similar commodities separate for some portion of the marketing chain. One example of commodity identity preservation is the handling of non-genetically modified (non-GM) grains and oilseeds and/or organic grains and oilseeds. Kansas plants between 350,000 to 600,000 acres of non-GM corn and soybeans each year (Figure 132).

Figure 132. Non-GM Corn and Soybean Acres in Kansas



In recent years total production of non-GM corn and soybeans would generate about 40 million bushels of grain that might be segregated or identity-preserved. A portion of that production is likely to have been fed on the farm as part of livestock production that needed non-GM feeds for the specialty marketing program of that commodity. A portion of that would have been moved into commercial markets, either through direct delivery from the farm or through handlers that have set aside some portion of their facility to handle identity-preserved grains.

For commercial facilities that need to be sure that the commodity they are receiving is non-GM, there is often a testing procedure that is employed at the receiving facility. A recent study released by IFEEDER[15] suggests that this testing can cost between $14 and $47 per test which depending on the size of container that is being tested (5,000 bushel bin, 1,000 bushel truck, 3,300 bushel rail car) the test can cost from a quarter of a cent per bushel to 1.5 cents per bushel. In the IFEEDER study, the cost of segregation and identity preservation ranged from $0.06 per bushel for GM/non-GM segregation of corn to $0.37 per bushel for segregation of high oil/regular corn. For soybeans, the cost ranges for segregation were $0.04 for high oil/regular soybeans to $0.72 per bushel for GM/Non-GM soybeans. The average cost per bushel for segregating corn and soybeans was approximately $0.21 for corn and $0.39 for soybeans.

All participants in the non-GM feed production supply chain will have additional costs related to segregation and isolation. The costs of segregation on the farm are very small. Even with the largest isolation range considered, the cost of on-farm segregation is less than $0.05 per bushel. Therefore, the costs of operationalizing segregation on the farm will likely not be a major factor guiding the decision to produce or not produce non-GM grain. It is expected that the farmer will continue to reconcile productivity and final price as part of the decision choice.

As an intermediary, the grain elevator not only buys non-GM grain at a premium price but also sells it at a higher price. Therefore, clarity and transparency on costs of segregation and isolation are critical for grain elevator decisions on whether or not to handle non-GM grain. Depending on the sale date to a feed mill, the grain elevator is able to negotiate a better value for its grain, but it is always conditioned to the market value. The elevator will spend an additional $0.05 to $0.07 per bushel to handle and segregate non-GM soybeans, compared with regular soybeans, and $0.07 to $0.09 per bushel for non-GM corn.

The feed mill, at the end of the feed production chain, marks the largest increase in the price of the final product, which has direct bearing on the price of meat, milk, and eggs derived from animals fed with non-GM feed. The additional cost of segregating non-GM ingredients ranges from $4.91 to $9.08 per ton for swine feed, $4.93 to $9.11 per ton for broiler feed, $5.14 to $9.32 per ton for the layer feed, $0.44 to $2.68 per ton for beef feed, and $1.32 to 3.57 for dairy feed. For the feed mill, the choice of the segregation strategy has greater weight in the final additional cost. Spatial segregation entails higher costs, especially for smaller facilities.

4.2 Movement of commodities

Total tonnage of grain and oilseed crop production in Kansas is 44 million tons (Figure 137). Assuming about 15% of corn and grain sorghum is now fed “on-farm”, then 90% of all grain and oilseeds (39.6 million tons) produced in Kansas move to a “first buyer” every year. If the average move to first buyer is a 20-mile trip, then there are 792 million ton-miles of commodity movement by trucks and/or tractors and wagons on Kansas roads involved in the first movement of grains and oilseeds (Figure 133 and Figure 134).

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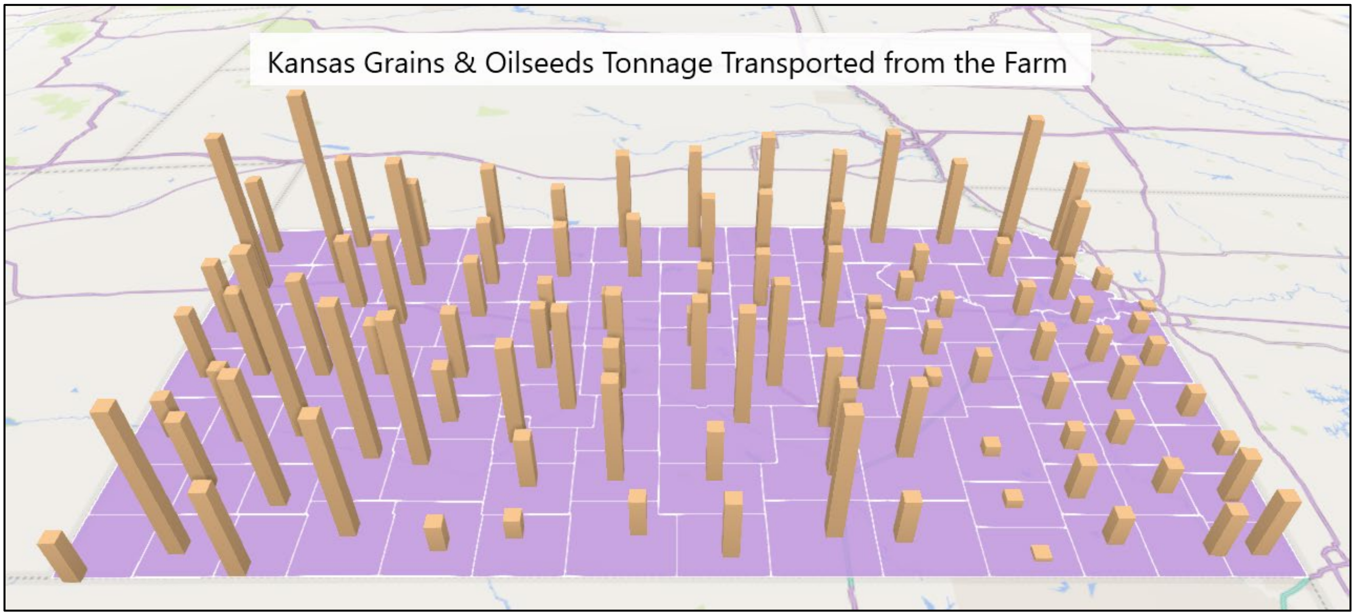
[15] Impact of Non-GM Livestock and Poultry Feed on the U.S. Feed Industry. Prepared by Iowa State University and Decision Innovation Solution, LLC. Funded by the Institute for Feed Education and Research (IFEEDER) in collaboration with Dairy Management Inc., MFA Incorporated, the National Corn Growers Association, the United Soybean Board, and U.S. Poultry and Egg Association.

Figure 133. Kansas grains & oilseeds tonnage transported from the farm



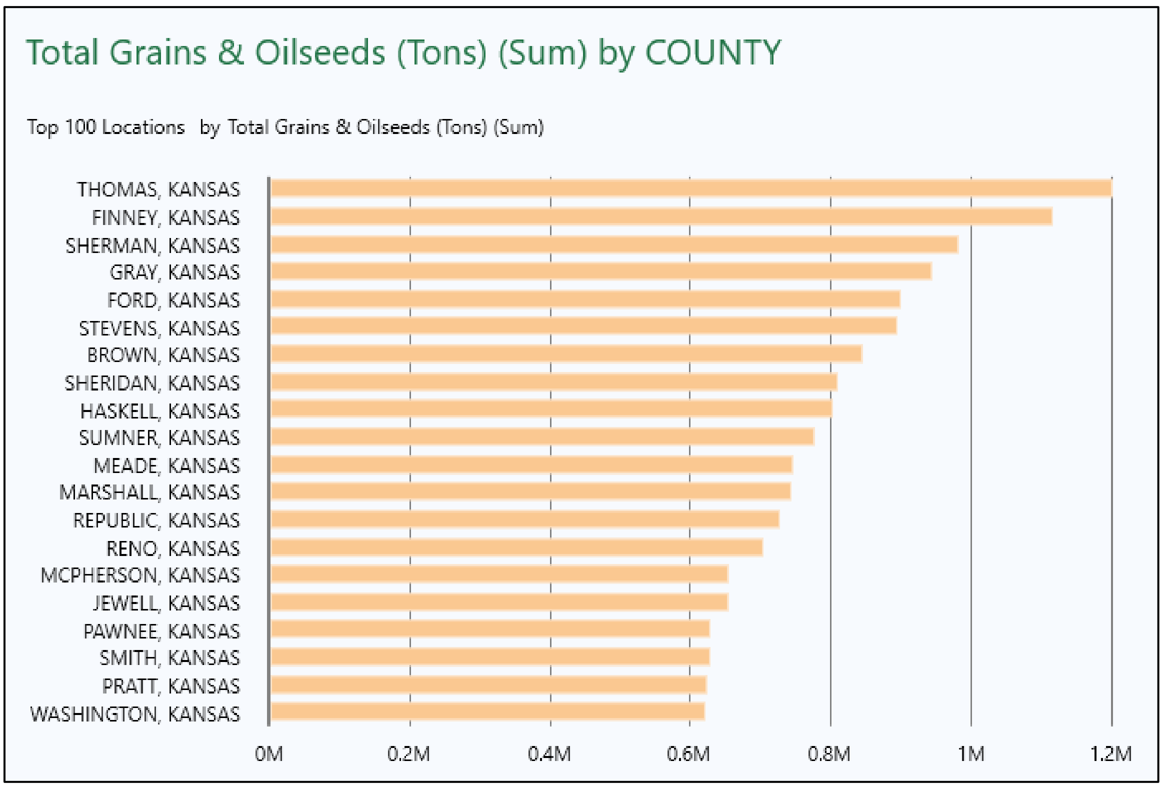
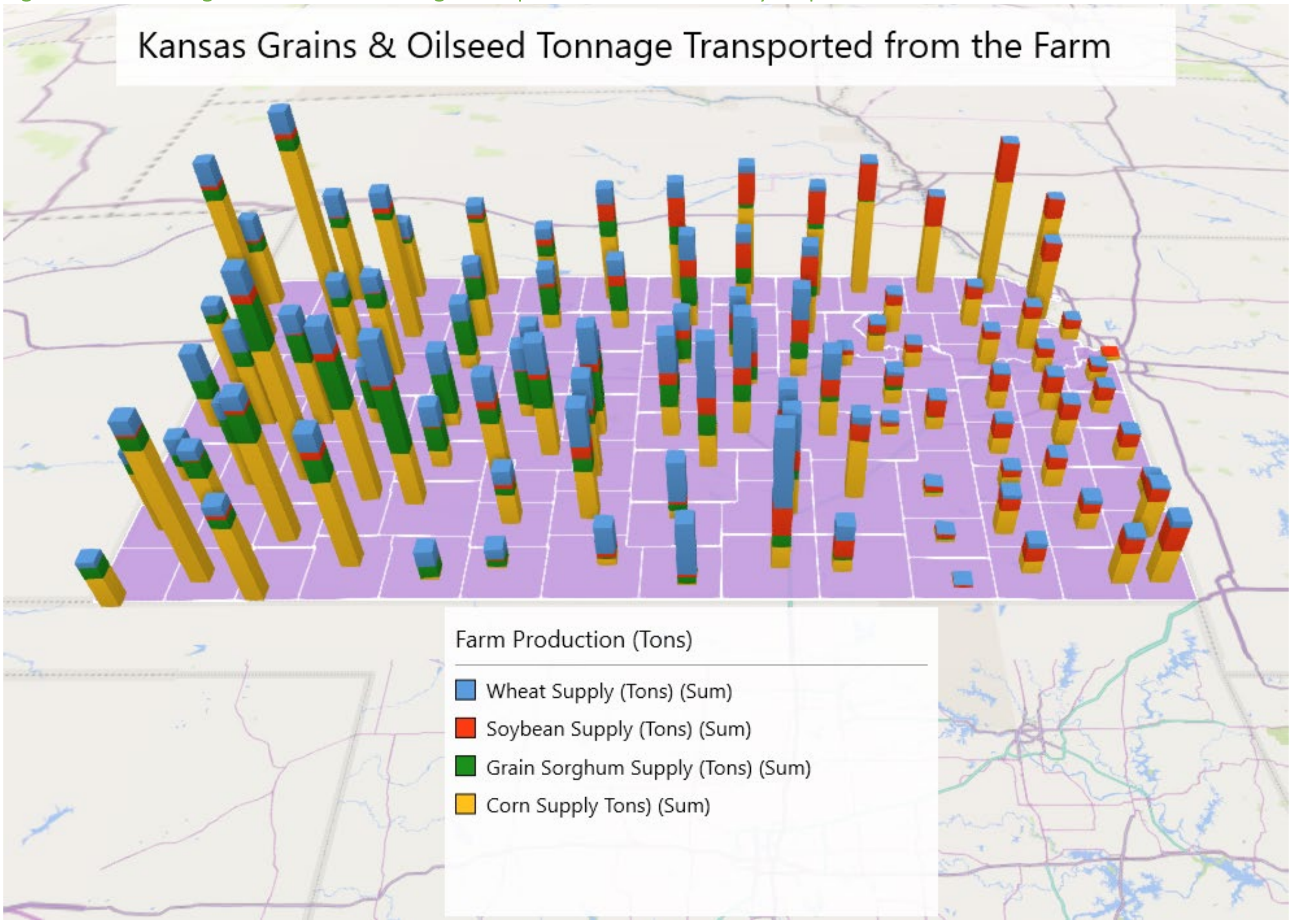
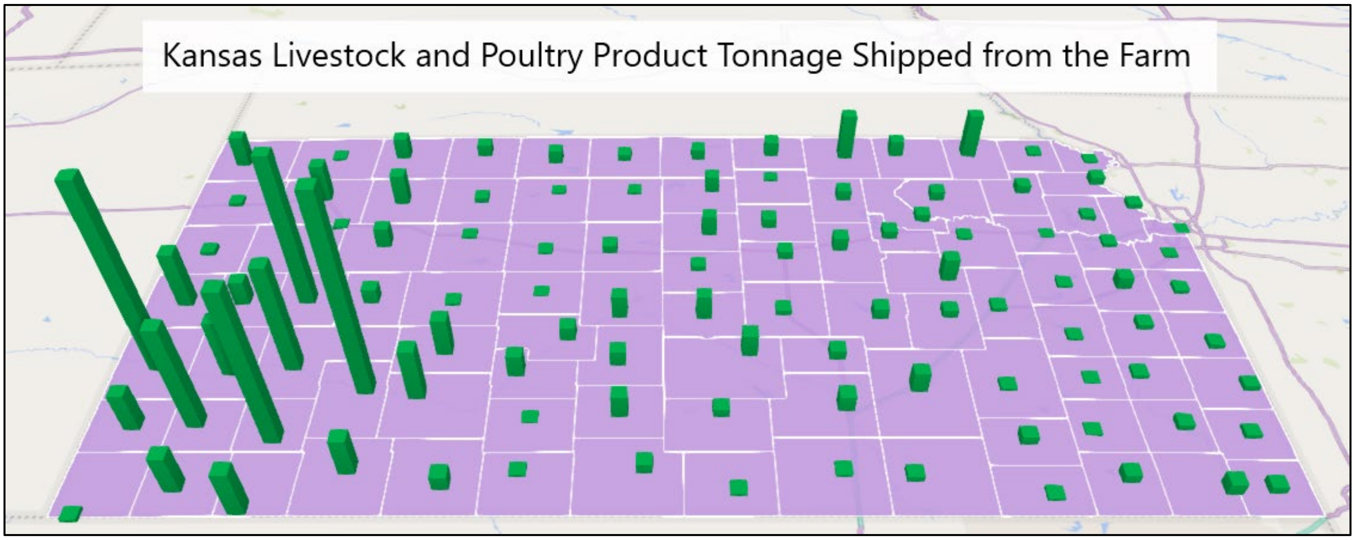


Figure 134. Kansas grains & oilseed tonnage transported from the farm by crop



Kansas produces 6 million tons of livestock and poultry products that move from the farm (Figure 135). This production moves from the farm to the first point of purchase, collection or processing by truck. The average first movement of livestock and poultry products is typically greater than that for grains. If the average first movement is 40 miles, then there are 240 million ton-miles of livestock and poultry products moving from Kansas farms to first purchasers on Kansas roads.

Figure 135. Kansas livestock and poultry product tonnage shipped from the farm



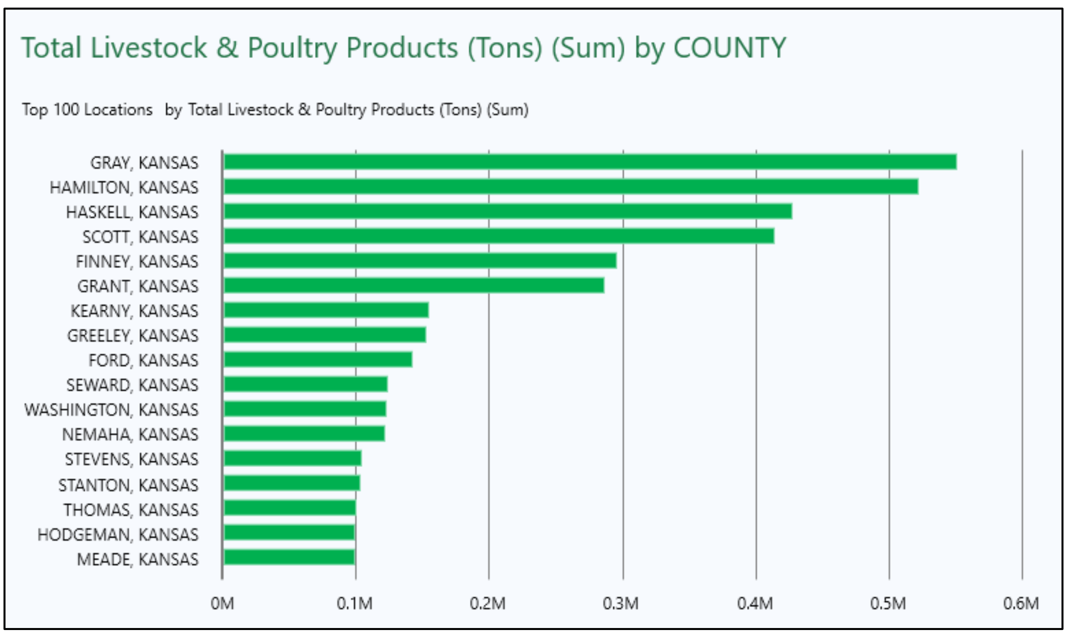


Figure 136. Kansas livestock and poultry product tonnage shipped from the farm, by product

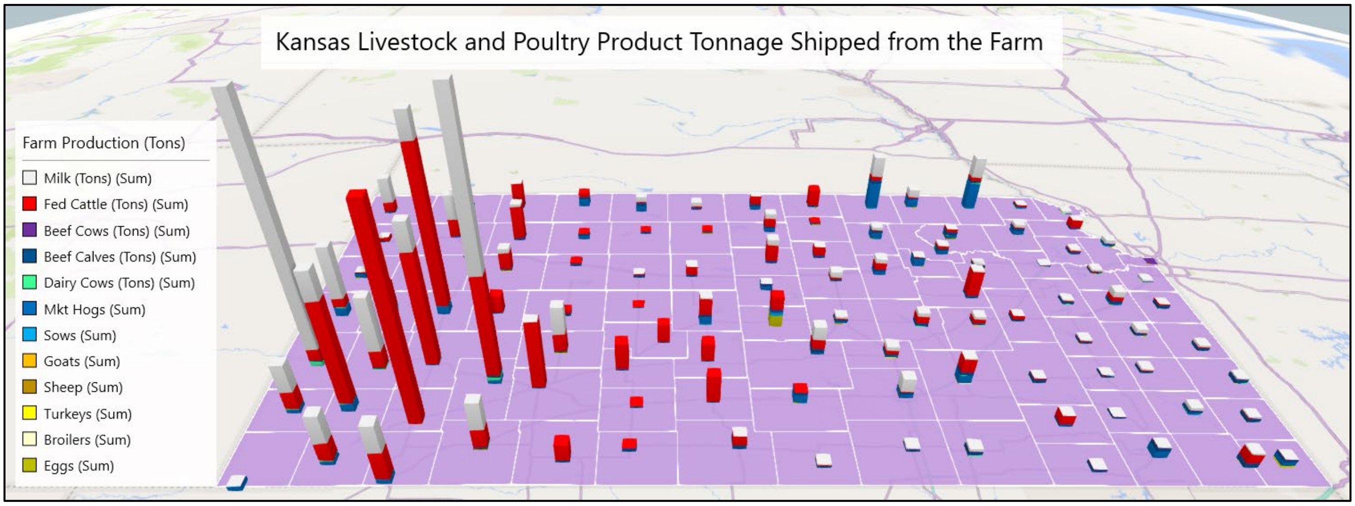
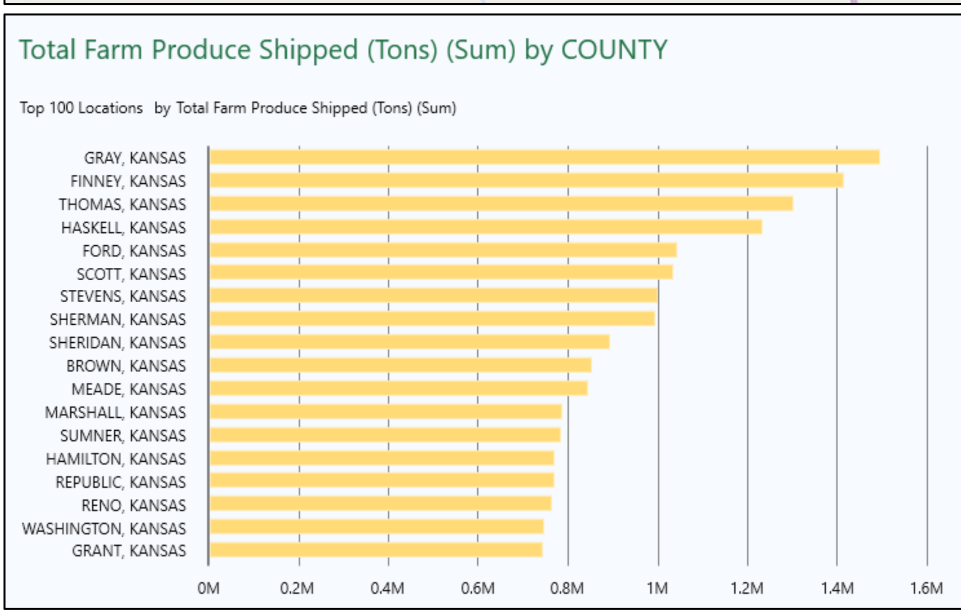


Figure 137. Kansas total farm product tonnage shipped from the farm



4.2.1 Movement of commodities to secondary markets

While some grains and oilseeds move directly from the farm to end users, a substantial portion of grains and oilseeds move through intermediate markets, often passing through local grain elevators and/or terminal elevators who provide significant storage and handling capacity during harvest as well as additional services such as drying, storage and aggregation for long-distance shipping via rail and barge. Commodities are then shipped to a variety of markets beyond the first purchaser. A summary of these is in Table 22.

Table 22. Major Markets beyond first purchaser—grains & oilseeds

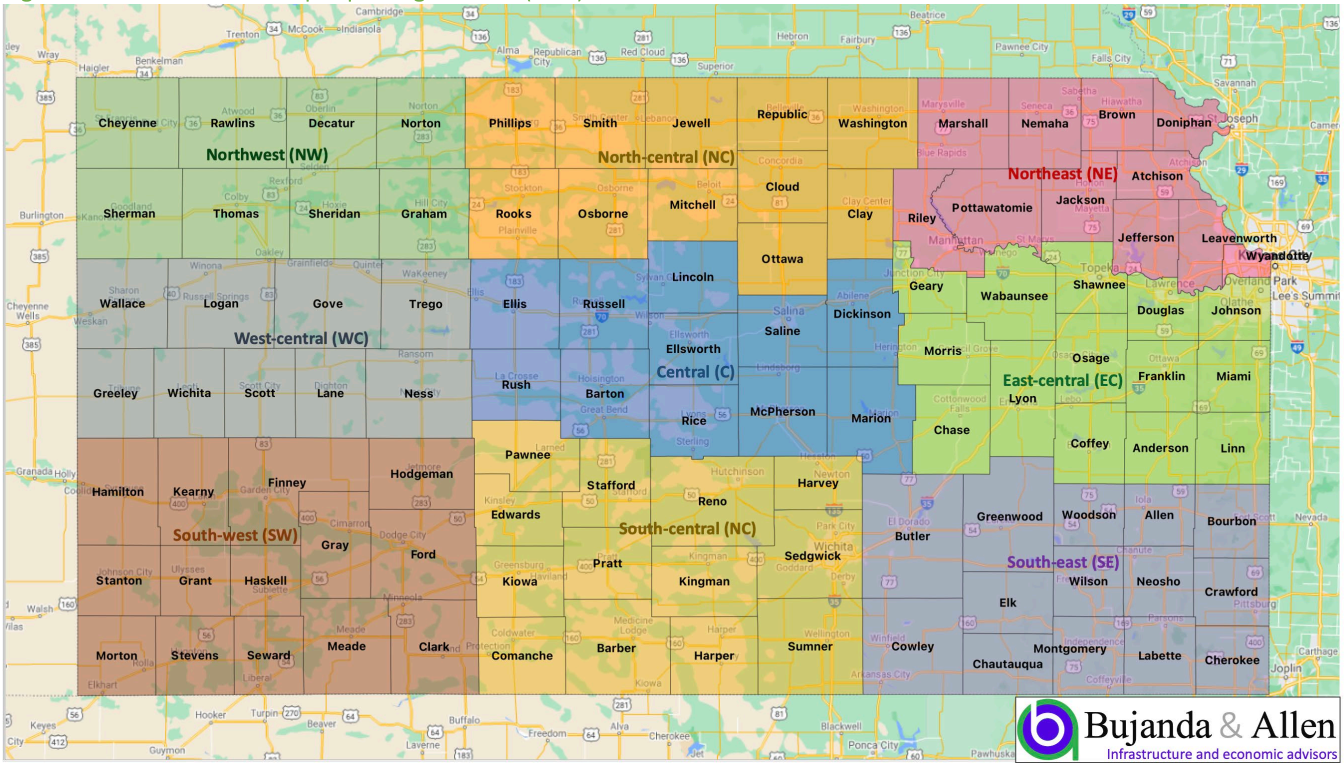
Major Markets Beyond First Purchaser – Grains & Oilseeds			
Corn	Grain Sorghum	Soybeans	Wheat
Feed mills/feedlots	Feed mills/feedlots	Soybean crush	Feed mills/feedlots
Pet food manufacturing	Pet food manufacturing	Soy flour	Pet food manufacturing
Ethanol and distilleries	Ethanol and distilleries	Export markets	Ethanol and distilleries
Corn products (starch, corn oil, corn meal, etc.)	Grain sorghum flour		Wheat flour mills
Export markets	Export markets		Wheat protein mills
			Export markets

Within the state of Kansas, the majority of these commodities move by truck. This is especially true for corn, grain sorghum and soybeans. A moderate amount of wheat that moves to flour mills may move by rail, especially if the wheat mill is on the same rail line as supplying elevators. Shipments to domestic markets outside of Kansas may use a mix of transportation modes depending on the distance between the origin and destination points. Most movement to export ports will use a combination of truck and rail with truck often used just to get to the rail shuttle loading points.

4.2.2 Commodity movements within Kansas

A total of 19.3 million tons of agricultural commodities move to processors, feedmills, and other intermediate domestic users between and among Kansas' 105 counties. These are commodities that originate in Kansas and are used in Kansas. Table 23 shows a summary of the movement of these commodities within and among Kansas counties summarized at the crop reporting district (CRD) level. The counties that comprise each of the nine CRDs in Kansas are illustrated in Figure 138.

Figure 138. Kansas' nine crop reporting districts (CRD)



Source: Bujanda & Allen, 2021.

While some commodities move across two or three CRD districts, the movement of 13.7 million tons (71.5%) of the in-state commodity movement is within the CRD district where the commodity is produced. There is clearly a synergy between local production of grains and feeds and local livestock production as well as local grain production and local grain/oilseed processing and likewise, local livestock production and local livestock processing. Yes, broader domestic markets and export markets are important to Kansas, but the local movement of commodities within Kansas highlights the importance of local market development and value-added activities for Kansas commodity production.

Table 23. Kansas intrastate commodity movement summary (tons)

Kansas Intrastate Commodity Movement Summary (Tons)									
CRDs	NW	WC	SW	NC	C	SC	NE	EC	SE
NW	523,687	285,775	600,968	1,872	-	-	-	-	-
WC	24,947	1,345,954	838,446	-	18,149	12,881	20,850	329	-
SW	-	36,879	6,281,426	100	8,960	178,627	-	2,820	49,710
NC	9,623	7,000	196,768	592,275	580,372	230,189	77,360	4,608	11,258
C	2,114	4,925	98,513	39,394	1,084,799	477,225	85,800	39,540	102,167
SC	8,374	33,505	549,358	13,638	109,471	1,955,884	6,433	9,646	268,360
NE	-	-	5,600	17,362	190	-	924,774	23,889	4,022
EC	-	-	13,830	4,000	34,924	720	41,648	570,259	100,832
SE	220	441	2,094	771	2,444	93,709	501	71,929	516,429
Read across to see where commodities from a CRD go; Read down to see where a CRD gets its commodities									Decision Innovation Solutions

4.2.3 Commodity movements out of Kansas

Table 24 shows the tons of each commodity leaving Kansas according to the commodity flow analysis. A total of 34.9 million tons of commodities leaves the state. Corn (12.2 million tons) is the largest outflow commodity by weight, followed by hard red winter wheat (7.6 million tons) and grain sorghum (5.0 million tons). The largest portion of Kansas agricultural commodities go to Texas, either for domestic use or for export.

Table 24. Summary of Kansas outflows by commodity

Summary of Kansas Outflows by Commodity (Tons)

	Arkansas	Colorado	Iowa	Illinois	Louisiana	Missouri	Nebraska	New Mexico	Oklahoma	Texas	Out of Region	Total
HRW Wheat	-	960	112,440	301,440	1,992,540	416,100	186,480	-	23,400	771,120	3,768,960	7,573,440
SRW Wheat	-	9,480	1,080	-	-	8,100	840	-	9,600	-	17,940	47,040
White Wheat	-	-	300	1,500	20,700	20,700	11,400	-	59,400	44,400	6,600	165,000
Wheat Midds	11,351	21,269	2,865	-	-	31,627	87,058	551	64,798	50,472	-	269,990
Soybeans	-	-	-	-	630,750	814,800	1,650	-	-	2,767,200	225,450	4,439,850
Corn	417,200	597,800	-	-	-	1,743,000	201,600	56,000	1,324,400	6,133,400	1,687,000	12,160,400
Grain Sorghum	115,584	15,456	-	9,576	-	1,232	14,000	-	196,280	4,320,064	310,688	4,982,880
Ethanol	19,092	129,363	-	-	1,975	19,092	2,304	66,492	307,442	562,218	251,813	1,359,791
Biodiesel	-	-	-	-	-	-	3,577	4,161	72,781	30,879	9,490	120,888
DDGs	6,612	-	-	-	2,204	9,918	8,816	4,408	233,624	265,582	3,306	534,470
Soybean Meal	5,000	46,000	-	-	-	46,000	-	117,000	268,000	529,000	249,000	1,260,000
Meat & Bone Meal	40,620	700	-	-	-	88,000	760	-	21,580	10,360	143,400	305,420
Hogs	-	-	-	-	-	113,666	195,823	-	168,983	-	-	478,471
Sheep	-	23	-	225	-	-	-	-	53	-	1,733	2,033
Fed Cattle	-	13,703	-	-	-	-	152,280	-	1,215	-	-	167,198
Cows	-	-	-	-	-	300	97,620	-	120	12,600	10,620	121,260
Turkeys	-	-	165	-	-	3,495	-	-	-	105	195	3,960
Broilers	780	-	-	-	-	-	-	-	-	-	-	780
Milk	-	62,700	100	-	-	802,700	100	-	-	-	-	865,600
Total	616,238	897,452	116,950	312,741	2,648,169	4,118,730	964,308	248,612	2,751,675	15,497,400	6,686,195	34,858,470

Table 25 shows the estimated quantities (total of 13.4 million tons) of commodity exports originating from Kansas. A majority (65%) of exports originating in Kansas leave through Texas. Grain sorghum, hard red winter wheat, and soybeans are Kansas' largest export commodities.

Table 25. Summary of Kansas exports by commodity

Summary of Kansas Exports by Commodity (Tons)

	California	Louisiana	Oregon	Texas Gulf	Texas Rail	Total
HRW Wheat	69,180	1,992,540	1,359,060	771,120	-	4,191,900
Wheat Midds	-	-	-	-	661	661
Soybeans	-	630,750	213,600	-	2,767,200	3,611,550
Corn	-	-	-	-	828,800	828,800
Grain Sorghum	-	-	306,992	4,149,040	171,024	4,627,056
Ethanol	-	-	-	-	11,192	11,192
Soybean Meal	-	-	-	-	22,000	22,000
Meat & Bone Meal	143,400	-	-	-	6,220	149,620
Total	212,580	2,623,290	1,879,652	4,920,160	3,807,097	13,442,779

Notes: Texas Rail denotes exports to Mexico via rail. Texas Gulf denotes exports to the rest of the world through ports in Texas.

4.2.4 Commodity volumes returning to Kansas

Kansas receives an estimated 5.8 million tons of agricultural commodities from other states, as shown in Table 26. DDGs (1.8 million tons), fed cattle (1.6 million tons), and corn (1.1 million tons) are the largest inflow commodities.

Table 26. Summary of Kansas inflows by commodity

Summary of Kansas Inflows by Commodity (Tons)												
	Arkansas	Colorado	Iowa	Illinois	Louisiana	Missouri	Nebraska	New Mexico	Oklahoma	Texas	Out of Region	Total
HRW Wheat	-	-	-	-	-	120	3,660	-	193,500	-	-	197,280
SRW Wheat	-	-	-	-	-	20,100	-	-	120	-	-	20,220
White Wheat	-	15,750	-	-	-	-	-	-	-	-	48,300	64,050
HRS Wheat	-	-	-	-	-	-	-	-	-	-	208,800	208,800
Durum Wheat	-	-	-	-	-	-	-	-	-	-	8,400	8,400
Wheat Midds	-	7,053	-	2,424	-	34,382	4,518	-	1,212	220	135,877	185,687
Soybeans	-	-	-	-	-	-	-	-	70,650	-	-	70,650
Corn	-	-	-	-	-	7,000	1,087,800	-	4,200	-	-	1,099,000
Grain Sorghum	-	3,752	-	-	-	1,568	13,832	-	9,744	-	-	28,896
Ethanol	-	988	62,871	-	-	73,733	69,125	-	-	-	-	206,717
Biodiesel	-	-	-	-	-	57,889	-	-	4,453	-	-	62,342
DDGs	-	19,836	590,672	-	-	58,406	990,698	-	-	-	139,954	1,799,566
Soybean Meal	-	-	-	-	-	59,000	67,000	-	-	-	-	126,000
Meat & Bone Meal	-	-	22,120	-	-	18,500	62,840	-	860	-	380	104,700
Hogs	-	116	-	-	-	566	218	-	44	-	-	943
Sheep	-	-	-	-	-	15	-	-	8	-	-	23
Fed Cattle	-	175,703	32,940	40,973	-	37,800	67,905	42,255	355,455	494,978	334,868	1,582,875
Cows	-	-	-	-	-	180	-	-	-	-	-	180
Turkeys	-	-	-	-	-	-	-	-	-	-	-	-
Broilers	-	-	-	-	-	-	-	-	-	-	-	-
Milk	-	200	-	-	-	-	8,900	-	18,600	-	-	27,700
Total	-	223,397	708,603	43,397	-	369,259	2,376,496	42,255	658,845	495,198	876,578	5,794,028

4.3 Feed demand

The seven most-used feed ingredients in Kansas and the 11-state region are corn, grain sorghum, wheat, soybean meal, DDGs, and meat & bone meal, and wheat midds. Total use of these ingredients in 2020 was 11.8 million tons in Kansas and 110.5 million tons in the 11-state region (Table 27). Corn is by far the leading feed ingredient at 7.4 million tons in Kansas and 75.8 million tons in the region. For Kansas, the next most used ingredient is DDG (2.4 million tons) followed by grain sorghum (986,000 tons), wheat midds (394,000 tons), soybean meal (331,000 tons), meat & bone meal (157,000 tons), and wheat (139,000 tons).

The order of ingredients changes for the 11-state region. Corn is still the leading feed ingredient with 75.8 million tons fed. The second most used feed ingredient is DDG (13.6 million tons); followed by soybean meal (12.9 million tons), wheat midds (3.5 million tons), grain sorghum (2.6 million tons), meat & bone meal (1.2 million tons), and wheat (960,000 tons).

Table 27. Feed demand mix for Kansas and 11-state region (tons)

Feed Demand Mix for Kansas and 11-State Region 1,000 Tons								
Area	Corn	Grain Sorghum	Wheat	Soybean Meal	DDG	Meat & Bone Meal	Wheat Midds	7-Ingredient Total
KS	7,377	986	139	331	2,415	157	394	11,798
11-State Region	75,828	2,600	960	12,875	13,601	1,167	3,488	110,519

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On a percent of the 7-ingredient total, Kansas feeds slightly more grains (76%) than does the 11-state region (74.6%) but Kansas feeds less corn, more grain sorghum and more wheat than the region as a whole. The 11-state region feeds more protein feeds (25.5%) than Kansas (24%) however, Kansas rations have less soybean meal but more DDG, more meat & bone meal, and slightly more wheat midds than rations in the 11-state region (Table 28).

Table 28. Feed demand mix for Kansas and 11-state region (percent of 7-ingredient total)

Feed Demand Mix for Kansas and 11-State Region Percent of 7-Ingredient Total							
Area	Corn	Grain Sorghum	Wheat	Soybean Meal	DDG	Meat & Bone Meal	Wheat Midds
KS	66.4%	8.3%	1.3%	3.0%	17.3%	1.4%	2.3%
11-State Region	71.4%	2.3%	0.9%	12.0%	10.2%	1.1%	2.2%

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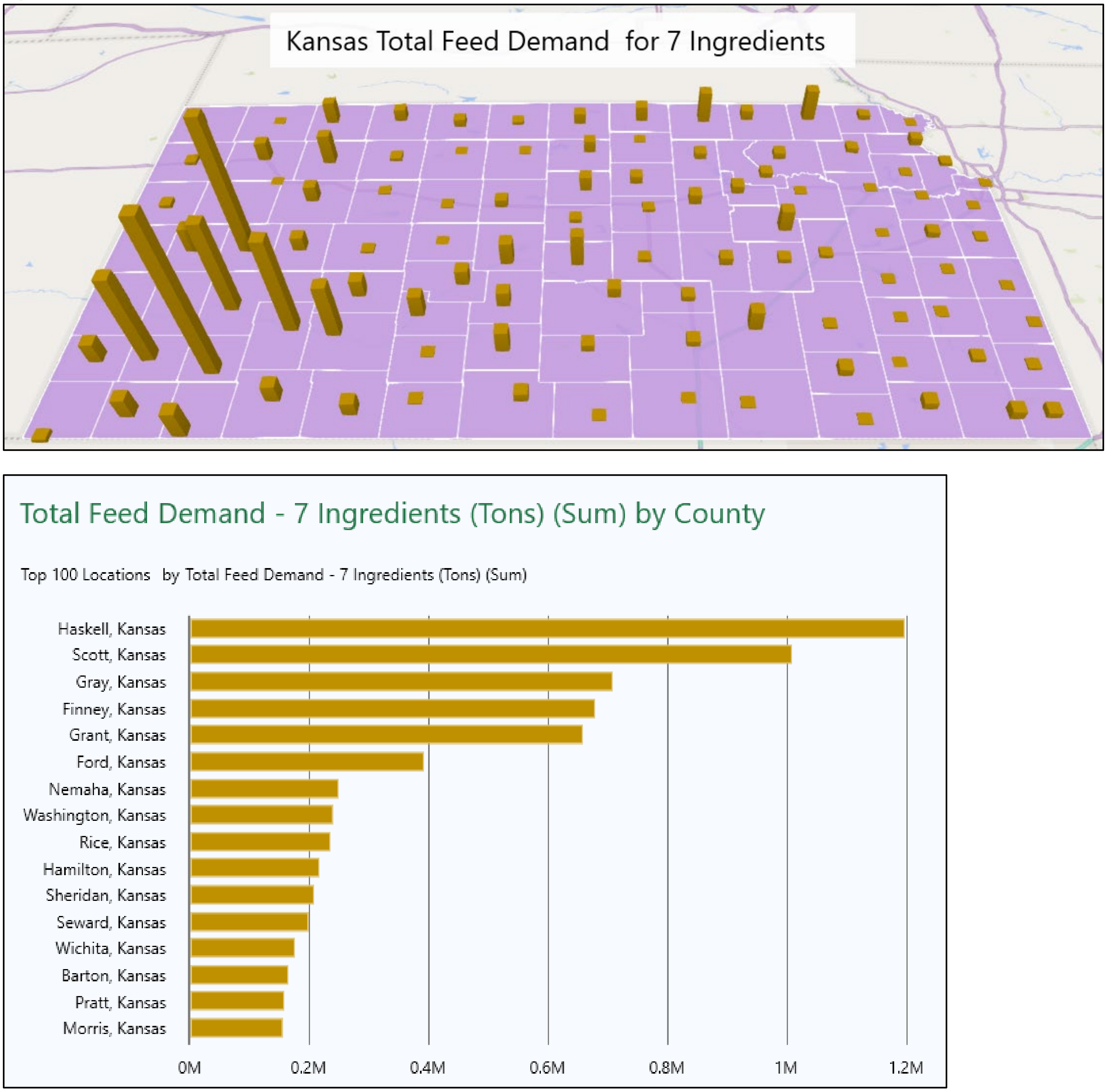
4.3.1 County level feed demand summary

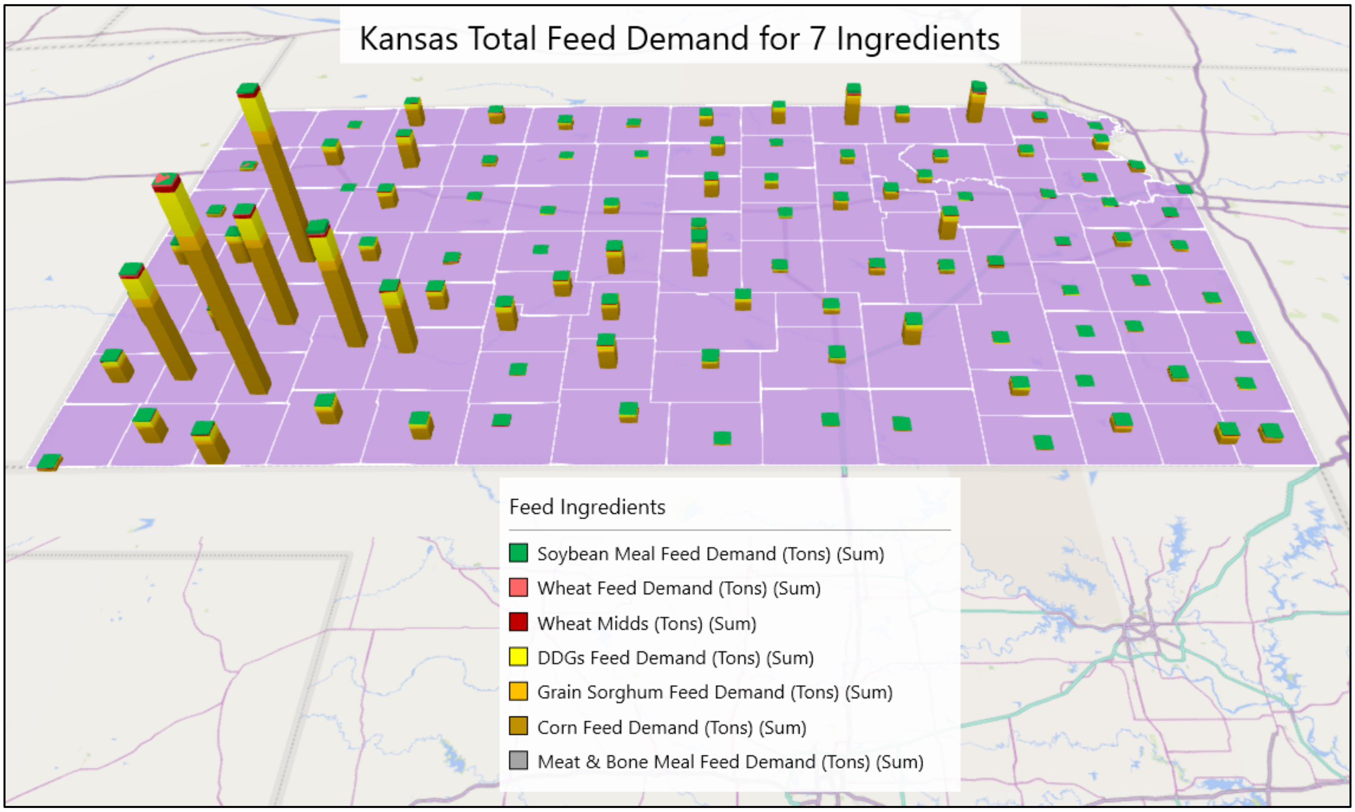
The seven most-used feed ingredients in Kansas are corn, grain sorghum, wheat, wheat midds soybean meal, DDGs, and meat & bone meal. Total use of these ingredients in 2020 was 11.1 million tons. Concentrated in the southwestern corner of Kansas, the top 10 counties for feed consumption use 52% of the feed in Kansas (Figure 139).

Figure 139. Kansas total feed demand



In Kansas, corn is the most used feed ingredient comprising 62.5% of the 7-ingredient total (Figure 140). Grain sorghum (8.4%), DDGs (20.5%), feed wheat (1.2%), wheat midds (3.3%), soybean meal (2.8%), and meat & bone meal (1.3%) make up the balance of feed ingredients used within Kansas.

Figure 140. Kansas total feed demand for 7 ingredients by ingredient



4.3.2 Potential gaps in feed supply

Of the seven major feed ingredients, DDGs are by far the commodity with the greatest risk for a potential gap in feed supply. As shown in section 3.1.1, not only is Kansas a net demander of more than one million tons of DDGs, but there is also significant demand-side pressure from neighboring states, particularly Oklahoma and Texas. As a result, Kansas DDG production only supplies one quarter of its total demand according to the commodity flow analysis. This is due to strong demand for DDGs from Kansas that draws DDGs supplies from Kansas ethanol plants to Oklahoma and Texas with Kansas feed lots and feed mills then importing DDDs from Nebraska and Iowa to fill the gap. (See Table 9.) This gap is likely to increase in the coming years, with the opening of a new cheese processing facility in Dodge City, which is likely to lead to an increase in Kansas dairy cows (and therefore increased DDG demand).

A similar situation exists with soybean meal. According to the commodity flow analysis, significant demand from southern states results in Kansas needing to receive some soybean meal from Missouri and Nebraska (section 3.1.2). However, the risk is smaller for soybean meal compared to DDGs for three reasons. First, soybean meal is relatively less important as a feed ingredient, making up 2.8% of Kansas feed consumption compared to DDGs' 20.5%. Second, Kansas currently produces more soybean meal than it consumes. It is likely that more in-state procurement of soybean meal could occur in the case of a shortage. Third, the upcoming construction of a new soybean processing facility in Coffeyville, Kansas will increase the availability of soybean meal for Kansas as well as the southern states currently receiving soybean meal from Kansas.

4.4 Key takeaways

1. Kansas has a substantial amount of on-farm storage and a strong country elevator and terminal elevator network. In addition, Kansas is well positioned with rail shuttle loading facilities within reasonable distances of the major crop growing areas (especially wheat).

2. Farm to market and other rural road infrastructure have become even more important to the viability of Kansas farms as farm-to-first-market transport of commodities has become reliant on 5, 6 and 7-axle semi-truck/trailer combinations.

3. Total tonnage of grain and oilseed crop production in Kansas is 44 million tons. Assuming about 15% of corn and grain sorghum is now fed “on-farm”, then 90% of all grain and oilseeds (39.6 million tons) produced in Kansas move to a “first buyer” every year.

4. Kansas produces 6 million tons of livestock and poultry products that move from the farm (Figure 135 and Figure 136). This production moves from the farm to the first point of purchase, collection or processing by truck. While some of this movement is on state and/or federal highways, a significant portion of this movement occurs on county roads and farm-to-market roads.

5. Off-farm commercial and terminal storage for grains and oilseeds plays an integral role in the marketing flows of Kansas crops. Wheat moves very rapidly from farms and farm storage to commercial storage with only 9% in on-farm storage one quarter after harvest and 58% of the current harvest in commercial and terminal storage. Soybeans stay on farm a bit longer with about 17% on-farm after 90 days and 43% of the harvest in commercial storage. Corn moves a bit slower with 20% still on-farm after 90 days and 33% in off-farm storage.

6. While some commodities move across two or three crop reporting districts, the movement of 13.7 million tons (71.5%) of the in-state commodity movement is within the crop reporting district where the commodity is produced.

7. Kansas used more than 11.1 million tons of major feed ingredients in 2020. Approximately 76% of the feed ingredients are grains (corn, grain sorghum and wheat) and 24% is some form of protein meal (DDG, soybean meal, meat & bone meal, wheat midds).

8. Kansas has net inflows of DDG. Kansas has net outflows of corn, grain sorghum, wheat, soybean meal, and meat & bone meal and wheat midds.

5 Infrastructure utilization

This section provides an overview of the transportation infrastructure serving the movement of freight for Kansas. The movement of agricultural commodities by **truck**, **rail**, and **barge** in and out of the state is analyzed. To estimate the number of **ton-miles**, first, the length of Kansas' freight transportation network for each mode is analyzed. Next, **origin-destination (O-D)** pairs are identified for each of the top freight generators and attractors. Volumes are assigned to the shortest route for each O-D pair. This section concludes with a list of key takeaways and a summary of freight flows by mode.

5.1 Freight infrastructure overview

Privileged by its geographic location, Kansas' multimodal freight system sits at the crossroads of supply chains serving the movement of agricultural freight, not only between Kansas and the rest of the U.S., but with Canada, Mexico, and the world. Kansas' most important exports include corn, soybeans, sorghum, and wheat primarily to Canada, Mexico, and Asia.

The Kansas Department of Transportation (KDOT) defined their freight network in 2014. This network is comprised of highways, rail facilities, waterways, river ports, airports, pipelines, and intermodal facilities. A proposed improvement project must be located on the freight network to be considered in the prioritization process for funding. The infrastructure serving the movement of agricultural freight enjoys access to three modes: truck, rail, and barge, each analyzed next.[16]

5.1.1 Highways

While most state highways entail two-lane undivided roads, interstates provide the highest traffic capacity and handle most traffic. Kansas trucking freight network comprises 10,533 miles of roadways, equal to 8% of the state highways; however, these handle more than two-thirds of the state's freight. Kansas has nine interstate routes covering more than 877 miles, primarily designed for long-distance travel. These routes provide at least four lanes, connect more than 24 major cities and entry/exit points for the state freight movement. These nine routes, their mileage, and the major cities they serve are shown in Table 29.

Table 29. Kansas Interstate highways

Interstate	Miles	Major cities (population > 5,000)
I-35	236	Andover, El Dorado, Emporia, Gardner, Haysville, Kansas City, Lenexa, Merriam, Mission, Olathe, Ottawa, Overland Park, Wichita.
I-70	425	Abilene, Bonner Springs, Colby, Hays, Junction City, Kansas City, Lawrence, Salina, Topeka.
I-135	96	McPherson, Newton, Salina, Wichita.
I-235	17	Wichita.
I-335 (KTA)	50	Emporia, Topeka.
I-435	28	Kansas City, Lenexa, Olathe, Overland Park, Shawnee.
I-470	14	Topeka.
I-635	9	Kansas City.
I-670	2	Kansas City.
Total: 9 routes	**877**	**24 major cities**

Source: FHWA Route Log and Finder List, Table 3 Interstate Routes.

[16] The KDA has concluded its *2019 Strategic Action Plans for KS Agricultural Growth* and is working on close collaboration with the Kansas Department of Transportation (KDOT) to complete the next State Freight Plan and Kansas State Rail Plan updates. Their latest versions publicly available were the *2017 State Freight Plan* and *2017 Kansas State Rail Plan*. KDOT provided the most recent data available for the next updates of these plans.

5.1.2 Truck miles traveled

To establish project, maintenance, and operational priorities for Kansas' trucking freight network, KDOT classifies routes in five categories (Class A-E):

- **Class A:** Same category as interstates. Kansas' main interstates serving freight movement are part of the Primary Highway Freight System (PHFS): I-35, I-70, I-135, I-335, and I-470. Kansas has 730 miles on the PHFS, including the Kansas Turnpike, a 236-mile toll-road owned by the Kansas Turnpike Authority (KTA) between Kansas City and Oklahoma's state line.
- **Class B:** This category includes principal arterials and non-PHFS corridors used by and long-haul carriers. These routes are widely spaced throughout the state connecting the southern state line with the northern one (i.e. the majority run in the north-south direction).
- **Class C:** These routes are closely integrated with Class A and B routes to serve all parts of the state. Locations that are not connected by Class A or B routes are served by a Class C route.
- **Class D:** This category includes minor routes providing access to small urban areas and other communities not on a higher-class route; particularly important for inter- and intra-county travel, serving short trips.
- **Class E:** These routes are used to connect rural residents with the other routes or to provide access to small towns in the same area.

Although the interstates and turnpike account for only 8% of the centerline miles, these highways accommodate over 44% of the annual truck miles in Kansas. The State Highway System by classification, miles, and truck miles of travel is listed in Table 30.

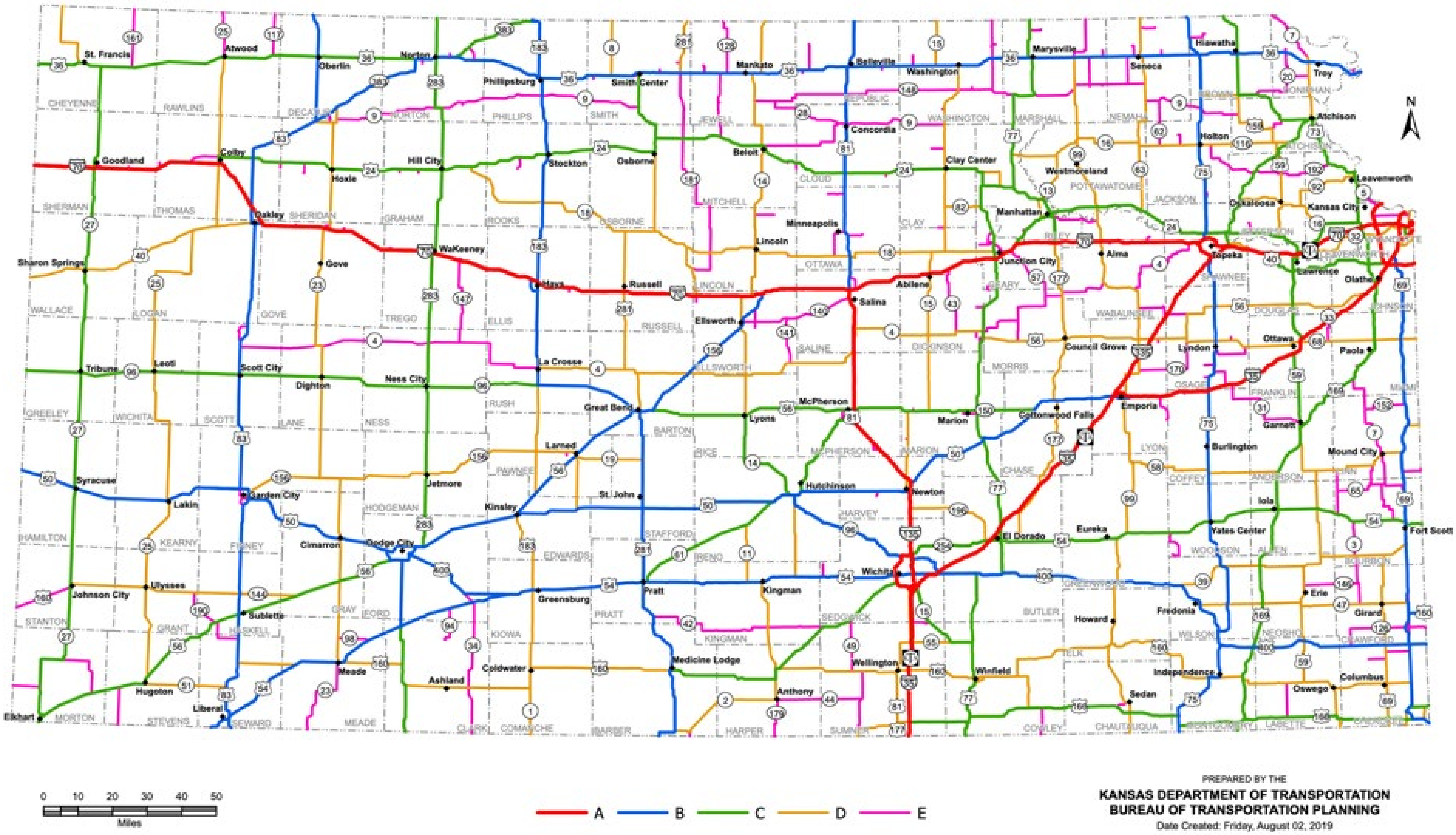
Table 30. Mileage and daily travel by KDOT route classification system

KDOT classification	Centerline miles	% From State total	Total truck miles of travel	% From State total	Total truck miles of travel	
					As % of total VMT	As % of total truck miles
Class A	874	8.3%	3,378,550	43.8%	16.2%	43.8%
Class B	2,177	20.7%	2,176,715	28.2%	18.3%	28.2%
Class C	2,453	23.3%	1,245,753	16.1%	12.9%	16.1%
Class D	3,233	30.7%	755,865	9.8%	13.6%	9.8%
Class E	1,797	17.1%	165,280	2.1%	11.2%	2.1%
Total	**10,534**	**100%**	**7,722,163**	**100%**	**15.6%**	**100%**

Source: KDOT, 2015. Modified by Bujanda & Allen.

The Kansas highway network includes several freeways with four or more lanes and principal arterials also with multiple lanes. Two-lane highways, mostly equipped with passing lanes, often serve as first- and last-mile connections to major originators and attractors of agricultural freight in rural areas. More than 20,000 miles of non-state rural collectors also provide connectivity to the Kansas highway network. Kansas' highway network and each county are illustrated in Figure 141.

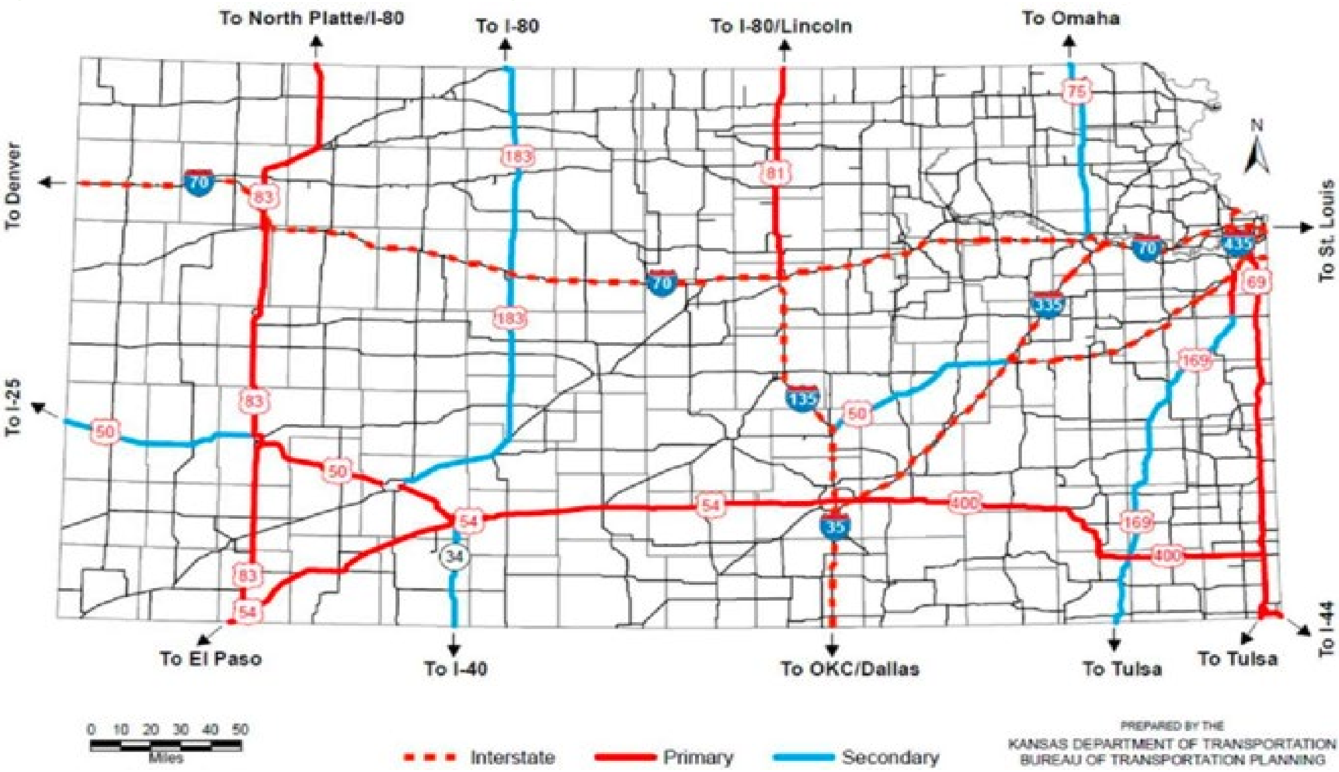
Figure 141. KDOT Route Classification System



Source: KDOT, 2020

The Kansas State Freight Corridors of Significance is designated by the Kansas Freight Advisory Committee (KFAC) to prioritize the most important corridors for the movement of cargo. The latest version was approved by the KFAC in 2014. Kansas State Freight Corridors of Significance consider the PHFS as the backbone for commerce and expand the network by including additional roadways critical for the flow of cargoes. The Kansas Freight Corridor of Significance map is shown in Figure 142.

Figure 142. Kansas' State Freight Corridors of Significance



Source: KDOT, 2017.

5.1.3 Intermodal connectors

Intermodal connectors link major freight generators and attractors to highways. These connectors are usually located near points of origin and import-export gateways. They provide enhanced accessibility and connectivity to rail yards, river ports, airports, and other freight activity nodes. Intermodal connectors provide flexibility by allowing the most efficient use of individual modes for different trip segments. Kansas' intermodal connectors, as designated by the Federal Highway Administration (FHWA), are shown in Table 31.

Table 31. FHWA Intermodal connectors serving the movement of agribulk freight

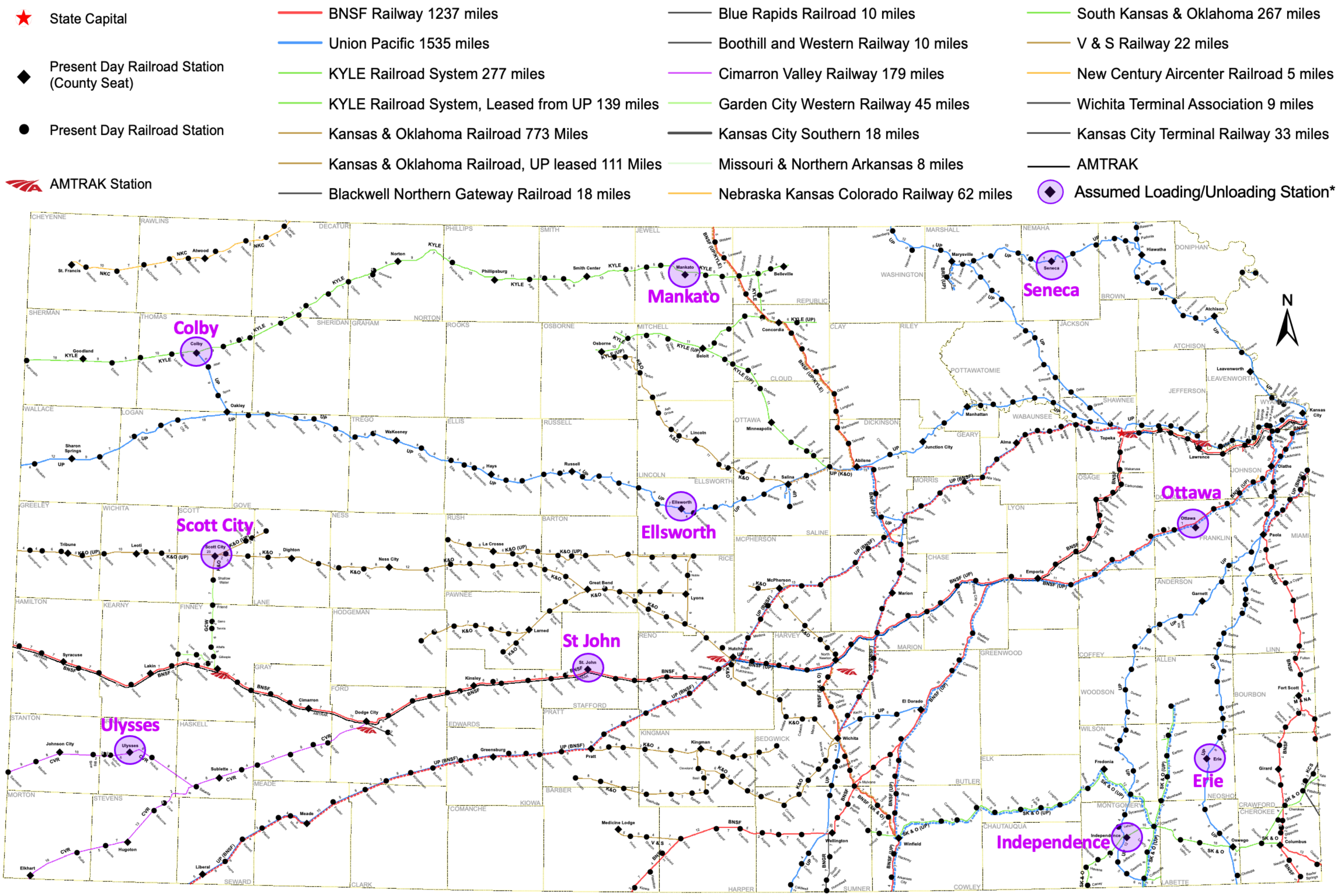
Intermodal facility	Type	Number	Description	Length (mi)	ID
BNSF Argentine Yard, Kansas City	Truck/Rail facility	1	From I-635 E on K-32 for 0.462 mi, S 0.1 mi on 39^{th}, E 0.1 mi on Fairbanks, S 0.1 mi on 38^{th}	0.8	KS2R
BNSF Argentine Yard, Kansas City	Truck/Rail facility	2	From U.S. 69 W on K32 for 1.248 mi, S 0.1 mi on 39th, E 0.1 mi on Fairbanks, S 0.1 mi on 38th	1.3	KS2R
UP's 18^{th} St Yard, Kansas City	Truck/Rail facility	1	From I-635 E on K-32 for 1.710 mi, N 0.2 mi under 18th, 0.3 mi west on Baynard	0.5	KS3R
UP's 18^{th} St Yard, Kansas City	Truck/Rail facility	2	From U.S. 69 under 18th St heading north, west on Baynard (no additional miles)	0.0	KS3R
Total: 4 routes				**2.6 mi**	

Source: FHWA Planning, NHS, Intermodal Connectors, Kansas.

5.1.4 Rail

Kansas is a critical hub for rail transportation in North America. It has the sixth-largest statewide freight rail network in the nation, connecting more than 900 incorporated and unincorporated communities on or near the tracks with domestic and international markets. Kansas rail network comprises 4,216 miles of total track, which are served by **four Class I** railroads, **eleven Class III** short lines, and **three switching railroads**. There are more than 105 freight transfer facilities in the state. Union Pacific (UP), BNSF Railway, and Kansas City Southern Railway (KCS) are the three Class Is that own and operate tracks in the state. Norfolk Southern Railway (NS) operates over 3 miles of trackage rights. Short lines operate about 40 percent of the state's total track. Kansas' freight rail network is shown in Figure 143.

Figure 143. Kansas' freight rail network



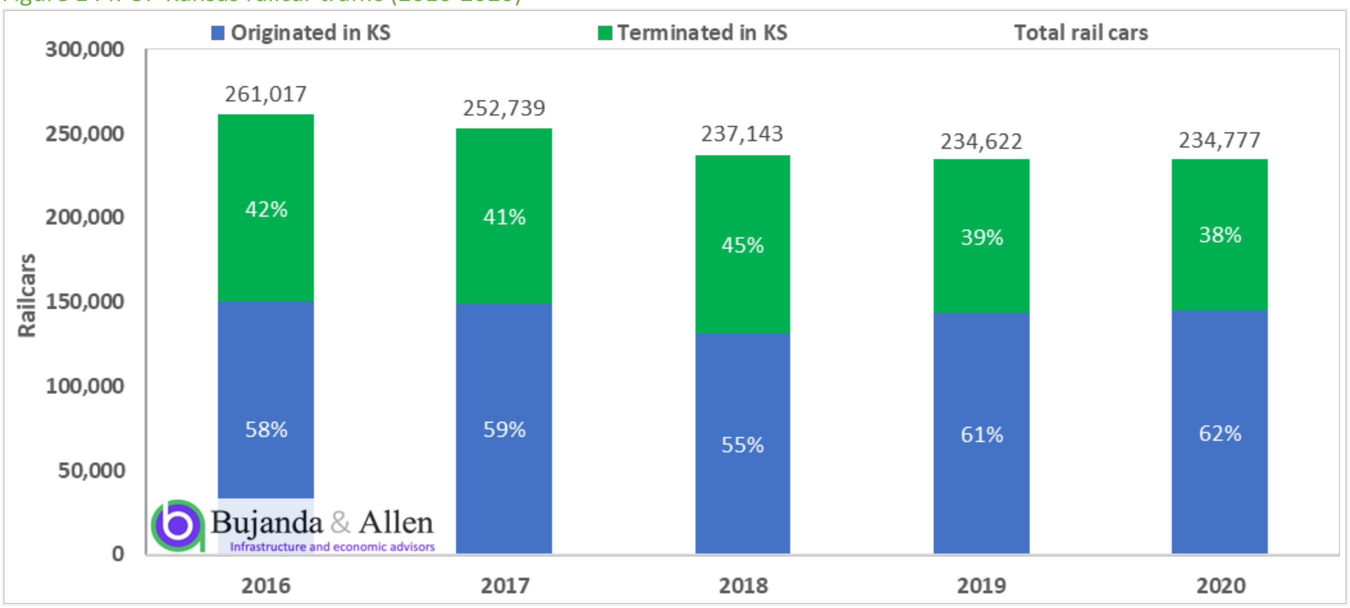
Source: 2019 Kansas State Rail Map, KDOT.

Class Is operate 2,723 miles of owned tracks in Kansas (i.e., excluding trackage rights over lines not owned), from which 313 miles are leased to Class III short lines. UP and BNSF are the top-2 owners of main lines, with UP owning 1,563 miles and BNSF 1,142 miles, respectively. KCS only owns 18 miles in the state. All railroads operate more track miles under leasing and similar agreements.

Union Pacific

UP has 13 subdivisions in Kansas totaling 2,199 miles of track, most aligned into corridors, with six main ones. Each corridor handles substantial volumes in and through the state and considerable first and last mile traffic for local shippers and receivers. In the northeast part of the state, a piece of a transcontinental corridor passes through Topeka and Kansas City. In the North-South direction, important corridors connect the state to the U.S.-Mexico border and seaports in Texas and Louisiana. From 2016-2020, railcars originated in Kansas have been 59% on average of the total Kansas' railcar traffic, compared to 41% for those terminating in the state, as illustrated in Figure 144. The top commodities moved for the state in 2020 are shown in Table 32.

Figure 144. UP Kansas railcar traffic (2016-2020)



Source: Bujanda & Allen, 2021.

Table 32. Top-5 commodities shipped and received to/from Kansas by UP in 2020

Shipped	Received
1. Assembled autos	1. Assembled autos
2. Biofuels & sweeteners	2. Cement, roofing, & misc. minerals
3. Fertilizer	3. Coal
4. Grain	4. Fertilizer
5. Wheat & flour	5. Stone & gravel

Source: Bujanda & Allen with data from UP.

The six main corridors for UP in Kansas (only segments within the state) are described next:

- **Golden State Route**—This is the primary route between Southern California, including the Ports of Los Angeles and Long Beach, and Kansas City (455 miles), subsequently routed to St. Louis and Chicago. This route enters Kansas near Liberal, in the state's southwestern corner, and terminates at Kansas City. Most of it is single-track, with centralized traffic controls (CTC).
- **Marysville Cutoff**—Begins at Gibbon, NE where it leaves UP's main east-west line, enters Kansas along its northern state line, and terminates at Kansas City (173 miles). This route handles mainly coal trains

from the Powder River Basin in Wyoming to utilities in Kansas, Missouri, Oklahoma, Louisiana, Arkansas, and Texas. Most of it is double-track with CTC.

- **Kansas Pacific Route**—Begins at Denver entering the state near Sharon Springs en route to Kansas City (445 miles). Primary traffic is unit coal trains that originate in the Yampa and North Fork Coal fields in Colorado en-route to the Midwest. It also originates grain moving in unit trains and blocks of 26 – 52 cars. Most of it is single-track, not equipped CTC.
- **Falls City Subdivision**—Begins at Omaha, NE and terminates at Kansas City (96 miles). Primary traffic is general freight. Most of it is single-track, equipped with CTC.
- **Oklahoma, Kansas & Texas Railroad (OK&T)**—Formed out of the bankruptcy of the Chicago Rock Island & Pacific Railroad, this route begins at Herrington, exiting Kansas near Wellington en route to Oklahoma City and Fort Worth (125 miles). Main traffic is unit grain trains originating on the Kansas Pacific. The OK&T is single-track and is mostly not signaled.
- **Missouri Pacific and Katy Lines Routes**—Both lines run south from Kansas City leaving the state near Coffeyville and Chetopa. The Missouri Pacific line runs 142 miles south from Paola, while the Katy line is about 160 miles between the Kansas-Oklahoma border and Paola. These lines carry unit grain trains destined to poultry feeders in Arkansas, Oklahoma, and Texas, as well as grain trains for export at Galveston or the Mexican border. Both are single-track with CTC.

UP's network in Kansas can carry maximum loaded car weights of 286,000 pounds and has no clearance restrictions. Overall, UP reports no capacity shortages in Kansas. In 2020, UP realized $107.1 million of capital investments in the state.

BNSF

BNSF has 11 subdivisions in Kansas totaling 2,084 miles of track, which funnel into two main corridors connecting to the U.S. West Coast (USWC): (i) The Kansas-Panhandle-Albuquerque-Los Angeles-Oakland corridor and (ii) The Kansas-Las Animas-Denver-Wyoming-Spokane-Pacific Northwest. BNSF's Transcontinental (Transcon) corridor connects Chicago to Los Angeles and Oakland, but it is not a primary export grain route as it skirts the primary grain growing areas.[17] The Kansas segment of the Transcon is about 305 miles in length.

To the south, BNSF subdivisions in Kansas funnel also into three main corridors: (i) The Kansas-Panhandle-Albuquerque-El Paso connecting with Ferromex on the Mexican side, (ii) The Kansas-Emporia-Dallas-Houston/Laredo, primarily for unit grain trains destined to export at Galveston or Laredo connecting with KCS at the Mexican border, and (iii) The Kansas-Memphis-Atlanta, primarily for general intermodal freight. Most of BNSF corridors are double-track equipped with CTC. BNSF subdivisions in Kansas are described in Table 33.

[17] Port of Oakland, USDA Partner to Speed Up Agricultural Exports. *Port of Oakland*, February 1st, 2022. https://www.portofoakland.com/press-releases/port-of-oakland-usda-partner-to-speed-up-agricultural-exports. The Port of Oakland, with the help of the USDA, set up and started operations on a 22-acre, pop-up container yard specifically for agricultural exports. Bujanda & Allen expects this will increase traffic in the Kansas-Oakland BNSF corridor, providing farmers in Kansas, Iowa, Minnesota, Illinois, and other Midwestern states with a competitive alternative to the PNW route.

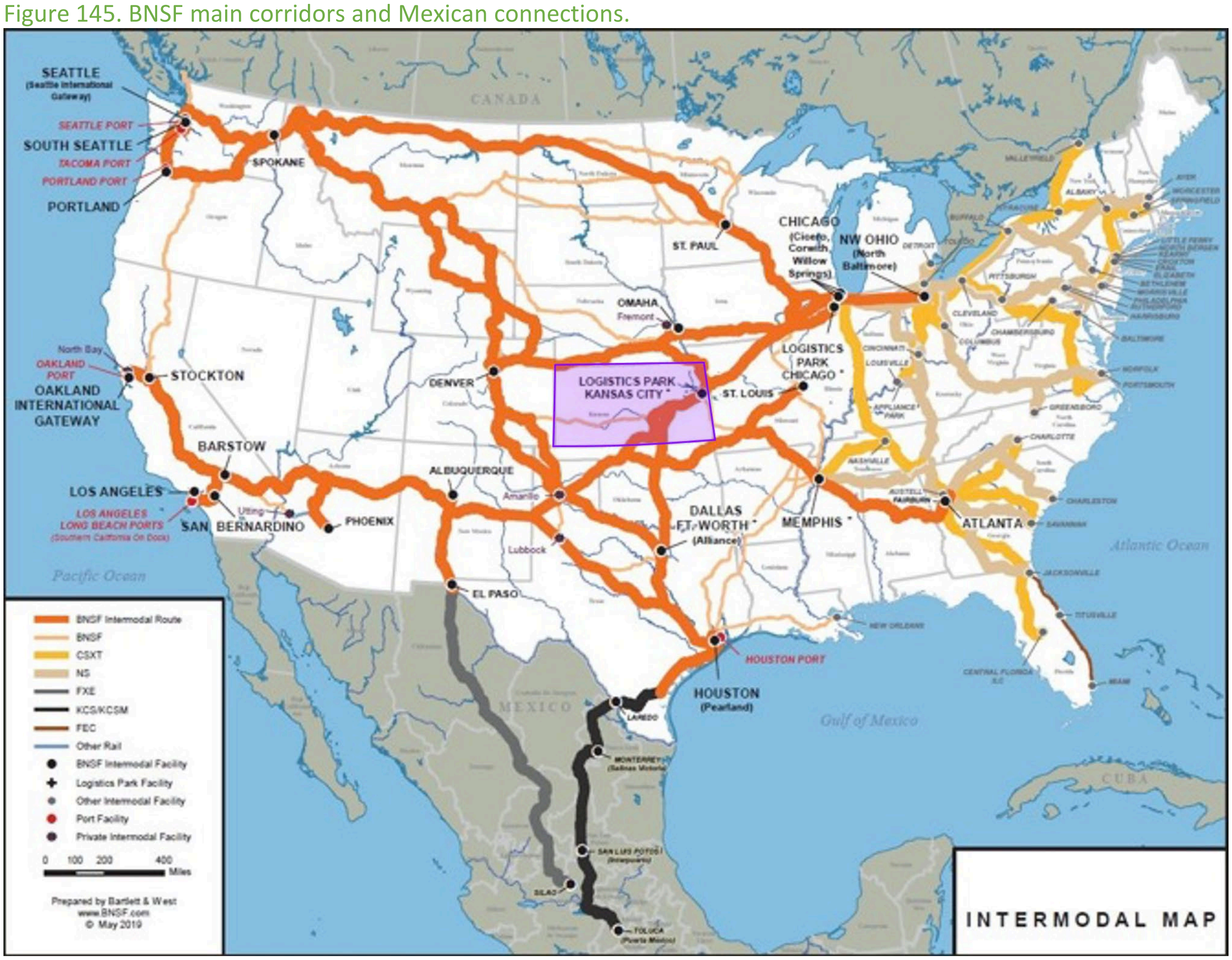
Table 33. BNSF information for Kansas subdivisions

BNSF subdivision	Track miles	Avg. Trains per Day	Main commodities
Afton	83	12	Coal, general freight
Arkansas City	78	31	Coal, **grain**, intermodal, general freight
Douglas	31	10	Coal, **grain**, intermodal, general freight
Emporia	239	81	Coal, **grain**, intermodal, general freight
Fort Scott	199	18	Coal, **grain**, general freight
La Junta			
Elinor-Newton	61	34	**Grain**, intermodal, general freight, Amtrak
Newton-Dodge City	168	6	**Grain**, general freight, Amtrak
Dodge City - Las Animas, CO	184	6	General freight, Amtrak
Panhandle	313	58	**Grain**, intermodal, general freight
Red Rock	260	25	Coal, **grain**, intermodal, general freight
St Joseph	207	43	Coal, **grain**, general freight
Strong City	151	5	Coal, **grain**, general freight
Topeka	110	7	General freight, Amtrak
BNSF totals	**2,084**	**336**	

Source: 2017 KDOT State Rail Plan.\

BNSF's Logistics Park Kansas City intermodal facility provides access to intermodal service between the Midwest, ports, and major markets using BNSF's transcontinental and I-35 trade corridors. This 433-acre, $250 million facility opened in October 2013, with an initial lift capacity of 500,000 containers per year, with plans to expand to 1.5 million. The logistics park and its corridors are shown in Figure 145.

Figure 145. BNSF main corridors and Mexican connections.



Source: BNSF, 2019.

As of 2021, BNSF had line capacity expansion projects between Wellington and Ellinor driven by customer demand to eliminate constraints and bottlenecks. BNSF's network in Kansas can carry maximum loaded car weights of 286,000 pounds and has no clearance restrictions.

KCS

There are two KCS subdivisions in Kansas, and these subdivisions are part of KCS's one principal north-south route. The main line follows the Kansas–Missouri border southbound from Kansas City (mostly on the Missouri side) and crosses into Kansas northeast of Pittsburg. The line exits Kansas southeast of Pittsburg continuing into Missouri. KCS reported that the capacity on the two subdivisions in Kansas is adequate for providing fluid conditions for the planned traffic. KCS's network in Kansas can carry maximum loaded cars of 286,000 pounds. KCS has no clearances restrictions on its network in Kansas. KCS has no major improvement planned outside of routine maintenance for Kansas.

Class III

Class III railroads are also known as local, terminal, and switching railroads. Class III carriers providing line haul services are known as short lines and they provide connections for shippers to the Class Is and the national rail system. There are 11 short lines and three terminal and switching railroads in Kansas. The Class III railroads and their mileages appear in Table 34.

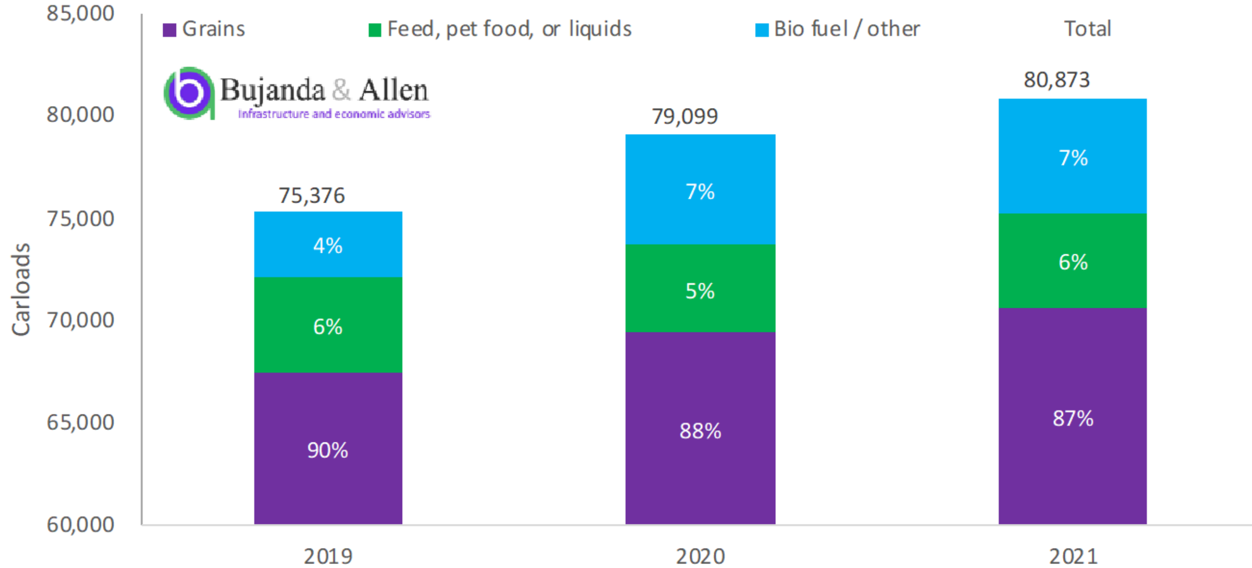
Table 34. Class III railroad short lines in Kansas

Class III short lines	Main lines owned (mi)	Lines leased from Class I (mi)	Total excluding trackage rights (mi)
1. Blackwell Northern Gateway Railroad	18		18
2. Blue Rapids Railroad	10		10
3. Boot Hill & Western Railroad	10		10
4. Cimarron Valley Railroad	179		179
5. Garden City Western Railroad	45		45
6. Kansas & Oklahoma Railroad	554	166	720
7. Kyle Railroad	282	139	421
8. Missouri & Northern Arkansas		8	8
9. Nebraska, Kansas, Colorado Railway	62		62
10. South Kansas & Oklahoma	267		267
11. V&S Railway	25		25
Switching and terminal railroads			
1. Kansas City Terminal (KAW River Railroad)	27		27
2. New Century Air Center	5		5
3. Wichita Terminal Assoc. & Wichita Union Terminal	9		9
Total Class III	**1,493**	**313**	**1,806**

Source: 2017 KDOT State Rail Plan.

Bujanda & Allen and KDOT interviewed the top short lines operating in the state to obtain traffic volumes by commodity from 2019 to 2021. Such data was aggregated in three general commodity types to preserve confidentiality. Overall carloads increased 4.9% from 75,376 in 2019 to 79,099 in 2020. From 2020 to 2021, carloads handled by the main short lines increased 2.2% to 80,873. Carload volume of surveyed short lines in Kansas are shown in Figure 146.

Figure 146. Carload volume of surveyed short lines in Kansas and share by commodity type



Source: Bujanda & Allen, 2021.

Railroad projects in KS

KDOT supports rail projects through two funding programs, each with the following characteristics:

- **State Rail Service Improvement Fund (RSIF)**—Through the RSIF, qualified entities that may apply for project that improve the condition or expand the capacity of the state's railroads and projects that can be used to recruit or expand business by providing better access to the state's rail network. Typical projects include major rail rehabilitation, construction, and expansion projects, such as rail spurs, sidings, and extensions. Qualified entities that may apply include:
  - **Class III short lines**, as defined in 49 C.F.R., part 1201 holding a certificate of public convenience from the STB.
  - **Port authorities**, established by Kansas Statute, in coordination with the serving railroad (short line or Class 1).
  - **Local governments** (city or county) in coordination with the serving railroad (short line or Class I); and
  - **Shippers** in coordination with the serving railroad (short line or Class I).

  A benefit-cost analysis (BCA) is required on all RSIF applications. The resulting benefit-cost ratio (BCR) must be at least one to qualify. Qualifying projects are ranked based on: BCR, operating efficiencies, car loadings, improved service, job creations, and geographic distribution. A list of the RSIF projects from 2020 to 2022 is provided in Table 35.

- **Short-line Rail Improvement Fund (SLRIF)**—This new program, which is part of the Eisenhower Legacy Transportation Program, is for the purpose of facilitating maintenance, rail relay and the rehabilitation of track, bridge, industrial leads, and sidings on Class II or III (short line) railroads in Kansas. Qualified entities include any Class II or Class III railroad, as defined in 49 C.F.R., or any owner or lessee located on or adjacent to a Class II or Class III (short line) railroad. 30% of total project costs is required in the form of matching funds from the qualified entity. A grant of 70% of total project costs is applied to approved projects. Projects are selected based on their ability to improve:
  - **Maintenance**. Must support the long- term operation of a rail segment, provide direct safety benefits, or have a higher maintenance priority over competing projects.

- **Spurs/sidings.** Must provide economic benefits, competitiveness, new businesses, tie into additional investments, local support, improve efficiencies, or create jobs.
- **Major rehab.** Must help to reduce truck traffic on the highway network, provide more efficient operations and increased reliability, and enhance the safety of rail operations.

A BCA can assist with KDOT's project selection, but it is not required. A list of the SLRIF projects from 2021 to 2022 is provided in Table 36 and a comprehensive list since 2001 in Appendix C.

Table 35. State Rail Service Improvement Fund (RSIF) projects, 2020-2022

Railroad or recipient	Project Number	Length	Subdivision	City to City	Total Project Cost	Loan Amount	Railroad Share	Grant Amount
Boothill and Western	RR-8019-21	9.0	Dodge City	Dodge City to Wilroads	$616,370	$246,548	$184,911	$184,911
Kansas & Oklahoma	RR-8029-22	50.0	Hutchinson	Wichita to Hutchinson	$988,125	$395,250	$296,438	$296,438
Kansas & Oklahoma	RR-8029-23	10.0	McPherson	McPherson to Conway	$372,000	$148,800	$111,600	$111,600
Kansas and Oklahoma	RA-2921-21	1.4	Scott City	Bazine	$1,868,844	$0	$934,422	$934,422
V and S	RA-5711-21	8.0	Medicine Lodge	Attica to Medicine Lodge	$1,064,668	$0	$532,334	$532,334
Kyle	RR-8033-21	85.0	Belleville (#3)	Scandia to Phillipsburg	$666,285	$266,514	$199,885	$199,885
Kyle 286K - Bridges	RA-3331-20	235.5	Multiple	Courtland to Kanorado	$2,492,565	$0	$747,770	$1,744,796
Kyle	RA-3311-21	4.5	Concordia	Beloit to Glen Elder	$3,815,890	$0	$1,526,356	$2,289,534
South Kansas & Oklahoma	RR-8054-21	27.0	Neodesha	Cherryvale to Fredonia	$627,750	$251,100	$188,325	$188,325
South Kansas & Oklahoma	RR-8054-22	29.8	Tulsa	Cherryvale to Caney	$750,301	$300,120	$225,090	$225,090
SKO 286K	RA-5431-20	51.0	Moline, Neodesha W.	Cherryvale to Winfield	$6,416,542	$0	$2,566,617	$3,849,925
South Kansas & Oklahoma	RA-5411-21		Moline, Neodesha	n.a.	$1,903,844	$0	$951,922	$951,922
Cimarron Valley	RA-1611-21	3.385	CVR/Manter	n.a.	$1,618,695	$0	$647,478	$971,217
Cargill, Inc.	RA-9321-21	0.1	n.a.	n.a.	$300,000	$0	$120,000	$180,000
Occidental Chemical	RA-8421-21	2.57	n.a.	n.a.	$4,524,280	$0	$2,262,140	$2,262,140
Total					**$28,026,159**	**$1,608,332**	**$11,495,288**	**$14,922,539**

Source: Bujanda & Allen with data from KDOT, 2022.

Table 36. Short-line Rail Improvement Fund (SLRIF), 2021-2022

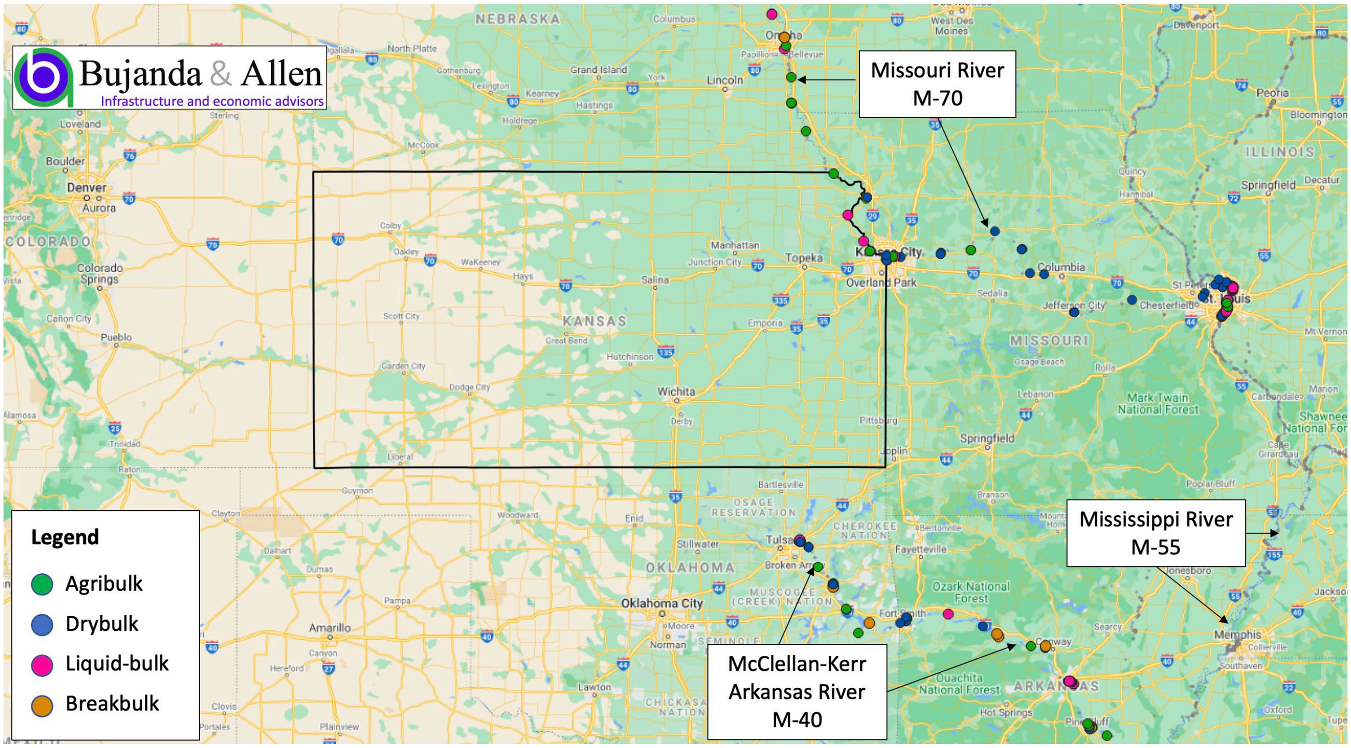
Railroad or recipient	Project Number	Total Project Cost	Railroad Share	Grant Amount
2021				
V&S	4 RA-5716-21	$963,439	$289,032	$674,407
New Century AirCenter Railroad	6 RA-7216-21	$365,947	$109,784	$256,163
Skyland Grain - Elkhart	5 RA-9218-21	$64,284	$19,285	$44,999
Scoular Grain - Downs	1 RA-9317-21	$138,917	$41,675	$97,242
Scott City Coop - Grigston	6 RA-9417-21	$51,497	$15,449	$36,048
Scott City Coop - Manning	6 RA-9417-21	$50,435	$15,131	$35,304
Scoular Grain - Goodland	1 RA-9316-21	$101,866	$30,560	$71,306
Skyland Grain - Manter	4 RA-9216-21	$49,936	$14,981	$34,955
Cimarron Valley	6 RA-1616-21	$1,639,698	$491,909	$1,147,789
South Kansas and Oklahoma	6 RA-5416-21	$596,558	$178,967	$417,591
Total		**$4,022,577**	**$1,206,773**	**$2,815,804**
2022				
Bartlett Grain	5 RA-6321-22	$2,591,358	$777,408	$1,813,950
South Kansas & Oklahoma	9 RA-5412-22	$163,893	$49,168	$114,725
KYLE	2 RA-3311-22	$1,000,000	$300,000	$700,000
Central Valley Ag Coop	2 RA-6221-22	$602,816	$180,845	$421,971
Scoular Grain - Downs	71 RA-9311-2	$260,847	$78,254	$182,593
Hutchinson Transportation	8 RA-6411-22	$733,883	$220,165	$513,718
Midland Marketing Cooperative	3 RA-6021-22	$667,870	$200,361	$467,509
Kansas & Oklahoma	7 RA-2911-22	$765,403	$229,621	$535,782
Gavilon Grain	7 RA-6611-22	$400,133	$120,040	$280,093
Total		**$7,186,203**	**$2,155,862**	**$5,030,341**

Source: Bujanda & Allen with data from KDOT, 2022.

5.1.5 Inland ports and waterways

Kansas has direct access to inland barge navigable waterway via the Missouri River, marine highway 70 (M-70), and indirect access via the McClellan–Kerr Arkansas River Navigation System (MKARNS), M-40. Both connect to the Mississippi River (M-55), as illustrated in Figure 147.

Figure 147. Inland barge navigable waterway serving Kansas by main cargo type



Source: Bujanda & Allen, 2021.

The Missouri River provides 122 miles of potential access to the waterway over several river ports and docks along the northeast corner of Kansas, which include **13 river terminals**. The main commercial terminals are located near St Joseph, Atchison, Leavenworth, Lansing, White Cloud, and Kansas City.

There are 4 terminals that handle primarily agribulk commodities:

- White Cloud Grain Co, in White Cloud, KS
- Bartlett and Co, in Buchanan County, MO
- Cargill Inc, in Clay County
- ADM-Growmark, in Leavenworth, KS

There are also 4 terminals that handle primarily drybulk commodities (sand, gravel, and fertilizer) located in Buchanan County, Clay County, Jackson County, and Platte County.

The MKARNS is composed by the Verdigris, Arkansas, and White Rivers and is 445 miles long, which include 73 river terminals. The main commercial terminal for Kansas' trade is in the Port of Catoosa, located in Tulsa, OK, 62 miles south from the Stateline near Coffeyville, KS. There are **17 terminals** that handle primarily agribulk commodities, as illustrated in Table 37.

Table 37. Terminals that handle primarily agribulk commodities in the McClellan–Kerr Arkansas River Navigation System.

	River terminal owner and/or operator	River mile	Location	State
1.	City of Tulsa – Rogers County Port Authority	445	Catoosa	OK
2.	Consolidated Grain and Barge Co.	412	Wagoner	OK
3.	Muskogee City-County Port Authority	393	Muskogee	OK
4.	Muskogee City-County Port Authority	393	Muskogee	OK
5.	Consolidated Grain and Barge Co.	363	Webbers Falls	OK
6.	Consolidated Grain and Barge Co.	299	Van Buren	AR
7.	West-Ark Export Elevator Inc.	298	Van Buren	AR
8.	Bruce Oakley Inc	172	Morrilton	AR
9.	Bunge Corporation	75	Pine Bluff	AR
10.	TW Pelton & Co	73	Pine Bluff	AR
11.	Tyson Foods Inc	71	Pine Bluff	AR
12.	Global Materials Services LLC	71	Pine Bluff	AR
13.	Tyson Foods Inc	70	Pine Bluff	AR
14.	Bunge Corporation	55	Linwood	AR
15.	Riceland Inc	22	Dumas	AR
16.	Jack Whitmore	21	Dumas	AR
17.	Port of Keota Corporation	11	Keota	OK

Source: Bujanda & Allen, 2021.

5.2 Freight movements modal split

To determine the modal split by commodity, Bujanda & Allen analyzed data for the movement of agricultural commodities by truck and rail in and out of the state from the fifth version of the Freight Analysis Framework (FAF^5) from the FHWA. Based on 2020 FAF^5 data flows, O-D maps were developed for three main cargo flows in and out of Kansas: (i) Domestic flows inbound, (i) Domestic flows outbound, and (ii) Exports (outbound), each analyzed for all agricultural commodities combined in the following sections. Additional O-D pairs were also identified for each of the major commodity types moving in and out of Kansas:

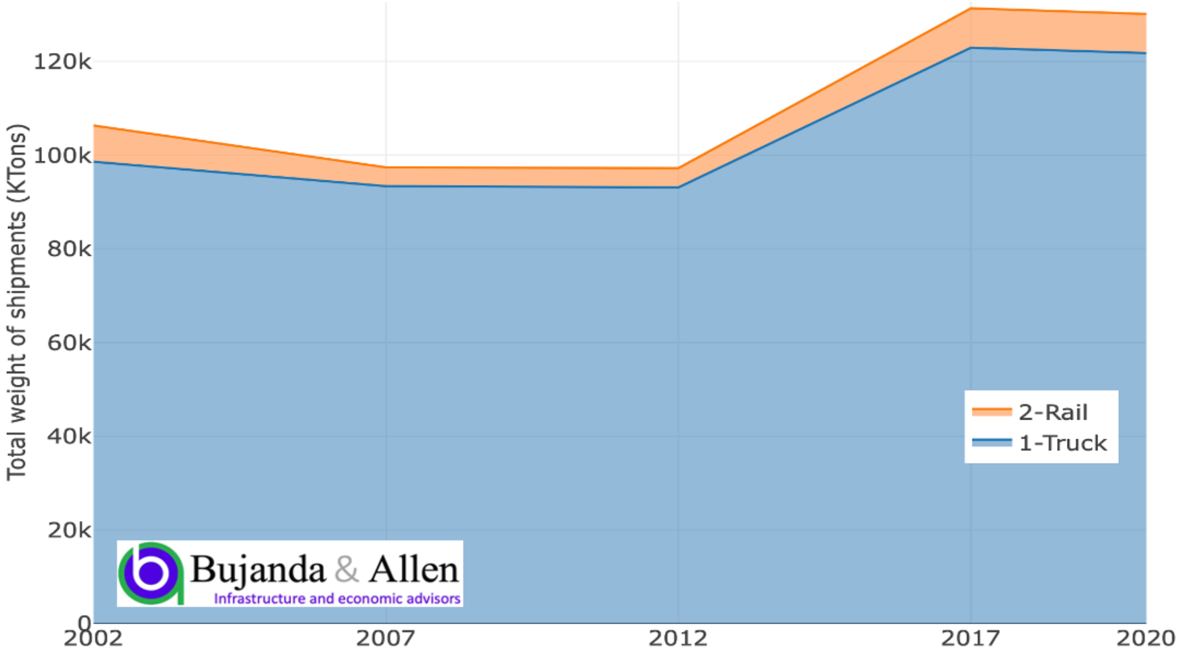
- **Grains:** corn, sorghum, soybeans, wheat.
- **Feed and Pet Food:** DDGs, soybean meal, wheat mill-feeds, meat & bone meal.
- **Livestock and Poultry:** beef & dairy cows, fed cattle, hogs, sheep and goat, broilers, turkeys, layers, horses.

The volume of Import flows (inbound) reported for ag commodities was minimal, hence, not considered.

5.2.1 Domestic flows *inbound*

Domestic flows comprise only shipments associated with domestic freight moved between domestic origins and domestic destinations (i.e. from Kansas to the remaining states and vice versa). No foreign trade is included in these flows. Historical trends between 2002 and 2020 indicate that truck has been by far the predominant transportation mode used within Kansas and between Kansas and the rest of the states. Domestic flows terminating in Kansas (*inbound*), historical FAF^5 data indicates a relatively constant modal split around **94% truck (6% rail)** through the entire period, as illustrated in Figure 148.

Figure 148. Modal split for ***domestic flows*** of agricultural commodities terminating in Kansas (***inbound***)



Source: Developed by Bujanda & Allen, with FAF5 data, 2021.

O-D maps were also created but now for the domestic flows ***terminating*** in Kansas using 2020 FAF5 data. Overall, the modal split is 94% truck (6% rail) when all states, including Kansas' intrastate movements, are considered. Domestic flows originate primarily in Oklahoma, Nebraska, Missouri, and Iowa. The modal split for 2020 domestic flows of agricultural commodities terminating in Kansas (*inbound*) and each of the top-10 states where these commodities originate are shown in Table 38.

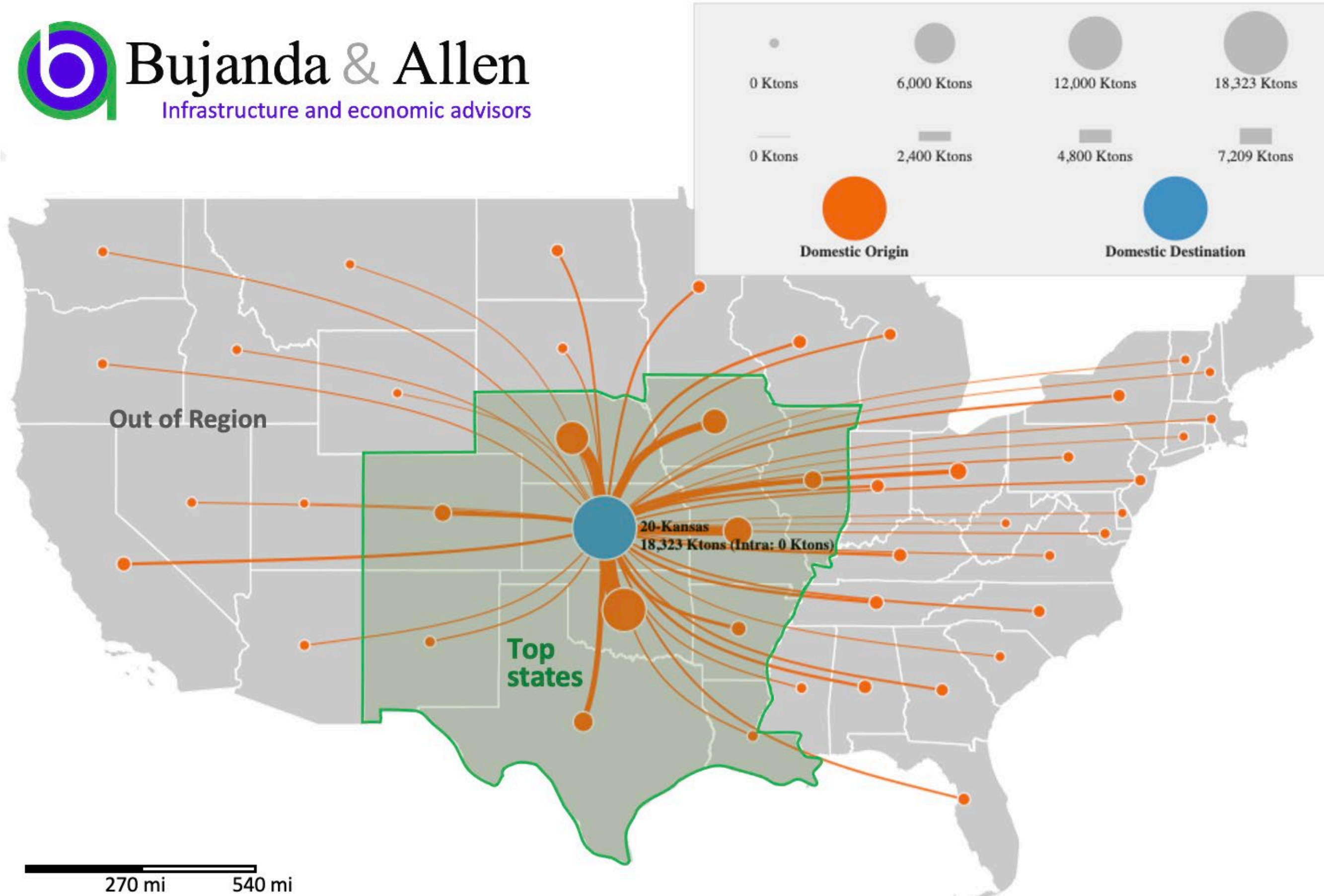
Table 38. Modal split for ***domestic flows*** terminating in Kansas: All Ag Commodities ***inbound***

Domestic Origin	2020 Truck/Rail modal split Truck	Rail	Total
1. Kansas (intrastate)	**94%**	**6%**	**100%**
2. Oklahoma	100%	0%	100%
3. Nebraska	93%	7%	100%
4. Missouri	100%	0%	100%
5. Iowa	90%	10%	100%
6. Texas	100%	0%	100%
7. Illinois	89%	11%	100%
8. Colorado	100%	0%	100%
9. Arkansas	100%	0%	100%
10. New Mexico	100%	0%	100%
11. Louisiana	100%	0%	100%
12. Out of Region	90%	10%	100%

Source: Developed by Bujanda & Allen, with FAF5 data, 2021.

Regarding total domestic flows of agricultural commodities, the vast majority of activity took place within Kansas (intrastate), with a modal split of 94% truck (6% rail). Oklahoma ranks next, with 100% of domestic movements taking place by truck. Nebraska is next with a modal split of 93% truck (7% rail). Missouri is in fourth place with 100% of the movements by truck. Iowa ranks in fifth place with a modal split of 90% truck (10% rail). The truck modal split for 2020 domestic flows terminating in Kansas (inbound), the top-10 states where these commodities are destined to, and the "Out of Region" states are shown in Figure 149.

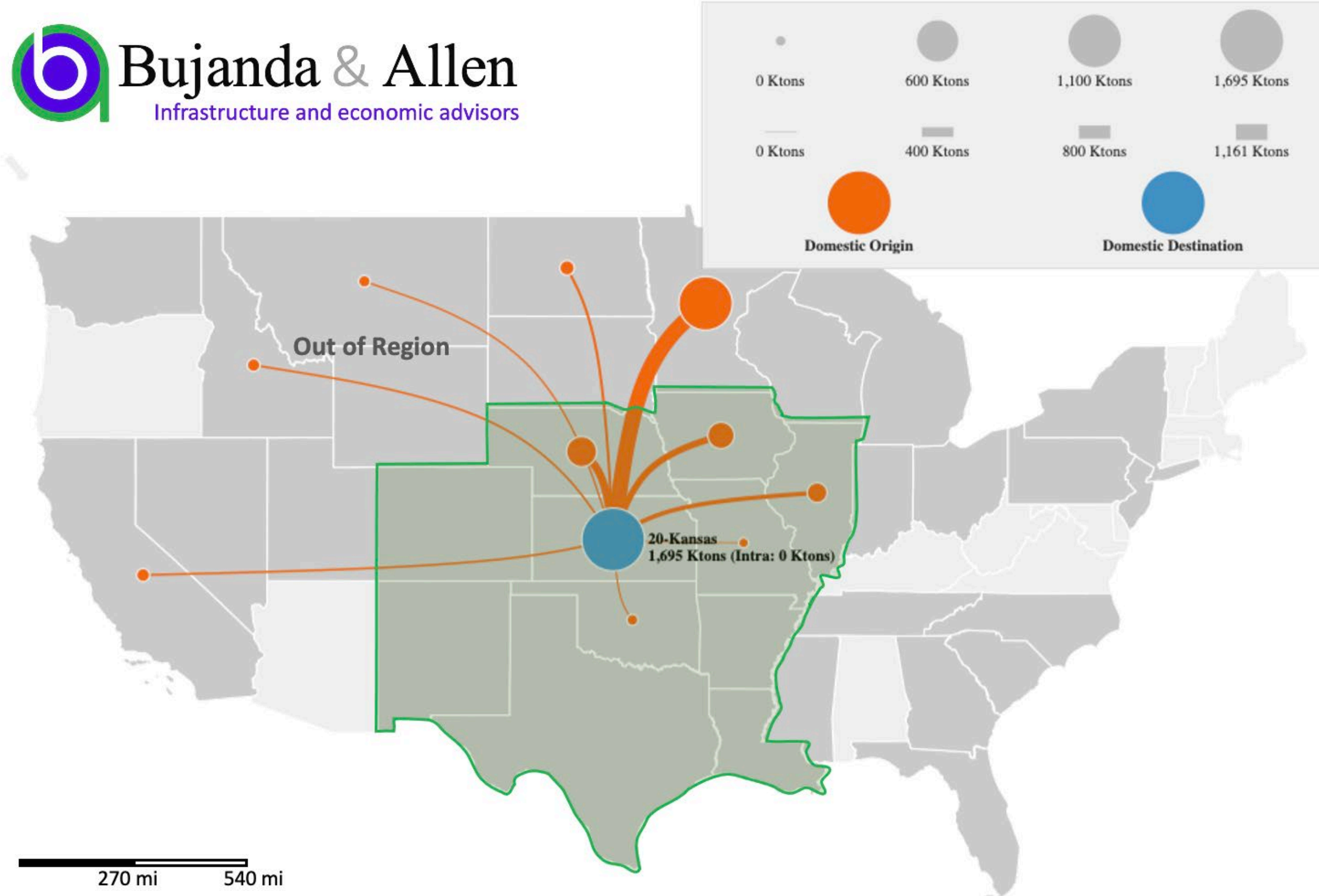
Figure 149. ***Domestic flows*** terminating in Kansas: All Ag Commodities ***inbound by truck*** in 2020.



Source: Developed by Bujanda & Allen, with FAF5 data, 2021.

By rail, domestic flows of agricultural commodities within Kansas accounted for 6% (the balance of the 94% by truck) for intrastate flows. For domestic flows coming from out of state, Nebraska is the dominant state with a modal split of 7% by rail. Iowa is next with 10% rail, followed by Illinois with 11% by rail for the top origin states within the study area. Minnesota, the dominant state by rail volume, as well as North Dakota, Idaho, Montana, and California all fall "Out of Region". This category has an average split of 10% rail. The rail modal split for 2020 domestic flows terminating in Kansas (inbound), each of the top-10 destination states, and the "Out of Region" states are shown in Figure 150.

Figure 150. ***Domestic flows*** terminating in Kansas: All Ag Commodities ***inbound by rail*** in 2020.

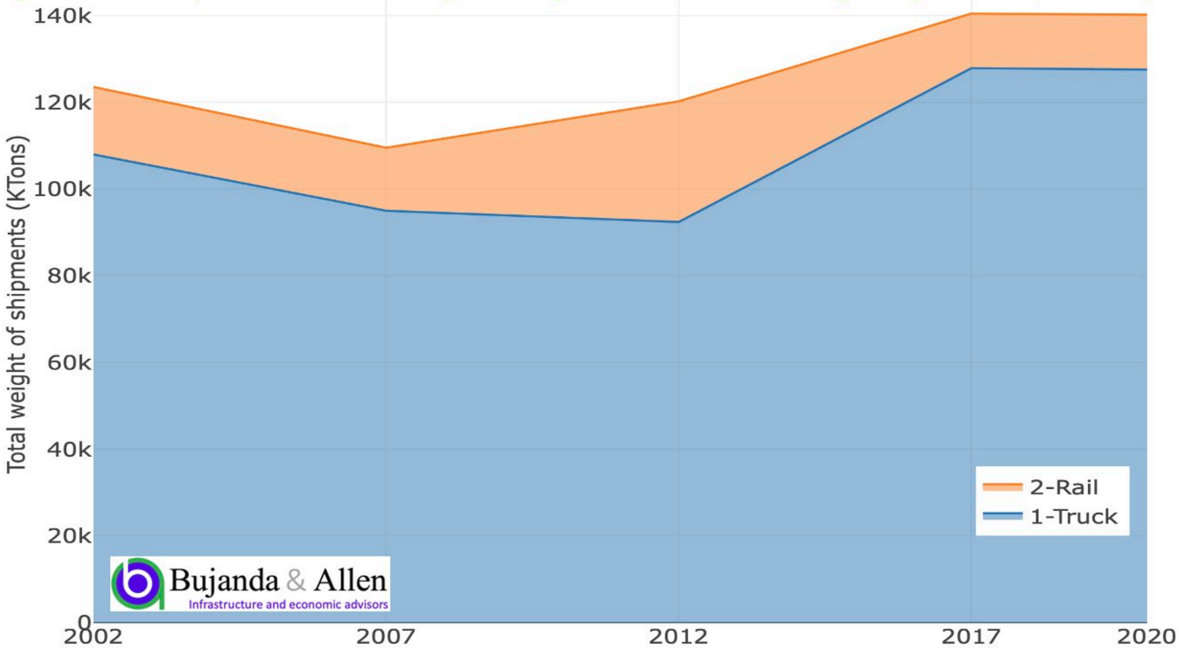


Source: Developed by Bujanda & Allen, with FAF[5] data, 2021.

5.2.2 Domestic flows *outbound*

Domestic flows comprise only shipments associated with domestic freight moved between domestic origins and domestic destinations (i.e. from Kansas to the remaining states and vice versa). No foreign trade is included in these flows. Historical trends between 2002 and 2020 indicate that truck has been by far the predominant transportation mode used within Kansas and between Kansas and the rest of the states. Historically, the modal split has increased from 87% truck (13% rail) in 2002 to **91%** truck (9% rail) in 2020. Modal split trends for domestic flows of agricultural commodities originating in Kansas (*outbound*) are illustrated in Figure 151.

Figure 151. Modal split for ***domestic flows*** of agricultural commodities originating in Kansas (***outbound***)



Source: Developed by Bujanda & Allen, with FAF[5] data, 2021.

The next step included the development of O-D maps for all the domestic flows ***originating*** in Kansas for all agricultural commodities moved by truck and rail based on 2020 FAF[5] data. The modal split is 91% truck when all states, including movements within Kansas (intrastate), are considered. For this mode, domestic cargoes are destined primarily to Nebraska, Missouri, Oklahoma, and Texas. The rail split is 9% when all states and movements within Kansas are considered. Domestic cargoes moved by rail are destined primarily to Texas, North Carolina, and Arizona. The modal split for 2020 domestic flows of agricultural commodities originating in Kansas (*outbound*) and each of the top-10 states where these commodities where destined to are shown in Table 39.

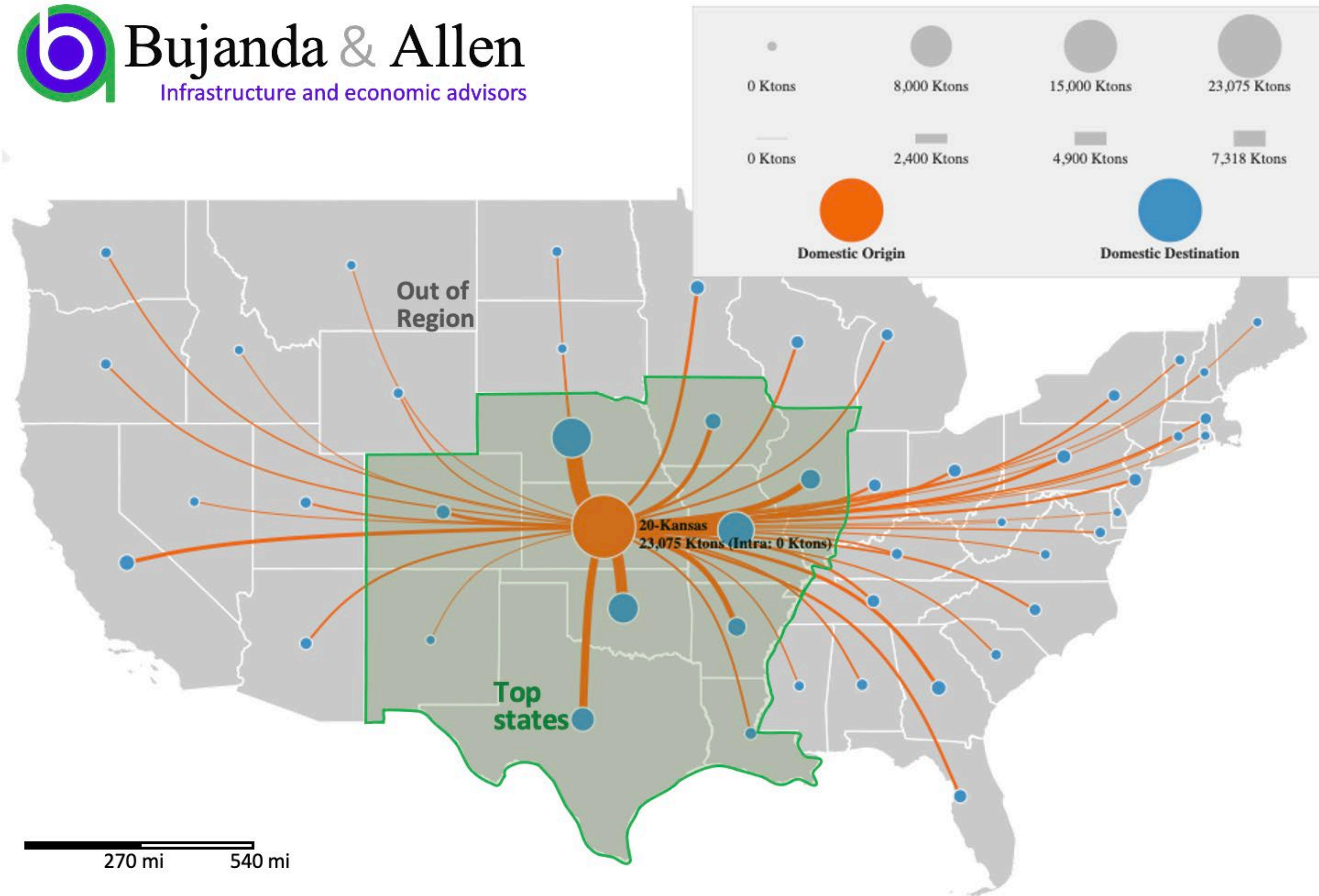
Table 39. Modal split for ***domestic flows*** originating in Kansas: All Ag Commodities ***outbound***

Domestic Destination	2020 Truck/Rail modal split		
	Truck	Rail	Total
1. Kansas (intrastate)	**94%**	**6%**	**100%**
2. Nebraska	100%	0%	100%
3. Missouri	98%	2%	100%
4. Oklahoma	100%	0%	100%
5. Texas	29%	71%	100%
6. Illinois	97%	3%	100%
7. Arkansas	99%	1%	100%
8. Iowa	99%	1%	100%
9. Colorado	99%	1%	100%
10. Louisiana	100%	0%	100%
11. New Mexico	100%	0%	100%
12. Out of Region	**80%**	**20%**	**100%**

Source: Developed by Bujanda & Allen, with FAF[5] data, 2021.

Regarding total domestic flows of agricultural commodities, the vast majority activity took place within Kansas (intrastate), with a modal split of 94% truck (6% rail). Nebraska ranks next, with 100% of domestic movements taking place by truck. Missouri is next with a modal split of 98% truck (2% rail). Oklahoma is in fourth place with 100% of the movements by truck. Texas ranks in fifth place with a modal split of 29% truck (71% rail). The truck modal split for 2020 domestic flows originating in Kansas (*outbound*), the top-10 states where these commodities are destined to, and the "Out of Region" states are shown in Figure 152.

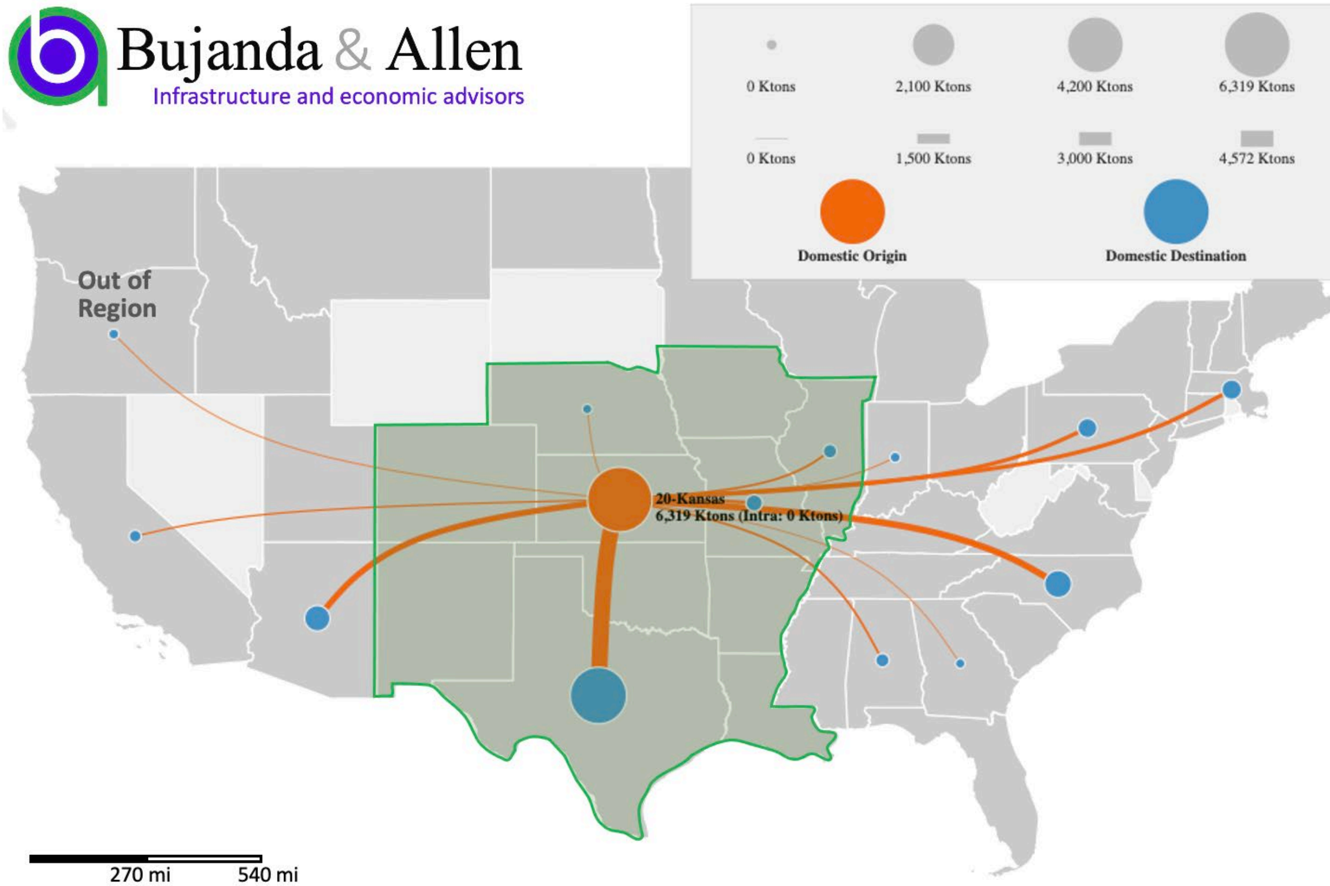
Figure 152. ***Domestic flows*** originating in Kansas: All Ag Commodities ***outbound by truck*** in 2020.



Source: Developed by Bujanda & Allen, with FAF5 data, 2021.

By rail, domestic flows of agricultural commodities within Kansas accounted for 6% (the balance of the 94% by truck) for intrastate flows. For domestic flows moving out of state, Texas is the dominant state with a modal split of 71% by rail. North Carolina, Arizona, Massachusetts, and Pennsylvania all fall "Out of Region". This category has an average modal split of 20% rail. The rail modal split for 2020 domestic flows originating in Kansas (*outbound*), each of the top-10 destination states, and the "Out of Region" states are shown in Figure 153.

Figure 153. ***Domestic flows*** originating in Kansas: All Ag Commodities ***outbound by rail*** in 2020.

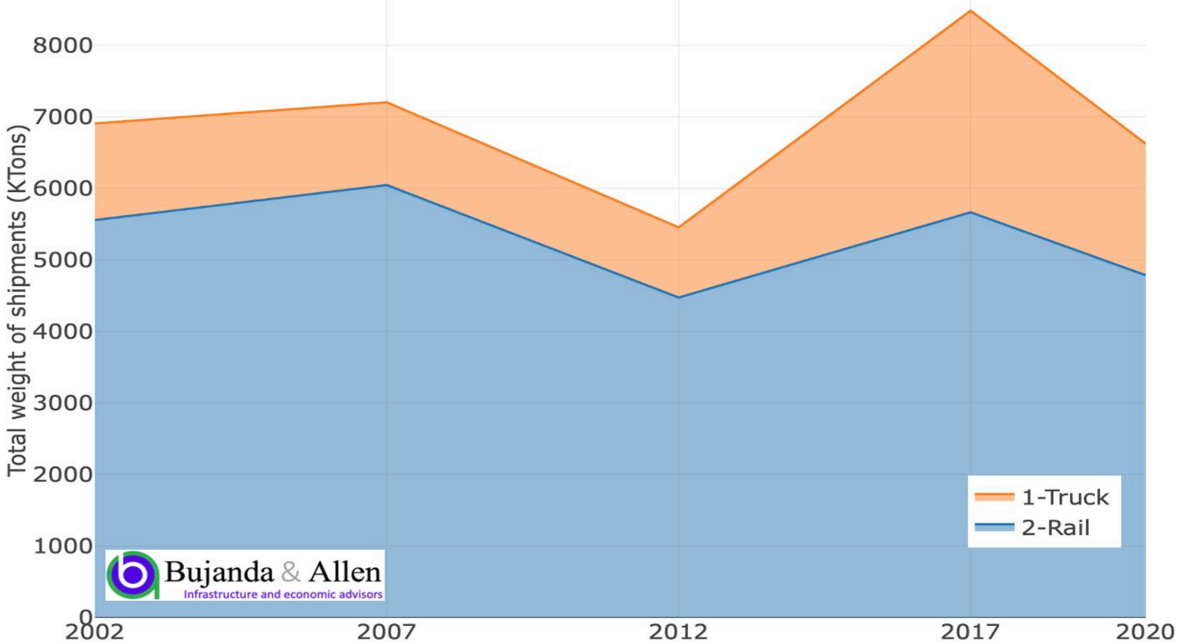


Source: Developed by Bujanda & Allen, with FAF[5] data, 2021.

5.2.3 Export flows *outbound*

Export trade flows comprise freight originating in Kansas and moved to foreign nations (i.e. from Kansas to the world). In this analysis, Kansas is considered the domestic origin for exports to foreign destinations for all agricultural commodities combined. The transportation mode consists of two parts: (i) the domestic mode used between Kansas and its export gateway (U.S. Exit Region) and (ii) the foreign mode used between the export gateway and a foreign destination. Historical trends indicate that rail has been by far the predominant transportation mode for long-haul movement of agricultural commodities originating in Kansas to U.S. Exit Regions. Modal split trends for export flows of all agricultural commodities originating in Kansas (*outbound*) show a 77% average share for rail from 2002 to 2020 (23% by truck), as illustrated in Figure 154.

Figure 154. Modal split for ***export flows*** of agricultural commodities originated in Kansas (2002-2020, KTons)



Source: Developed by Bujanda & Allen, with FAF[5] data, 2021.

O-D maps were also developed for export flows of all agricultural commodities ***originating*** in Kansas based on 2020 FAF[5] data. Overall, the modal split is 28% truck (**72% rail**) when all U.S. Exit Regions are considered. Exports via the U.S. Gulf Coast (USGC) rank at the top, leaving the U.S. through seaports in Texas and Louisiana. Exports via the Texas-Mexico Border rank next departing the country through land ports, with Laredo and El Paso being the top ones. Exports through the Pacific Northwest (PNW) rank in third place via seaports in Oregon and Washington. Exports through seaports in the USWC (excl. PNW) rank in fourth place. The modal split for 2020 export flows of agricultural commodities originating in Kansas (*outbound*) and each of the top U.S. Exit Regions are shown in Table 40.

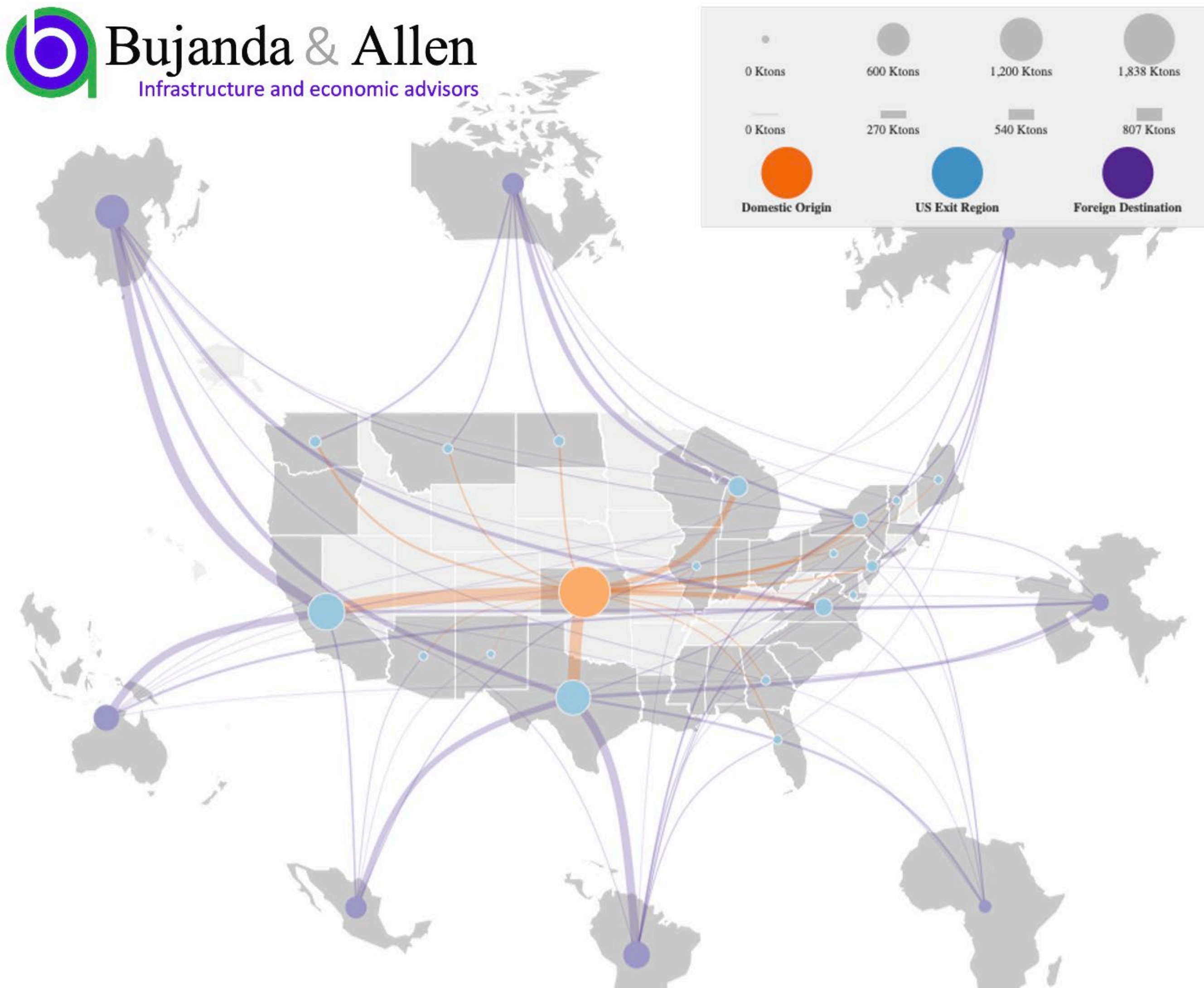
Table 40. Modal split for ***export flows*** originating in Kansas: All Ag Commodities ***outbound***

Exports originating in KS	Truck	Rail	Total
1. U.S. Gulf Coast (USGC)			
Texas	15%	85%	100%
Louisiana	0%	100%	100%
2. Texas-Mexico Border			
Laredo	4%	96%	100%
El Paso	0%	100%	100%
3. Pacific Northwest (PNW)			
Oregon	5%	95%	100%
Washington	5%	95%	100%
4. U.S. West Coast USWC (excl. PNW)			
California	89%	11%	100%

Source: Developed by Bujanda & Allen, with FAF[5] data, 2021.

The **truck split** is 28% when the average of all states that serve as a U.S. Exit Region for Kansas exports is considered. Kansas exports via the USGC leaving the U.S. through seaports in Texas show a modal split of 15% truck (85% rail). FAF[5] data reports no exports by truck through Louisiana. Exports via the Texas-Mexico land ports indicate a 4% truck (96% rail) modal split thru Laredo and 0% truck (100% rail) thru El Paso. The modal split for exports through PNW seaports was 5% truck (95% rail), based on local knowledge. FAF[5] data for exports through seaports in California showed an 89% truck (11% rail) modal split. These are exports primarily destined to eastern Asia (primally China). The O-D map for the 2020 ***export flows by truck*** of agricultural commodities originating in Kansas (outbound) and each of the U.S. Exit Regions is shown in Figure 155.

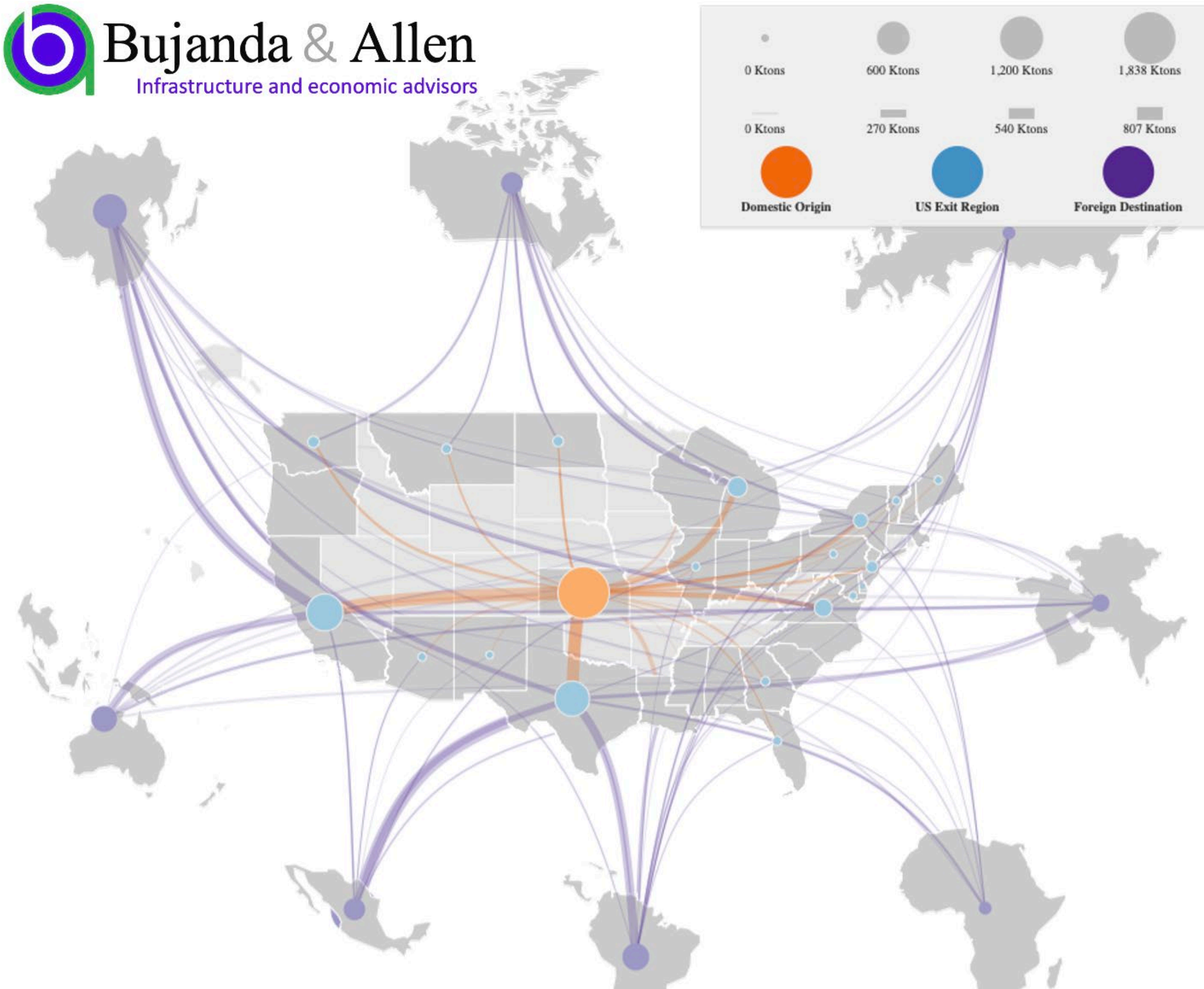
Figure 155. Export flows originating in Kansas: All Ag Commodities ***outbound by truck*** in 2020.



Source: Developed by Bujanda & Allen, with FAF[5] data, 2021.

The **rail split** is 72% when the average of all states that serve as a U.S. Exit Region for Kansas exports is considered. Kansas exports via the USGC leaving the U.S. through seaports in Texas show a modal split of 85% rail. FAF[5] data reports all exports through Louisiana by rail, where they are transferred into bulk vessels en route primarily to South America, Africa, and Europe. Exports via the Texas-Mexico land ports indicate a 96% rail modal split thru Laredo and 100% rail thru El Paso. Most exports by rail head southbound into Mexico trough Laredo, where UP connects with KCSM, and through El Paso where both BNSF and UP connect with Ferromex on the Mexican side. The modal split for exports through PNW seaports was 95% rail, based on local knowledge, as FAF[5] data was deemed not representative just for this O-D pair. FAF[5] data for exports through seaports in California showed an 11% rail modal split. The O-D map for the 2020 ***export flows by rail*** of agricultural commodities originating in Kansas (*outbound*) and each of the U.S. Exit Regions is shown in Figure 156.

Figure 156. Export flows originating in Kansas: All Ag Commodities ***outbound by rail*** in 2020.



Source: Developed by Bujanda & Allen, with FAF5 data, 2021.

5.2.4 Modal split of live animals and milk (*inbound* and *outbound*)

Regarding the modal split of live animals and milk, FAF5 data reports that 100% of the movements for these commodities take place by truck, which was confirmed by KDOT. These commodities were treated separately to increase the accuracy of the modal split calculation for the corresponding volumes.

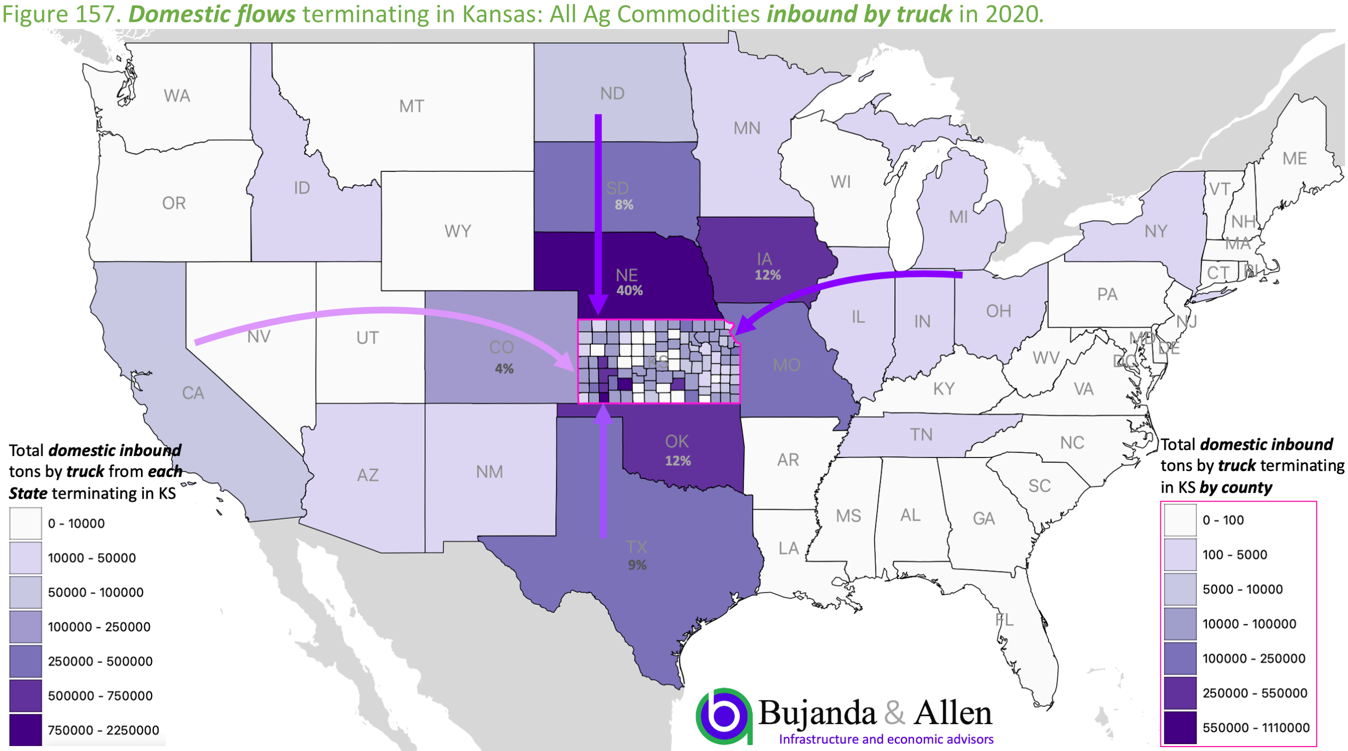
5.3 Ton-miles by transportation mode

Based on Kansas freight transportation network and using the O-D pairs and volumes analyzed in the previous sections to understand the split patterns by transportation mode, this section presents the estimation of ton-miles by transportation mode. The route length for each mode is analyzed and subsequently the traffic assignment of freight volumes to a particular route by mode based on the shortest path for each O-D pair is conducted. Lastly, the ton-miles by transportation mode are estimated for Kansas' Freight Network, first, for trucks, and then for rail.

5.3.1 Ton-miles of domestic flows *inbound*

Regarding the agricultural commodity flows terminating in Kansas ***by truck***, most of the traffic originated in adjacent states, with 40% of the total inbound freight volumes coming from Nebraska, 12% from Oklahoma, 12% from Iowa, 9% from Texas, 8% from South Dakota, 7% from Missouri, 4% from Colorado, and 8% collectively from the rest of states. Most of these flows were destined to counties in the SW [30] CRD, which received 67% of the total inbound volumes by truck, followed by the WC [20] CRD which received 11%. The domestic flows for all agricultural commodities by truck from each state and terminating in each county within Kansas are illustrated in Figure 157.

Figure 157. ***Domestic flows*** terminating in Kansas: All Ag Commodities ***inbound by truck*** in 2020.



Source: Bujanda & Allen, 2021.

The next step involved the estimation of ton-miles. This was done by identifying the shortest route for each of the for each state-county O-D pair and multiplying the portion of each route within the state (in miles) times the total volume of all ag commodities (tons) for each O-D pair, respectively. The estimation of ton-miles for the domestic flows of agricultural commodities by truck from each state and terminating in each of the counties withing Kansas (and grouped by CRD) are shown in Table 41.

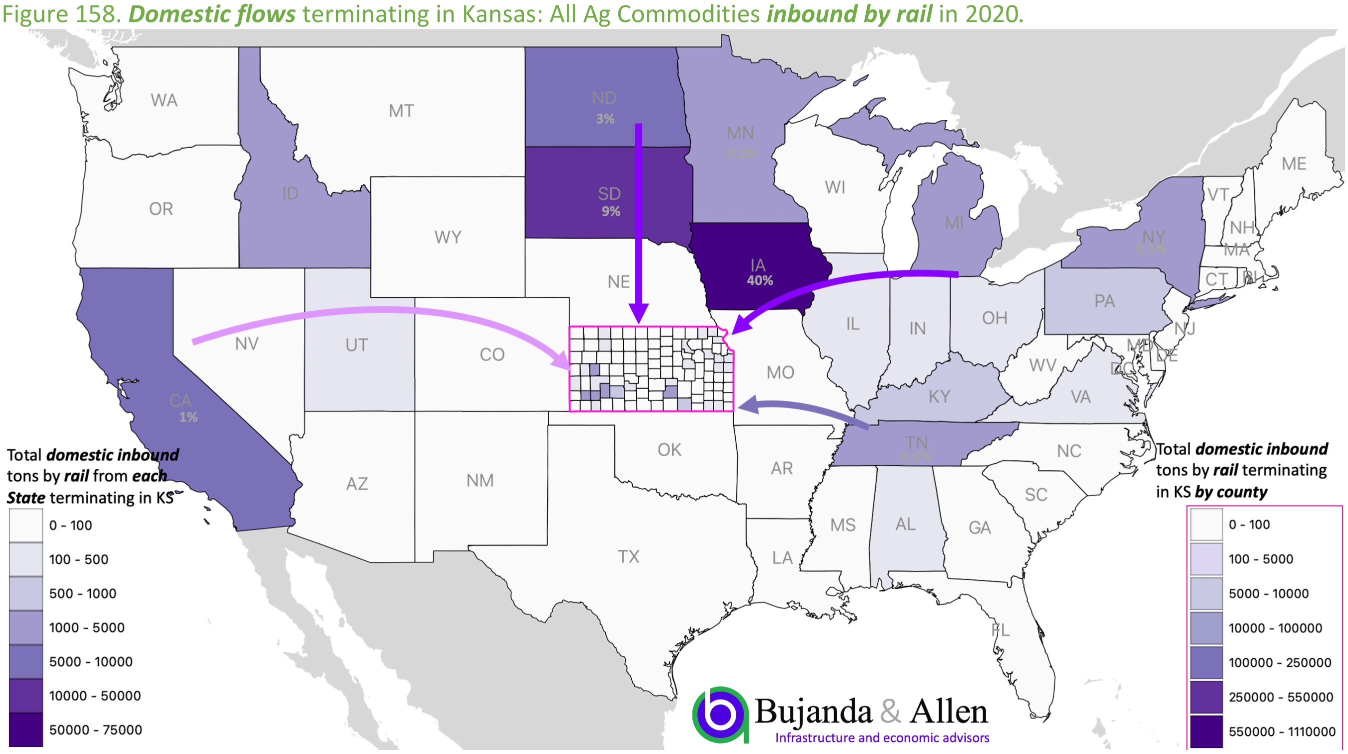
Table 41. ***Domestic flows*** terminating in Kansas: All Ag Commodities ***inbound by truck*** **(000s ton-miles within KS only)**

Crop Reporting Dist.		Total Truck DomIB	Arkansas	Colorado	Illinois	Iowa	Louisiana	Missouri	Nebraska	New Mexico	Oklahoma	Texas	Out of Region
C	[50]	9,986	-	-	42	-	-	609	8,964	-	-	-	371
NC	[40]	12,354	-	-	13	7	-	247	12,075	-	-	-	11
NE	[70]	13,956	-	368	-	1,824	-	5,344	4,277	-	-	-	2,144
NW	[10]	15,216	-	474	105	173	-	1,023	12,385	-	268	-	788
EC	[80]	18,563	-	-	-	4,504	-	4,937	9,119	-	-	-	3
SE	[90]	38,977	-	2,850	-	1,789	-	4,594	5,021	-	6,029	-	18,694
SC	[60]	64,694	-	2,462	56	-	-	2,237	24,989	-	10,033	-	24,916
WC	[20]	84,202	-	110	108	53,180	-	1,356	21,020	-	125	-	8,303
SW	[30]	528,577	-	35,570	14,126	137,755	-	15,437	192,127	3,930	10,240	18,394	100,999
Total		**786,526**	**-**	**41,835**	**14,450**	**199,232**	**-**	**35,784**	**289,976**	**3,930**	**26,696**	**18,394**	**156,228**

Source: Bujanda & Allen, 2021.

From the agricultural commodity flows terminating in Kansas ***by rail***, 40% of the total inbound freight volumes originated in Nebraska, 40% in Iowa, and almost the remaining 20% out of region. Most of these flows were destined to counties in the SW [30] CRD, which received 61% of the total inbound volumes by rail, followed by the WC [20] CRD which received 16%, and the SC [60] with 9% for the top-three. The domestic flows for all agricultural commodities by rail from each state and terminating in each county within Kansas are illustrated in Figure 158.

Figure 158. ***Domestic flows*** terminating in Kansas: All Ag Commodities ***inbound by rail*** in 2020.



Source: Bujanda & Allen, 2021.

The next step involved the estimation of ton-miles. This was done by identifying the shortest route for each of the state-county O-D pairs and multiplying the portion of each route within the state (in miles) times the total volume of all ag commodities (tons) for each O-D pair, respectively. The estimation of ton-miles for the domestic flows of agricultural commodities by truck from each state and terminating in each of the counties withing Kansas (grouped by CRD for reporting practicality) are illustrated in Table 42.

Table 42. ***Domestic flows*** terminating in Kansas: All Ag Commodities ***inbound by rail*** (**000s ton-miles, within KS only**)

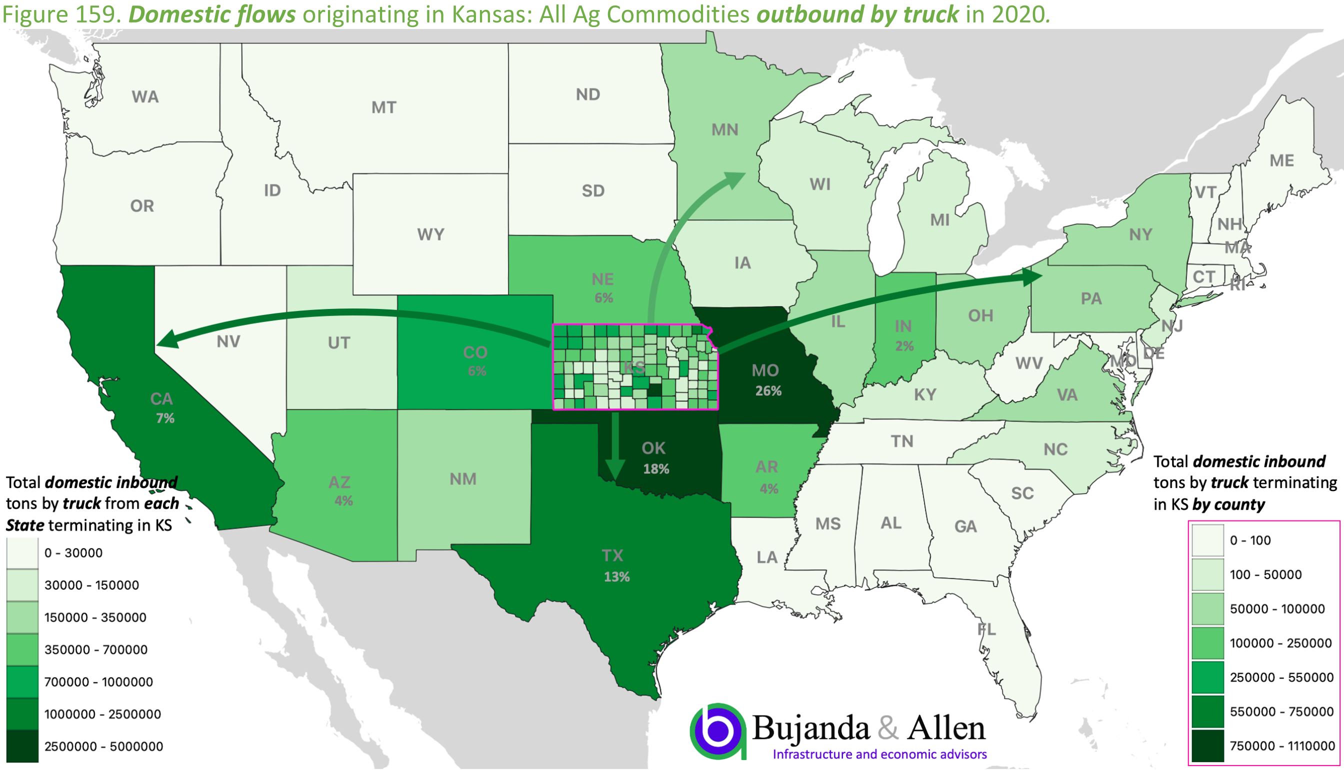
Reporting Dist.		Tot. Rail Dom. IB	Arkansas	Colorado	Illinois	Iowa	Louisiana	Missouri	Nebraska	New Mexico	Oklahoma	Texas	Out of Region
C	[50]	757	-	-	6	-	-	-	708	-	-	-	43
NE	[70]	800	-	-	-	213	-	-	337	-	-	-	250
NC	[40]	956	-	-	2	1	-	-	953	-	-	-	1
NW	[10]	1,103	-	-	14	20	-	-	978	-	-	-	92
EC	[80]	1,246	-	-	-	526	-	-	721	-	-	-	0
SE	[90]	2,787	-	-	-	209	-	-	397	-	-	-	2,181
SC	[60]	4,759	-	-	7	-	-	-	1,845	-	-	-	2,907
WC	[20]	8,843	-	-	14	6,204	-	-	1,661	-	-	-	964
SW	[30]	33,508	-	-	52	14,795	-	-	14,269	-	-	-	4,391
Total		**54,760**	**-**	**-**	**94**	**21,968**	**-**	**-**	**21,868**	**-**	**-**	**-**	**10,829**

Source: Bujanda & Allen, 2021.

5.3.2 Ton-miles of domestic flows *outbound*

Regarding the agricultural commodity flows originating in Kansas ***by truck***, most of the traffic was destined to Missouri with 26%of the total outbound freight volumes leaving Kansas by truck. Oklahoma was next with 18%, followed by Texas with 13%, California with 7%, and Colorado with 6% for the top-five. Domestic flows originating in Kansas into the rest of the states out of region accounted for 28%. The counties in the SW [30] CRD generated 18% of the total outbound freight volumes leaving Kansas by truck, like the ones in the NW [10] CRD which generated another 18%. Counties in the SC [60] CRD generated 14%, followed by C [50] with 13% and NC [40] with 12% for the top-five CRDs. The domestic flows for all agricultural commodities by truck originating in each county within Kansas and destined to each state are illustrated in Figure 159.

Figure 159. ***Domestic flows*** originating in Kansas: All Ag Commodities ***outbound by truck*** in 2020.



Source: Bujanda & Allen, 2021.

The estimation of ton-miles for the domestic flows of agricultural commodities by truck from each county withing Kansas (grouped by CRD for practicality) into each state are shown in Table 43.

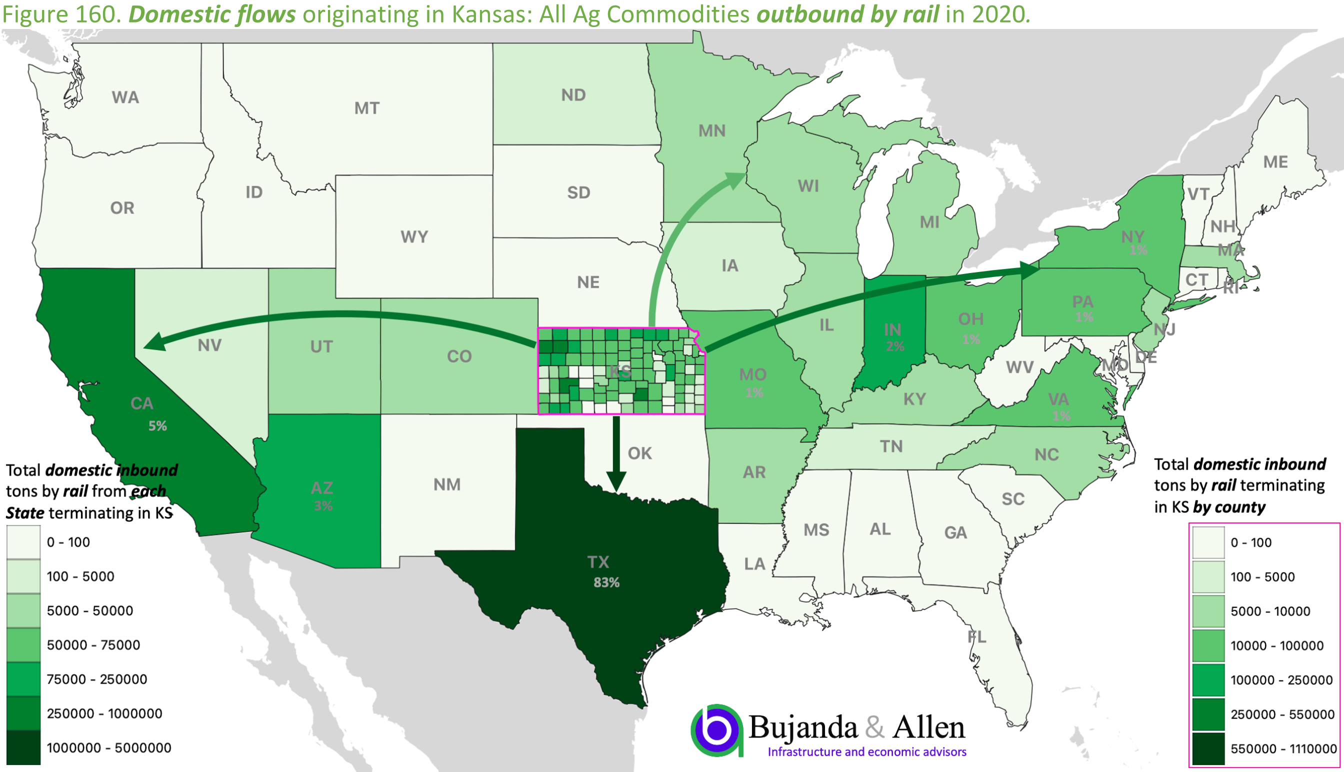
Table 43. ***Domestic flows*** originating in Kansas: All Ag Commodities ***outbound by truck*** (**000s ton-miles within KS only)**

Crop Reporting Dist.		Tot. Truck Dom. OB	Arkansas	Colorado	Illinois	Iowa	Louisiana	Missouri	Nebraska	New Mexico	Oklahoma	Texas	Out of Region
SE	[90]	114,974	11,773	3,229	1,086	10	-	45,997	6,588	-	30,127	7,156	9,008
NE	[70]	121,635	2,827	19	413	212	-	74,679	4,400	-	1,337	27,654	10,093
WC	[20]	140,274	-	9,878	63	30	-	44,526	1,650	742	19,276	41,288	22,821
EC	[80]	155,217	15,853	744	3,199	103	422	44,113	3,910	6,447	14,799	29,035	36,593
C	[50]	257,780	3,512	1,663	26,084	3,994	-	60,172	12,086	-	20,652	13,578	116,039
NC	[40]	287,776	8	4,467	8,328	4,413	-	13,032	14,381	1,023	26,736	56,957	158,430
SC	[60]	306,719	13,042	21,738	12,998	343	-	26,258	17,123	20,847	75,549	19,987	98,835
NW	[10]	374,681	-	6,340	3,322	184	-	1,495	24,909	-	53,465	170,562	114,405
SW	[30]	379,782	5,594	34,117	548	-	1,179	247,365	956	3,478	31,610	26,390	28,544
Total		**2,138,838**	**52,609**	**82,195**	**56,042**	**9,287**	**1,602**	**557,636**	**86,003**	**32,538**	**273,550**	**392,607**	**594,769**

Source: Bujanda & Allen, 2021.

For the domestic agricultural commodity flows originating in Kansas and leaving the state ***by rail***, 83% of the total domestic outbound freight volumes by rail were destined to Texas. California was next with 5% of the volumes, and almost 14% out of region. Most of these flows were originated in counties in the NW [10] CRD with 40%, followed by counties in the NC [40] CRD with 16%, and WC [20] with 10%. The domestic flows for all agricultural commodities by rail from each county within Kansas and terminating in each state are illustrated in Figure 160.

Figure 160. ***Domestic flows*** originating in Kansas: All Ag Commodities ***outbound by rail*** in 2020.



Source: Bujanda & Allen, 2021.

The estimation of ton-miles for the domestic flows of agricultural commodities by rail from each county within Kansas (grouped by CRD for practicality) and terminating in each state are shown in Table 44.

Table 44. ***Domestic flows*** originating in Kansas: All Ag Commodities ***outbound by rail*** **(000s ton-miles within KS only)**

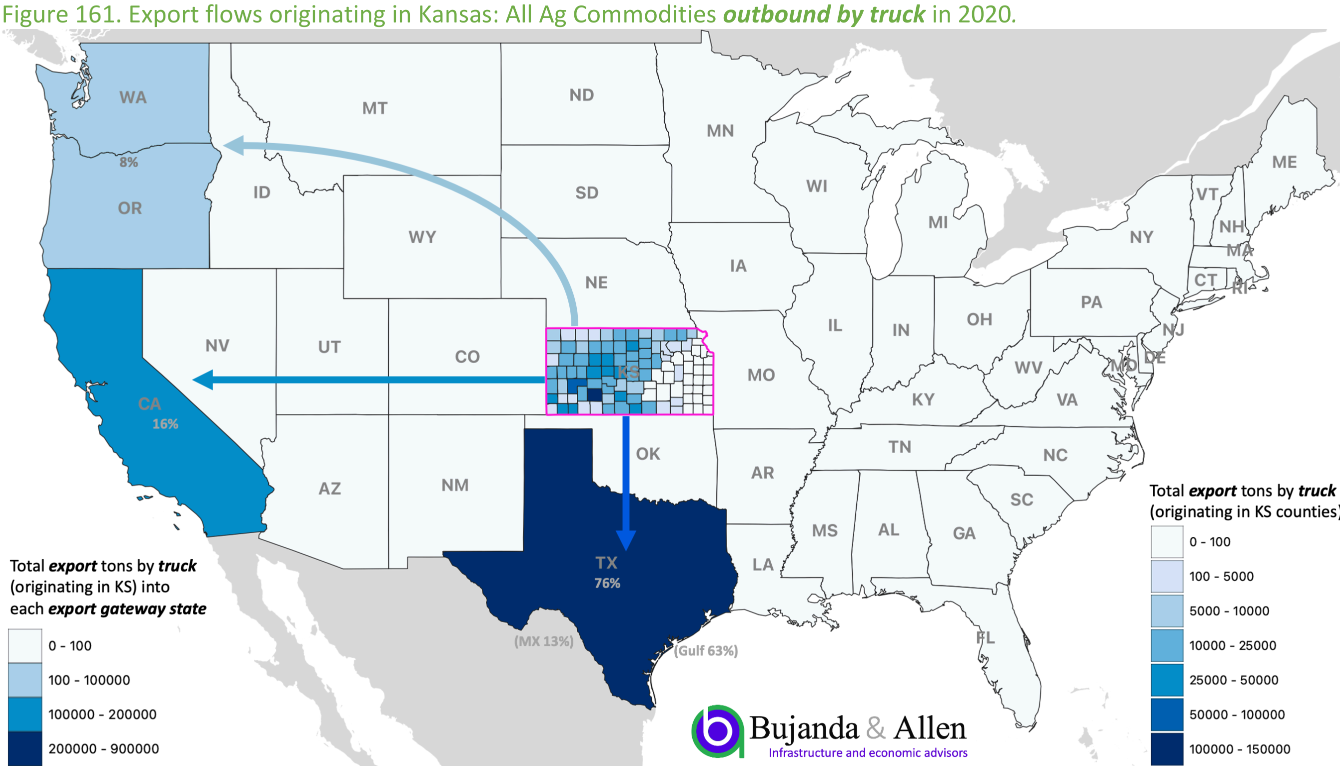
Crop Reporting Dist.		Tot. Truck Dom. OB	Arkansas	Colorado	Illinois	Iowa	Louisiana	Missouri	Nebraska	New Mexico	Oklahoma	Texas	Out of Region
SE	[90]	21,834	125	34	35	0	-	888	-	-	-	18,393	2,358
C	[50]	67,543	37	18	847	42	-	1,245	-	-	-	34,906	30,448
SW	[30]	73,317	59	361	17	-	-	638	-	-	-	64,936	7,305
NE	[70]	75,221	30	0	13	2	-	1,441	-	-	-	71,090	2,645
SC	[60]	78,635	137	231	422	4	-	545	-	-	-	51,370	25,928
EC	[80]	85,406	168	8	104	1	-	881	-	-	-	74,641	9,603
WC	[20]	112,420	-	103	2	0	-	212	-	-	-	106,139	5,962
NC	[40]	188,411	-	47	270	47	-	51	-	-	-	146,420	41,575
NW	[10]	468,650	-	54	108	2	-	-	-	-	-	438,462	30,025
Total		**1,171,436**	**557**	**856**	**1,818**	**98**	**-**	**5,902**	**-**	**-**	**-**	**1,006,356**	**155,848**

Source: Bujanda & Allen, 2021.

5.3.3 Ton-miles of export flows *outbound*

Regarding the agricultural commodity flows originating in Kansas and leaving the state ***by truck*** to gateways for export into other countries, 76% of the total domestic outbound freight volumes by rail were destined to Texas. Of these volumes, 63% was routed through the U.S. Gulf (i.e. Galveston, TX) and 13% through the Mexican border (i.e. Laredo, TX). California was next with 16% of the volumes, presumably all containerized cargoes exported through the Ports of Los Angeles and Long Beach (POLALB). 8% of the total domestic outbound freight volumes by rail were routed through agribulk export gateways located in the Pacific Northwest (PNW). Most flows originated in counties in the SW [30] CRD with 23% of the total agricultural export flows originating in Kansas and leaving the state by rail, followed by 21% originating in NC [40], and 16% in the WC [20] CRD. The domestic flows for all agricultural commodities by rail from each county within Kansas and terminating in each export gateway state are illustrated in Figure 161.

Figure 161. Export flows originating in Kansas: All Ag Commodities ***outbound by truck*** in 2020.



Source: Bujanda & Allen, 2021.

The estimation of ton-miles for the export flows of agricultural commodities by truck from each county withing Kansas (grouped by CRD for practicality) into each state are shown in Table 45.

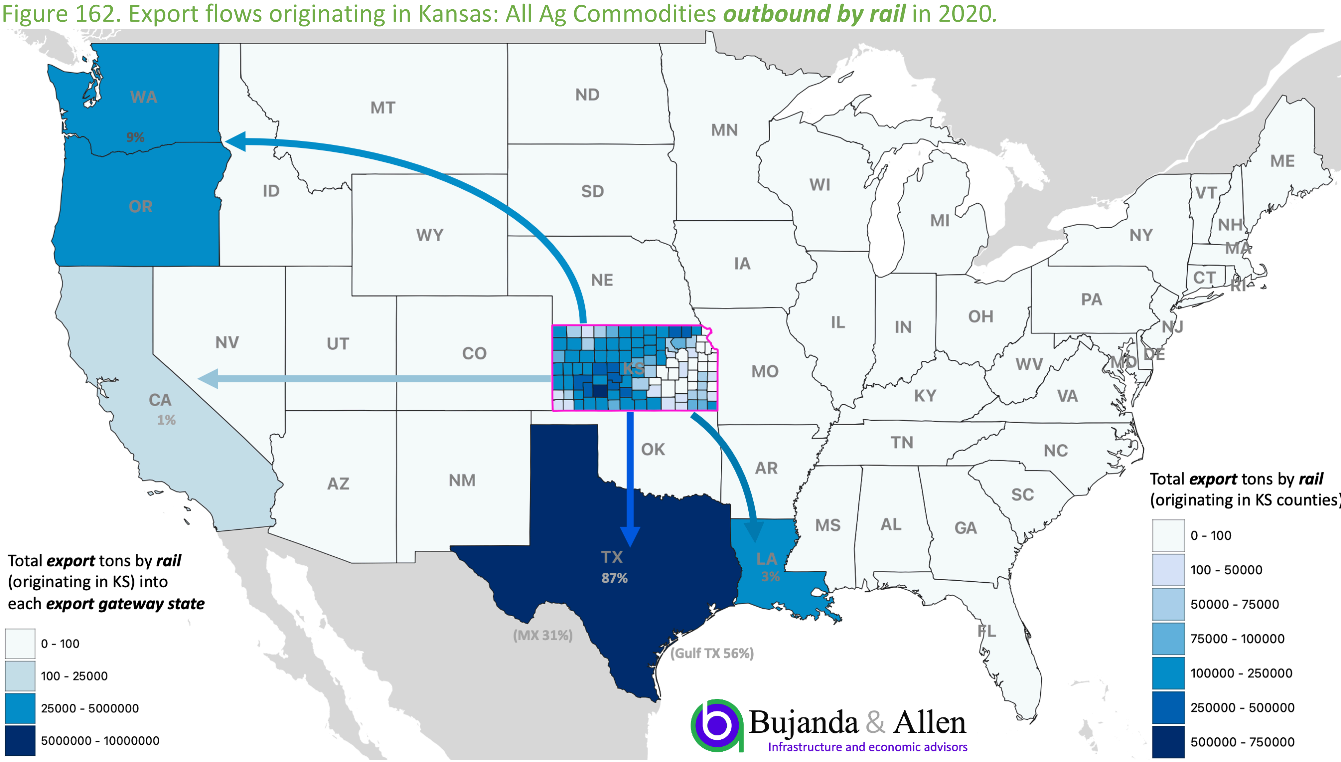
Table 45. Export flows originating in Kansas: All Ag Commodities ***outbound by truck*** (000s ton-miles within KS only)

Crop Reporting Dist.		Tot Truck EXP OB	California	Louisiana	Oregon	Texas Gulf	Texas MX
SE	[90]	9	-	-	-	-	9
EC	[80]	123	-	-	-	-	123
NE	[70]	9,292	-	-	551	-	8,741
SC	[60]	9,575	-	-	-	8,906	668
C	[50]	10,006	-	-	-	8,788	1,218
NW	[10]	13,976	-	-	1,151	8,826	3,999
WC	[20]	17,794	-	-	3,013	14,388	394
NC	[40]	23,035	-	-	-	12,880	10,155
SW	[30]	24,608	12,980	-	1,002	9,294	1,331
Total		**108,417**	**12,980**	**-**	**5,716**	**63,082**	**26,638**

Source: Bujanda & Allen, 2021.

For the domestic agricultural commodity flows originating in Kansas and leaving the state **by rail**, 83% of the total domestic outbound freight volumes by rail were destined to Texas. California was next with 5% of the volumes, and almost 14% out of region. Most of these flows were originated in counties in the NW [10] CRD with 40%, followed by counties in the NC [40] CRD with 16%, and WC [20] with 10%. The domestic flows for all agricultural commodities by rail from each county within Kansas and terminating in each state are illustrated in Figure 162.

Figure 162. Export flows originating in Kansas: All Ag Commodities ***outbound by rail*** in 2020.



Source: Bujanda & Allen, 2021.

The estimation of ton-miles for the export flows of agricultural commodities by rail from each county withing Kansas (by CRD) into each state are shown in Table 46.

Table 46. Export flows originating in Kansas: All Ag Commodities ***outbound by rail*** (**000s ton-miles, within KS only**)

Crop Reporting Dist.		Tot Rail EXP OB	California	Louisiana	Oregon	Texas Gulf	Texas MX
SE	[90]	224	-	-	-	-	224
EC	[80]	10,811	-	7,699	-	-	3,112
SC	[60]	69,834	-	-	-	52,992	16,842
C	[50]	82,983	-	-	-	52,287	30,695
SW	[30]	142,337	1,684	31,810	19,995	55,299	33,548
WC	[20]	155,636	-	-	60,100	85,609	9,927
NW	[10]	176,241	-	-	22,963	52,515	100,763
NE	[70]	231,258	-	-	10,983	-	220,275
NC	[40]	332,538	-	-	-	76,635	255,903
Total		**1,201,862**	**1,684**	**39,509**	**114,041**	**375,338**	**671,289**

Source: Bujanda & Allen, 2021.

5.4 Key takeaways

Overall, the counties producing most of the truck traffic are located on the western part of the state. This is more evident when all flows inbound, outbound, domestic, and exports are combined. Particularly, the SW [30] CRD and the NW [10] handled a combined 44% of the agricultural truck traffic, as measured by ton-miles (composed of 31% and 13%, respectively). Missouri is the top-trading partner for the movement of commodities by truck handling 20% of the total truck flows. Texas ranks in second place with 17% of the truck traffic, followed by Nebraska with 12%, and Oklahoma with 10%. Inbound and outbound truck traffic originating and terminating out of region accounted for 25%. The summary of total truck flows (domestic plus exports, originating, and terminating in Kansas and the lower 48) are illustrated in Table 47.

Table 47. Summary total ***truck flows***: Domestic + Exports, IB + OB (**000s ton-miles, within KS only**)

Crop Reporting Dist.		Total Truck (Dom+Exp, IB+OB)	Arkansas	Colorado	Illinois	Iowa	Louisiana	Missouri	Nebraska	New Mexico	Oklahoma	Texas	Out of Region	% by CRD (from Total)
NE	[70]	144,883	2,827	387	413	2,036	-	80,024	8,677	-	1,337	36,395	12,788	5%
SE	[90]	153,960	11,773	6,079	1,086	1,799	-	50,592	11,609	-	36,156	7,165	27,702	5%
EC	[80]	173,903	15,853	744	3,199	4,607	422	49,050	13,028	6,447	14,799	29,159	36,595	6%
WC	[20]	242,271	-	9,988	171	53,210	-	45,882	22,670	742	19,401	56,070	34,137	8%
C	[50]	277,772	3,512	1,663	26,126	3,994	-	60,781	21,050	-	20,652	23,584	116,410	9%
NC	[40]	323,164	8	4,467	8,341	4,420	-	13,279	26,456	1,023	26,736	79,992	158,441	11%
SC	[60]	380,987	13,042	24,200	13,054	343	-	28,494	42,112	20,847	85,582	29,561	123,751	13%
NW	[10]	403,873	-	6,814	3,426	357	-	2,518	37,294	-	53,733	183,386	116,344	13%
SW	[30]	932,967	5,594	69,687	14,674	137,755	1,179	262,801	193,083	7,408	41,850	55,409	143,525	31%
Total		**3,033,780**	**52,609**	**124,030**	**70,492**	**208,520**	**1,602**	**593,420**	**375,979**	**36,467**	**300,246**	**500,722**	**769,693**	**100%**
% by state		100%	2%	4%	2%	7%	0%	20%	12%	1%	10%	17%	25%	

Source: Bujanda & Allen, 2021.

For rail traffic, the counties with most rail traffic, considering inbound, outbound, domestic, and exports combined, are located on the NW [10] CRD, contributing to 27% of the ton-miles generated. The NC [40] contributed to 21% of the total agricultural flows by rail, followed by NE [70] with 13%. Texas is by far the top-trading partner for the movement of commodities by rail handling 85% of the total agricultural flows by rail. Inbound and outbound rail traffic originating and terminating out of region accounted for 12%. The summary of total rail flows (domestic plus exports, originating, and terminating in Kansas and the lower 48) are illustrated in Table 48.

Table 48. Summary total ***rail flows***: Domestic + Exports, IB + OB (**000s ton-miles, within KS only**)

Crop Reporting Dist.		Total Truck (Dom+Exp, IB+OB)	Arkansas	Colorado	Illinois	Iowa	Louisiana	Missouri	Nebraska	New Mexico	Oklahoma	Texas	Out of Region	% by CRD (from Total)
SE	[90]	24,845	125	34	35	209	-	888	397	-	-	18,618	4,539	1%
EC	[80]	97,463	168	8	104	527	7,699	881	721	-	-	77,753	9,603	4%
C	[50]	151,282	37	18	852	42	-	1,245	708	-	-	117,888	30,491	6%
SC	[60]	153,228	137	231	429	4	-	545	1,845	-	-	121,204	28,834	6%
SW	[30]	249,162	59	361	69	14,795	31,810	638	14,269	-	-	153,784	33,376	10%
WC	[20]	276,899	-	103	16	6,205	-	212	1,661	-	-	201,675	67,026	11%
NE	[70]	307,279	30	0	13	215	-	1,441	337	-	-	291,365	13,878	13%
NC	[40]	521,905	-	47	272	48	-	51	953	-	-	478,958	41,576	21%
NW	[10]	645,995	-	54	121	22	-	-	978	-	-	591,740	53,080	27%
Total		**2,428,058**	**557**	**856**	**1,912**	**22,066**	**39,509**	**5,902**	**21,868**	**-**	**-**	**2,052,984**	**282,403**	**100%**
		100%	0%	0%	0%	1%	2%	0%	1%	0%	0%	85%	12%	

Source: Bujanda & Allen, 2021.

6 Infrastructure assessment

This section provides an assessment of the transportation infrastructure serving the movement of freight in Kansas for all modes. This assessment begins with an assessment of the Port of Catoosa, located in Tulsa, OK given its relevance to Kansas' agricultural products trade, followed by the ports of Kansas City (PortKC), AgriServices of Brunswick (ASB), and St. Joseph, MO. This section identifies transportation hurdles faced by producers, such as the weight restrictions imposed on bridges, channel, and waterway issues, followed by the transportation hurdles faced by beneficial cargo owners (BCOs) and shippers. This section concludes with an overview of potential solutions, proposed by agricultural industry participants, to ameliorate some hurdles.

6.1 Port of Catoosa

Located at the navigational head of the MKARNS, the Port of Catoosa sits in Rogers County, within the municipality of Tulsa, OK. The port is about 8 miles from the Tulsa International Airport and 15 miles from downtown. This port provides waterway access to the marine highway (M-40) in the Arkansas River via the Verdigris River. The MKARNS (M-40) connects to the Mississippi River (M-55) and ultimately to the major gateways located at its terminus in the U.S. Gulf Coast (USGC), such as the Port of New Orleans. The Port of Catoosa is located 445 river miles from its northern terminus at its junction with the Mississippi River.

6.1.1 Infrastructure

With an overall area of 2,500 acres, the Port of Catoosa is the largest in Oklahoma and one of the most inland river-ports in the U.S. offering year-round, ice-free, barge service to more than 70 companies in its industrial park and designated foreign trade zone (FTZ). The port is fully equipped offering multi-modal transportation and allowing truck-barge, truck-rail, and rail-barge transloading options.

The port has five public terminals that can transfer inbound and outbound bulk freight between barges, trucks, and railroad cars.

- **Dry cargo terminal**—Owned by Tulsa Port of Catoosa and operated by Tuloma Stevedoring Inc. Primarily handles commodity iron and steel products. The dock is 720 ft long with a 230-ft-wide concrete apron, cranes, and forklifts, including a 200 short-ton overhead traveling bridge crane.
- **Dry bulk terminal**—Public terminal owned by Tulsa Port of Catoosa and operated by Gavilon Fertilizer LLC. It handles materials such as pig iron and fertilizer. This terminal has two pedestal cranes and an outbound conveyor loading system. Open and covered storage is available.
- **Roll-on Roll-off (RoRo)**—Public wharf operated by the Port Authority, primarily handles very large cargo (e.g. certain process equipment used in oil refineries). Often these cannot be shipped easily by truck or rail because of their weight or their overall dimensions. Sometimes these are shipped internationally by sea, and must be transferred to or from ocean-going vessels at the Port of Houston or the Port of New Orleans.
- **Bulk liquids terminals**—handle such commodities as chemicals, asphalt, refined petroleum products and molasses. There are seven such terminals at the Port.

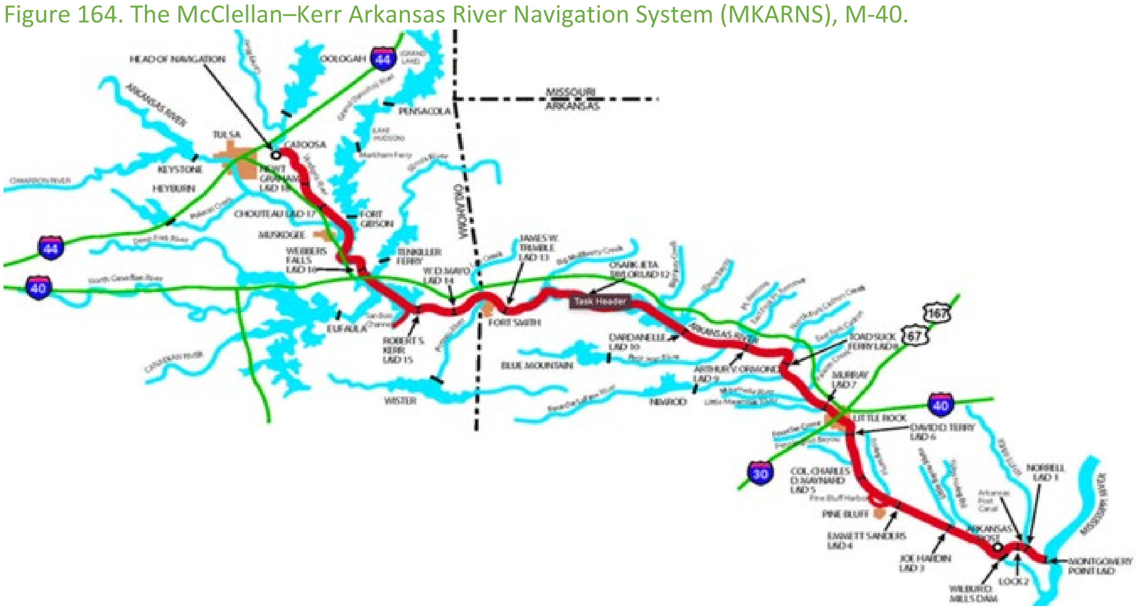
BNSF and the South Kansas and Oklahoma Railroad provide the rail service allowing connection to the national rail network. The port also provides rail switching with three dedicated port-owned switching engines. An aerial image of the port and existing infrastructure is shown in Figure 163.

Figure 163. Port of Catoosa

Source: Port of Catoosa, 2021.

The MKARNS is 445-miles long and includes the Verdigris, Arkansas, and White Rivers. The System has an elevation differential of 420 ft from its beginning at mile 600 on the Mississippi River to the head of navigation near Tulsa. Serves a 12-state region due to the Port of Catoosa being the most westerly inland river port that is ice free 24/7/365. The states include AR, OK, KS, TX, CO, MO, NE, MN, SD, ND, MT, and ID. There are 18 locks and dams – 13 in Arkansas and 5 in Oklahoma; each lock chamber is 110 ft wide x 600 ft long and can handle 8 barges and a towboat. The MKARNS is shown in Figure 164.

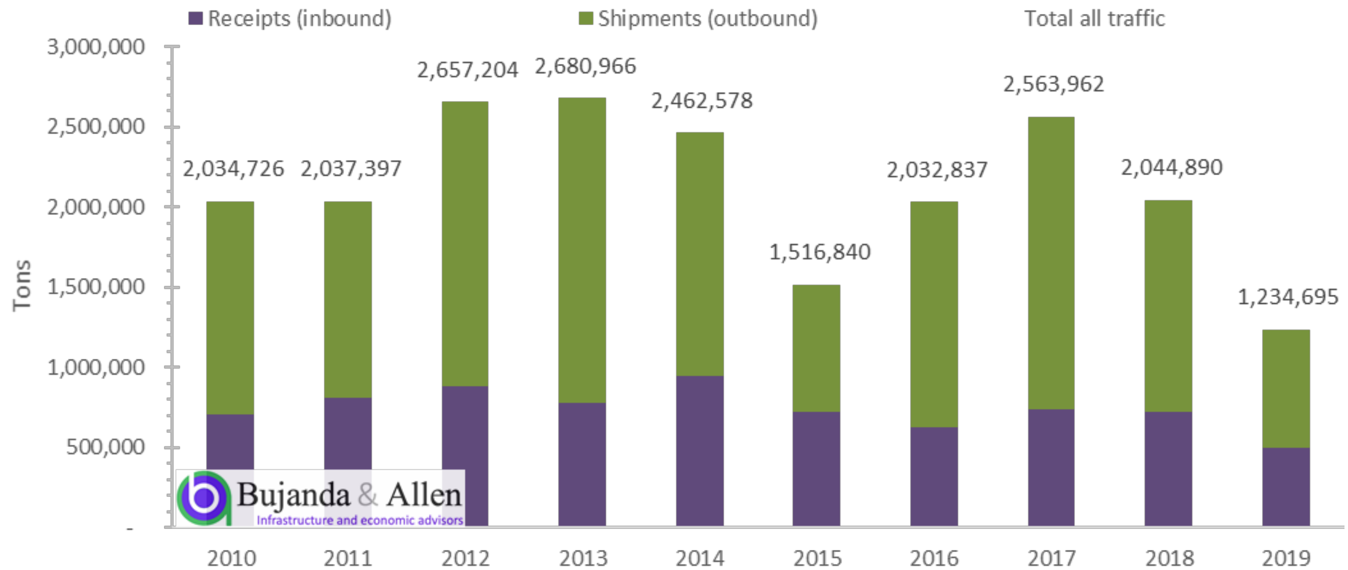
Figure 164. The McClellan–Kerr Arkansas River Navigation System (MKARNS), M-40.



6.1.2 Traffic volumes

The Port of Catoosa is a major economic engine for the region, allowing shipments of manufactured goods and agricultural products to the rest of the world. Between 2010 and 2020, the port has surpassed the 2 million tons mark every year except for 2015 and 2019. During this time, total throughput port volumes peaked in 2013 with 2,680,966 tons driven primarily by outbound shipments, a 9.6% CAGR from 2010. In 2019, the port handled 1,234,695 tons from which 41% where receipts (*inbound*) and 59% were shipments (*outbound*). Inbound, outbound, and total traffic volumes are illustrated in Figure 165.

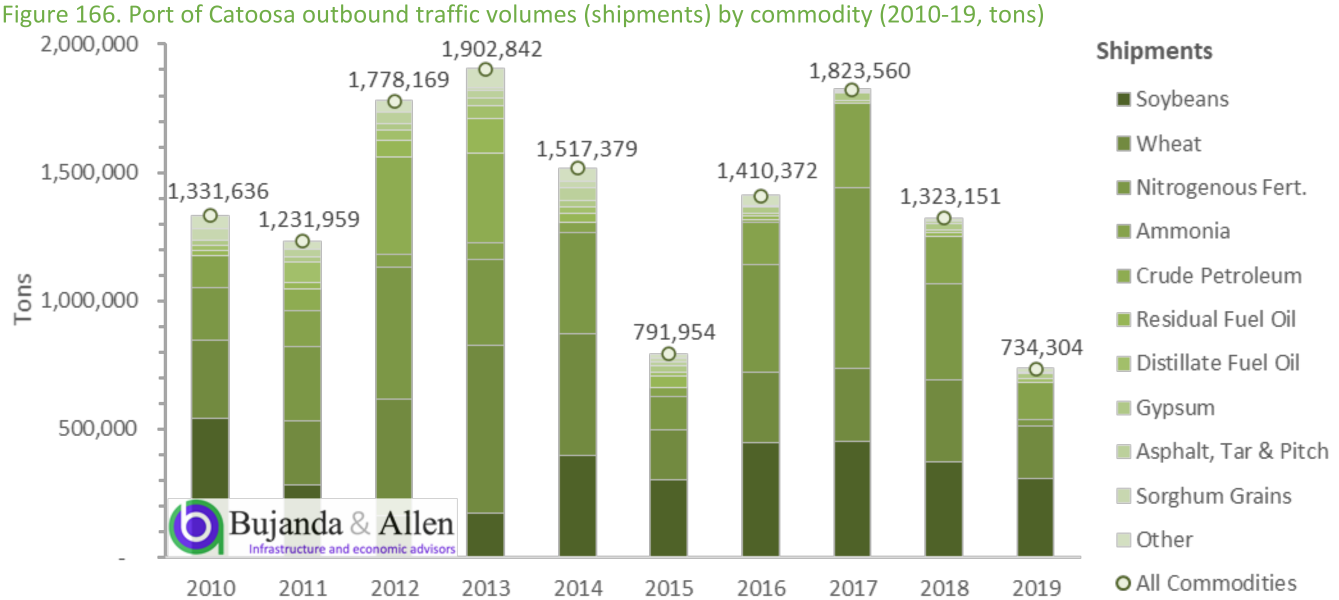
Figure 165. Port of Catoosa inbound and outbound traffic volumes (2010-19, tons)



Source: Bujanda & Allen with data from USACE, 2021.

The composition of outbound traffic volumes from the port has remained consistent during the last 10 years. Soybeans, wheat, and fertilizers have been in the top-3 commodities every year since 2010. Sorghum grains has been in the top-10 also every year since 2010, although with a lower volume. Outbound traffic volumes broken by commodity-type are illustrated in Figure 166.

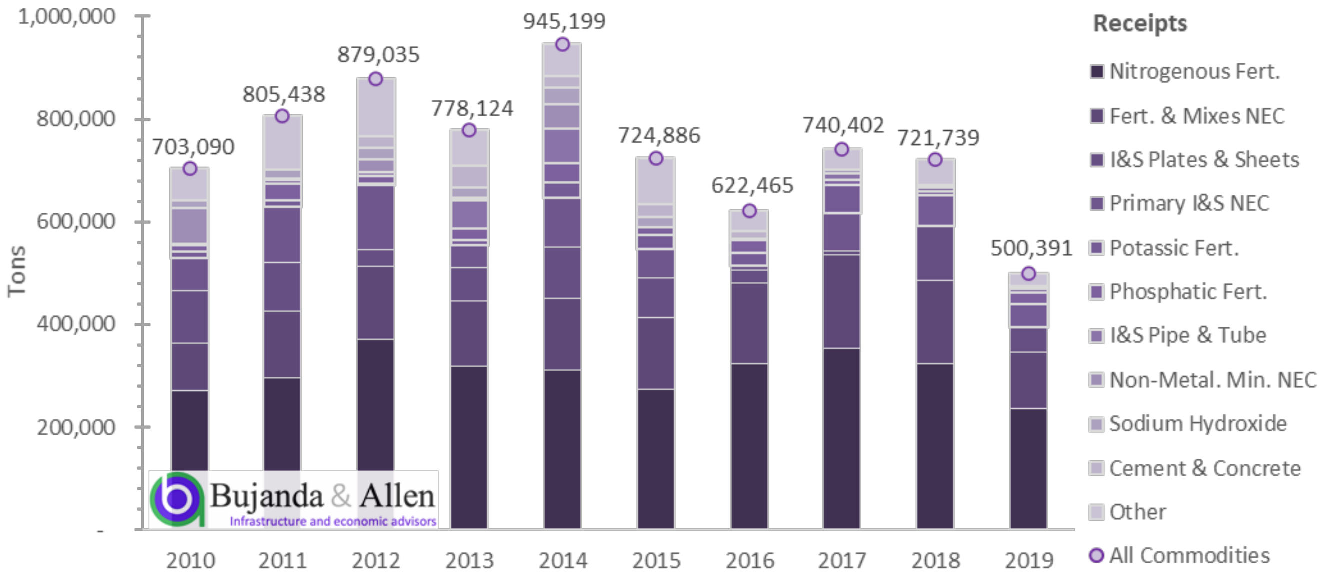
Figure 166. Port of Catoosa outbound traffic volumes (shipments) by commodity (2010-19, tons)



Source: Bujanda & Allen with data from USACE, 2021.

The composition of inbound volumes has also remained consistent during the last 10 years. Diverse types of fertilizers have been in the top-2 commodities and I&S plates and sheets in the top-3, every year since 2010. The top-10 also include other types of fertilizers, diverse steel, metallic, and non-metallic products, as well as minerals. Inbound traffic volumes broken by commodity-type are illustrated in Figure 167.

Figure 167. Port of Catoosa inbound traffic volumes (receipts) by commodity (2010-19, tons)



Source: Bujanda & Allen with data from USACE, 2021.

6.2 Port of Kansas City (PortKC)

PortKC is located on the confluence of the Missouri and Kansas rivers, at the intersection of six Class I railroads and numerous interstates (i.e. I-70, I-35, I-29, and Hwy 71). Some of its intermodal yards are near the dense central business district. The facility's capabilities include transfer between barge, rail, and truck. Top commodities include fertilizer, structural steel, shredded scrap, and coal slag. It also handles grain, corn, meal, barley, bark, rock clinker, salt, rolled and coiled steel, and petroleum coke.

6.2.1 Infrastructure

In August 2015, PortKC welcomed its first barge since 2007. Since reopening,[18] annual throughput has been about 110,000 tons. The port advertises that its potential annual capacity is 800,000 tons. A rail spur was completed in 2017, connecting the port to the UP rail line. As part of the effort to grow waterborne commerce, PortKC is planning the redevelopment of a former 415-acre steel mill site into an intermodal hub using a public-private partnership (P3).[19] Key characteristics are listed in Table 49. An aerial image of the port and existing infrastructure is shown in Figure 168.

[18] Due to reduced volumes, the port closed its Woodswether Terminal in 2007, when it was handling about 600,000 tons (544,310 MT) per annum. The Kansas City Port Authority took over responsibility for the port and reopened it for commercial use in August 2012. In 2019, the port handled its first rail cars loaded with salt for roads.

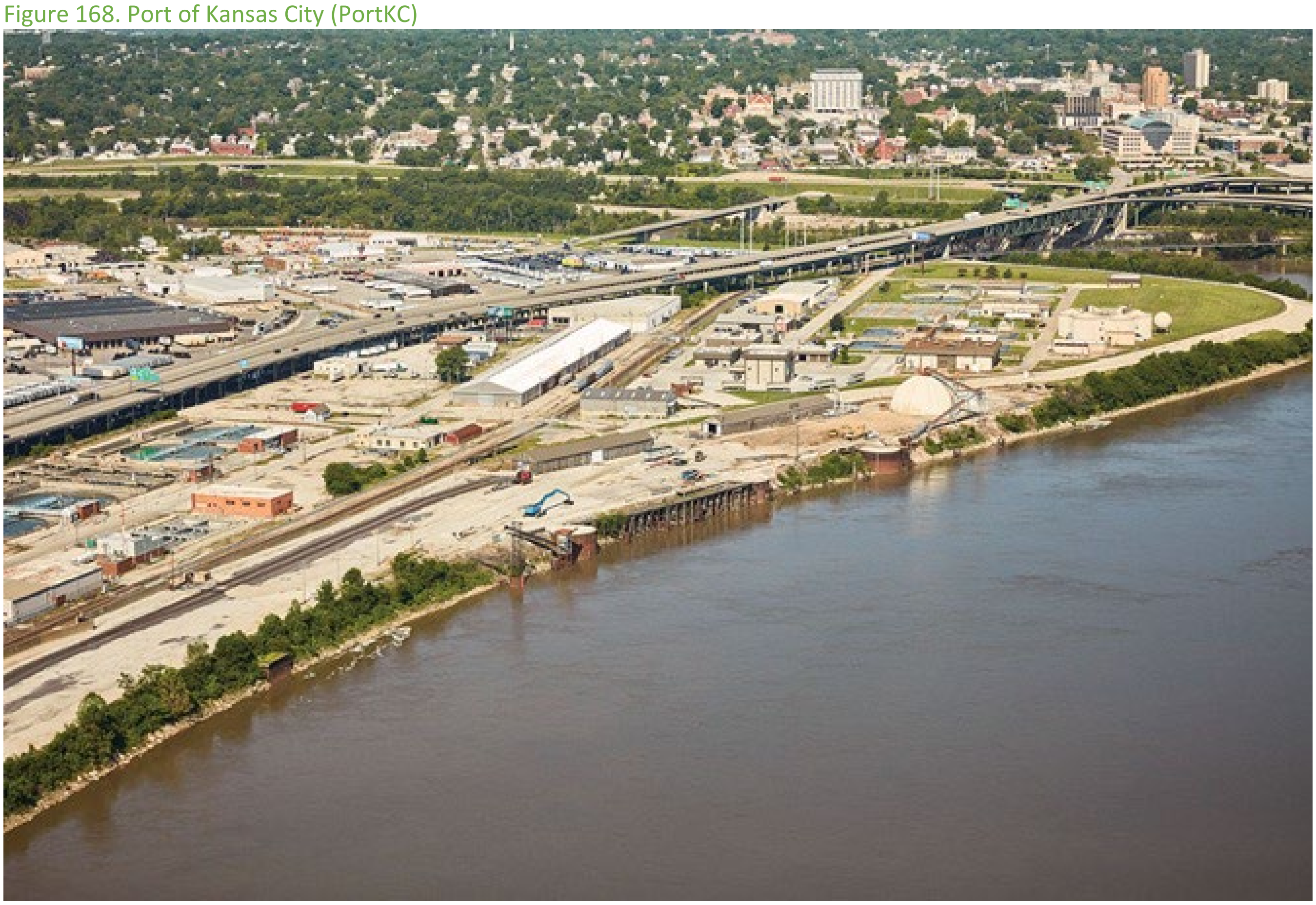
[19] *Port KC advances Missouri River Terminal work with selection of KPMG*. PortKC, July 10, 2019. https://portkc.com/port-kc-advances-missouri-river-terminal-work-with-selection-of-kpmg/

Table 49. Port of Kansas City (PortKC)—terminal characteristics

Facility area	Cargo type	Equipment, capabilities, or capacity
Receiving Infrastructure and inbound conveyance (marine leg)	▪ Agribulk ▪ Breakbulk ▪ Drybulk/Fert	▪ 3 load cells and docking structures for 14 barges (on 900 feet of shoreline) ▪ 3 cranes (25-ton) ▪ 8 front-end loaders ▪ Portable conveyor systems
Storage	▪ Agribulk	▪ 60,000 tons of covered storage ▪ Open storage space
	▪ Breakbulk	▪ Open storage space
	▪ Drybulk/Fert	▪ Open storage space ▪ 145 acres of vacant land available for expansion
Outbound conveyance or outload capabilities	▪ Agribulk ▪ Breakbulk ▪ Drybulk/Fert	▪ Loaders, dump trucks, conveyors ▪ On-site truck scale ▪ Connects to the main UP branch on-dock

Source: Bujanda & Allen, with data from the USACE, 2021.

Figure 168. Port of Kansas City (PortKC)

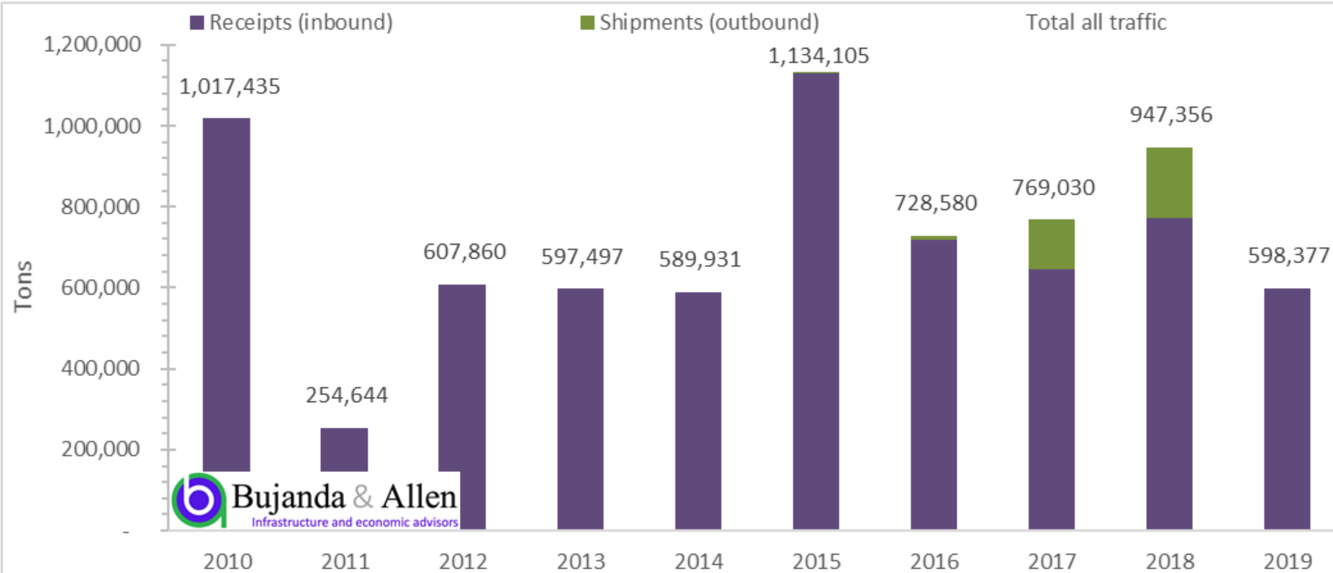


Source: PortKC, 2021.

6.2.2 Traffic volumes

PortKC is a major economic engine for the region, allowing shipments of manufactured goods and agricultural products to the rest of the world. Between 2010 and 2020, the port surpassed the 500,000 tons mark every year except for 2011. During this time, total throughput port volumes peaked in 2015 with 1,134,105 tons driven primarily by receipts (inbound) shipments. In 2019, the port handled 598,377 tons from which 100% where receipts (inbound). Inbound, outbound, and total traffic volumes are illustrated in Figure 169.

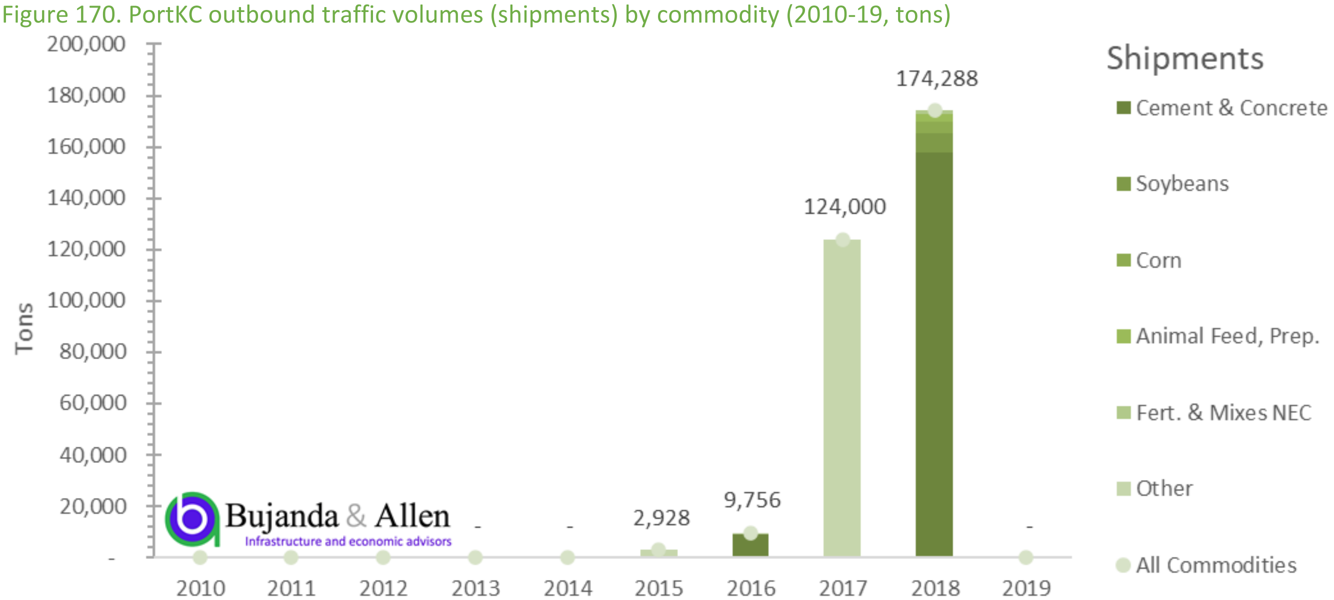
Figure 169. PortKC inbound and outbound traffic volumes (2010-19, tons)



Source: Bujanda & Allen with data from USACE, 2021.

The composition of outbound traffic volumes from the port comprises Cement, Soybeans, and Corn, which have been in the top-3 commodities. Animal Feed and Fertilizers have also shown some movement, although with a lower volume. Outbound traffic volumes broken by commodity-type are illustrated in Figure 170.

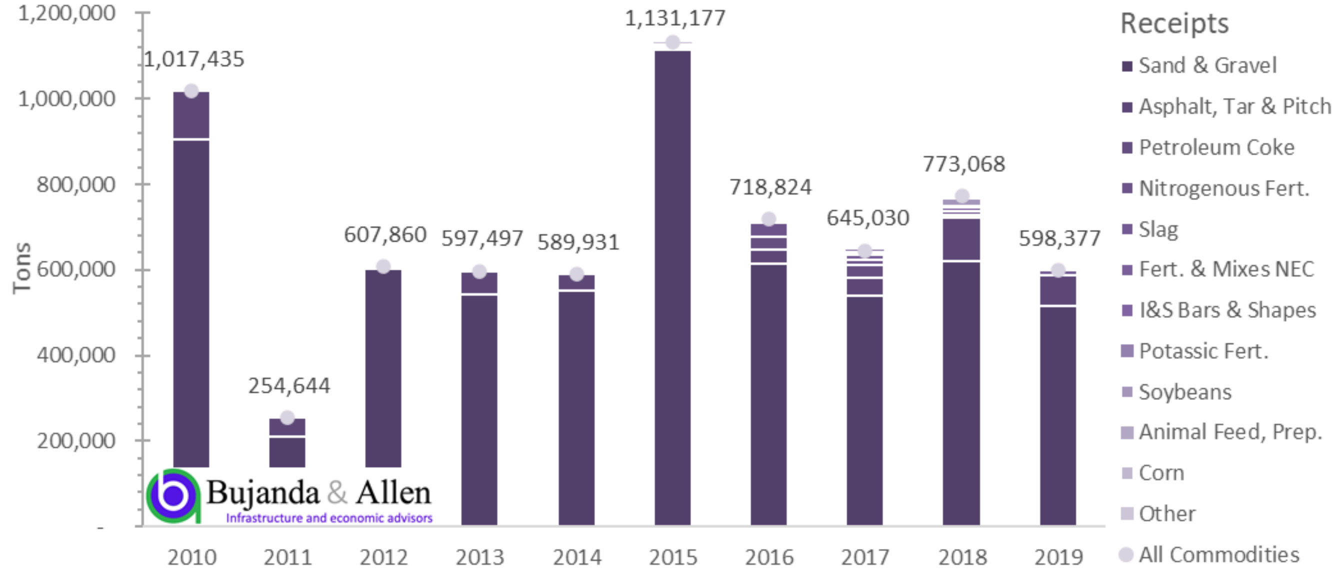
Figure 170. PortKC outbound traffic volumes (shipments) by commodity (2010-19, tons)



Source: Bujanda & Allen with data from USACE, 2021.

The composition of inbound volumes has remained more consistent during the last 10 years. Sand & Gravel, Asphalt, and Petroleum Coke have ranked in the top-3. The top-10 also include diverse types of fertilizers, diverse steel, metallic, and non-metallic products, as well as minerals. Inbound traffic volumes broken by commodity-type are illustrated in Figure 171.

Figure 171. PortKC inbound traffic volumes (receipts) by commodity (2010-19, tons)



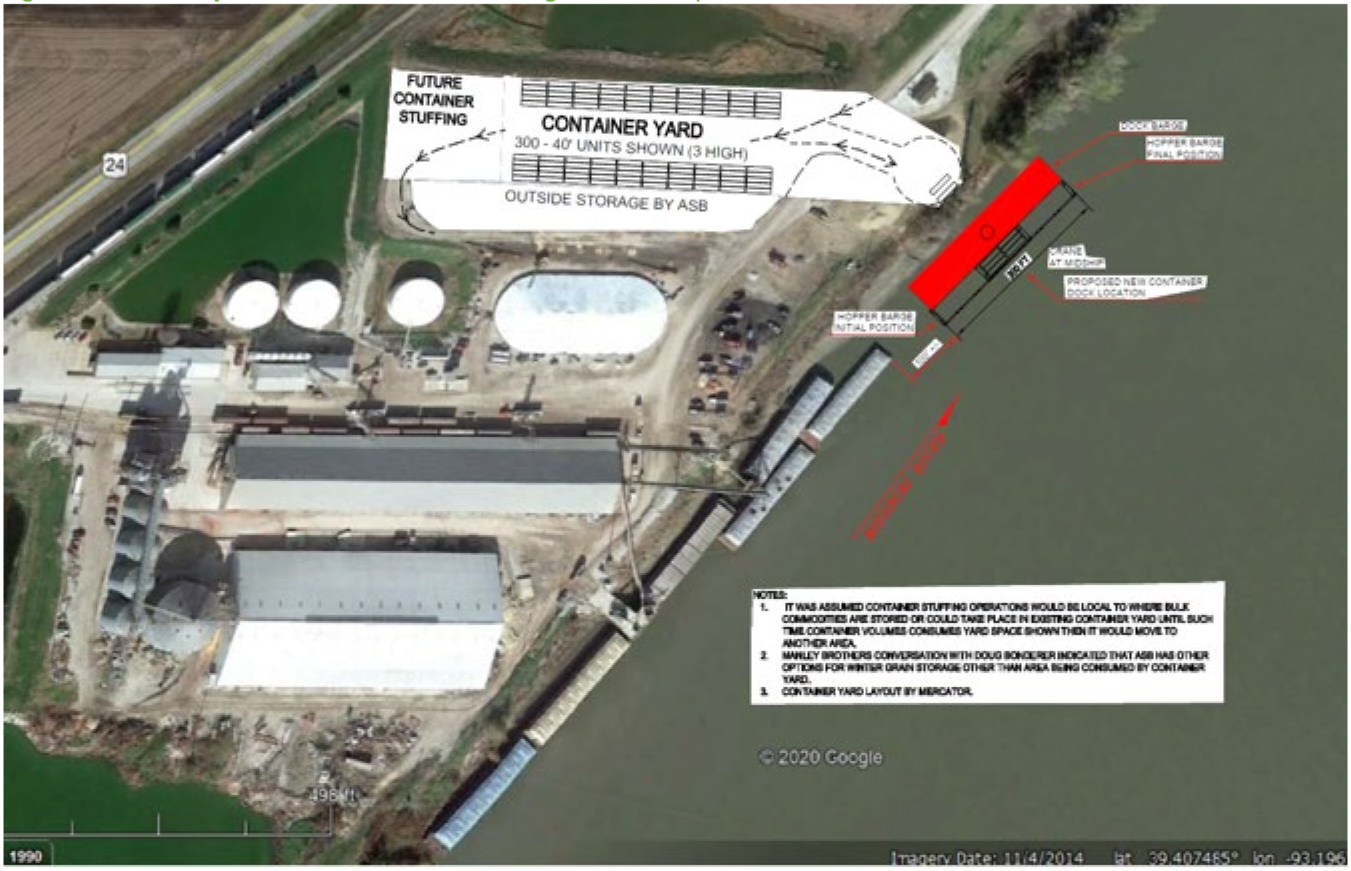
Source: Bujanda & Allen with data from USACE, 2021.

6.3 AgriServices of Brunswick (ASB)

Located at 40,135 US-24 in De Witt, MO, ASB traces its roots as far back as 1870 in Mendon, MO. In the mid 1970's, Walker C. Fletcher and William P. Jackson had a mutual interest in developing a barge facility in central Missouri to move agricultural inputs, especially fertilizer, into the region and take advantage of the backhaul to move grain to New Orleans export gateways.

Using the Norfolk Southern rail, US-24 highway, and its inland waterway system, ASB provides wholesale and retail customers a logistical advantage that translates into the ability to purchase agricultural inputs and sell grain, not only at more competitive prices, but using a more environmentally friendly transportation mode. ASB's inland waterway system remains one of the most cost-effective mode of transportation for high bulk, low value products and has been the backbone of the regional transportation system continuously since 1978. An aerial image of the port, existing, and proposed infrastructure is shown in Figure 172.

Figure 172. ASB Project: site and container-on-barge terminal layout



Source: ASB, 2020.

6.4 St. Joseph Regional Port Authority

Inaugurated a new storage facility on October 2018 to welcome the port's new operator, TransPort 360, a newly formed division of MK Minerals Inc. of Wathena, KS. MK Minerals produces pelletized lime, gypsum, and other products for application on agricultural fields, golf courses, landscaping projects, home lawns, and gardens. An aerial image of the port and existing infrastructure is shown in Figure 173.

Figure 173. St. Joseph Regional Port Authority

a) River side infrastructure | b) Land side infrastructure

Source: St. Joseph Regional Port Authority, 2020.

6.5 Transportation hurdles for producers

The research in this section also aims to surface and document transportation hurdles faced by agricultural producers. This section presents an analysis of the condition of bridges and applicable restrictions. Harbor channel and inland waterway draft issues are analyzed. A synopsis of how market concentration for ocean carriers and equipment imbalances (i.e. headhaul fulls vs backhaul empties) contribute to the list of hurdles faced by agricultural exporters. Similarly, a summary of the impacts from the COVID-19 pandemic into supply chains is provided. This section concludes with an overview of potential solutions, proposed by industry participants, to ameliorate some of these hurdles.

6.5.1 Bridges

Kansas is the fifth state with most bridges. FHWA evaluates bridges with a good, fair, or poor rating based on age, maintenance, and overall condition. Kansas' proportion of bridges in **good condition** is better than the national average. KDOT and KTA have prioritized maintaining, repairing, and replacing the 24,934 bridges in the state. In 2020, more than 99 percent of Kansas' state-owned bridges had **good or fair condition** rating (the highest in the country). State-owned bridges in **poor condition** in Kansas have remained below 2% for the 10 years prior to 2020. However, between 2012 and 2020, state-owned bridges in **good condition** fell due to age, reduction of state maintenance forces, and reduced spending on bridge preservation. The number of bridges by type and jurisdictional ownership in the state are shown in Table 50.

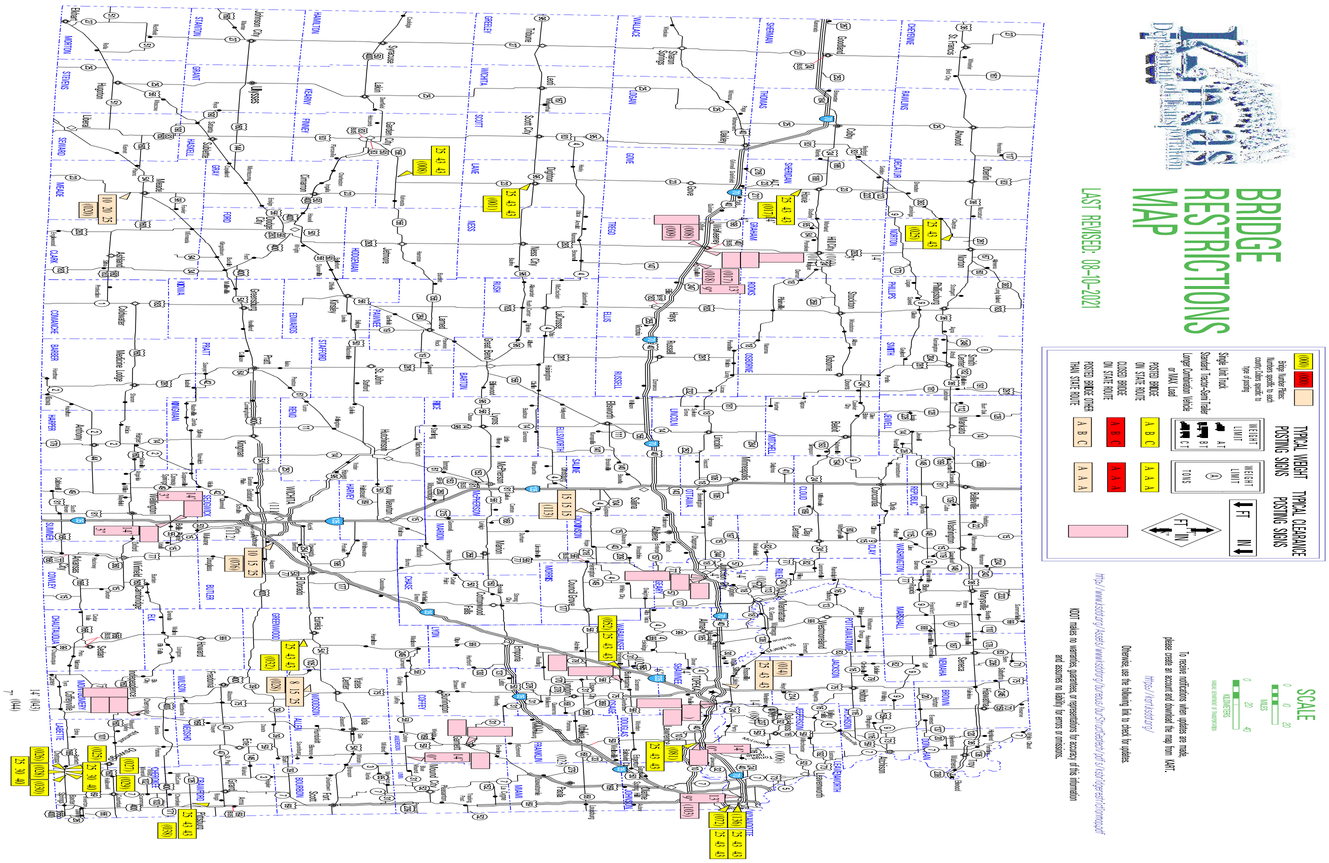
Table 50. Bridges by type and jurisdictional ownership.

Bridge type	State	Local	KTA	Other	Total
Slab	1,337	3,843	7	37	5,224
Beam/girder	2,005	8,510	328	50	10,893
Truss/arch	9	349	0	3	361
Culvert	1,772	6,586	29	33	8,420
Other	5	31	0	0	36
Total	**5,128**	**19,319**	**364**	**123**	**24,934**

Source: KDOT, 2017.

In terms of bridge restrictions, KDOT has two types of restrictions: (i) weight limits and (ii) maximum clearance. West of Wichita (I-35/135), there are only four bridges with posted weight limits on state routes and three bridges with clearance restrictions. The weight limits are 25 tons for single unit trucks and 43 tons for semis and longer combination trailers. These four bridges are located within the counties of Norton, Sheridan, Lane, and Finney respectively. The clearance restrictions are 14 ft 4 in and 14 ft 3 in within Trego County and 13 ft 9 in within Ellis County. To the east of Wichita, there are eight bridges with posted weight limits on state routes and ten bridges with clearance restrictions. As of August 2021, there are no closed bridges in the state. KDOT is also in the process of replacing six of the bridges with weight limits on the eastern part of the state in 2022. A map of KDOT's bridge restrictions is illustrated in Figure 174.

Figure 174. KDOT Bridge restrictions map



Source: KDOT, 2021.

6.5.2 Harbor channel and inland waterway draft issues

Drought and sedimentation (shoaling) often contribute to insufficient channel depths and widths. To avoid waterway draft issues because of low water levels, barges must be loaded to less than capacity resulting in higher transportation costs per unit of cargo.[20] Regarding available channel widths, the number of barges in a tow may be reduced and one-way or daytime-only traffic restrictions may be imposed, resulting in more barges and vessels requirements and larger transit times.

Channel and waterway draft and width issues impeded barged grain movements and access to ports for extended periods of time causing significant loses. At a 9 ft draft, a typical U.S. barge size is 195 ft x 35 ft, which holds up to 1,500 short tons (1,360.8 metric tons (mt)) of cargo. For each foot of reduced draft, the barge loses about 200 short tons (181.4 mt) of capacity.[21] When harbor channels are at less than authorized depths, S-Class container vessels lose 3,840 short tons (3,483.6 mt) of capacity per foot. Panamax bulk grain carriers lose 2,148 short tons (1,948.6 mt) per ft.[22]

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[20] Marathon, Nick and Kuo-Liang "Matt" Chang. Low Water Impacts on Barge Navigation. U.S. Dept. of Agriculture, Agricultural Marketing Service. Grain Transportation Report. Oct 5, 2017. https://www.ams.usda.gov/sites/default/files/media/GTR100517.pdf#page=2

[21] Draft Table, Cargo in Short Tons. FMT Dry Cargo. Oct 14, 2014. http://fmtdrycargo.com/wp-content/uploads/2015/07/B0207-212.pdf

[22] America's Ports and Intermodal Transportation System. U.S. Dept. of Transportation, Maritime Administration. January 2009. http://www.glmri.org/downloads/Ports&IntermodalTransport.pdf

The ongoing dredging project led by USACE and the State of Louisiana to deepen the shipping channel from the Gulf of Mexico to Baton Rouge from a depth of 45 ft (13.7 meters) to 50 ft (15.2 meters) aims to reap an average annual benefit of $96.8 million, with a benefit-to-cost ratio of about 5.47 to 1.[23]

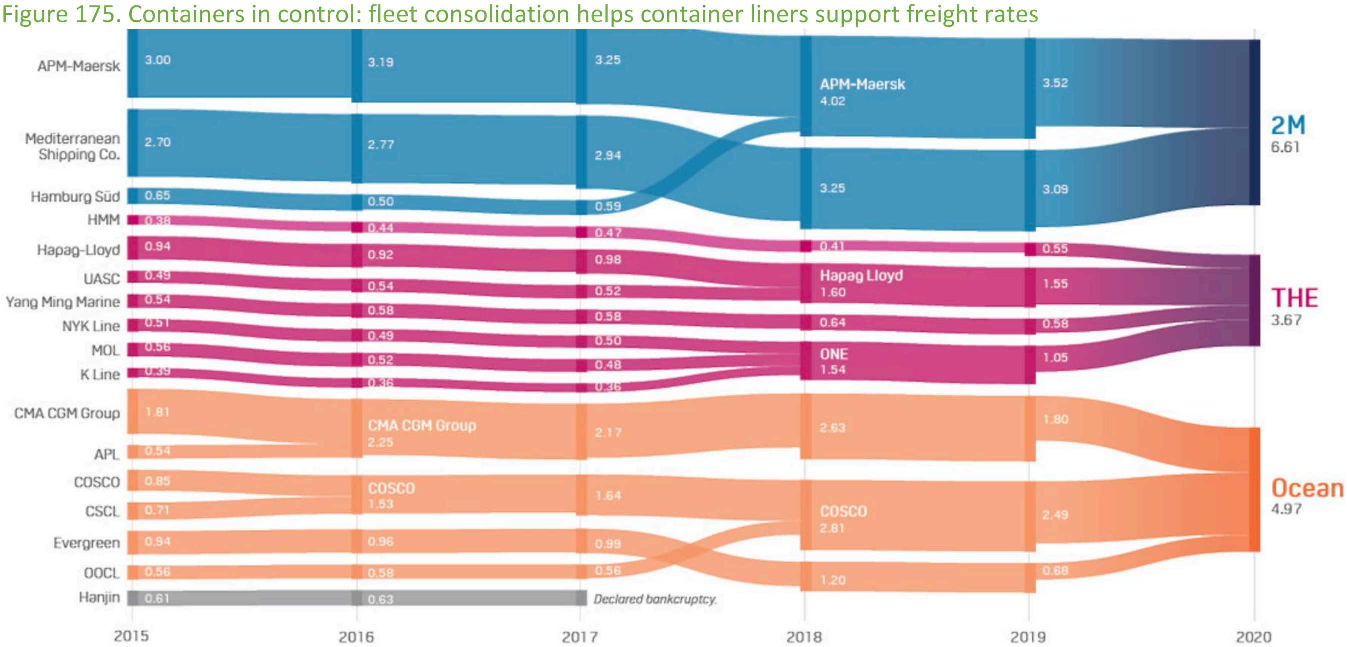
6.5.3 Market concentration and equipment imbalances

U.S. agricultural exporters compete on world prices; however, ocean carrier alliances have become a dominant feature in container shipping having a direct impact on the price of U.S. agricultural exports. Over the last 20 years, consolidation in ocean shipping has concentrated container capacity (i.e. liner shipping, container production, and box-leasing capacity). The world's shipping container capacity is controlled by 3 alliances:

- **2M Alliance:** comprised by APM-Maersk and Mediterranean Shipping Co (MSC), controlling over 1,301 vessels with more than 8.6 million TEUs (20 ft equivalent units) of capacity.
- **Ocean Alliance:** comprised by COSCO, CMA CGM, and Evergreen controlling 1,258 vessels with more than 7.5 million TEUs of container vessel capacity.
- **THE Alliance:** conformed by Hapag Lloyd, ONE, Hyundai Merchant Marine (HMM), and Yang Ming, controlling 641 vessels with more than 4.7 million TEUs.

These 3 alliances combined represent more than 80% of the global capacity of the containership fleet and even a higher percentage of the linehaul capacity. Considering only the East-West trade lanes, where the major flows take place, these three alliances operate around 95% of total ship capacity. Consolidation of these alliances have increased market concentration, not only for the provision of larger vessels and network coverage, but for the control of container equipment beyond the ports.[24,25] Containerized agriculture exports have grown every year since 2015, as shown in Figure 175.

Figure 175. Containers in control: fleet consolidation helps container liners support freight rates



Source: S&P, 2020.

[23] 50-Foot Dredging Depth Proposed for Lower Mississippi River. NOLA.com, July 2021. https://lcaships.com/category/position-papers/

[24] The Impact of Alliances in Container Shipping, OECD International Transport Forum 2018. https://www.itf-oecd.org/sites/default/files/docs/impact-alliances-container-shipping.pdf

[25] Container Alliances Moving Toward more Landside Cooperation, JOC 2020. https://www.joc.com/maritime-news/container-lines/consolidation-accelerating-landside-cooperation-among-ocean-carriers_20200626.html

Due to the continuously increasing U.S. trade deficit and the fact that shipping rates on headhaul trades (Asia to U.S.) are more lucrative than backhaul ones (U.S. to Asia), carriers often prefer picking up empty containers in the U.S. and reposition them back to Asia, rather than taking agricultural exports as backhauls. Carriers often focus on choosing gateways based on equipment repositioning opportunities and existing relationships with rail providers. When no containers are available near U.S. producing agricultural regions, agricultural exporters unquestionably suffer to ship their products to Asian countries.[26] Given the natural container imbalance favoring Asia to U.S. businesses, the services of container lines have become less flexible and customer oriented affecting U.S. exports.[27]

6.5.4 Supply chain impacts from COVID-19

Officially declared by the World Health Organization (WHO) on March 11, 2020, the coronavirus (COVID-19) pandemic created an unexpected shock to most supply chains. The U.S. agricultural sector was no exception. The supply chain disruptions triggered by the COVID-19 pandemic exacerbated the number of transportation hurdles for agricultural producers on the supply side and the demand one (e.g. feedlots that had nowhere to send finished animals and consumers who faced limited supplies and higher retail prices).

On the demand side, U.S. consumers switched from spending over half of their food dollars on food away from home (FAFH) to preparing and consuming most of their meals at home, food-at-home (FAH). Between 2019 and 2020, household FAFH purchases fell by 17 percent, the first decline since 2009.[28] With more people staying at home, demand also shifted from services to goods, triggering a surge for imports of goods. Supply chains for FAFH and FAH are often separate, have different processes, and are intended for different markets (e.g. different packaging sizes, labeling, refrigeration requirements, etc). For meat, poultry, hog, and broilers, among other supply chains, this shift from consumption at restaurants to grocery stores caused problems and bottlenecks.

On the supply side, processing plants struggled to maintain output and slaughter capacity primarily at the beginning of the COVID-19 pandemic due to different factors, among the main one, a shortage of workers. As of May 31, 2020, 16,233 workers contracted COVID-19 and 86 workers died from the virus across 239 meat (beef, pork, poultry, bison, and lamb) processing plants in 23 states.[29] Large beef, pork, and chicken packing plants increased county transmission rates by 110 percent, 160 percent, and 20 percent, respectively, within 150 days of COVID-19 emergence in a county.[30] The shortage of workers forced many facilities to dramatically slow production or even shut down temporarily, leading to a drop in the supply of meat, particularly beef and pork. In the medium- and long-terms, however, COVID-19 infection rates in counties with meatpacking plants became like counties without plants.

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[26] Ag Shippers Slam Carriers for Refusing Some Export Loads, JOC 2020. https://www.joc.com/maritime-news/container-lines/ag-shippers-slam-carriers-refusing-some-export-loads_20201023.html.

Maritime Shippers Refuse to Load Agricultural Exports, Western FarmPress, Feb 2021. https://www.farmprogress.com/trade/maritime-shippers-refuse-load-agricultural-exports

Shipping Carriers Rejected Tons of U.S. Agricultural Exports, Opting to Send Empty Containers to China, CNBC Jan 2021. https://www.cnbc.com/2021/01/26/shipping-carriers-rejected-us-agricultural-exports-sent-empty-containers-to-china.html

[27] FMC Chairman Addresses Export Container Availability, FMC Dec 2020. https://www.fmc.gov/fmc-chairman-addresses-export-container-availability

[28] U.S. Department of Agriculture, Agricultural Marketing Service. 2021a. USDA Livestock, Poultry, & Grain Market News, "5 Area Weekly Weighted Average Direct Slaughter Cattle," U.S. Department of Agriculture, Washington, DC.

[29] Waltenburg, M.A., et al., 2020. Update: COVID-19 Among Workers in Meat and Poultry Processing Facilities—U.S. April-May 2020. Morbidity and Mortality Report: 887-892, U.S. Department of Health and human Services, Centers for Disease Control and Prevention.

[30] Saitone, T., K.A. Schaefer, and D.P. Scheitrum. 2021. COVID-19 Morbidity and Mortality in U.S. Meatpacking Counties, Food Policy 101.

The transportation segment of the supply chains was also impacted. As consumers began panic shopping (e.g. toilet paper, hand sanitizers, cleaning supplies, etc), truck fleets and drivers focused on keeping retail consumers afloat.[31] Although lower traffic congestion was observed due to stay-at-home restrictions, higher detention times at U.S. and Chinese sea ports due to the shortage of workers increased congestion. Sea ports became the chokepoints of most supply chains reporting more than 100 vessels at times waiting to berth and be unloaded. These delays trickled down to entire supply chains. Cargo owners had few options if they needed more capacity, not only on vessels, but at port, trucks, railroads, and container equipment—impacting agricultural exports.[32, 33]

6.5.5 Potential supply chain solutions

The Agriculture Transportation Coalition (AgTC) was asked by U.S. government agencies, the White House, and Congressional Committees for potential solutions to the supply chain crisis. The Inventory of Supply Chain Solutions (November 2021) was proposed by exporters, importers, port leaders, truckers, terminal operators (confidentially), public officials, and AgTC members. Each of these potential solutions requires a more detailed description and discussion of the feasibility, cost, benefits, interests, as well as the short- and long-term impacts on the supply chain. A summary of these solutions is provided in *Box 1.*

[31] COVID-19 Impacts on the Trucking Industry, American Transportation Research Institute, April 2020.
[32] Widespread Port Congestion Threatens Farm Exports, Market Intel, October 2021. https://www.fb.org/market-intel/widespread-port-congestion-threatens-farm-exports
[33] Continued Transpacific Vessel Pressure, Sea-Intelligence, February 2022.

Box 1. Inventory of supply chain solutions (AgTC, 2021)

1. **Marine terminal operations and trucking into terminals.** Expand terminal gate hours at least 2 hours earlier in the morning and 1 hour in the afternoon. Avoid shutting down terminals in the middle of the day. Allow sufficient time for the shipper to collect a container from the terminal and return it. Assess no demurrage charges if the earliest return date changes. Automate marine terminal operations, in line with global practices.
2. **Additional land and warehousing near ports and inland.** Find space for containers off the terminals in densely populated cities and amend zoning codes and land restrictions respectively. Allow higher stacking of containers. Develop inland terminals, even if just rudimentary truck and storage yards near ports. Develop inland ports where cargo can be transported on trains 100-200 miles inland.
3. **Trucking costs and truck driver shortage**. Increase U.S. and California's restrictive national uniform truck weight limits to global standards. Increase flexibility on existing regulations to incentivize the number of commercial drivers. Establish penalty fees for terminal delays (e.g. if the carrier arrives to the terminal and container is not ready).
4. **Information/transparency of the supply chain investment.** Create a single data portal that tracks cargo movement shipping availability; trucking wait time; terminal appointments and gate operations, cargo cut, equipment location and availability, etc.to allow better business operations and logistics. Mandate participation by all port stakeholders, particularly the marine terminals, ocean carriers, chassis providers.
5. **Rail service at inland rail ramps for access to marine terminals.** Inland rail terminals should seek adjacent space from nearby communities for storing containers short-term. Inland rail terminals should expand operating hours and, as with port terminals, start to ramp up operations 24/7, with incentives for truckers and BCO's for off-hours usage. Railroads should identify possible additional container storage and intermodal service at other rail terminals and inland ports that are currently little or non-used for container service.
6. **Chassis shortage.** Remove trade barriers that increase costs of chassis being exported to the U.S. and stimulate U.S. chassis manufacturing. Ocean carriers should provide chassis at the same cost and set "free time" (no detention or demurrage) for their champion account importers at same terms as they do to smaller and medium importers. This will assure all importers have an equal incentive to get containers off chassis and off terminals. Any available chassis should be eligible to carry any container.
7. **Ocean carrier practices; Federal Maritime Commission enforcement.** Mandate carriers provide their shipper customers, terminals, truckers with accurate data of arrival times, loading windows, cargo cut, container equipment return dates (ERD) and continuously update (as airlines do). Prohibit ocean carriers from "marking up" marine terminal demurrage charges as set forth in their published tariffs. Typically, the marine terminals' demurrage ranges from $20/day to $40/day. But carriers add another $100 to $200/day, then invoice the BCO.
8. **Creating a competitive marketplace.** The Justice Department should assess if the current structure of ocean container shipping services is limiting competition (i.e. facilitating rate increases and control of capacity).
9. **Federal Agency contribution to increased export and import fluidity.** Allow USDA Inspection Services and associated documentation to allow for port delays and additional re-inspections. CBP should review its import enforcement and facilitation processes (e.g. holds, intensive exams, advance import data sharing with ports and terminals) and initiate changes to increase import fluidity through the terminals and to the importer.
10. **Federal financial assistance for agriculture lost sales, transport costs, product damage.** Apply farmer payments for product loss or sales because of port delays or delayed arrivals at scheduled export destinations.
11. **Restoring Port Authority control over port operations.** Port Authorities which control terminal operations and policies can operate them in the public interest; several Southeast states are "operating ports". U.S. West Coast ports are "landlord ports", leasing property to companies which control terminal operations and pricing.

Source: AgTC 2021, https://agtrans.org/solutions.

7 Freight rate analysis

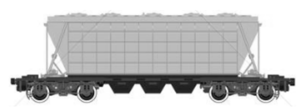
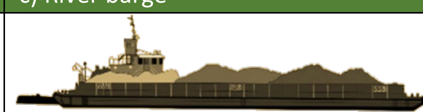
This section presents a freight rate analysis evaluating rail, truck, and inland waterway routes of the main target markets for Kansas' agricultural products for customers in Asia, Europe, Mexico, and South/Central America. This section evaluates the route cost competitiveness, in terms of logistics costs of agricultural logistic chains that utilize the 445 mi-long MKARNS (M-40). We analyze the route economics and identify potential route cost savings that could drive cargo to the available Marine Highways; that is, substituting barge for rail on the inland component (i.e. truck+rail vs. truck+barge) en-route to international export gateways. Our analysis compares the costs for key routes aiming to identify the more efficient ones. These analyses are done for ***non-containerized*** cargoes first, followed by ***containerized*** ones. This section concludes with logistical cost advantages of each route.

7.1 Non-containerized cargo routes

7.1.1 General assumptions

Bujanda & Allen calculated the route costs for agribulk cargo by modal component (i.e., truck, rail, and barge). Route costs were calculated first for the primary incumbent routes and then compared to the routes that the cargo would follow via the MKARNS barge route. Cost, distance, and similar inputs were obtained for each modal segment of the trip for each route analyzed. All costs were converted to dollars per metric ton ($/MT) to allow consistency across modes based on payload factors and the carrying capacity for each mode and their respective units, as shown in Figure 176.

Figure 176. Unit capacity by mode of transport, in metric tons (and pounds, lb).

a) Truck	b) Jumbo Hopper railcar (5,161 ft^3)	c) River barge
		
19 metric tons (41,888 lb)	**100 metric tons** (223,400 lb)	**2,000 metric tons** (4,409,245 lb)

Source: Bujanda & Allen, 2021.

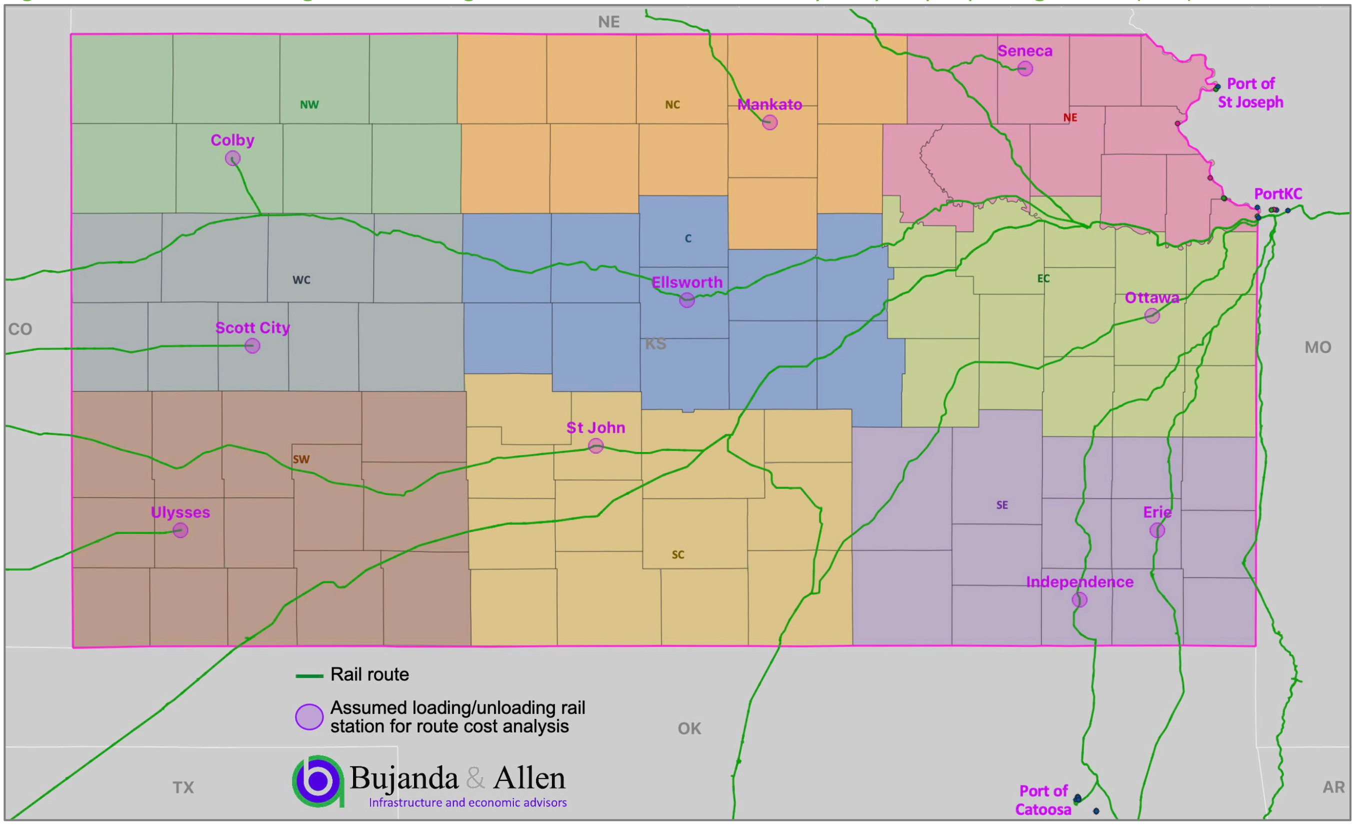
As observed, the river barge overshadows the other two transportation modes, handling roughly 20 times as much as a railcar and 100 times as much as a truck.

Bujanda & Allen analyzed route costs for the key non-containerized cargoes being exported from and imported into Kansas' market region by first segmenting the state into each of the nine CRDs as defined by the USDA:

- Northwest (NW)
- West-central (WC)
- Southwest (SW)
- North-central (NC)
- Central
- South-central (SC)
- Northeast (NE)
- East-central (EC)
- Southeast (SE)

We also assumed that loading and unloading rail stations for each of the nine CRDs acted as the start and terminus for each rail route analyzed. The location of the assumed loading and unloading rail stations for route cost analysis for each of the nine CRDs is illustrated in Figure 177. Given the short distance between the loading/unloading stations and each county (i.e., less than 45 miles on average), the vast availability of agribulk loading stations throughout each county and the overall state, and local knowledge, we assumed that the first/last leg of the trip was done by trucks owned by the farmers. The same cost is assumed for all rail stations based on the average trucking distance of 45 miles. Shuttle grain elevator in Kansas are provided in *Appendix C.*

Figure 177. Assumed loading and unloading rail stations for route cost analysis by crop reporting district (CRD)



Source: Bujanda & Allen, 2022.

7.1.2 Agribulk routes by rail

Bujanda & Allen in coordination with the KDA, KDOT, and rail operators in the state identified the main incumbent routes for agribulk exports from draw areas on each CRD: (i) Kansas – Portland, (ii) Kansas – Mexico City, (iii) Kansas – Houston, (iv) Kansas – New Orleans, and (v) Kansas St. Louis – Norfolk. All five have rail as the inland transport component and one has barge. An additional route is analyzed between Kansas and Oakland because the Port of Oakland recently announced its plans to permanently expand its agriculture export business. These incumbent routes are explained in detail in the following bullets and displayed in Figure 178.

- **Kansas – Portland**. This 1,880 mi long route is the primary route for agribulk exports via the Pacific Northwest (PNW), which includes the ports of Portland, Seattle, and Tacoma destined to Asia. This route is served by UP and BNSF. The nearest loading points are Colby, Scott City, and Ulysses on the western part of the state and Mankato and Seneca on the north-central and northeastern parts of the state, with a median distance of 35 mi by truck to/from each county in the corresponding CRDs.
- **Kansas – Mexico City.** This 1,680 mi corridor is served by UP on the U.S. side of the border. UP connects with Kansas City Southern Mexico (KCSM) in Laredo, Texas and this corridor extends all the way to Mexico City (Cd. de Mexico or CDMX). This corridor was considered the most representative route choice between the study area and Central Mexico.[34] There is also a water route from the current draw area to Mexico City, which incorporates truck and barge to New Orleans, a transgulf vessel to the Port of

[34] There are three main rail corridors connecting Central Mexico with the Texas border:

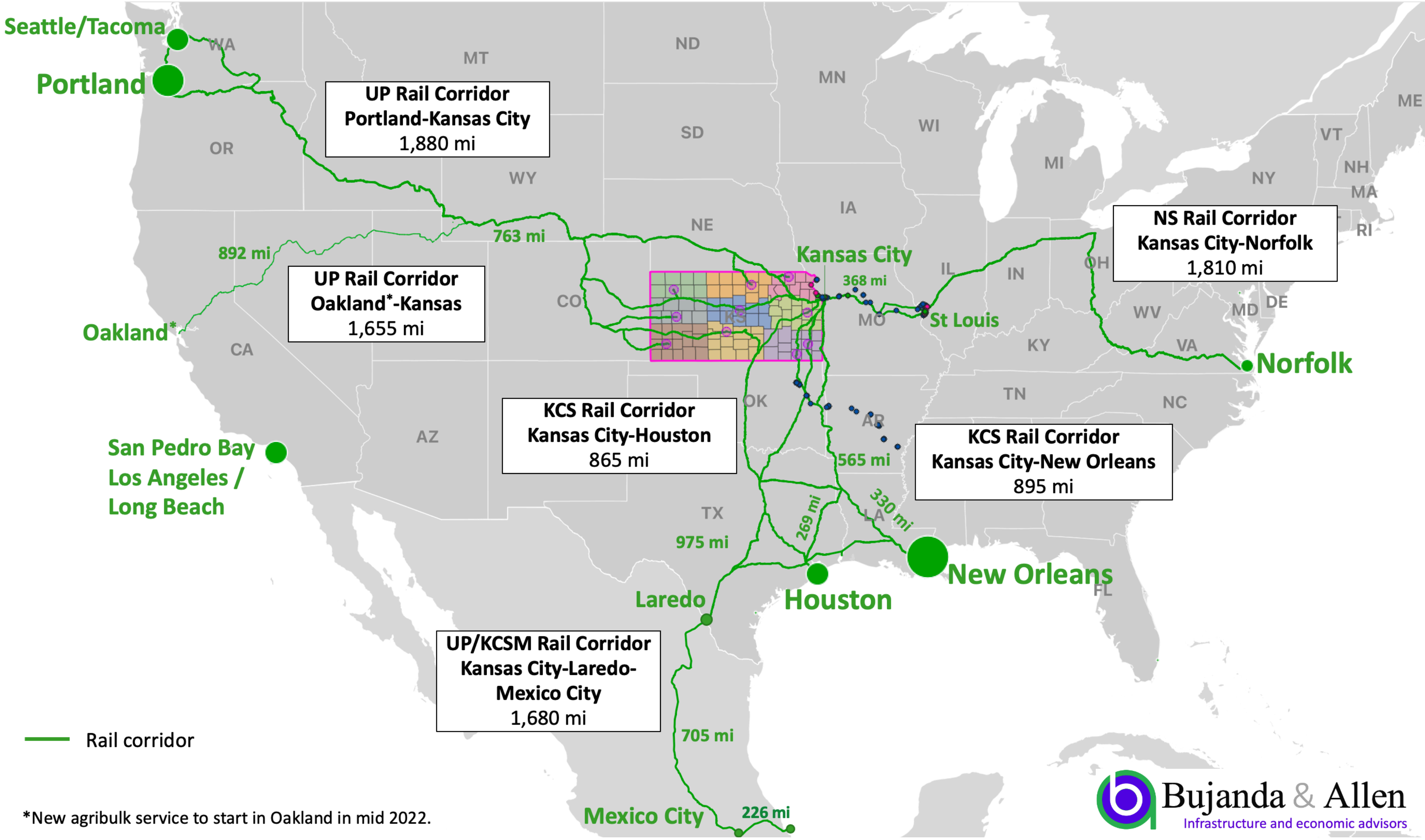
i. The Ferromex corridor that extends from Queretaro, Aguascalientes, Torreon, Chihuahua, and Cd. Juarez connecting with UP and BNSF in El Paso.
ii. The KCSM corridor that extends from Mexico City, San Luis Potosi, Saltillo, and Piedras Negras (interchanging with Ferromex) connecting with UP in Eagle Pass.
iii. The KCSM corridor extends from Mexico City to San Luis Potosi, Saltillo, and Nuevo Laredo connecting with UP in Laredo.

Veracruz, and truck 226 mi to Mexico City. The nearest loading points for this corridor are Kansas City and Ottawa on the eastern part of the state and Independence and Erie on the southeast, with a median distance of 32 mi by truck to/from each county.

- **Kansas** – **Houston.** This 865 mi corridor is served by three routes on the north-south direction connecting Kansas with the U.S. Gulf Coast (USGC). UP, BSNF, and KCS serve this corridor in the north-south direction. The nearest loading points are Kansas City and Ottawa on the eastern part of the state and Independence and Erie on the southeast, with a median distance of 32 mi by truck to/from each county.
- **Kansas** – **New Orleans.** This is the main corridor for the Gulf Coast gateway for agribulk exports. There are two alternatives to move cargo from PortKC to St. Louis to New Orleans, by rail and barge, as described next:
  - **By rail.** UP, KCS, and CN serve this 895 mi corridor in the north-south direction (with BNSF and CSXT interchange in the east-west direction). St. Louis is the nearest loading point for non-containerized exports moving through the Port of New Orleans. Kansas City and Ottawa on the eastern part of the state and Independence and Erie on the southeast, with a median distance of 32 mi by truck to/from each county.
  - **By barge.** This 1,558 mi marine highway starts at Kansas City, where barge service is available along the Missouri River for 368 mi along M-70 to connect with the Mississippi River at St. Louis. The Port of St. Louis provides barge service along the Mississippi River for 1,190 mi over M-55 from St. Louis to New Orleans, the export gateway.[35] AgriServices of Brunswick is in the process of constructing a container-on-barge (COB) facility which will serve as an additional loading alternative on this route. The median distance of 120 mi by truck to/from each county.
- **Kansas** – **St. Louis** – **Norfolk.** This 1,810 mi route is the primary corridor for agribulk exports via Norfolk, VA in the East Coast. This route is served by the Norfolk Southern (NS) with interchange with CSXT. The nearest loading point for exports is St. Louis.
- **Kansas – Oakland.** This additional prospective route involves a rail movement from Kansas to the proposed new terminal in the Port of Oakland. The corridor is 1,655 mi (225 mi closer than Portland) and is designed over an existing track with maximum allowable gross weight of 286,000 lb controlled by UP. The nearest loading points are Colby, Scott City, and Ellsworth and St John on the central part of the state, with a median distance of 39 mi by truck to/from each county in the corresponding CRDs.

[35] The Port of Metropolitan St. Louis (PMSL), as defined by the USACE, is 70 miles long, including both sides of the Mississippi River. The City of St. Louis Port District, which is within the PMSL, covers 19 miles of riverfront and 6,000 acres of developable land, including the Municipal River Terminal (MRT). The Port is the second-largest inland port by trip ton-miles, and the third-largest by tonnage in the U.S., with more than 100 barge docks, 16 public terminals, and about 55 docks/terminals considering those outside the port limits in Madison, St Clair, and St Charles. The Port handles all non-containerized cargo-types and container on-barge by SCF.

Figure 178. Incumbent routes—main rail corridors for non-containerized ag exports from Kansas



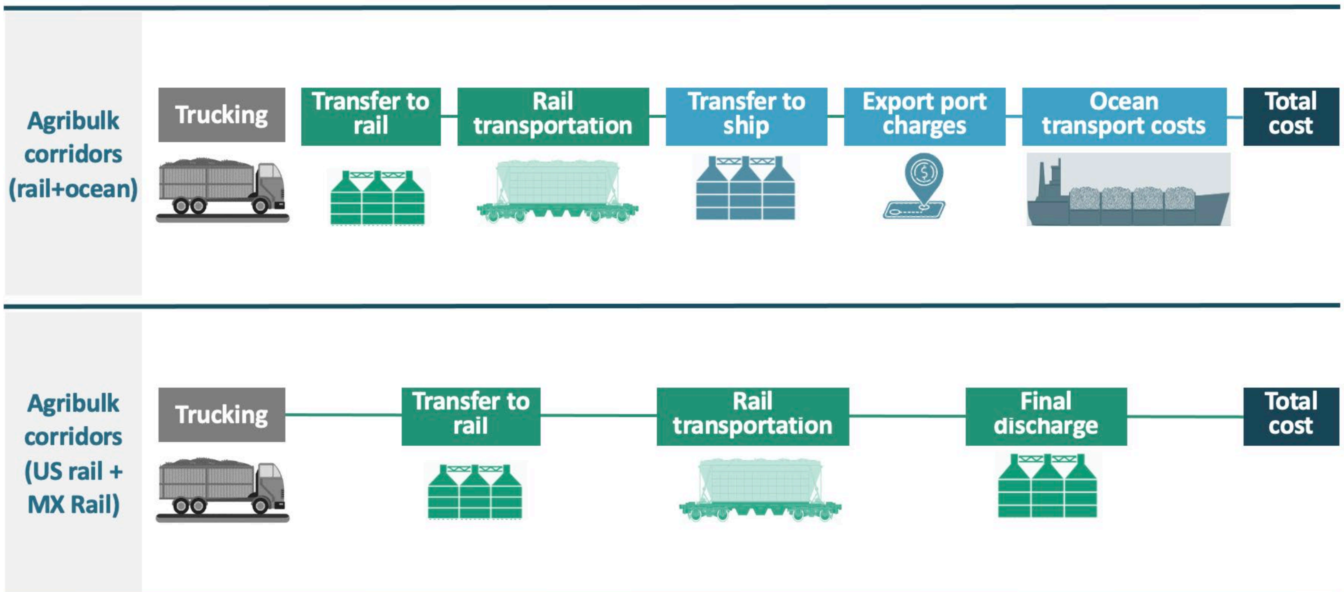
Source: Bujanda & Allen, 2022.

7.1.3 Route costs via agribulk cargo by rail

Farmers and BCO's looking to export agribulk cargoes out of the current draw area rely on trucking as the first mode of transportation to get cargoes to the nearest long-haul intermodal platforms. Since the average distance between the loading stations and each county is less than 45 miles, we assumed that the first/last leg of the trip was done by trucks owned by the farmers. Also given the vast availability of rail stations on each county and throughout the state, the same cost is assumed for all rail stations based on the average trucking distance of 45 miles.

Once in one of these loading points, shipments must be discharged from the trucks into temporary storage areas (e.g., grain silos), and then loaded into railcars or onto barges. The estimation of our rail costs incorporates discharging of trucks, temporary storage, and loading to railcar, as indicated by the quotes obtained from the industry. Similarly, there is cost at the export gateway related to unloading, temporary storage, and loading of the ocean vessel. Trucking, rail, transloading, and ocean transportation costs assumptions per metric ton are illustrated in Figure 179.

Figure 179. Rail, transloading, and ocean transportation costs for agribulk cargo by rail ($/MT).



Source: Bujanda & Allen LLC, 2022.

The export gateways analyzed are on the USGC, PNW, and the East Coast, reflecting the five incumbent corridors for the movement of agribulk exports from Kansas. For each of these gateways, the analysis is further broken down into tradelanes to account for differences in transportation costs to the most relevant destination. The structure of the route costs assumed for agribulk cargoes using rail routes is illustrated in Table 51.

Table 51. Route costs via rail routes: agribulk cargo, 2022 ($/MT)

Rail (bulk)	Rail station $/MT	Total $/MT	Distance mi	Total mi	Transit time days (approx.)	Total days (app)
Railroad inland transportation						
Truck to rail station	$ 20.0		45		1.0	
Transfer to rail	$ 6.4	-			3.0	
Rail transportation to						
U.S. Gulf	$ 74.0		895		5.0	
U.S. PNW	$ 81.0		1,880		10.4	
U.S. East Coast	$ 131.0		1,810		10.1	
U.S. West Coast (Oakland)	$ 73.0		1,655		9.2	
Transfer to ship	$ 6.4	-			3.0	
Export port handling charges	$ 13.0	-			1.0	
Subtotal inland via						
U.S. Gulf	$ 119.8		941		13.0	
U.S. PNW	$ 126.8		1,926		18.4	
U.S. East Coast	$ 176.8		1,856		18.1	
U.S. West Coast (Oakland)	$ 118.8		1,701		17.2	
Ocean vessel transportarion		**Total**				
U.S. Gulf to:						
Asia	$ 69.6	$ 189.4	9,127	**10,068**	29.5	**42.5**
Europe	$ 25.3	$ 145.1	4,786	**5,727**	15.5	**28.5**
Mexico	$ 24.0	$ 143.8	775	**1,716**	2.5	**15.5**
U.S. PNW to:						
Asia	$ 38.8	$ 165.6	9,127	**11,053**	29.5	**47.9**
U.S. East Coast to:						
Europe	$ 23.1	$ 199.9	4,786	**6,642**	15.5	**33.6**
U.S. West Coast (Oakland) to:						
Asia	$ 41.1	$ 159.9	9,127	**10,828**	29.5	**46.7**

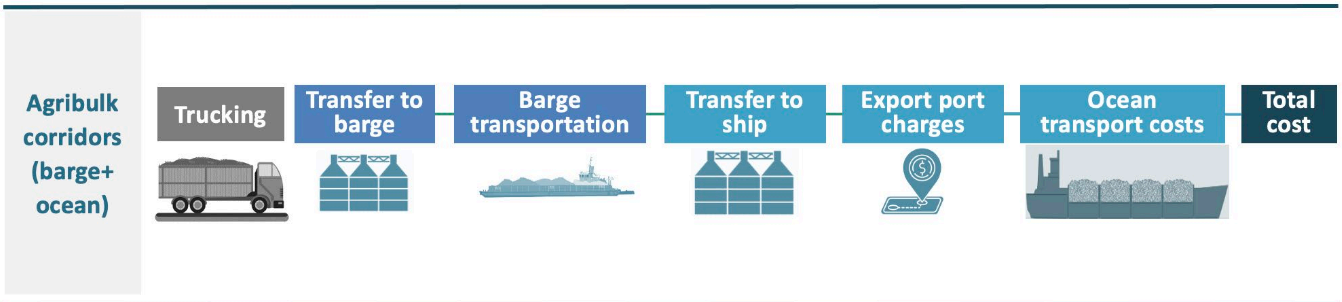
Source: Bujanda & Allen LLC, 2022.

The PNW is the most economical for shipments going to Asia. The U.S. Gulf is the most economical gateway by rail for shipments going to Europe. For shipments to Mexico, the all-rail route crossing the border at Laredo is competitive to all the other gateways, including barge. With each transport mode having its own advantages and disadvantages in addition to cost (e.g., reliability, travel time, frequency, parcel size, safety, etc.), many of these factors have a strong influence on logistic choices made by BCOs and play an increasingly important role on transportation mode and route selection.

7.1.4 Agribulk route costs via the barge routes

Figure 180 provides the cost elements for exporting agribulk cargo to these same foreign destination regions but using routes that would rely on the barge route either via PortKC or the MKRNS route via the Port of Catoosa. By using the marine waterway alternative, shippers looking to export agribulk cargoes out of Kansas would have to truck their cargoes to either PortKC or the Port of Catoosa. Once in the port, shipments will have to be discharged from the trucks into temporary storage and then loaded into barges for transportation to the gateway port in the Gulf. The construction of the barge rate includes truck discharge, storage, barge loading, barge transportation from either ports to New Orleans, and a transfer cost from the barge to the ocean liner vessel.

Figure 180. Route costs via the barge route for agribulk cargo to Asia ($/MT)



Source: Bujanda & Allen LLC, 2022.

The cost chains for intact intermodal container exports were divided into the following categories:

- **Trucking (drayage).** The first leg of an export trip begins with the movement of an empty container from Kansas City to the BCO site where the cargo is originated.
- **Barge transport costs.** Long-haul barge movements represent the next leg of the trip to NOLA. These costs include loading and discharging costs incurred by the barge operator.
    - *Barge loading*. These costs are incurred at the port, and paid by the barge operator.
    - *Barge discharging*. These costs are for discharging the box from the barge into the container yard at the export gateway (e.g. NOLA), and as with the loading operation, are paid by the barge operator.
- **Transfer costs (ship loading) at the gateway.** These are costs that are incurred at the gateway port for loading the container onto the ocean vessel for transportation to destination ports in Asia and Europe.
- **Ocean transport costs.** The representative destination ports in Asia and Europe (e.g. Shanghai and Rotterdam) for exports and its associated ocean transportation costs remained unchanged.

The route costs developed for containerized exports via the inland waterway transportation (i.e., PortKC and the Port of Catoosa) and the New Orleans gateway are detailed in Table 52 and Table 53.

Table 52. Port of Kansas City: route costs via barge routes: agribulk cargo, 2022 ($/MT)

Barge (bulk)		Kasas City, MO $/MT	Total $/MT	Distance mi	Total mi	Transit time days (approx.)	Total days (app)
Waterway inland transportation							
Truck to loading terminal	$	30.0		120		1	
Transfer to barge	$	6.4	-			5	
Barge transportation	$	27.0		1,558		8.5	
Transfer to ship	$	6.4	-			5	
Export port handling charges	$	13.0	-			1	
Subtotal inland	$	82.8		1,678		20.5	
Ocean vessel transportation							
U.S. Gulf to:							
Asia	$	69.6	$ 152.4	9,127	**10,805**	29.5	**50.0**
Europe	$	25.3	$ 108.1	4,786	**6,464**	15.5	**36.0**
Mexico	$	24.0	$ 106.8	775	**2,453**	2.5	**23.0**
U.S. PNW to:							
Asia	$	38.8	$ 121.6	9,127	**10,805**	29.5	**50.0**
U.S. East Coast to:							
Europe	$	23.1	$ 105.9	4,786	**6,464**	15.5	**36.0**
U.S. West Coast (Oakland) to:							
Asia	$	41.1	$ 123.9	9,127	**10,805**	29.5	**50.0**

Source: Bujanda & Allen LLC, 2022.

Table 53. Port of Catoosa: route costs via barge routes: agribulk cargo, 2022 ($/MT)

Bulk barge		Catoosa, AR $/MT	Total $/MT	Distance mi	Total mi	Transit time days (approx.)	Total days (app)
Waterway inland transportation							
Truck to loading terminal		30.0		120		1	
Transfer to barge		6.4	-			5	
Barge transportation		17.0		1,558		8.5	
Transfer to ship		6.4	-			5	
Export port handling charges		13.0	-			1	
Subtotal inland	$	72.8		1,678		20.5	
Ocean vessel transportation							
U.S. Gulf to:							
Asia	$	69.6	$ 142.4	9,127	**10,805**	29.5	**50.0**
Europe	$	25.3	$ 98.1	4,786	**6,464**	15.5	**36.0**
Mexico	$	24.0	$ 96.8	775	**2,453**	2.5	**23.0**
U.S. PNW to:							
Asia	$	38.8	$ 111.6	9,127	**10,805**	29.5	**50.0**
U.S. East Coast to:							
Europe	$	23.1	$ 95.9	4,786	**6,464**	15.5	**36.0**
U.S. West Coast (Oakland) to:							
Asia	$	41.1	$ 113.9	9,127	**10,805**	29.5	**50.0**

Source: Bujanda & Allen LLC, 2022.

7.1.5 Potential route cost savings for agribulk cargo

As the route cost analysis demonstrates, the transport efficiencies offered by barge service via the barge route create a lower cost alternative for agribulk cargo shippers. However, these efficiencies can be offset by an increase on total transit times up to seven days and a half. Nonetheless, for some routes the increase in transit times might not be large enough to still consider the potential transportation cost savings attractive. An estimation of the route cost savings and transit time differentials is summarized in Table 54.

Table 54. Route cost savings for agribulk cargo offered by the Marine Highways: via Kansas City and MKRNS ($/MT)

Total transportation	By rail	By barge via Kansas City	via Catoosa	Benefits via Kansas City	via Catoosa
U.S. Gulf to:					
Asia	$ 189.4	$ 152.4	$ 142.4	$ 37.0	$ 47.0
Europe	$ 145.1	$ 108.1	$ 98.1	$ 37.0	$ 47.0
Mexico	$ 143.8	$ 106.8	$ 96.8	$ 37.0	$ 47.0
U.S. PNW to:					
Asia	$ 165.6	$ 121.6	$ 111.6	$ 44.0	$ 54.0
U.S. East Coast to:					
Europe	$ 199.9	$ 105.9	$ 95.9	$ 94.0	$ 104.0
U.S. West Coast (Oakland) to:					
Asia	$ 159.9	$ 123.9	$ 113.9	$ 36.0	$ 46.0
Transit time days (approx.)					
U.S. Gulf to:					
Asia	42.5	50.0	50.0	(7.5)	(7.5)
Europe	28.5	36.0	36.0	(7.5)	(7.5)
Mexico	15.5	23.0	23.0	(7.5)	(7.5)
U.S. PNW to:	-				
Asia	47.9	50.0	50.0	(2.1)	(2.1)
U.S. East Coast to:	-				
Europe	33.6	36.0	36.0	(2.4)	(2.4)
U.S. West Coast (Oakland) to:	-				
Asia	46.7	50.0	50.0	(3.3)	(3.3)

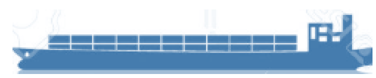
Source: Bujanda & Allen LLC, 2022.

7.2 Containerized cargo routes

7.2.1 General assumptions

Bujanda & Allen calculated the route costs for containerized cargo by component—truck, rail, and barge—for the primary incumbent routes, and then compared them to the routes that the cargo would follow via the Missouri River and the MKARNS barge routes. Once cost inputs were obtained or calculated for each cost component per route, all costs were converted to dollars per 40 ft container ($/FEU). The capacities assumed by mode are illustrated in Figure 181. For container on barge service, presently, there is one barge operator providing service between the Port of Catoosa and New Orleans[36] This weekly service operates 195-200 ft barges capable to accommodate 36 loaded containers (40 ft) each (3 high) and 48 if empties (4-high). Typically, 1 tugboat can push up to six container barges.

Figure 181. Unit capacity by assumed mode of transport, in metric tons and 40 ft containers.

a) 40 ft container by truck	b) 40 ft container by rail	c) River barge
		
15 metric tons (33,070 lb)	**15 metric tons** (33,070 lb)	**236-48 containers** per barge

Source: Bujanda & Allen, 2022.

7.2.2 Containerized routes by rail

Shippers and receivers looking to export containerized cargoes from Kansas have two primary gateway alternatives through which containers can be routed: (i) San Pedro Bay on the West Coast (SPB) and (ii) New York-New Jersey on the East Coast (NYNJ). Secondary corridors go through the ports of the Northwest Seaport Alliance (NWSA), Seattle and Tacoma, for the Asia tradelane and through Baltimore and Norfolk for the Europe tradelane. NOLA also serves as a gateway for some traffic to or from Asia, Europe, and South America, and is the only alternative providing connection to a marine highway (M-55). Presently, these corridors utilize intermodal rail between the gateway ports and an inland hub in Kansas City. These routes, defined and named after their gateway ports for this report, are explained in detail in the following bullets and displayed in Figure 182.

- **NYNJ**—This is the primary corridor for containerized imports/exports via the Atlantic Coast. This 1,310 mi long corridor is served by NS from Kansas City to New York. This corridor is suitable for double-stack trains. Containers are railed between NYNJ and Kansas City (1,310 mi) and trucked up to 45 mi to/from destinations in the state.[37]
- **San Pedro Bay (SPB)**—This is the main route for containerized imports from Asia via the Pacific Coast. This rail corridor is 1,740 mi long and is served by UP. Marine containers on double-stack trains dominate this route. Although the tracks on this corridor extend beyond Kansas City all the way to St. Louis, almost parallel to the river, there are no intermediate intermodal ramps. Hence, this indicates that import containers are railed from the Ports of Los Angeles and Long Beach to Kansas City (1,740 mi), where we

[36] Interview with SFC.

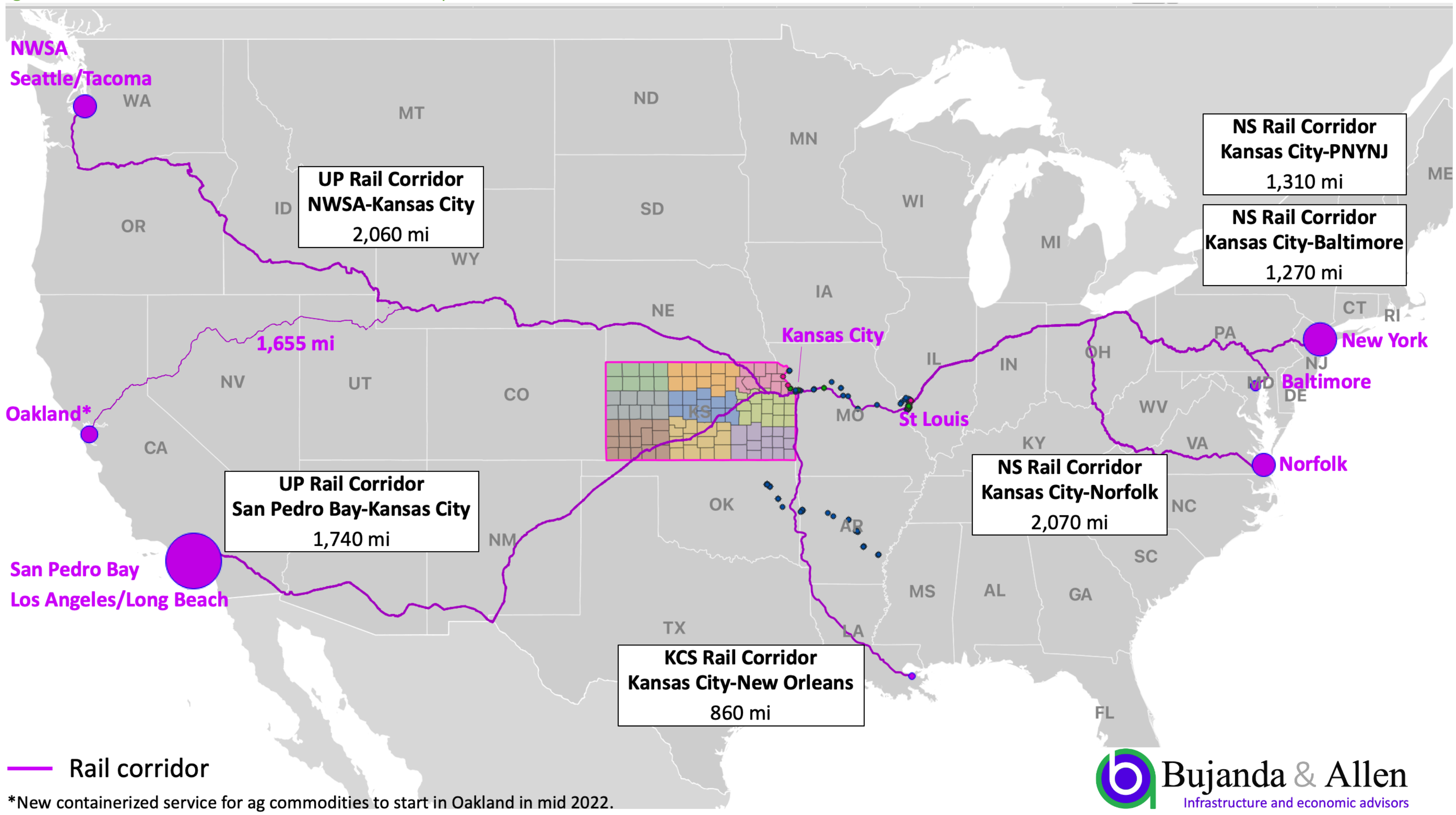
[37] **Baltimore**—This gateway port is an alternative to NY/NJ. The route is 1,270 mi, and is also served by NS from Kansas City through Fort Wayne, Cleveland, Pittsburgh, and Harrisburg where it diverts southbound towards Baltimore. Although this corridor offers a slightly shorter distance to Kansas City, it is dwarfed by traffic generated by the container terminals in NYNJ. Moreover, this corridor is not presently suitable for double-stack trains due to tunnel restrictions near the Port of Baltimore.

Norfolk—This is a third alternative gateway for containerized imports via the Atlantic Coast. The route is 1,250 mi, served by NS from Kansas City via Fort Wayne to Bellevue, where it diverts southbound towards Columbus, Roanoke, and onwards to the Norfolk port. This corridor is also suitable for double-stack trains and offers numerous interchanges with CSXT.

believe the majority are emptied, with cargo held in regional warehouses before being trucked (an average of 45 miles) to the destinations in the CRD areas.

- **NWSA**—This is a second alternative for containerized imports via the Pacific Coast. It is 2,060 mi and it is served by UP from Kansas City to Portland and then northbound to the Seattle/Tacoma area where it connects to container terminals part of the NWSA. This corridor is also suitable for double-stack trains.
- **NOLA**—This is an alternative for containerized cargo handled via the USGC potentially competing with a COB service via the Mississippi River (M-55). It is 860 mi and it is served by KCS from Kansas City to Shreveport southbound to the Port of New Orleans. This corridor is also suitable for double-stack trains.
- **Kansas – Oakland.** This additional prospective route involves intermodal rail movement from Kansas to the proposed new terminal in the Port of Oakland. The corridor is 1,655 mi (225 mi closer than Portland) and is designed over an existing track with maximum allowable gross weight of 286,000 lb controlled by UP loading in Kansas City.

Figure 182. Intermodal rail routes for containers imported into Kansas



Source: Bujanda & Allen, 2022.

7.2.3 Route costs via containerized cargo by rail

Ocean transport costs, either from Asia to San Pedro Bay or from Europe to New York-New Jersey, represent the first leg of the import trip. Ocean transport costs were estimated by Bujanda & Allen and validated with third-party sources for each tradelane. Long-haul rail movements represent the next leg of the trip from either San Pedro Bay to Kansas City or from New York-New Jersey to St. Louis. There is cost at the import gateway port related to ship-to-shore transfer and loading to railcar. The rail rate incorporates loading/discharging, from railcar-to-yard-to-truck, as indicated by the quotes obtained from the industry. Trucking represents the last mode of transportation to get cargoes from the nearest long-haul intermodal platform (i.e. Kansas City and St. Louis) to Kansas City. The structure of the 2022 route costs assumed for containerized cargoes using incumbent routes is illustrated in Figure 183.

Figure 183. Route costs via intermodal rail routes for containerized cargo imports, 2022

Source: Bujanda & Allen, 2022.

The export gateways analyzed are on the USGC, PNW, and the East Coast, reflecting the five incumbent corridors for the movement of containerized intermodal exports from Kansas. For each of these gateways, the analysis is further broken down into tradelanes to account for differences in transportation costs to the most relevant destination. The structure of the route costs assumed for containerized cargoes using intermodal rail routes is illustrated in Table 55.

Table 55. Route costs via intermodal rail routes: containerized cargo, 2022 ($/FEU)

Rail (intermodal container)	Rail station $/FEU	Total $/FEU	Distance mi	Total mi	Transit time days (approx.)	Total days (app)
Railroad inland transportation						
Truck to rail station	$ 256.5		45		1.0	
Transfer to rail	$ 104.9	-			0.5	
Rail transportation to						
U.S. Gulf	$ 5,034		895		4.0	
U.S. PNW	$ 6,012		1,880		10.4	
U.S. East Coast	$ 5,788		1,810		10.1	
U.S. West Coast (Oakland)	$ 5,550		1,655		9.2	
Transfer to ship	$ 105	-			1.0	
Export port handling charges	$ 312	-			1.0	
Subtotal inland via						
U.S. Gulf	$ 5,812		1,673		7.5	
U.S. PNW	$ 6,790		2,658		13.9	
U.S. East Coast	$ 6,566		2,588		13.6	
U.S. West Coast (Oakland)	$ 6,328		2,433		12.7	
Ocean vessel transportarion		Total				
U.S. Gulf to:						
Asia	$ 2,085	$ 7,897	9,127	10,800	29.5	37.0
Europe	$ 1,403	$ 7,215	4,786	6,459	15.5	23.0
Mexico	$ 3,153	$ 8,965	775	2,448	2.5	10.0
U.S. PNW to:						
Asia	$ 1,892	$ 8,682	9,127	11,785	29.5	43.4
U.S. East Coast to:						
Europe	$ 915	$ 7,481	4,786	7,374	15.5	29.1
U.S. West Coast (Oakland) to:						
Asia	$ 1,699	$ 8,027	9,127	11,560	29.5	42.2

Source: Bujanda & Allen, 2022.

7.2.4 Containerized route costs via the barge routes

To estimate the prospective route economics advantage that could be offered via the barge routes, we analyzed route costs shipping via PortKC and the MKARNS barge route and compared these with costs that do not rely on the port. The structure of the 2022 route costs assumed for containerized cargoes using the barge routes, which involve river transport via the New Orleans Gateway.

The cost chains for intact intermodal container exports were divided into the following categories:

- **Trucking (drayage).** The first leg of an export trip begins with the movement of an empty container from Kansas City and Catoosa to the BCO site where the cargo is originated.
- **Barge transport costs.** Long-haul barge movements represent the next leg of the trip to NOLA. These costs include loading and discharging costs incurred by the barge operator.
    - *Barge loading*. These costs are incurred at the port, and paid by the barge operator.
    - *Barge discharging*. These costs are for discharging the box from the barge into the container yard at the export gateway (e.g. NOLA), and as with the loading operation, are paid by the barge operator.
- **Transfer costs (ship loading) at the gateway.** These are costs that are incurred at the gateway port for loading the container onto the ocean vessel for transportation to destination ports in Asia and Europe.
- **Ocean transport costs.** The representative destination ports in Asia and Europe (e.g. Shanghai and Rotterdam) for exports and its associated ocean transportation costs remained unchanged.

The route costs developed for containerized exports via the inland waterway transportation (i.e., PortKC and the Port of Catoosa) and the New Orleans gateway are detailed in Table 56.

Table 56. Route costs for exports via the MKARNS barge route—barge and ocean transport cost assumptions

Barge (container on barge)	Kasas City, MO $/FEU	Total $/FEU	Distance mi	Total mi	Transit time days (approx.)	Total days (app)
Waterway inland transportation						
Truck to loading terminal	$ 444.0		120		1	
Transfer to barge	$ 104.9	-			5	
Barge transportation	$ 648.0		1,558		8.5	
Transfer to ship	$ 104.9	-			5	
Export port handling charges	$ 312.0	-			1	
Subtotal inland	$ 1,613.8		1,678		20.5	
Ocean vessel transportation						
U.S. Gulf to:						
Asia	$ 2,085	**$ 3,699**	9,127	**10,805**	29.5	**50.0**
Europe	$ 1,403	**$ 3,017**	4,786	**6,464**	15.5	**36.0**
Mexico	$ 3,153	**$ 4,767**	775	**2,453**	2.5	**23.0**
U.S. PNW to:						
Asia	$ 1,892	**$ 3,506**	9,127	**10,805**	29.5	**50.0**
U.S. East Coast to:						
Europe	$ 915	**$ 2,529**	4,786	**6,464**	15.5	**36.0**
U.S. West Coast (Oakland) to:						
Asia	$ 1,699	**$ 3,312**	9,127	**10,805**	29.5	**50.0**

Source: Bujanda & Allen, 2022.

Table 57. Route costs for exports via the MKARNS barge route—barge and ocean transport cost assumptions

Barge (container on barge)	Catoosa, AR $/FEU	Total $/FEU	Distance mi	Total mi	Transit time days (approx.)	Total days (app)
Waterway inland transportation						
Truck to loading terminal	444.0		120		1	
Transfer to barge	104.9	-			5	
Barge transportation	17.0		1,558		8.5	
Transfer to ship	104.9	-			5	
Export port handling charges	312.0	-			1	
Subtotal inland	$ 982.8		1,678		20.5	
Ocean vessel transportation						
U.S. Gulf to:						
Asia	$ 2,085	$ 3,068	9,127	**10,805**	29.5	**50.0**
Europe	$ 1,403	$ 2,386	4,786	**6,464**	15.5	**36.0**
Mexico	$ 3,153	$ 4,136	775	**2,453**	2.5	**23.0**
U.S. PNW to:						
Asia	$ 1,892	$ 2,875	9,127	**10,805**	29.5	**50.0**
U.S. East Coast to:						
Europe	$ 915	$ 1,898	4,786	**6,464**	15.5	**36.0**
U.S. West Coast (Oakland) to:						
Asia	$ 1,699	$ 2,681	9,127	**10,805**	29.5	**50.0**

Source: Bujanda & Allen, 2022.

7.2.5 Potential route cost savings for containerized cargo

Based on the analyses of route costs for rail versus COB routes, Bujanda & Allen constructed route cost comparison tables for the tradelanes analyzed. These route cost comparisons include a breakdown for each of the cost components and the total route costs. As the route cost analysis demonstrates, the transport efficiencies offered by the COB service via the barge route can create a lower cost alternative for agribulk cargo shippers. However, these efficiencies can be offset by an increase on total transit times up to thirteen days. An estimation of the route cost savings and transit time differentials is summarized in Table 58.

Table 58. Route cost savings for containerized cargo by the Marine Highways: via Kansas City and MKRNS ($/FEU)

	By rail	Barge (container on barge)		Benefits	
Total transportation		**via Kansas City**	**via Catoosa**	**via Kansas City**	**via Catoosa**
U.S. Gulf to:					
Asia	$ 7,897	$ 3,699	$ 3,068	$ 4,199	$ 4,830
Europe	$ 7,215	$ 3,017	$ 2,386	$ 4,199	$ 4,830
Mexico	$ 8,965	$ 4,767	$ 4,136	$ 4,199	$ 4,830
U.S. PNW to:					
Asia	$ 8,682	$ 3,506	$ 2,875	$ 5,177	$ 5,808
U.S. East Coast to:					
Europe	$ 7,481	$ 2,529	$ 1,898	$ 4,953	$ 5,584
U.S. West Coast (Oakland) to:					
Asia	$ 8,027	$ 3,312	$ 2,681	$ 4,715	$ 5,346
Transit time days (approx.)					
U.S. Gulf to:					
Asia	**37.0**	50.0	50.0	(13.0)	(13.0)
Europe	**23.0**	36.0	36.0	(13.0)	(13.0)
Mexico	**10.0**	23.0	23.0	(13.0)	(13.0)
U.S. PNW to:					
Asia	**43.4**	50.0	50.0	(6.6)	(6.6)
U.S. East Coast to:					
Europe	**29.1**	36.0	36.0	(6.9)	(6.9)
U.S. West Coast (Oakland) to:					
Asia	**42.2**	50.0	50.0	(7.8)	(7.8)

Source: Bujanda & Allen, 2022.

7.3 Key takeaways

The analysis above shows the potential savings that can be generated by replacing the inland rail transportation with transportation via the rivers, and how such savings vary for each of the target markets. For containers from Asia, inland cost savings from using a barge or ship from New Orleans are significant compared to shipping a box by rail more than 1,740 mi from San Pedro Bay to Kansas City and then trucking it 190 mi to its final destination. The savings from the barge route outweigh the increases in ocean shipping costs.

As this route cost analysis demonstrates, Marine Highways could provide a competitive alternative in terms of cost for containers on barge to/from New Orleans, particularly for those destined to or originating closer to the river ports.[38] However, not all BCOs will be incentivized by cost alone. For some, transit times might be more critical, in which case, rail will remain the mode of choice.

[38] SCF, the only container on barge operator in St. Louis, is currently operating a service on a weekly basis between St. Louis and New Orleans for Hapag-Lloyd. SCF estimated it would require at least about 210 boxes/week (11,200 boxes/year) to establish a dedicated service between the Heartland Port and New Orleans.

8 Observations and market opportunities

8.1 Anticipated changes to future commodity flows

The time used for this analysis has been 2020. During 2021 and early 2022 several agricultural processing projects have either commenced, or shortly will commence, that have implications for the estimated commodity flows presented in this report. The notable ones are briefly described below.

8.1.1 Seaboard Energy, Hugoton, Stevens County, Kansas

This is a 6,500 barrel per day (100 million gallon annually) that will ship end products by short-line rail west where they will end up on the BNSF rail system. The primary destination for this renewable diesel is most likely California. This project will result in 70 on-going jobs in Hugoton. It is likely going to use animal fats from beef and pork processing plants in Kansas and Oklahoma as significant feedstocks for the renewable diesel. Demand for renewable diesel is growing, especially in the "West Coast" markets of California, Oregon and Washington.

Currently, the bulk of the Kansas biodiesel moving out of the state moves south into Oklahoma and Texas. The renewable biodiesel from this plant is expected to be pulled to west coast markets due to its score under the California carbon scoring for biofuels.

8.1.2 Summit Ingredients, Phillipsburg, Phillips County, Kansas

ICM, Inc. has signed a design-build agreement with Summit Sustainable Ingredients, an affiliate of Summit Agricultural Group to develop a wheat protein (vital wheat gluten) ingredients production facility in Phillipsburg, Kansas. The new plant will be located next to Prairie Horizon Agri-Energy, a biorefinery acquired by Summit in 2021. When fully operational in 2023, this facility will be the largest producer of wheat protein in North America.[39] The plant is expected to use about 18 million bushels of wheat per year and produce 50 million gallons of ethanol from the wheat starch that is left over from the wheat protein extraction process.

This new facility is expected to affect flows of HRW that currently go to feed demand, and exports both in the Louisiana Gulf ports and the Pacific Northwest ports. The production of a low-carbon-score ethanol is likely to see demand for the ethanol arise from California and other states that are at the forefront of low-carbon liquid fuels consumption.

8.1.3 Hilmar Cheese Processing, Dodge City, Ford County, Kansas

Hilmar Cheese Company is planning to open a new cutting-edge cheese and whey production facility in Dodge City, Kansas. When fully operational in 2024, this plant will source an added 8 million pounds of fluid milk per day (29.2 million cwt of milk per year) from 100,000 milk cows. The additional milk demand is likely to spawn the expansion of milk production in Kansas and surrounding areas through a combination of new dairy development or expansion of existing dairies.[40] An expansion of milk production (potentially 100,000 more dairy cows) would have impacts on commodity flows for corn, soybean meal, DDGs, wheat midds, and likely on forages. It is likely that the forage requirements for 100,000 cows would be significant enough to switch some corn grain production to corn or sorghum silage production, further impacting corn grain flows in the counties where the dairy (milk) production expansion takes place.

[39] Ethanol Producer Magazine, December 15, 2021

[40] Hilmar Cheese Company press release, May 5, 2021.

Kansas currently ships about 29.6 million hundredweights of milk out of state to processors in Missouri, Texas and other states within the region. The addition of this plant will significantly affect those flows until or unless there are additional cows added to the production network.

8.1.4 Kansas Dairy Ingredients, Hugoton, Stevens County, Kansas

Another dairy processing expansion, Kansas Dairy Ingredients Cheese Company, has been announced for the Hugoton area. Expansion of this facility will include investments to produce American-style, Italian-style, Hispanic-style cheese and European-style cheese and butter.[41] At the moment, the amount of increase in fluid milk consumption is unknown, but any increase in in-state fluid milk consumption is likely to reduce current shipments that are moving out of state. The expansion began in December 2020.

8.1.5 Bartlett/Savage Soybean Processing, Coffeyville, Montgomery County, Kansas

When fully operational in 2024, this plant will handle approximately 38.5 million bushels of soybeans annually to crush into soybean meal and refined soybean oil, feedstock used in producing renewable fuels, food products and animal feeds.[42] Construction is scheduled to start in early 2022, with plant operations anticipated to begin in 2024. The Bartlett facility will create about 50 permanent jobs and process about 110,000 bushels of soybeans per day.

Soybean crush capacity in Kansas (as noted in Section 2.3) is currently 69.8 million bushels per year and uses 35% of the Kansas soybean crop. The opening up of a new facility would represent a 55% increase in soybean crush capacity in Kansas and when operational would bring Kansas soybean crush capacity to 108.3 million bushels per year which would be 56% of the average Kansas soybean crop.

Kansas is a significant supplier of soybean meal to the poultry production areas of Arkansas, Oklahoma, and Texas as well as a supplier of soybean meal for export to Mexico. Construction of a new plant in southeastern Kansas will likely see flows of soybean meal to northwestern Arkansas, eastern Oklahoma, and eastern Texas as well as being a catalyst for potential expansion of poultry production into southeastern Kansas.

8.1.6 Hills Pet Food

Hill's Pet Nutrition is expanding its manufacturing footprint in Kansas. The company in June 2021 announced plans to invest more than $250 million to construct a new pet food manufacturing facility in Leavenworth County, specifically Tonganoxie, creating at least 80 new jobs in the area by 2025[43]. Hill's Pet Nutrition, a subsidiary of the Colgate-Palmolive Company, reported the new facility will help meet growing demand for its science-based dog and cat food products. Depending on its size the addition of a new pet food manufacturing location could have a significant impact on the movement of agricultural commodities to Leavenworth County.

8.2 Market opportunities

8.2.1 Biofuels and DDGs

Counties in northern and northwestern Kansas have net supplies of corn. While some of that corn already moves to feedlots in Colorado and southwestern Kansas, a significant amount moves to export markets. Kansas is a net importer of DDGs. This would suggest that there may be opportunities for more value-adding activities related to biofuel production and use of DDGs within the State of Kansas. Logistical considerations will be important for siting of a new facility with rail access for distribution of the biofuel a key determinant, but also, co-location near

[41] Food Business News, June 22, 2021.
[42] Savage News Release, October 12, 2021.
[43] Petfoodprocessing.net, June 22, 2021.

a feedlot would allow for use of wet distiller's grains rather than drying them, thus improving the carbon score of the biofuel and reducing overall operating costs.

Renewable diesel presents another opportunity for Kansas given the large supply of byproducts from Kansas beef processing facilities and the potential to turn tallow and soybean oil into renewable diesel. The demand for renewable diesel is trending upward and with more emphasis on carbon scores of liquid fuels, Kansas seems well positioned to add value to these products in the future.

8.2.2 Broiler production

With an abundance of meat and bone meal and the potential for additional supplies of soybean meal, southeastern Kansas presents opportunities for development of broiler production and potentially processing. The broiler industry is already well established in southwestern Missouri and northwestern Arkansas. A moderate level of production has developed in northeastern Oklahoma and the potential to capitalize on expansion of soybean meal production in Montgomery County, Kansas by developing broiler production in the surrounding areas is an opportunity that should be explored. The development of Lincoln Premium Poultry in conjunction with Costco around the Fremont, Nebraska area could serve as a case study in how the development of broiler production in Kansas could evolve.

9 Case study: Additional value-added activity in Southeast Kansas

9.1 Impact of new Kansas soybean processor on soybean movement

Figure 184 shows the counties supplying Kansas processing demand with the addition of a soy processor located in Montgomery County, Kansas demanding approximately 38.5 million bushels annually. While the new processing plant does take some soybeans from counties that previously supplied existing plants in Sedgwick and Lyon Counties, much of its supply comes from counties in southeast Kansas that previously sent soybeans out of the state. The new plant also gets some soybeans from Missouri, Oklahoma, and Arkansas.

Figure 184. Counties supplying Kansas soybean demand, addition of new processing plant

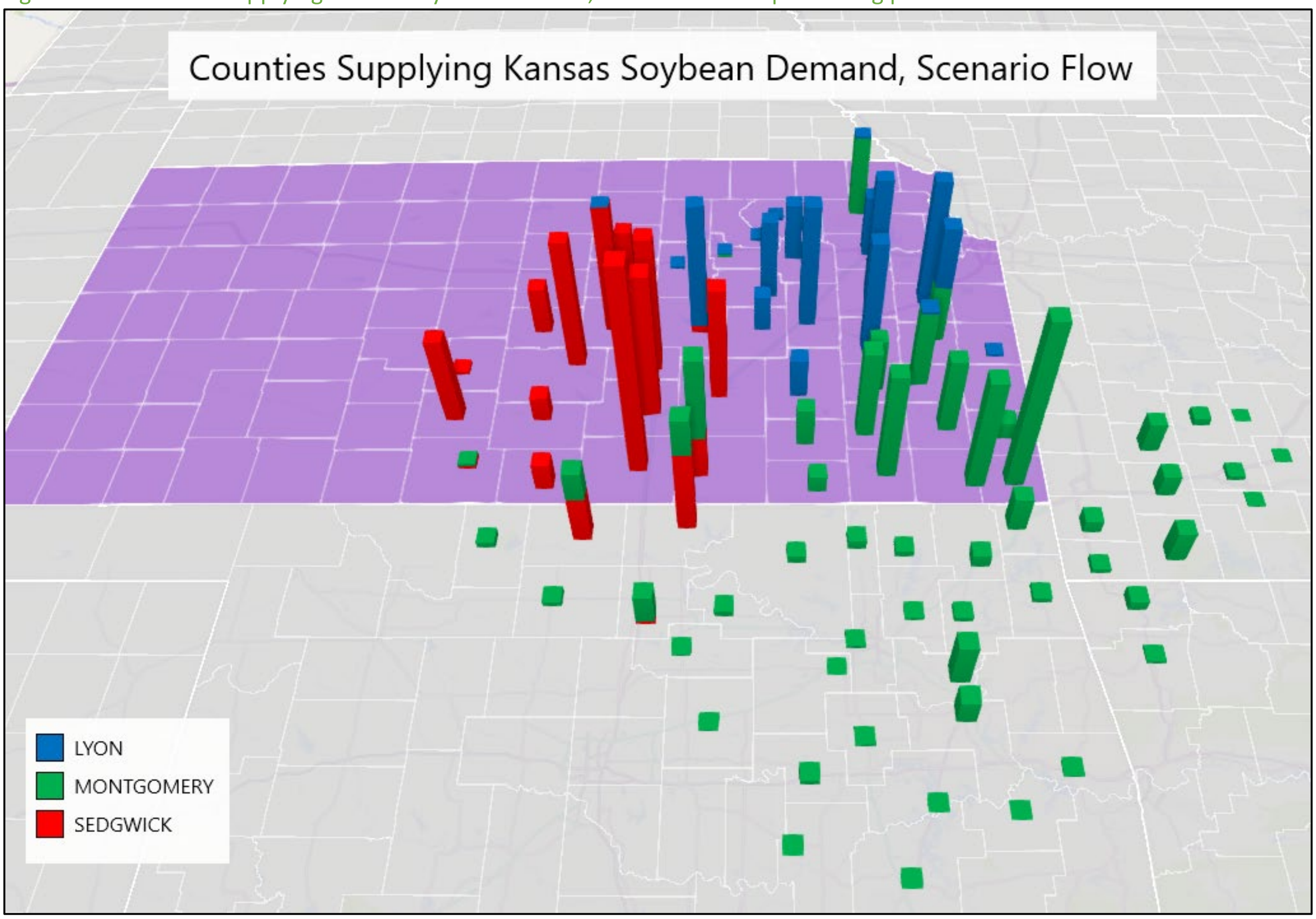
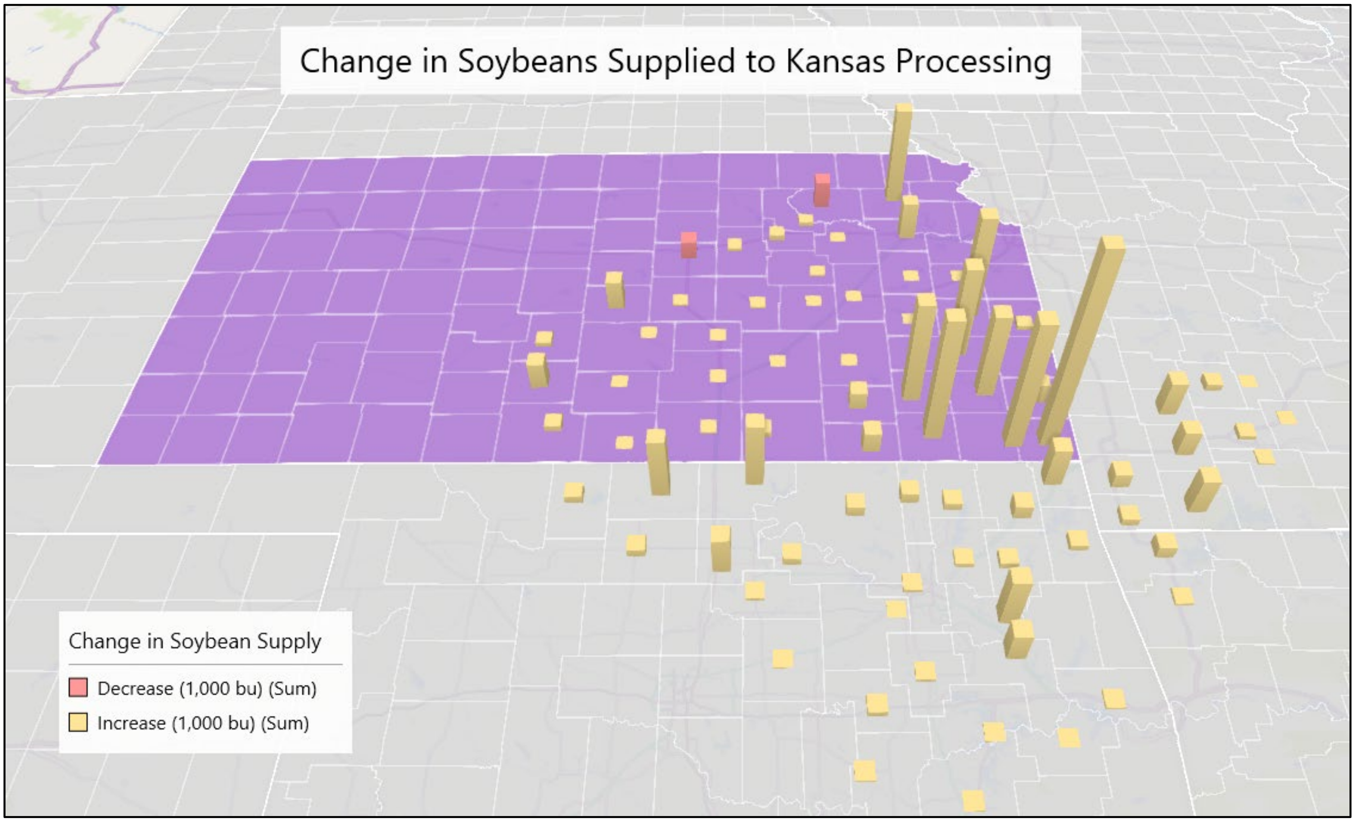
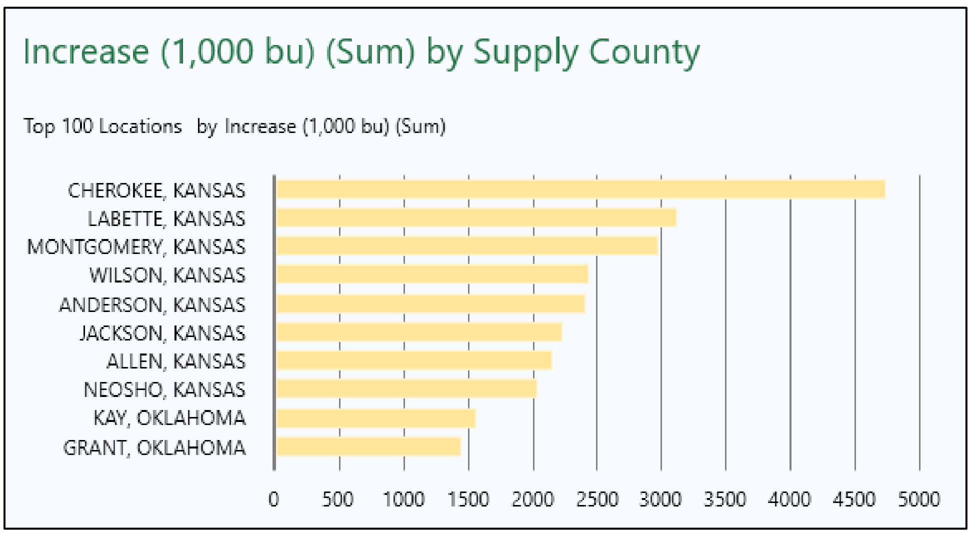


Figure 185 shows the change in soybeans supplying total Kansas demand because of the new processing plant. While the figure shows all additional soybeans moving to Kansas, most of this additional supply is going to the new processing plant. The greatest increase in supply comes from southeast Kansas. There is also an increase in supply used from south Central and northeast Kansas, as well as from neighboring states. Note that the reduced soybeans supplied from Pottawatomie and Saline Counties go to exports through Texas instead, as the increased demand in southern Kansas causes export demand to shift farther north.

Figure 185. Counties Supplying Kansas Soybean Demand, Comparison of Baseline and Scenario Flows





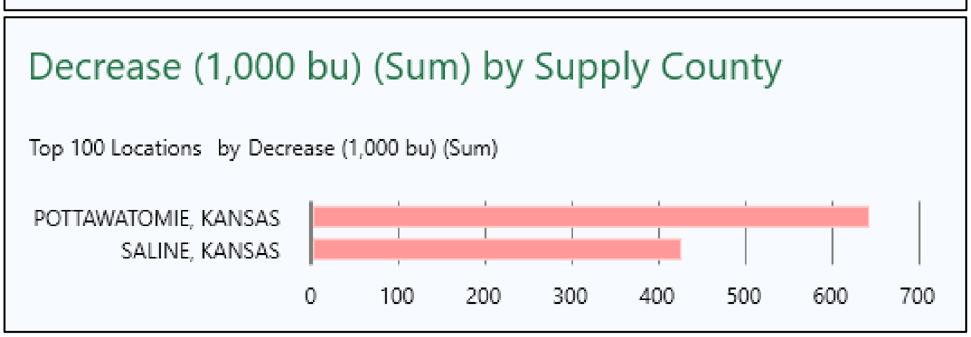
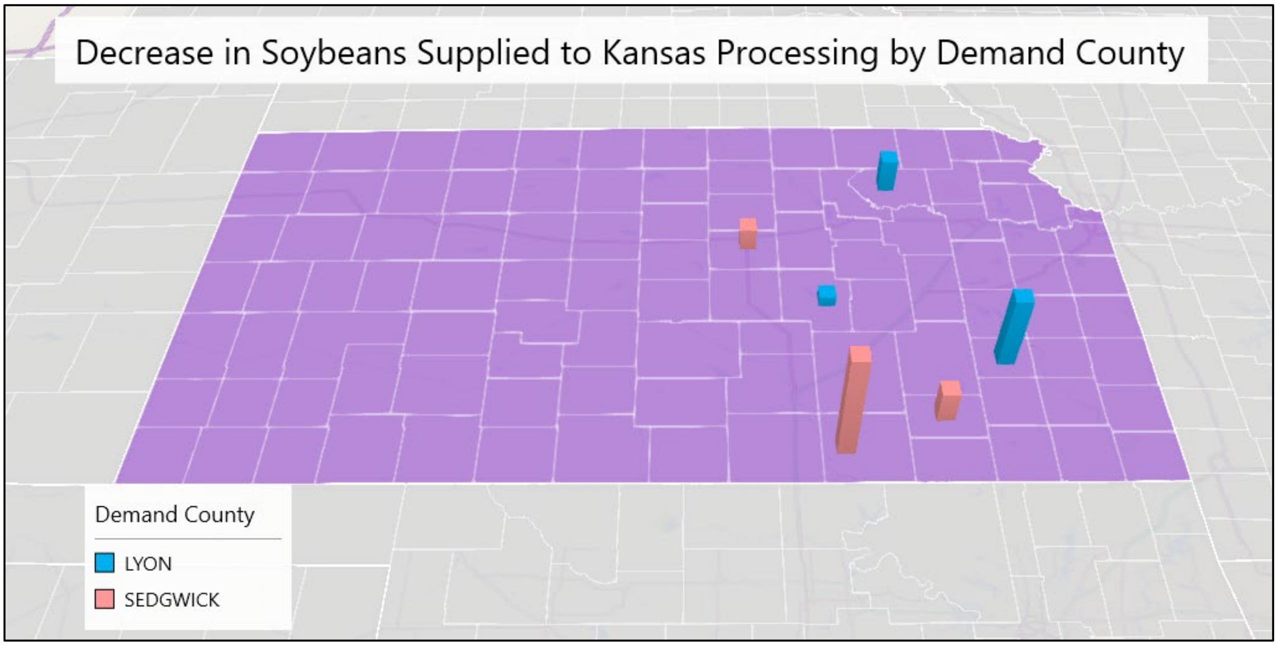


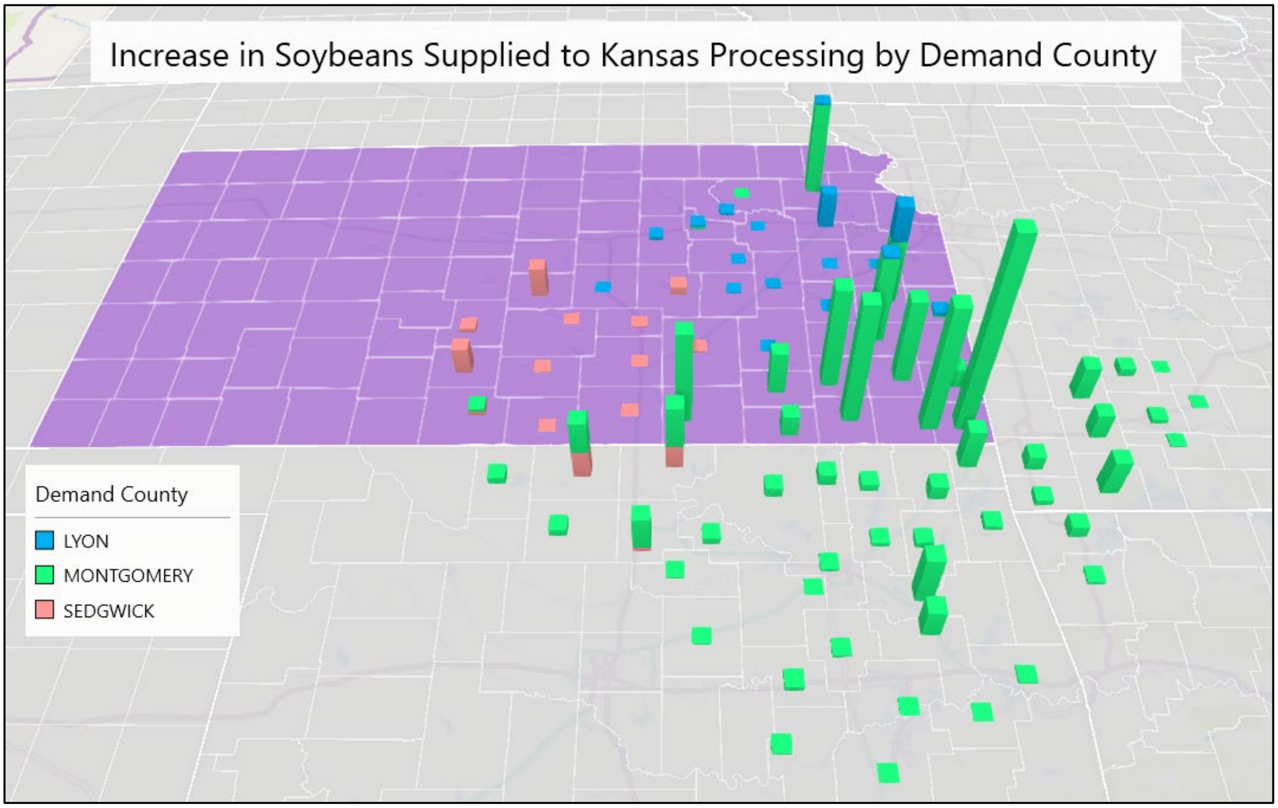
Figure 186 shows the decrease in soybeans supplied to processors in Kansas broken down by demand county. These decreases in soybeans supplied to the two existing processors in Kansas are caused by the increased competition for soybeans brought by the new processing facility.

Figure 186. Decrease in Soybeans Supplied to Kansas Processing by Demand County



The increase in soybeans supplied to each Kansas processor is shown in Figure 187. The decrease in supply to Lyon and Sedgwick Counties is compensated for by an increase in supply from other nearby counties. Of the three processing facilities, the one in Montgomery County draws from the largest area.

Figure 187. Increase in Soybeans Supplied to Kansas Processing by Demand County



A summary of the change in soybean movement to Kansas processors is shown in Table 59. Of the 38.5 million bushels in additional demand, 25.7 million bushels (67%) comes from within Kansas, while 12.8 million bushels (33%) comes from Oklahoma, Missouri, and Arkansas. The 1.4 million fewer bushels of Kansas soybeans going to Sedgwick County instead go to the new processing plant, and they are replaced with soybeans from Oklahoma.

Table 59. Summary of changes to supply of Kansas soybean demand

Summary of Changes to Supply of Kansas Soybean Demand (1,000 bu)				
	Demand County			
Supply State	Lyon	Montgomery	Sedgwick	Total
Arkansas	-	350	-	350
Kansas	-	27,085	(1,365)	25,720
Missouri	-	3,180	-	3,180
Oklahoma	-	7,885	1,365	9,250
Total	-	38,500	-	38,500

Figure 188 shows the regional destination of Kansas soybeans after the addition of the processing plant in Montgomery County, and Figure 189 shows the change from the baseline scenario resulting from this addition. Nearly all the Kansas soybeans going to the new processor went to the Louisiana Gulf for export in the baseline commodity flow. A small number of soybeans also come out of Texas rail exports to Mexico (Maverick County) and from the processor in Sedgwick County.

Figure 188. Regional destination of Kansas soybean supply, addition of new processing plant

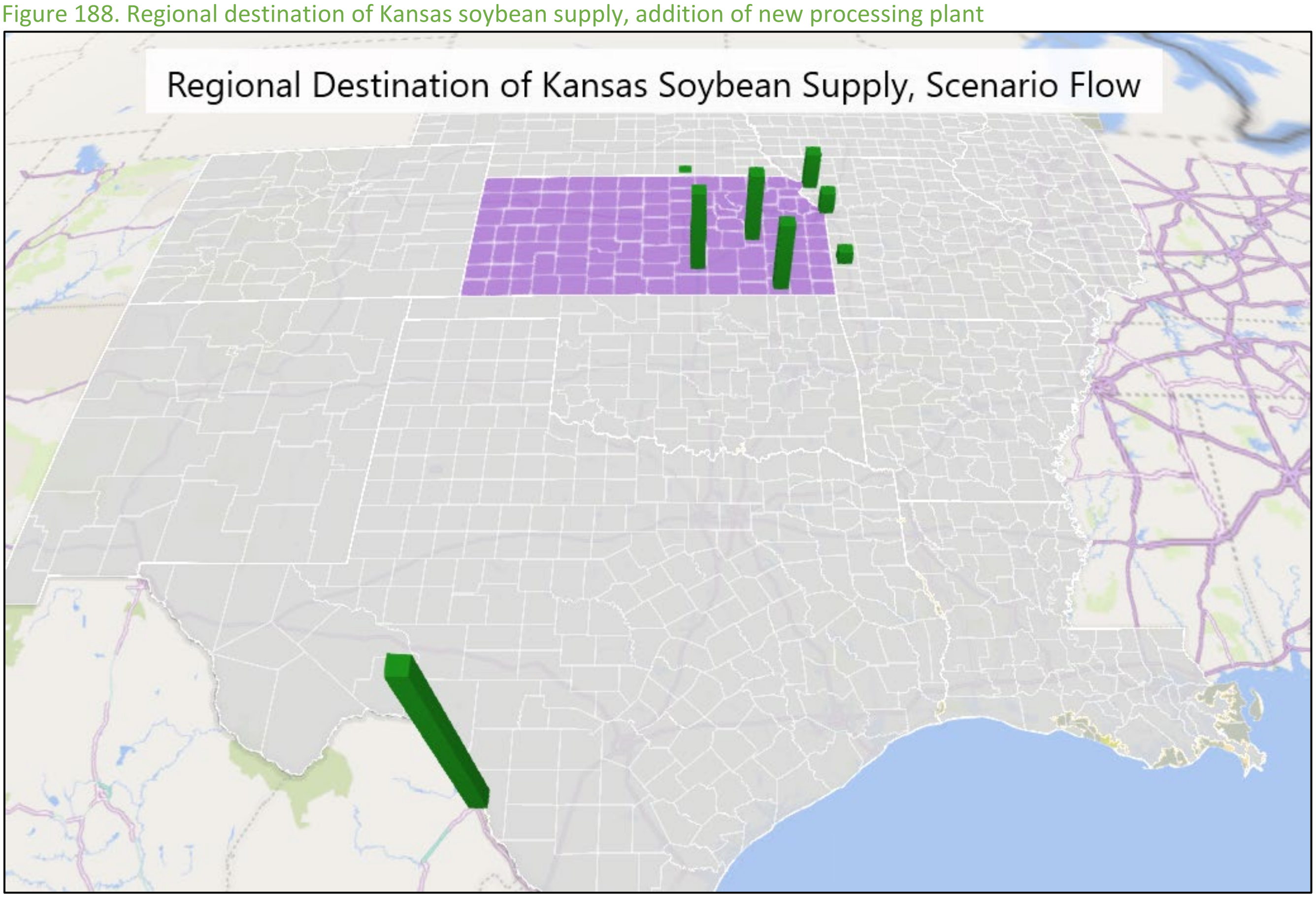
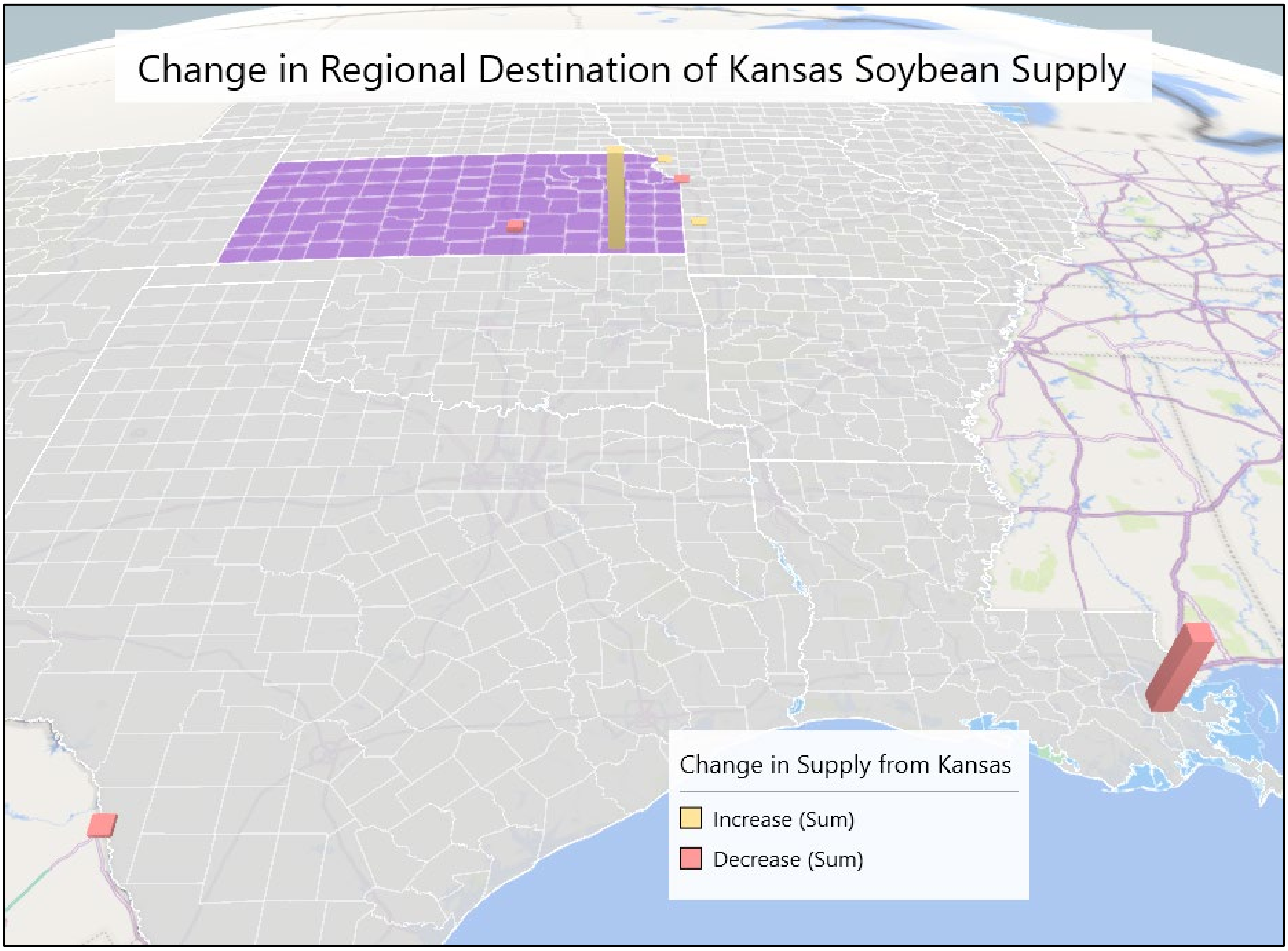
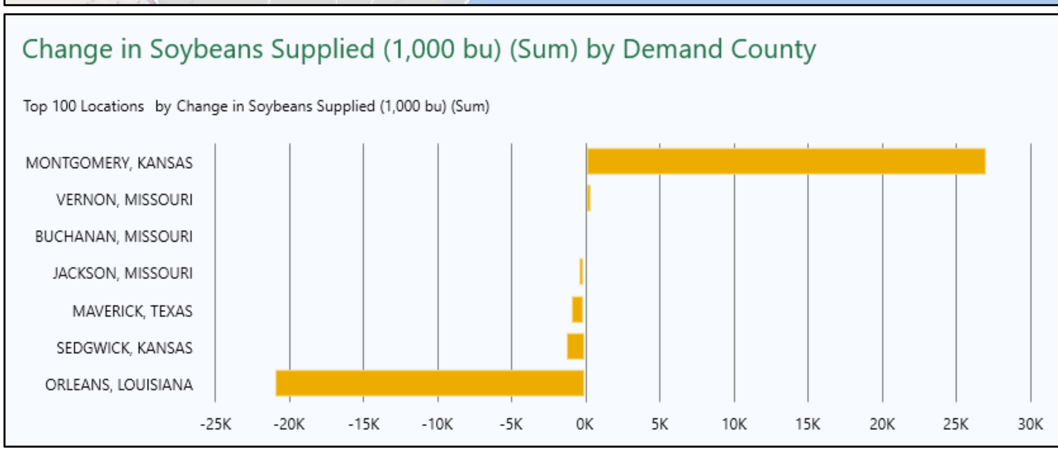


Figure 189. Regional destination of Kansas soybean supply, comparison of baseline and scenario flows





9.2 Impact of new soybean processor on soybean meal movement

Figure 190 shows the counties receiving soybean meal from Kansas after the addition of the new processing plant. According to the commodity flow analysis, the soybean meal from the Montgomery County facility largely goes to Arkansas, eastern Oklahoma, and eastern Texas. Compared to the baseline flow (Figure 59), the addition of the facility in Montgomery County pushes soybean meal from Sedgwick County slightly to the west.

Figure 190. Regional destination of Kansas soybean meal supply, addition of new processing plant

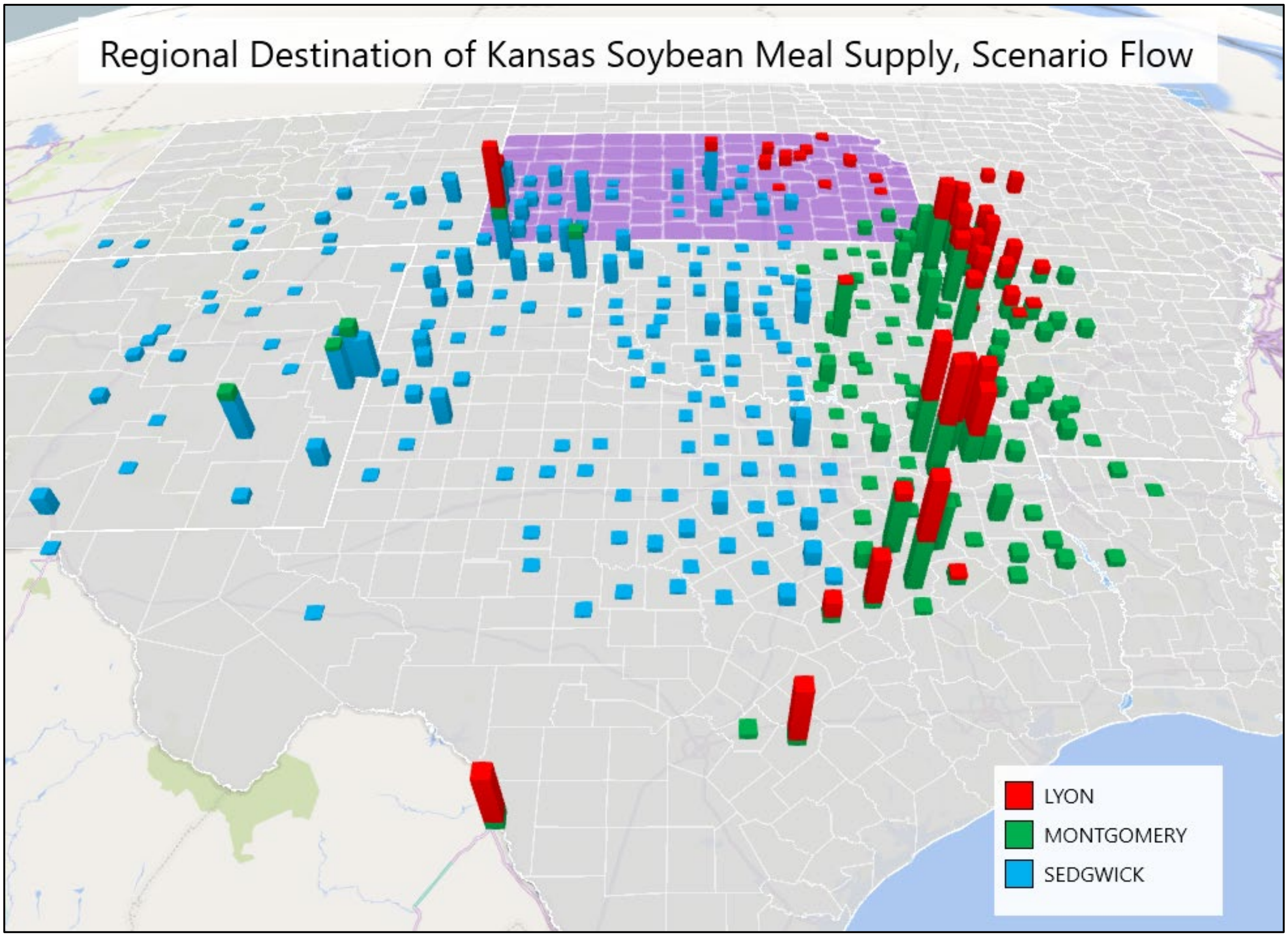
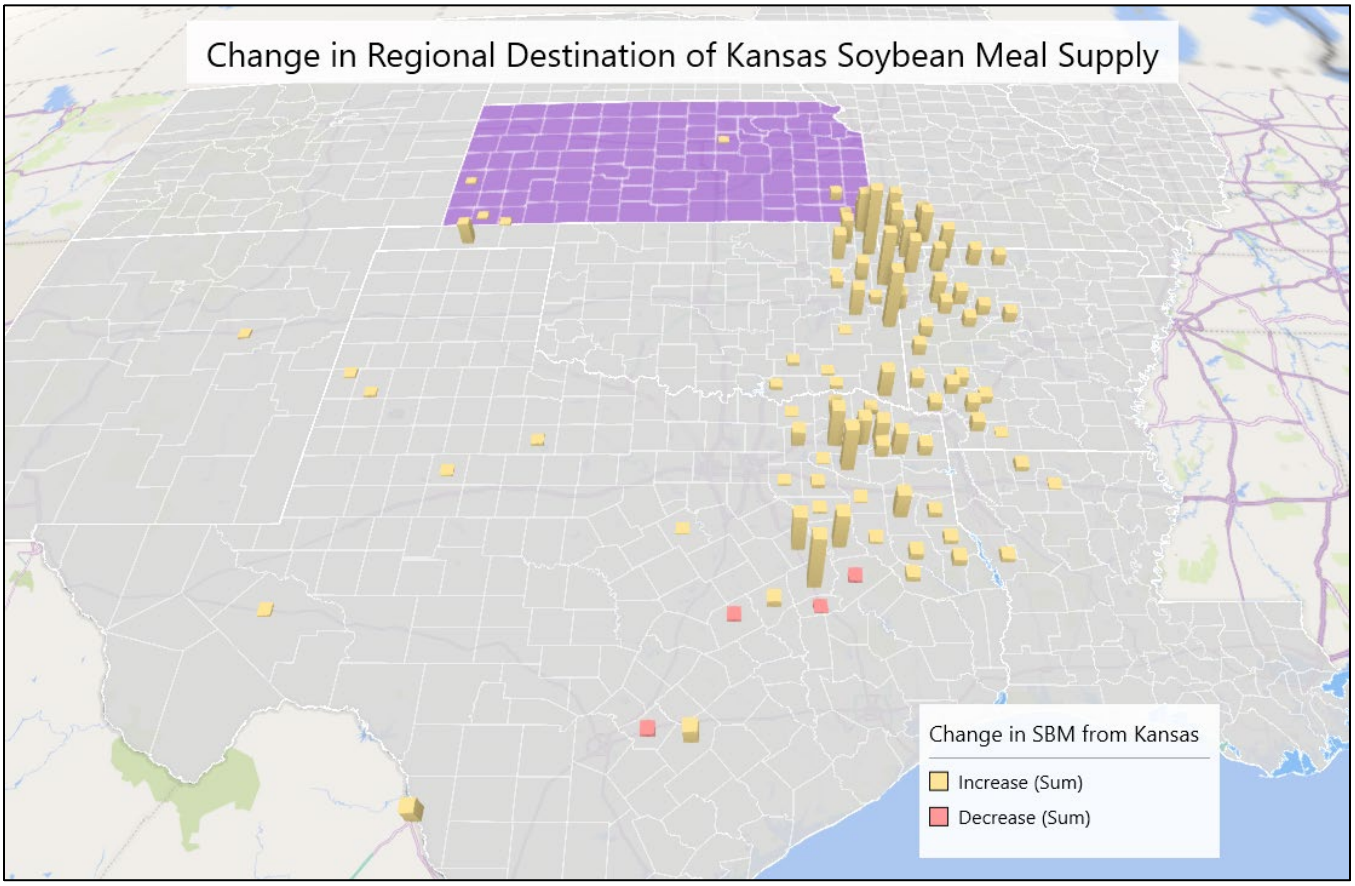
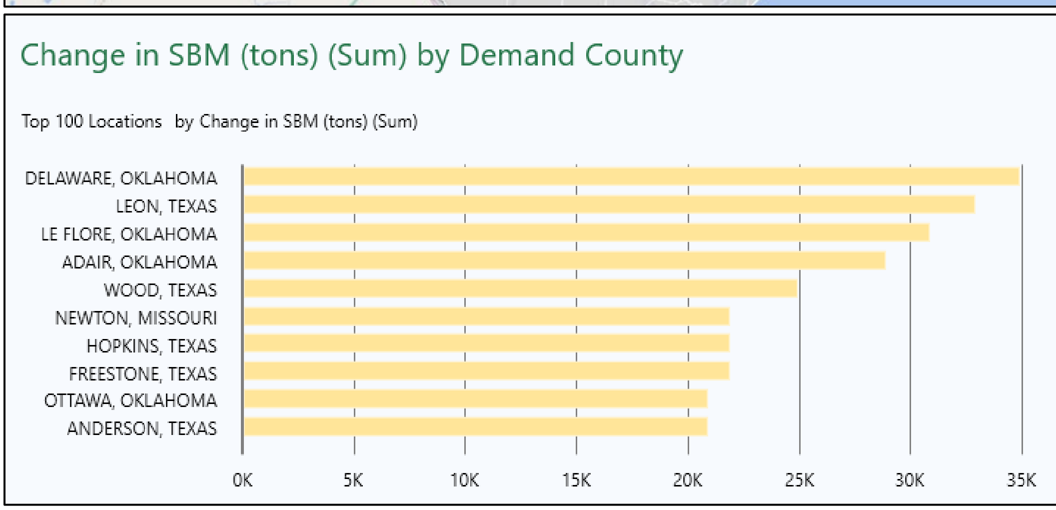


Figure 191 shows the changes to counties receiving Kansas soybean meal because of the new processor. While a small amount of the additional soybean meal remains in Kansas, the vast majority leaves the state. Most of the additional soybean meal goes to southwest Missouri, western Arkansas, eastern Oklahoma, and eastern Texas.

Figure 191. Regional destination of Kansas soybean meal supply, comparison of baseline and scenario flows





The counties receiving decreased and increased soybean meal supplied from Kansas processors are shown in Figure 192 and Figure 193, respectively. The addition of a new processing plant in southeast Kansas displaces some of the Kansas soybean meal originally going to eastern Oklahoma and Texas. This displaced supply goes to a variety of locations within the region: some remains in Kansas, some goes to locations farther west, and some goes to the areas of heavy poultry production in Missouri and Arkansas.

Figure 192. Decrease in Kansas Soybean Meal Supplied by County

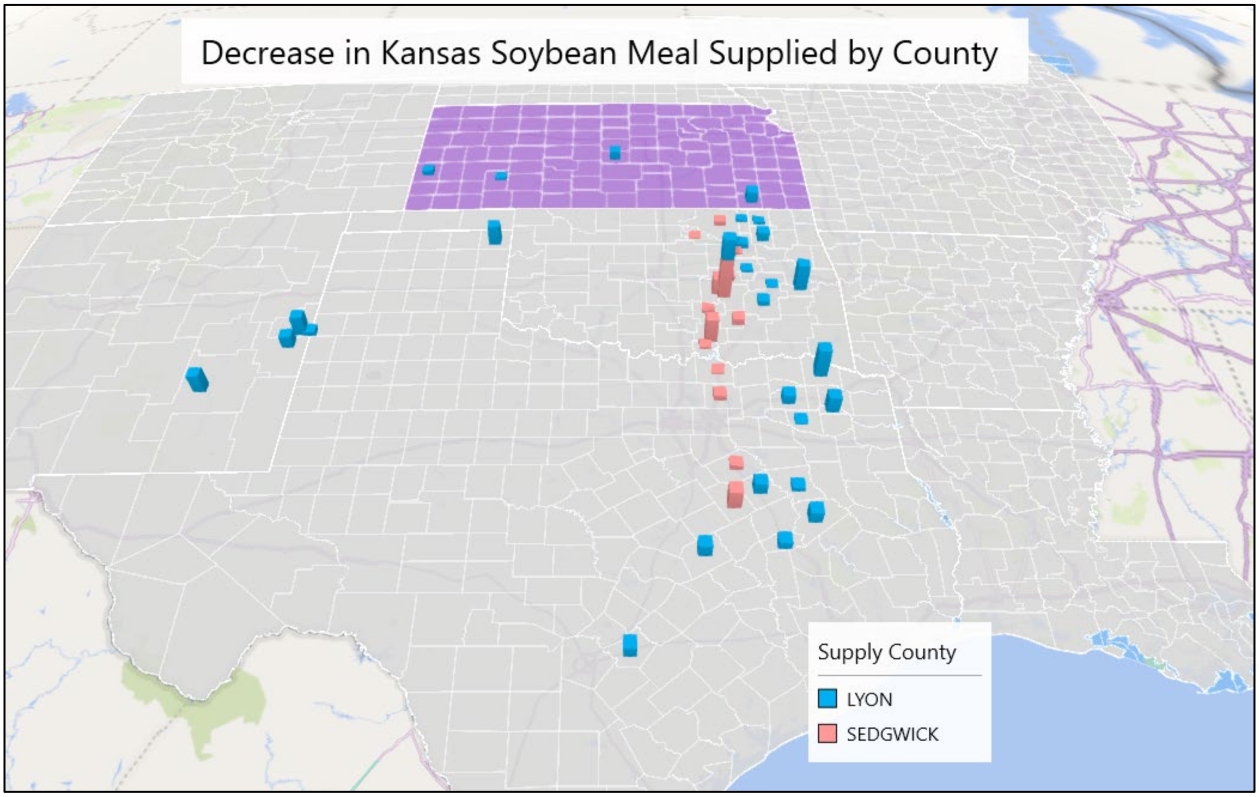
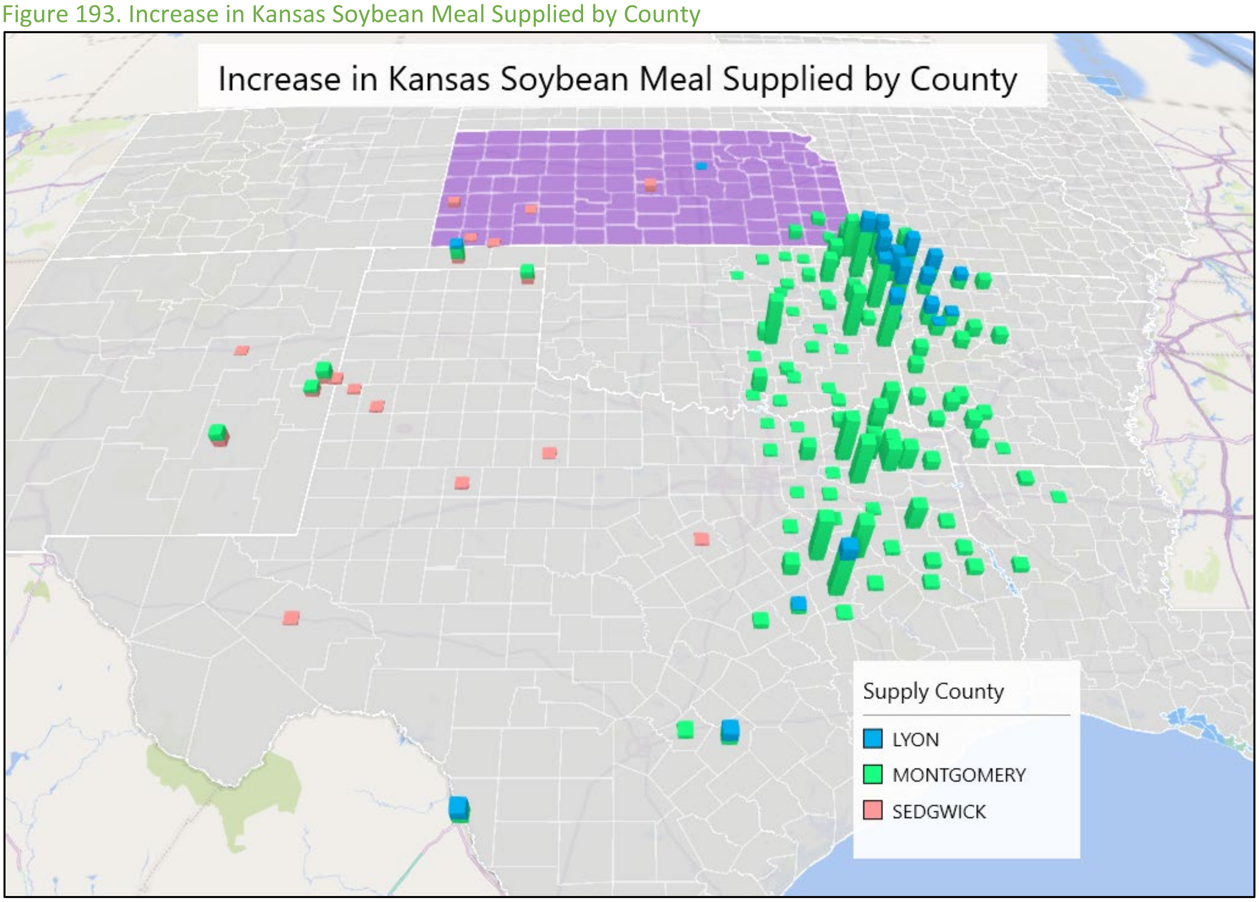


Figure 193. Increase in Kansas Soybean Meal Supplied by County



A summary of the changes to soybean meal movement from Kansas processors is shown in Table 60. The largest increases in soybean meal supplied from Kansas are to Texas (257,000 tons), Oklahoma (211,000 tons), and Arkansas (185,000 tons).

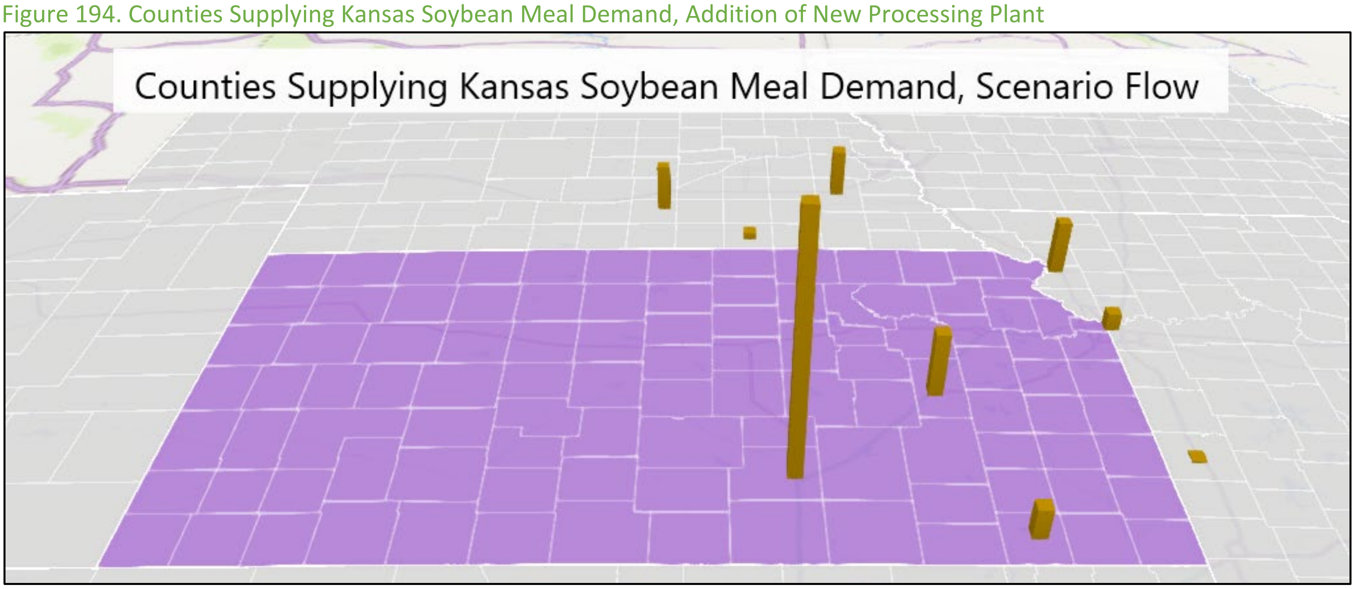
Table 60. Summary of changes to destination of Kansas SBM supply

Summary of Changes to Destination of Kansas SBM Supply (1,000 tons)				
	Supply County			
Demand State	Lyon	Montgomery	Sedgwick	Total
Arkansas	53	132	-	185
Kansas	(11)	19	10	18
Louisiana	-	7	-	7
Missouri	29	45	-	74
New Mexico	(21)	11	11	1
Oklahoma	(14)	267	(42)	211
Texas	(38)	296	(1)	257
Out of Region	2	31	22	55
Total	-	808	-	808

Decision Innovation Solutions

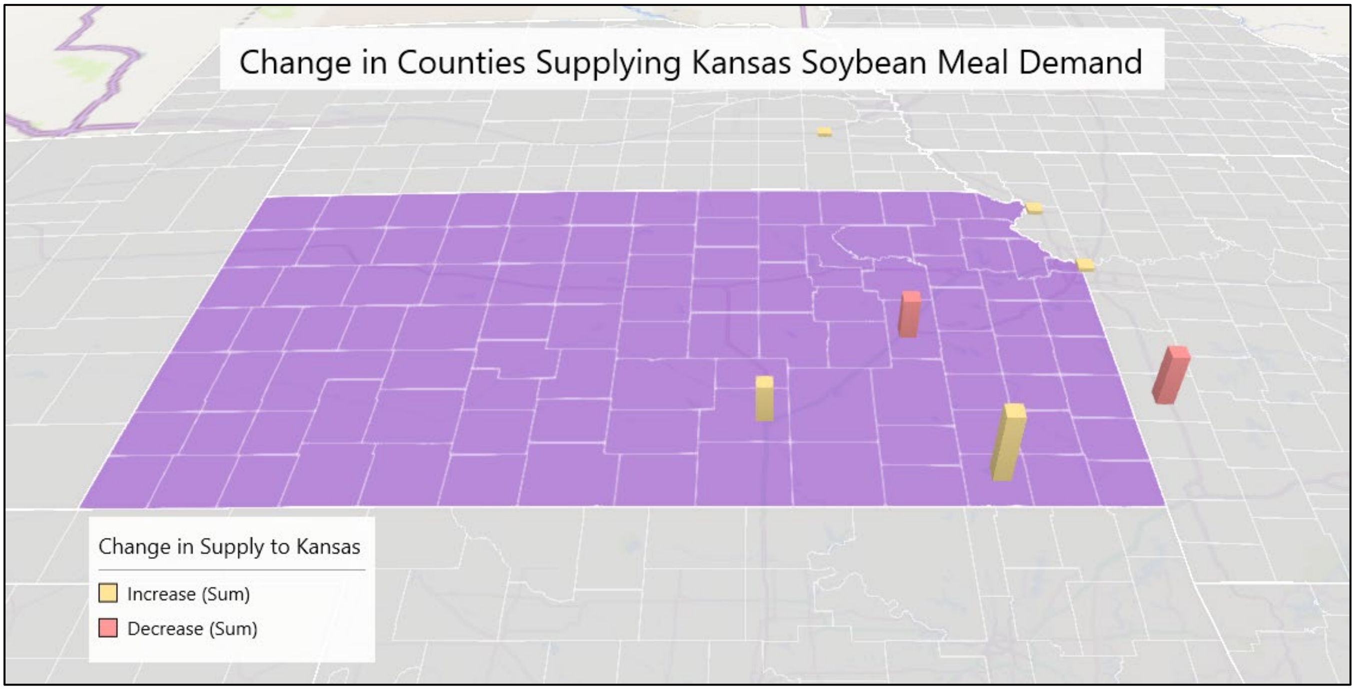
Figure 194 shows the counties supplying soybean meal to Kansas after the addition of the soybean processor in Montgomery County supplying an estimated 808,000 tons of soybean meal.

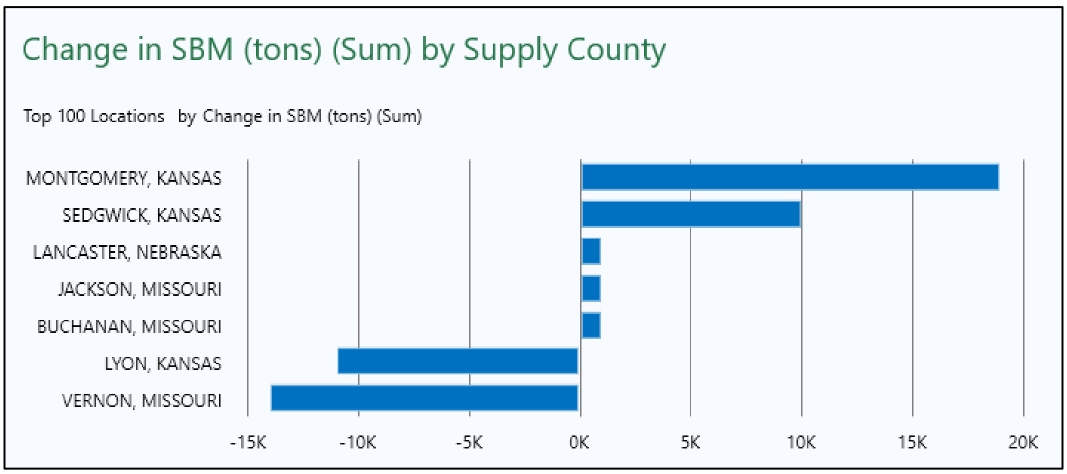
Figure 194. Counties Supplying Kansas Soybean Meal Demand, Addition of New Processing Plant



The change in soybean meal supplied to Kansas because of this addition is shown in Figure 195. Kansas receives more of its soybean meal from Montgomery and Sedgwick Counties, and it receives less soybean meal from Lyon County and Vernon County, Missouri.

Figure 195. Counties Supplying Kansas Soybean Meal Demand, Comparison of Baseline and Scenario Flows





9.3 Key takeaways

The above analysis shows the changes in the flow of soybeans and soybean meal resulting from a new soy processor beginning operations in southeast Kansas. In addition to new economic activity and jobs that would be provided, this new value-added activity results in an estimated 25.7 million bushels of Kansas soybeans remaining in Kansas for further processing instead of being exported or processed outside of the state. This activity results in Kansas livestock consuming an additional 18,000 tons of soybean meal produced within the state rather than sourcing it from outside of the state. Our analysis suggests that there is ample demand for this new soybean meal in nearby areas of heavy livestock production, particularly in Arkansas, Oklahoma, and Texas.

10 Appendix A: Methodology

The DIS commodity flow methodology includes the following general steps:

- Estimate supply of each commodity for which a flow is being conducted at the county level.
- Estimate demand of each commodity at the county level by demand category (feed use (including pet food manufacturing), biofuels production use, other processing demand (including flour milling).
- For grains, oilseeds, and selected feed ingredients, estimate export demand at the point of port loading.
- For grains, oilseeds, and selected feed ingredients, estimate imports at the point of entry point clearance.
- For hogs and fed cattle for slaughter estimate imports at the point of entry point clearance.

Details of these steps are included in the commodity flow analysis.

10.1 Dynamic flow analysis

The dynamic commodity flow was determined for each of the commodities in this study through the following procedure:

1. Determine overall supply and demand for each commodity at the county level according to the commodity-specific methodologies listed in Sections 10.2 through 10.16.
    a. Where applicable, imports and exports of a commodity are allocated to a subset of counties representing ports of entry or exit. For example, all goods exported through Louisiana are assigned to Orleans Parish. Allocations to port areas (PNW, Gulf, Texas rail, Canada, the Great Lakes, etc. were determined by assessing the regional destinations[44] of each commodity (such as Asia-Pacific, Europe, Africa, eastern South America, the Caribbean, etc) and assigning a percentage of the commodities exported to these regions to the ports taking into consideration the production regions of the commodity. (For example, HRS wheat exports destined for Asia are assigned to the PNW, HRS wheat exports to Europe were assigned to the Great Lakes and the Gulf, HRS wheat exports to Mexico were assigned to the Texas Gulf, Texas Rail, and the Gulf. HRW wheat exports to Asia were divided among the PNW, Los Angeles, and the Gulf with the largest share of HRW exports to Asia assigned to the PNW. HRW wheat exports to Mexico were assigned to the Texas Gulf and Texas rail.
2. Determine geographic center (centroid) of each county in the study area
3. Assign county supply and demand to the centroid of county
4. Conduct Dynamic Flow Analysis (using SAS)
    a. Randomize the order of selection for all demand points
    b. One at a time, determine distance from demand points to remaining supply points and allow all demand points to "claim" nearby[45] supply points
    c. Export demand points that have been satisfied and supply points that have been depleted (reduced to 0)
    d. If necessary, automatically adjust the quantity drawn per loop[46]

[44] For example, for wheat, information on wheat exports by destination was derived from Table 25 of the USDA Wheat Yearbook which sources its data from the U.S. department of Commerce, Bureau of Census, Foreign Trade Statistics.

[45] At the beginning of each iteration, a distance is defined universally for all demand points. If a demand point has one or more supply points within this distance, it draws from all of them. If no supply points are within this distance, the demand point instead draws from the nearest supply point. This distance starts at 10 miles and is automatically increased as supply points are depleted.

[46] This quantity increases if only very large demand points remain, and it decreases once a demand point goes below a certain threshold (this prevents a demand point from drawing more than it is allocated).

   e. Repeat steps 4a – 4d until all demand points are satisfied
5. Create data files, maps, charts, and other visuals to illustrate:
   a. All demand points and their relative level of demand
   b. All supply points and their relative level of supply
   c. Movement of commodities from supply points to demand points

10.2 Corn

10.2.1Corn production

Corn production data was obtained from the 2017 USDA Census of Agriculture (COA) at the state and county level. For counties for which county level production data was available, that data was used directly. For counties for which production data was not available, county level data was obtained on operations by acreage category size. From this data, estimates of production were made by assigning the average acreage to each of the operations in each category, then multiplying that acreage times the average yield for the missing county level production for each state. Once a level of corn production was determined for each county that had corn production operations in the 2017 COA, the percentage of state production in 2017 was calculated for each county.

For 2020 corn production, for counties for which corn production data was available, that data was used. For counties for which data was not disclosed by USDA, estimates of county level corn production were calculated by calculating the quantity of non-disclosed county level corn production for each state and then allocating that corn to the non-disclosed counties according to each county's production share from the 2017 COA.

10.2.2 Corn feed demand

Feed demand for corn was calculated using the DIS Ration Cost Optimization (RCO) software and algorithms developed by Decision Innovation Solutions. Feed demand is calculated for each of the major species (beef cattle, dairy cattle, swine, sheep, goats, chickens, turkeys, horses, and pet foods). The DIS RCO considers growth stages and production segments within each species. For example, for beef cattle, separate estimates are made for beef cows, bulls, calves, replacement heifers, and cattle on feed with cows divided into multiple segments for gestation and lactation phases, and growing cattle divided into several weight categories for which separate nutritional needs and diets are formulated. Similar processes are used for hogs, with separate categories for sows and finishing hogs with multiple developmental stages employed within the model. The feed demand model also considers state and regional prices for feed ingredients and for the major livestock and poultry species utilizes a number of state-specific ration combinations based on relative ration ingredient costs. The RCO is not just a least-cost optimization model in that it considers state and regional feed supplies and overall national feed ingredient supply availability at the national level.

Within the RCO, feed demand by major ingredient is calculated for each species and summarized at the state level. County-level feed demand is then calculated by taking the county share of state inventory by species and allocating feed ingredient consumption to each county, by that county's share of the state inventory. Feed consumption for each of the major ingredients at the county level, by species, is then summed to calculate feed consumption by ingredient at the county level. Calculations within the RCO are aggregated into metric tons. For corn, these quantities were converted to bushels for use in the commodity flow study.

10.2.3 Corn ethanol demand

Corn demand for ethanol production at the plant level is calculated by taking the listed capacity of an ethanol plant[47], adjusting that for overall state ethanol production based on January 2020 USDA data for ethanol production facilities capacity by state, and then allocating the state's ethanol production among the operating plants in the state according to each plant's share of state production capacity. A factor of 2.8 bushels of corn for each gallon of ethanol produced is used to calculate corn demand at each plant. Corn use for ethanol is then summed for all plants within a county to determine county level corn demand for ethanol production.

10.2.4 Non-ethanol corn processing demand

Information on non-ethanol corn processing demand was derived from a proprietary database of DIS which contains information on corn processing for all purposes. Plant-specific demand quantifications are derived from public and company-specific information sources and from DIS allocations of non-disclosed processing capacities to individual plants with national capacity utilization adjusted to match USDA WASDE estimates of national non-ethanol corn processing demand.

10.2.5 Corn exports

Corn export demand for calendar year 2020 was calculated from USDA estimates for corn exports for the 2019-2020 marketing year and the 2020-21 marketing year. Corn exports were allocated to export port facilities based on information contained in the U.S. Exports by Selected Destinations dataset in the USDA-ERS Feedgrain Outlook that was published October 2021. Allocations of export quantities to specific port regions were also informed by information obtained from the U.S. Grains Council.

10.3 Grain sorghum

10.3.1 Grain sorghum production

Grain sorghum production data was obtained from the 2017 USDA Census of Agriculture (COA) at the state and county level. For counties for which county level production data was available, that data was used directly. For counties for which production data was not available, county level data was obtained on operations by acreage category size. In the 2017 COA, USDA categorized farm operations by size using the following categories (1 to 24.9 acres; 25 to 99.9 acres; 100 to 249 acres; 250 to 999 acres; and 1,000 or more acres). From this data, estimates of production were made by assigning the average acreage to each of the operations in each category, then multiplying that acreage times the average yield for the state in 2017. If state yield data was missing, the national average yield was used to estimate production in counties in those states. Once a level of grain sorghum production was determined for each county that had grain sorghum production operations in the 2017 COA, the percentage of state production in 2017 was calculated for each county.

For 2020 grain sorghum production, for counties for which grain sorghum production data was available, that data was used. For counties for which data was not disclosed by USDA, estimates of county level grain sorghum production were calculated by calculating the quantity of non-disclosed county level grain sorghum production for each state and then allocating that production to the counties based on each county's share of state production in 2017. For states for which there was production reported in the 2017 COA, but data was not

[47] Multiple sources were used to determine ethanol capacity by plant for all ethanol plants in the contiguous 48-states. Data sources included the U.S. Energy Information Administration, the most recent map of Kansas ethanol plants and production capacities provided by the Kanas Energy Information Network, company-specific websites and data sources, as well as updates from Ethanol Producer Magazine's Plant List.

estimated for 2020, the level of production at the county level was used as the estimate of 2020 production for commodity flow analysis purposes.

10.3.2 Grain sorghum feed demand

Feed demand for grain sorghum was calculated using the DIS Ration Cost Optimizer (RCO) software and algorithms developed by Decision Innovation Solutions. Within the RCO, feed demand by major ingredient is calculated for each species and summarized at the state level. County-level feed demand is then calculated by taking the county share of state inventory by species and allocating feed ingredient consumption to each county, by that county's share of the state inventory. Feed consumption for each of the major ingredients at the county level, by species, is then summed to calculate feed consumption by ingredient at the county level. Calculations within the RCO are aggregated into metric tons. For grain sorghum, these quantities were converted to bushels for use in the commodity flow study.

10.3.3 Grain sorghum ethanol and milling demand

Grain sorghum demand for ethanol production at the plant level is calculated by taking the listed capacity of an ethanol plant[48], adjusting that for overall state ethanol production based on January 2020 USDA data for ethanol production facilities capacity by state, and then allocating the state's ethanol production among the operating plants in the state according to each plant's share of state production capacity. A factor of 2.8 bushels of grain sorghum for each gallon of ethanol produced is used to calculate grain sorghum demand at each plant. For ethanol plants that use grain sorghum in combination with other feedstocks, an estimate of grain sorghum's share of the ethanol production at the plant level was made. Grain sorghum use for ethanol at all plants was estimated for calendar year 2020 and adjusted to match USDA's estimate of grain sorghum use for ethanol. Grain sorghum use for ethanol is then summed for all plants within a county to determine county level grain sorghum demand for ethanol production.

Information on non-ethanol grain sorghum processing demand was derived from a proprietary database of DIS which contains information on grain sorghum processing for all purposes. Plant-specific demand quantifications are derived from public and company-specific information sources and from DIS allocations of non-disclosed processing capacities to individual plants with national capacity utilization adjusted to match USDA World Agricultural Supply and Demand Estimates of national non-ethanol grain sorghum processing demand.

10.3.4 Grain sorghum exports

Grain sorghum export demand for calendar year 2020 was calculated from USDA estimates for grain sorghum exports for the 2019-2020 marketing year and the 2020-21 marketing year contained in the October 2021 WASDE report. Grain sorghum exports were allocated to export port facilities based on information contained in the U.S. Exports by Selected Destinations dataset in the USDA-ERS Feedgrain Outlook that was published October 2021. Allocations of export quantities to specific port regions (Gulf, Mexico, Pacific Northwest) were also informed by information obtained from the U.S. Grains Council and data on waterborne shipments from the U.S. Army Corp of Engineer's Waterborne Commerce Statistics Center (WCSC) database.

[48] Multiple sources were used to determine ethanol capacity by plant for all ethanol plants in the contiguous 48-states. Data sources included the U.S. Energy Information Administration, the most recent map of Kansas ethanol plants and production capacities provided by the Kanas Energy Information Network, company-specific websites and data sources, as well as updates from Ethanol Producer Magazine's Plant List.

10.4 DDGs

10.4.1 DDGS production

DDGs production was calculated as a fixed yield per bushel of corn and grain sorghum processed for ethanol at each ethanol plant. Based on USDA data for ethanol production and DDGs production, the yield factor used for 2020 DDGs production was 14.54 pounds of DDGs per bushel of corn or grain sorghum used for ethanol. This was calculated by dividing the total amount of DDGs production in pounds by the total amount of corn and grain sorghum used for ethanol production.

10.4.2 DDGS feed demand

Feed demand for DDGs was calculated using the DIS Ration Cost Optimizer (RCO) software and algorithms developed by Decision Innovation Solutions. Within the RCO, feed demand by major ingredient is calculated for each species and summarized at the state level. County-level feed demand is then calculated by taking the county share of state inventory by species and allocating feed ingredient consumption to each county, by that county's share of the state inventory. Feed consumption for each of the major ingredients at the county level, by species, is then summed to calculate feed consumption by ingredient at the county level. Calculations within the RCO are aggregated into metric tons.

10.4.3 DDGs imports and exports

Data for DDGs imports was obtained from the Table 8 of the USDA Feed Grain Yearbook and allocated to two import points, Wayne County, Michigan and St. Lawrence County, New York. Data for DDG exports by destination was obtained from USDA-FAS for the 2019/20 and 2020/21 marketing years. Exports of DDGs were allocated to U.S. ports based on the destination of the exports. Allocations were made to ports in the Pacific Northwest (58%), the Gulf (22.3%), Mexico rail (15.8%), Canada (truck and rail) (1.8%) and the Great Lakes (Toledo, OH 1.8%). Allocations to these representative port locations was based on data regarding export destinations of DDGs.

10.5 Soybeans

10.5.1 Soybean production

Soybean production data was obtained from the 2017 USDA Census of Agriculture (COA) at the state and county level. For counties for which county level production data was available, that data was used directly. For counties for which production data was not available, county level data was obtained on operations producing soybeans in each county. From this data, estimates of production were made by assigning the average production per operation for those operations in non-disclosed counties, then multiplying the number of operations in that county by the average production per operations for the missing county level production for each state. Once a level of soybean production was determined for each county that had soybean production operations in the 2017 COA, the percentage of state production in 2017 was calculated for each county.

For 2020 soybean production, for counties for which soybean production data was available, that data was used. For counties for which data was not disclosed by USDA, estimates of county level soybean production were calculated by calculating the quantity of non-disclosed county level soybean production for each state and then allocating that soybean to the non-disclosed counties according to each county's production share from the 2017 COA.

10.5.2 Soybean processing demand

Demand for soybeans for domestic processing was derived from public and private sources of information on soybean processing capacity by plant. Soybean processing capacity by plant was adjusted to reflect the level of national soybean processing as reported by USDA in the October 2021 WASDE report for marketing years 2019-20 and 2020-21 and calculated for the 2020 calendar year.

10.5.3 Soybean exports

Soybean export demand for calendar year 2020 was calculated from USDA estimates for soybean exports for the 2019-2020 marketing year and the 2020-21 marketing year. Soybean exports were allocated to export port facilities based on information contained in the U.S. Global Agricultural Trade System (GATS). Allocations of export quantities to specific port regions were also informed by data from specific ports such as the Port of Kalama, WA.

10.5.4 Soybean meal production

Soybean meal processing capacity for 85 soybean processing plants was obtained from a variety of industry resources and company-specific information. Production of soybean meal was calculated as 44 pounds of soybean meal per bushel of soybeans processed in 2020. Soybean crush annual capacity was multiplied by an adjustment factor of 95.14% to match USDA estimates of national soybean crush and soybean meal production. Production of soybean meal in tons was converted to metric tons for the commodity flow analysis.

10.5.5 Soybean meal feed demand

Feed demand for soybean meal was calculated using the DIS Ration Cost Optimizer (RCO) software and algorithms developed by Decision Innovation Solutions. Within the RCO, feed demand by major ingredient is calculated for each species and summarized at the state level. County-level feed demand is then calculated by taking the county share of state inventory by species and allocating feed ingredient consumption to each county, by that county's share of the state inventory. Feed consumption for each of the major ingredients at the county level, by species, is then summed to calculate feed consumption by ingredient at the county level. Calculations within the RCO are aggregated into metric tons.

10.6 Wheat

10.6.1 Wheat production

Wheat production was estimated by allocating state level wheat production by class to counties. For counties for which USDA published 2020 production by class at the county level, that data was used. For counties with non-disclosed production data by class, allocations of the non-disclosed wheat production per state were allocated based on the most recent county level allocations available (which for spring and white wheats was generally 2006 – 2007 data. In addition, general areas of wheat production by class of wheat were supplemented by information from the maps on the U.S. Wheat Associates website and the National Association of Wheat Growers website[49]. Allocations of soft red winter wheat production in Kansas and hard white wheat production in Kansas was guided by the Kansas Wheat Varieties publication of the USDA-NASS and funded by the Kansas Wheat Commission.

[49] http://maps.heartlandgis.com/StoryMaps/USWheatAssociates/USWheatSupplyChain/

10.6.2 Wheat imports

Wheat imports by class of wheat were obtained from USDA World Agricultural Supple and Demand Estimates (WASDE) reports. These imports were assigned to selected border counties as the entry point into the U.S. and the flow analysis used these imports as additional supplies to 2020 production.

10.6.3 Wheat milling demand

A list of wheat milling facilities was compiled from multiple sources including company websites and the 2021 Grain and Milling Annual Report[50]. From these sources, wheat flour milling capacities and wheat bushels milled were estimated for each plant and adjusted to reflect regional flour milling production data published by USDA for 2020. To the degree possible, milling capacity was estimated for several classes of wheat including hard red winter wheat, soft red winter wheat, hard red spring wheat, and white wheats. Conversion of daily flour production capacity to wheat for milling demand used 137 pounds of wheat milled per hundredweight of flour produced. Wheat mills were estimated to operate an average of 360 days per year. Total operating capacity was adjusted by state/regional operating capacity estimated from the USDA Flour Milling Products Report[51]. Wheat milled for ethanol production from wheat starch was included in the wheat milling demand.

10.6.4 Wheat feed demand

Feed demand for wheat was calculated using the DIS Ration Cost Optimizer (RCO) software and algorithms developed by Decision Innovation Solutions. Within the RCO, feed demand by major ingredient is calculated for each species and summarized at the state level. County-level feed demand is then calculated by taking the county share of state inventory by species and allocating feed ingredient consumption to each county, by that county's share of the state inventory. Feed consumption for each of the major ingredients at the county level, by species, is then summed to calculate feed consumption by ingredient at the county level. Calculations within the RCO are aggregated into metric tons. For wheat, these quantities were converted to bushels for use in the commodity flow study.

10.6.5 Wheat export demand

Wheat export demand by class of wheat was obtained from USDA WASDE data tables. Exports were assigned to export port facilities based on data regarding U.S. wheat trade by country contained in the U.S. GATS dataset[52] and took into consideration the location of production of each class of wheat.

10.6.6 Wheat millfeeds (midds) production

Wheat midds production was estimated by taking the daily flour production per mill (in hundredweights) times 37 pounds per hundredweight of flour produced and then converting to tons.

10.6.7 Wheat midds feed demand

Feed demand for wheat midds was calculated using the DIS Ration Cost Optimizer (RCO) software and algorithms developed by Decision Innovation Solutions. Within the RCO, feed demand by major ingredient is calculated for each species and summarized at the state level. County-level feed demand is then calculated by taking the county share of state inventory by species and allocating feed ingredient consumption to each county, by that county's share of the state inventory. Feed consumption for each of the major ingredients at the county level, by species, is then summed to calculate feed consumption by ingredient at the county level.

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[50] Sosland Publishing's 2021 Grain & Milling Annual

[51] USDA Flour Milling Products, a quarterly report of the National Agricultural Statistics Service (NASS).

[52] Global Agricultural Trade System (GATS), supported by the Foreign Agricultural Service (FAS) of USDA. https://apps.fas.usda.gov/gats/default.aspx?publish=1

Calculations within the RCO are aggregated into metric tons. For wheat midds, these quantities were converted to metric tons for use in the commodity flow study.

10.6.8 Wheat midds imports and exports

Data on imports and exports of wheat midds (HS Code 230230) was obtained from the Tridge.com website. This data provided information on the value of wheat midds imports to the U.S. from the major suppliers and information on the value of wheat midds exports to the top destinations. The value of imports and exports in million dollars was converted to the equivalent metric tons at the average value of U.S. wheat midds for 2020 according to USDA data.

10.7 Ethanol

10.7.1 Ethanol production

Ethanol production was estimated for 11 ethanol plants in Kansas and a total of 189 ethanol plants in the U.S. Ethanol production at the plant level is calculated by taking the listed capacity of an ethanol plant,[53] adjusting that for overall state ethanol production based on January 2020 USDA data for ethanol production facilities capacity by state, and then allocating the state's ethanol production during 2020 among the operating plants in the state according to each plant's share of state production capacity. Ethanol production is then summed for all plants within a county to determine county level production of ethanol for use in the ethanol flow demand analysis.

10.7.2 Ethanol consumption

2020 ethanol consumption was first estimated at the state level by applying each state's five-year (2015-2019) average share of ethanol consumption relative to total U.S. consumption to the 2020 U.S. consumption (EIA and USDA data)[54]. County level ethanol consumption was calculated by multiplying the share of each county's population relative to the state population by the corresponding state's ethanol consumption.

10.7.3 Ethanol imports and exports

Data for ethanol imports was sourced from Table 2 of the USDA-ERS U.S. Bioenergy Statistics and allocated to one import point (Los Angeles, California). Data for ethanol exports by destination was obtained from EIA for 2020 calendar year. Exports of ethanol were distributed to U.S. ports based on the destination of the exports. Allocations were made to ports in the Pacific Northwest, the Gulf, Mexico rail, and Canada (truck and rail).

10.8 Biodiesel

10.8.1 Biodiesel production

Biodiesel production was estimated for one biodiesel plant in Kansas and a total of 94 biodiesel plants in the U.S. To estimate biodiesel production at the plant level, the share of each biodiesel plant capacity to total U.S.

[53] Multiple sources were used to determine ethanol capacity by plant for all ethanol plants in the contiguous 48-states. Data sources included the U.S. Energy Information Administration (https://www.eia.gov/petroleum/ethanolcapacity/), the most recent map of Kansas ethanol plants and production capacities provided by the Kanas Energy Information Network, company-specific websites and data sources, as well as updates from industry publications (Ethanol Producer Magazine), Renewable Fuels Association (https://ethanolrfa.org/resources/ethanol-biorefinery-locations), and press releases.

[54] Source: U.S. Department of Energy, Energy Information Administration, Petroleum Navigator. Prior to 2010 trade data is from U.S Department of Commerce, Bureau of the Census, export data for Harmonized Tariff codes 2207106000 and 2207200000, 220700090. Total and domestic disappearance are USDA, Economic Research Service calculations.

capacity was applied to U.S. biodiesel production in 2020 (as reported in October 2021 by USDA)[55]. For plants indicating soybean oil as feedstock, soybean-based biodiesel production was equal to total production. For plants indicating a combination of feedstocks in their biodiesel production only 60.8%[56] of total production was allocated as soybean oil-based biodiesel production at that plant and the remaining production was assigned to biodiesel production from other sources. The biodiesel facility located in Kansas had an allocation of 100% soybean oil as the feedstock for its biodiesel production. Soybean oil-based biodiesel production and biodiesel production based on other inputs for each plant were summarized at the county level to determine county level supply of biodiesel for use in the biodiesel flow demand analysis.

10.8.2 Biodiesel consumption

2020 biodiesel consumption was first estimated at the state level by multiplying each state's five-year (2015-2019) average share of biodiesel consumption relative to total U.S. consumption by 2020 U.S. consumption (EIA and USDA data). County level biodiesel consumption was calculated by multiplying the share of each county's population relative to the state's population by the state's biodiesel consumption.

10.8.3 Biodiesel imports and exports

Data for biodiesel imports was sourced from EIA's U.S. biodiesel imports by country of origin[57], and allocated to three import points (Pacific Northwest, the Gulf, and Canada (truck and rail)). Data for biodiesel exports by destination was obtained from EIA for the 2020 calendar year. Exports of biodiesel were distributed to U.S. ports based on the country of destination[58]. Allocations were made to ports in the Pacific Northwest, the Gulf, Mexico rail, and Canada (truck and rail).

10.9 Cattle

10.9.1 Cow slaughter supply

Beef cow slaughter supply was calculated by multiplying the ratio of beef cow slaughter to beef cow inventory at the national level [59] times the beef cows inventory at the county level. County level beef cow inventory was taken directly from USDA 2020 inventory data (USDA Quick Stats) if published. For counties where beef cow inventory was not published, data from the 2017 COA was used to estimate beef cow inventory for each county. For 2017, if county level data was published, that data was used. If County level inventory data was not available and there was published data on operations with inventory by inventory-size category, that data was used to estimate county level inventory. From the county level inventory data, an estimate of each county's share of state inventory was estimated. For counties with unpublished data in 2020, the county share of state inventory was used to allocate whatever share of the state's 2020 inventory was not published at the county level.

Dairy cow slaughter supply was calculated by multiplying the ratio of dairy cow slaughter to dairy cow inventory at the national level times the inventory of dairy cows at the county level. County level dairy cow inventory was taken directly from USDA 2020 inventory data (USDA Quick Stats) if published. For counties where dairy cow inventory was not published, data from the 2017 COA was used to estimate dairy cow inventory for each county. For 2017, if county level data was published, that data was used. If county level inventory data was not available

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[55] USDA Bioenergy Statistics, https://www.ers.usda.gov/data-products/u-s-bioenergy-statistics/
[56] U.S. soybean-oil based biodiesel production to total U.S. biodiesel production in 2020 was 60.8%
[57] https://www.eia.gov/dnav/pet/pet_move_impcus_a2_nus_EPOORDB_im0_mbbl_a.htm
[58] https://www.eia.gov/dnav/pet/pet_move_expc_a_EP00_EEX_mbbl_m.htm
[59] At the national level, beef cow and dairy cow slaughter are tracked by USDA. Breakouts of beef cow and diary cow slaughter are not available at the state level, and even if available, state cow slaughter levels cannot be used to estimate cull cow supply since animals slaughtered in a state can originate from outside the state.

and there was published data on operations with inventory by inventory-size category, that data was used to estimate county level inventory data. From that data, an estimate of each county's share of state inventory was estimated. For counties with unpublished data in 2020, the county share of state inventory was used to allocate whatever share of the state's 2020 inventory was not published at the county level.

Imports of beef and dairy cows directly for slaughter were allocated to counties where the likely port of entry is located.

10.9.2 Cow slaughter demand

Facilities that slaughter cows and bulls were identified from industry lists, company-specific data, USDA Food Safety Inspection Service's (FSIS) federally inspected meat processing facility lists, and state lists of state inspected and exempt slaughter facilities. For federally inspected slaughter facilities, data on slaughter capacity at the daily, weekly or annual basis was obtained from industry-lists, company websites and new-release sources. For facilities for which no published data could be found, DIS allocated sufficient slaughter capacity on a plant-by-plant basis and then normalized to USDA data on state and regional slaughter for 2020. For small, state-inspected and exempt slaughter facilities, an estimate of average weekly slaughter capacity was made[60].

10.9.3 Fed cattle slaughter supply

Fed cattle slaughter supply was calculated by multiplying the ratio of fed cattle slaughter to fed cattle inventory at the national[61] level times the inventory of fed cattle at the county level. County level fed cattle inventory was taken directly from USDA 2020 inventory data (USDA Quick Stats) if published. For counties where fed cattle inventory was not published, data from the 2017 COA was used to estimate fed cattle inventory for each county. For 2017, if county level data was published, that data was used. If county level inventory data was not available and there was published data on operations with inventory by inventory-size category, that data was used to estimate county level inventory data. From that data, an estimate of each county's share of state inventory was estimated. For counties with unpublished data in 2020, the county share of state inventory was used to allocate whatever share of the state's 2020 inventory was not published at the county level. Imports of fed cattle directly for slaughter were allocated to counties where the likely port of entry is located.

10.9.4 Fed cattle slaughter demand

Facilities that slaughter fed cattle were identified from industry lists, company-specific data, FSIS federally inspected meat processing facility lists, and state lists of state inspected and exempt slaughter facilities. For federally inspected slaughter facilities, data on slaughter capacity at the daily, weekly, or annual basis was obtained from industry-lists, company websites and news release sources. For facilities for which no published data could be found, DIS allocated sufficient slaughter capacity on a plant-by plant basis and then normalized to USDA data on state and regional slaughter for 2020. For small, state inspected and exempt slaughter facilities, an estimate of average weekly slaughter capacity was made.

[60] FSIS uses the Small Business Administration definition of size category to assign size to slaughter facilities. A very small facility is less than 10 employees; a small facility is 10 to 499 employees; and a large facility is 500 or more employees.

[61] At the national level, fed cattle slaughter is tracked by USDA. Breakouts of fed cattle slaughter is not available at the state level, and even if available, state fed cattle slaughter levels can not be used to estimate fed cattle supply since animals slaughtered in a state can originate from outside the state.

10.10 Hogs

10.10.1 Hogs slaughter supply

Sow, boar, and market hog slaughter supply was calculated by multiplying the ratio of hog breeding animal slaughter to breeding animal inventory at the national level times the inventory of hog breeding stock inventory at the county level and the ratio of market hog slaughter to market hog inventory at the national level times the market hog inventory at the county level. County level inventories for hogs, breeding hogs and market hogs inventory was taken directly from USDA 2020 inventory data (USDA Quick Stats) if published. For counties where hog inventory was not published, data from the 2012 and 2017 COA was used to estimate hog inventory for each county. For 2017, if county level data was published, that data was used. If county level inventory data was not available and there was published data on operations with inventory by inventory-size category, that data was used to estimate county level hog inventory data. From that data, an estimate of each county's share of state inventory was estimated. For counties with unpublished data in 2020, the county share of state inventory was used to allocate whatever share of the state's 2020 inventory was not published at the county level. For counties for which data was not published on the breakout of hogs for breeding versus market hogs, data from the 2012 COA was used to allocated hog inventory between breeding inventory and market hog inventory. That percentage was used to allocate 2017 and 2020 inventories at the county level between breeding inventory and market hog inventory. Imports of hogs directly for slaughter were allocated to the counties where the likely ports of entry are located.

10.10.2 Breeding hogs slaughter demand

Facilities that slaughter sows and boars were identified from industry lists, company-specific data, FSIS federally inspected meat processing facility lists, and state lists of state inspected and exempt slaughter facilities. For federally inspected slaughter facilities data on slaughter capacity at the daily, weekly, or annual basis was obtained from industry-lists, company websites and new-release sources. For facilities for which no published data could be found, DIS allocated sufficient slaughter capacity on a plant-by plant basis, and then normalized to USDA data on state and regional slaughter for 2020. For small, state inspected and exempt slaughter facilities an estimate of average weekly slaughter capacity was made.

10.10.3 Market hog slaughter demand

Facilities that slaughter market hogs were identified from industry lists, company-specific data, FSIS federally inspected meat processing facility lists, and state lists of state inspected and exempt slaughter facilities. For federally inspected slaughter facilities data on slaughter capacity at the daily, weekly, or annual basis was obtained from industry-lists, company websites and new-release sources. For facilities for which no published data could be found, DIS allocated sufficient slaughter capacity on a plant-by plant basis, and then normalized to USDA data on state and regional slaughter for 2020. For small, state inspected and exempt slaughter facilities an estimate of average weekly slaughter capacity was made.

10.11 Meat and bone meal

10.11.1 Meat and bone meal production

Meat and bone meal production, which includes meat and bone meal, meat meal and bone meal, was calculated as if produced at the point of slaughter for slaughter cows, fed cattle, and hogs. The yield factor, obtained from industry contacts, used for meat and bone meal from cattle is 7.5% of the average live weight of slaughter cattle

(1,350 pounds) which is 101.25 pounds of meat and bone meal per head of slaughter. The yield factor used for meat and bone meal from hogs was 18 pounds per head of slaughter[62].

10.11.2 Meat and bone meal feed demand

Feed demand for meat and bone meal was calculated using the DIS Ration Cost Optimizer (RCO) software and algorithms developed by Decision Innovation Solutions. Within the RCO, feed demand by major ingredient is calculated for each species and summarized at the state level. County level feed demand is then calculated by taking the county share of state inventory by species and allocating feed ingredient consumption to each county, by that county's share of the state inventory. Feed consumption for each of the major ingredients at the county level, by species, is then summed to calculate feed consumption by ingredient at the county level. Calculations within the RCO are aggregated into metric tons for use in the commodity flow study.

10.11.3 Meat and bone meal imports and exports

U.S. exports of meat and bone meal from cattle and hogs was calculated as the residual of production plus imports minus domestic feed demand for meat and bone meal. Additional data on meat and bone meal imports and exports (HS Code 230110) was obtained from the USATradeCensus.gov website. This data included values of imports and exports of meat and bone meat and other animal by-product protein products for the U.S. and the major sources and destinations of U.S. imports and exports. The value of meat and bone meal imports and exports by country were converted to metric ton quantities at the 2020 annual average price contained in the USDA Feed Grain Yearbook. Imports and exports were assigned to U.S. port locations based on a combination of origin and destination. Imports and exports at each port location were normalized to match the net residual supply available for export.

10.12 Sheep

10.12.1 Sheep slaughter supply

Sheep slaughter supply at the county level was calculated by multiplying the national ratio of national sheep slaughter to national sheep inventory times the inventory of sheep at the county level. County level sheep inventory numbers for 2020 were used if available. If there was no published data for county level sheep inventory, then an estimate of 2020 county level sheep inventory was made by taking the 2017 county's share of state sheep inventory times the 2020 state sheep inventory. County level estimates of sheep inventory in 2017 were taken directly from the 2017 COA if published. If not published, then an estimate of county inventory was made by allocating the unallocated state inventories to counties according to the number sheep operations per county published in the 2017 COA.

10.12.2 Sheep slaughter demand

Facilities that slaughter sheep were identified from industry lists, company-specific data, FSIS federally inspected meat processing facility lists, and state lists of state inspected and exempt slaughter facilities. For federally inspected slaughter facilities, data on slaughter capacity at the daily, weekly or annual basis was obtained from industry-lists, company websites and new-release sources. For facilities for which no published data could be found, DIS allocated sufficient slaughter capacity on a plant-by plant basis, and then normalized to USDA data on state and regional slaughter for 2020. For small, state inspected and exempt slaughter facilities an estimate of average weekly slaughter capacity was made.

[62] Sustainability and Economic Analysis Report, North American Renderers Association, February 2020.

10.13 Equine (for feed ingredient demand)

Inventories of equine at the county level were derived from the 2017 Census of Agriculture. Feed demand for horses was estimated by using the DIS RCO algorithms and estimates were updated to reflect estimated 2020 inventories.

10.14 Pet food manufacturing (for feed ingredient demand)

Data on pet food ingredients were taken from a January 2020 report, *Pet Food Production and Ingredient Analysis***.** Data on total U.S. pet food production was factored up to reflect 2020 pet food production in the U.S. This data included estimates of standardized ingredient content by both ingredient and weight of the ingredients in those pet foods. In total, there were 542 standardized ingredients found to be used in the pet foods analyzed. These 542 standardized ingredients were further categorized into 353 similar or combined ingredient classifications. These 353 ingredients were then used to quantify total ingredient weight. The total quantity of pet food ingredients was allocated to individual states based on each state's share of national pet food manufacturing value of production as contained in the IMPLAN 2019 national dataset. A database of pet food manufacturing facilities was created by DIS from a variety of data sources including industry lists, company-specific websites and lists from state and federal regulatory agencies. For some facilities production quantities were known. For those that were not published or known, estimates of production per facility were made by DIS by allocating the undistributed quantities in each state to each facility based on the state average per facility. Pet food ingredients included in this analysis include: corn, grain sorghum, wheat, soybean meal, DDGs, wheat midds, and meat and bone meal.

10.15 Poultry

10.15.1 Broiler supply

Broiler inventories at the state and county level were obtained from USDA inventory data (USDA Quick Stats) for 2020 if available. For states and counties for which data for 2020 was not published, estimates of 2020 inventories were made from 2017 COA data on operations per county and each county's share of 2020 state production.

10.15.2 Broiler processing

A database of broiler processing facilities was created by DIS from industry lists, company websites, the Federal Poultry Slaughter Inspection database[63] maintained by USDA FSIS, and state lists of state inspected and exempt facilities. For many locations, an annual estimate of slaughter capacity was known. For facilities for which the slaughter capacity is unknown, DIS estimated or allocated annual slaughter capacity from the unallocated state or national slaughter capacity levels. A variety of methods were employed to create these estimates including using aerial maps to estimate square footage at facilities and comparing that to square footage at facilities with known processing capacity. In some cases where a company's total slaughter capacity was known, the average facility capacity for that company was applied to facilities for which capacity was unknown. Once a national slaughter capacity was established, slaughter capacity was adjusted to match USDA estimates of broilers processed in 2020.

10.15.3 Layers (for feed ingredient demand)

Layer chicken inventories at the state and county level were obtained from USDA inventory data (USDA Quick Stats) for 2020 if available. For states and counties for which data for 2020 was not published, estimates of 2020

[63] https://www.fsis.usda.gov/inspection/establishments/meat-poultry-and-egg-product-inspection-directory

inventories were made from 2017 COA data on operations per county and each county's share of 2020 state production. The inventory data was used to estimate feed demand for layers by state using the DIS RCO feed demand algorithms. Feed demand for corn, grain sorghum, wheat, soybean meal, DDGs, wheat midds and meat and bone meal were made for layers.

10.15.4 Turkey Supply

Turkey inventories at the state and county level were obtained from USDA inventory data (USDA Quick Stats) for 2020 if available. For states and counties for which data for 2020 was not published, estimates of 2020 inventories were made from 2017 COA data on operations per county and each county's share of 2020 state production.

10.15.5 Turkey Processing

A database of turkey processing facilities was created by DIS from industry lists, company websites, the Federal Poultry Slaughter Inspection database, and state lists of state inspected and exempt facilities. For many locations, an annual estimate of slaughter capacity was known. For facilities for which the slaughter capacity is unknown, DIS estimated or allocated annual slaughter capacity from the unallocated state or national slaughter capacity levels. A variety of methods were employed to create these estimates including using aerial maps to estimate square footage at facilities and comparing that to square footage at facilities with known processing capacity. In some cases where a company total slaughter capacity was known, the average facility capacity for that company was applied to facilities for which capacity was unknown. Once a national slaughter capacity was established, slaughter capacity was adjusted to match USDA estimates of turkeys processed in 2020.

10.16 Milk

10.16.1 Milk production

Milk production at the state level for 2020 was obtained from USDA Quick Stats. State-level milk production was allocated to the counties based on a county's share of the state's milk cow inventory. State level 2020 inventories were obtained from USDA Quick Stats, and milk cow inventories at the county level were obtained according to the methodology outlined above in "Cow Slaughter Supply." (See Section 11.9.1)

10.16.2 Milk processing

Milk processing demand for Kansas was calculated from State of Kansas milk processing fee data obtained from the Kansas Department of Agriculture. The milk demand data for other states was estimated from sales data and product mix data obtained from Data Axle USA and from DIS estimates of production volumes (for facilities for which no sales data was available) from analysis of square footage and processing plant characteristics visible on Google maps. Sales volumes in dollars were converted to milk equivalent volumes in hundredweights by applying proprietary sales-to-volume coefficients developed by DIS for seven major categories of fluid milk and milk product characterizations of milk processing plants.

11 Appendix B: Rail projects in KS

Railroad or recipient	Project Number	Length	Mile Post to Mile Post	Subdivision	City to City	Cross Ties	Cross Ties [#/mi]	Ballast [tons]	Ballast [tons/mi]	Rail Relay [tons]	Rail Relay [tons/mi]	Total Project Cost	Loan Amount	Railroad Share	Grant
Boothill and Western	RR-8019-21	9.0	0.0 - 9.0	Dodge City	Dodge City to Wilroads	7,200	800	4,300	478	0	0	$616,370	$246,548	$184,911	$184,911
KSW / Kansas & Oklahoma	RR-8028-01	22.2	550.5 - 572.7	Geneseo	Sterling to Geneseo	11,000	495	9,157	412	0	0	$622,588	$435,812	$186,776	$0
Kansas & Oklahoma	RR-8029-22	50.0	489.0 - 536.0	Hutchinson	Wichita to Hutchinson	35,146	703	3,954	79	0	0	$988,125	$395,250	$296,438	$296,438
Kansas & Oklahoma	RR-8029-23	10.0	44.0 - 54.0	McPherson	McPherson to Conway	8,689	869	5,601	560	0	0	$372,000	$148,800	$111,600	$111,600
Kansas & Oklahoma	RR-8029-32	17.0	103.1 - 120.1	Scott City	Amy to Scott City	8,510	501	9,300	547	0	0	$459,203	$183,681	$137,761	$137,761
Kansas & Oklahoma	RR-8029-33	13.5	223.2 - 236.7	Great Bend	Yaggy to Sterling	10,820	801	5,400	400	0	0	$437,691	$175,077	$131,307	$131,307
Kansas & Oklahoma	RR-8029-42	16.4	45.0 - 54.1 & 72.1 - 79.4	Kingman	Kingman to Calista & Waldeck to Pratt	8,631	526	5,090	310	0	0	$425,079	$170,032	$127,524	$127,524
Kansas & Oklahoma	RR-8029-43	1.2	482.3 - 482.8	Hutchinson	Wichita	2,875	2,396	4,311	3593	0	0	$376,104	$150,441	$112,831	$112,831
Kansas & Oklahoma	RR-8029-44	15.0	255.0 - 270.0	Great Bend	Alden to Great Bend	7,475	498	5,000	333	0	0	$445,975	$178,390	$133,793	$133,793
Kansas & Oklahoma	RR-8029-45	17.5	495. - 512.5	Isabel	Frontier to Conway Springs	11,314	647	3,630	207	0	0	$520,317	$208,127	$156,095	$156,095
Kansas & Oklahoma	RR-8029-52	64.0	0.00 - 64.0	Scott City	Great Bend to Ness City	32,000	500	10,900	170	0	0	$1,618,334	$1,132,834	$485,500	$0
Kansas & Oklahoma	RR-8029-63	14.0	506.0 - 492.0	Hutchinson	West Wichita to Andale	13,900	993	0	0	0	0	$542,099	$379,470	$162,630	$0
Kansas & Oklahoma	RR-8029-65	25.0	512.0 - 487.0	Newton	Newton to McPherson	13,354	534	3,737	149	0	0	$661,326	$462,928	$198,398	$0
Kansas & Oklahoma	RR-8029-91	13.0	223.0 - 236.0	Great Bend	Yaggy to Sterling	9,750	750	5,200	400	0	0	$779,183	$545,428	$233,755	$0
K & O/Kuhn-Krause	RF-0041-01	0.5	533.8 - 534.3	Hutchinson	Hutchinson	51	101	62	124			$59,361	$0	$0	$59,361
K & O/Golden Valley	RF-0044-01	0.3	12.1 - 12.3 & 23.9 - 24.0	Hanston Lead	Sanford and Burdett	784	2,613	1,170	3900	41	137	$439,071	$175,628	$131,721	$131,721
Kansas & Oklahoma	RF-0046-01	1.7	47.2 - 48.9	McPherson	McPherson	1,700	1,000	28,750	16912	451	265	$2,264,582	$905,833	$679,375	$679,375
Kansas & Oklahoma/PPA	RR-0218-61	35.3	21.7 - 57.0	Salina	Salina to Lincoln	12,949	367	1,500	42	0	0	$600,000	$600,000	$0	$0
Kansas and Oklahoma	RF-0049-01	0.5	N A	Great Bend	Great Bend	1,328	2,656	2,164	4328	98	195	$8,580,000	$0	$5,580,000	$3,000,000
Kansas and Oklahoma	RF-0059-01	1	14.5 - 15.5	Scott City	Albert	11,385	11,385	1,400	1400	62	62	$551,893	$220,757	$165,568	$165,568
Kansas and Oklahoma	RF-0067-01	1	92.10 - 91.10	Great Bend	Silica	0	0	0	0			$420,408	$168,163	$126,122	$126,122
Kansas and Oklahoma 286K	RA-2931-20	65	508.0 - 533.0 & 228.0 - 268.0	Huchinson, Great Bend	Wichita to Great Bend							$7,201,950	$0	$2,880,780	$4,321,170
Kansas and Oklahoma	RA-2921-21	1.4	47.2 - 48.6	Scott City	Bazine							$1,868,844	$0	$934,422	$934,422
V and S	RR-8024-51	10.0	10.5 - 20.5	Medicine Lodge	Sharon to Medicine Lodge	7,000	700	2,000	200	0	0	$332,753	$232,927	$99,826	$0
V and S	RR-8024-71	10.0	0.0 - 10.0	Medicine Lodge	Attica to Sharon	7,500	750	5000	500	0	0	$1,322,750	$925,925	$396,825	$0
V and S	RF-0042-01	21.0	0.0 - 21.0	Medicine Lodge	Attica to Medicine Lodge	16,357	779	10500	500	0	0	$3,191,740	$1,276,696	$957,522	$957,522
V and S	RA-5711-21	8.0	0.1 - 21.0	Medicine Lodge	Attica to Medicine Lodge	8,320	1,040					$1,064,668	$0	$532,334	$532,334
Kyle	RR-8033-01	62.0	189.0 - 353.0	Belleville/ Phillipsburg	Belleville to Dresden	17,200	277	0	0	0	0	$551,432	$386,002	$165,430	$0
Kyle	RR-8033-11	59.0	329.0 - 335.0 & 389.0 - 442.0	Phillipsburg/Goodland	Norton to Clayton & Colby to Kanorado	18,459	313	0	0	0	0	$567,462	$226,985	$170,239	$170,239
Kyle	RR-8033-21	85.0	199.0 - 284.0	Belleville (#3)	Scandia to Phillipsburg	0	0	45,845	539	0	0	$666,285	$266,514	$199,885	$199,885
Kyle	RR-8033-31	36.0	353.0 - 389.0	Phillipsburg	Dresden to Colby	18,514	514	15,578	433	0	0	$1,017,324	$406,930	$305,197	$305,197
Kyle	RR-8033-41	14.0	490.3 - 504.3	Yuma (#3)	Yuma to Scandia	8,676	620	8,917	637	0	0	$581,371	$232,548	$174,411	$174,411
Kyle	RF-0056-01	13.0	309.0 - 317.2 &	Phillipsburg	Almena to Clayton	10,000	769	6,500	500	0	0	$1,086,950	$434,780	$326,085	$326,085
Kyle	KA 2637-01		326.6 - 331.4									$408,283			$408,283
Kyle	RF-0066-01	41.0	241.0 - 255.0	Belleville	Lebanon to Phillipsburg	11,000	268	12,300	300	0	0	$2,498,444	$999,378	$749,533	$749,533
Kyle 286K - Bridges	RA-3331-20	235.5	203.5 - 439.0	Multiple	Courtland to Kanorado							$2,492,565	$0	$747,770	$1,744,796
Kyle	RA-3311-21	4.5	514.2 - 517.0 & 518.0 - 519.65	Concordia	Beloit to Glen Elder							$3,815,890	$0	$1,526,356	$2,289,534
Mid-States P.Authority/KYLE	RR-8035-71	0.2	189.0 - 189.2	Belleville	East of Belleville		0		0	0	0	$658,282	$460,797	$197,484	$0
Nebraska Kansas Colorado	RR-8049-01	73.2	133.1 - 59.9	St. Francis	Cedar Bluffs to St. Francis	7,418	101	7,555	103	197	3	$632,997	$443,098	$189,899	$0

Railroad or recipient	Project Number	Length	Mile Post to Mile Post	Subdivision	City to City	Cross Ties	Cross Ties [#/mi]	Ballast [tons]	Ballast [tons/mi]	Rail Relay [tons]	Rail Relay [tons/mi]	Total Project Cost	Loan Amount	Railroad Share	Grant
South Kansas & Oklahoma	RR-8054-01	28.4	218.1 - 246.5	Moline	Grant Summit to Winfield	12,900	454	912	32	0	0	$356,594	$249,616	$106,978	$0
South Kansas & Oklahoma	RR-8054-02	23.6	130.5 - 153.6	Chanute	Chanute to Cherryvale	8,047	341	7,492	317	0	0	$322,620	$225,834	$96,786	$0
South Kansas & Oklahoma	RR-8054-21	27.0	414.0 - 387.0	Neodesha	Cherryvale to Fredonia	22,809	845	4,039	150	0	0	$627,750	$251,100	$188,325	$188,325
South Kansas & Oklahoma	RR-8054-22	29.8	155.7 - 165.0 & 0.0 - 20.5	Tulsa	Cherryvale to Caney	17,705	594	15,822	531	0	0	$750,301	$300,120	$225,090	$225,090
South Kansas & Oklahoma	RR-8054-31	0.25	387.0 - 155.4	Neodesha/ Chanute Connector	Cherryvale	1,188	4,752	1,108	4432	0	0	$138,202	$55,281	$41,461	$41,461
South Kansas & Oklahoma	RR-8054-33	26.7	325.8 - 379.5	Pittsburg Branch	Cherokee to Sherwin	7,524	282	4,895	183	600	22	$475,294	$190,118	$142,588	$142,588
South Kansas & Oklahoma	RR-8054-35	37.2	350.8 - 386.9	Neodesha	Hallowell to Cherryvale	12,591	338	7,997	215	0	0	$618,018	$247,207	$185,405	$185,405
South Kansas & Oklahoma	RR-8054-37	20.0	210.0 - 230.0	Moline	Grendola to Burden	8,020	401	2,675	134	0	0	$409,302	$163,721	$122,791	$122,791
South Kansas & Oklahoma	RR-8054-38	18.1	0.0 - 18.1	Coffeyville	Cherryvale to Coffeyville	7,240	400	5,532	306	0	0	$445,191	$178,076	$133,557	$133,557
South Kansas & Oklahoma	RR-8054-42	8.0	132.0 - 140.0	Chanute	Chanute to Thayer	4,200	525	3,510	439	0	0	$209,789	$83,916	$62,937	$62,937
South Kansas & Oklahoma	RR-8054-51	19.0	160.0 - 199.0	Moline	Fredonia to Moline	10,500	553	7,878	415	0	0	$547,150	$383,005	$164,145	$0
South Kansas & Oklahoma	RR-8054-53	11.1	128.5 - 117.4	Humbolt Lead	Chanute - Humboldt	5,500	495	5,837	526	0	0	$280,203	$196,142	$84,061	$0
South Kansas & Oklahoma	RR-8054-61	13.0	143.0 - 156.0	Chanute	Morehead to Cherryvale	7,872	606	3,714	286	0	0	$441,334	$308,934	$132,400	$0
South Kansas & Oklahoma	RR-8054-62	22.0	232.0 - 210.0	Moline	Grenola to Burden	17,790	809	8,800	400	0	0	$614,663	$430,264	$184,399	$0
South Kansas & Oklahoma	RR-8054-63	33.0	155.5 - 165.5 & 0.0 - 23.0	Tulsa	Cherryvale to Caney	24,256	735	6,340	192	0	0	$1,091,048	$763,733	$327,314	$0
South Kansas & Oklahoma	RF-0017-01	2.0	150.2-152.2	Chanute	Cherryvale	14,000	7,000	20,000	10,000	1,017	509	$2,770,045	$0	$1,854,045	$916,000
South Kansas & Oklahoma	RF-0034-01	2.1	414-NA	Neodesha	Fredonia	6,206	2,955	6,172	2939	422	201	$1,825,844	$730,338	$547,753	$547,753
South Kansas & Oklahoma	RF-0036-01	4.5	150.8-155.3	Chanute	Cherryvale	0	0	0	0	901	200	$1,551,371	$620,548	$465,411	$465,411
South Kansas & Oklahoma	RF-0048-01	1.5	164.0 - 165.5	Tulsa	Independence	1,271	847	4,560	3040	93	62	$757,636	$303,054	$227,291	$227,291
South Kansas & Oklahoma	RF-0052-01	1.0	16.7-16.9	Coffeyville	Coffeyville	404	404	598	598	32	32	$1,266,558	$506,623	$379,967	$379,967
South Kansas & Oklahoma	RF-0055-01	6.0	144.0-150.0	Chanute	Cherryvale	0	0	3,650	608	622	104	$1,208,506	$483,402	$362,552	$362,552
South Kansas & Oklahoma 286k	RA-5431-20	51.0	153.0 - 185.0 & 395.0 - 414.0	Moline, Neodesha W.	Cherryvale to Winfield							$6,416,542	$0	$2,566,617	$3,849,925
South Kansas & Oklahoma	RA-5411-21		153.9 - 247.2 & 356.2 - 405 .5	Moline, Neodesha								$1,903,844	$0	$951,922	$951,922
New Century AirCenter	RR-8072-01	5.0	0.00 - 5.0	N/A	NCAC (Gardner)	750	150	10,221	2044	0	0	$300,000	$210,000	$90,000	$0
New Century AirCenter	RR-8072-31	5.0	0.00 - 5.0	N/A	NCAC (Gardner)	3,205	641	700	140	102	20	$542,993	$217,197	$162,898	$162,898
New Century AirCenter	RR-8072-41	5.0	0.00 - 5.0	N/A	NCAC (Gardner)	120	24	85	17	0	0	$200,071	$0	$0	$200,071
Cimarron Valley	RF-0001-01	170	3.5-119 1-63	CVR/Manter	Dodge City/Elkhart,Satanta/Saunders	100,000	588	51,000	300	1,500	9	$15,000,000	$2,000,000	$5,000,000	$8,000,000
Cimarron Valley 6 Bridges	RF-0025-01	6	59-66	CVR	near Satanta	1,000	167	0	0	300	50	$6,000,000	$2,000,000	$3,000,000	$1,000,000
Cimarron Valley 286K - Bridges	RA-1631-02	180.1	3.76 - 62.4 and 121.5		Dodge City to Elkhart and Saunders							$1,877,300	$0	$563,190	$1,314,110
Cimarron Valley	RA-1611-21	3.385	3.76 - 62.40 and 121.50	CVR/Manter								$1,618,695	$0	$647,478	$971,217
Rice County/JACAM	KA-3034-01	0.36			Sterling										
Bonanza Energy siding	RF-0020-01	1.0	401	LaJunta	Garden City	5,500	5,500	6,500	6500	425	425	$4,080,067	$1,000,000	$2,580,067	$500,000
City of Bel Aire	RF-0039-01	0.75		N A	Bel Aire	2,235	2,980	2,267	3023	137	182	$1,053,396	$421,358	$316,019	$316,019
Garden City Western	RF-0035-01	3.0	0.0-3.0	West Line	Garden City	1,600	533	833	278	0	0	$298,703	$119,481	$89,611	$89,611
Garden City Western	RF-0043-01	3.0	0.0-3.1	West Line	Garden City	2250	750	1200	400	0	0	$359,552	$143,821	$107,866	$107,866
Garden City Western	RF-0045-01	3.0	0.0-3.0	West Line	Garden City (switches)	0	0	2860	953	0	0	$1,039,189	$415,676	$311,757	$311,757
Garden City Western	RF-0054-01	2.3		West Line	Garden City (wye) - CANCELLED										
City of Garden City	RF-0050-01	2.6	397.0-398.0	La Junta	Garden City	7,622	2,932	8,481	3262	270	104	$5,405,376	$0	$2,405,376	$3,000,000
Cargill, Inc.	RF-0051-01	2.26	336.51-337.23	Falls City	Atchison	8,071	3,571	5,800	2566	440	195	$3,223,621	$1,289,448	$967,086	$967,086
Cargill, Inc.	RA-9321-21	0.1										$300,000	$0	$120,000	$180,000
Element, LLC	RF-0058-01	0.6	498.2 - 498.8	Hutchinson	Colwich	7,148	11,913	11,221	18702	599	998	$3,401,438	$1,360,575	$1,020,431	$1,020,431
Occidental Chemical	RA-8421-21	2.57										$4,524,280	$0	$2,262,140	$2,262,140
												$125,992,186	$29,024,369	$49,093,818	$47,874,000

12 Appendix C: Shuttle grain elevators in Kansas

Shuttle grain elevators in Kansas

City	Name	Capacity (railcars)	Elevator capacity (000 bushels)	Carriers
Abilene	Gavilon Grain LLC	110	4,839	UP, BNSF
Atchison	Bartlett Grain	85	936	UP
Atchison	Cargill	78	9,212	UP, BNSF
Atchison	Bunge Milling	62	10,929	UP, BNSF, KCS
Canton	Producer Ag	110	7,500	UP
Colby	Cornerstone Ag LLC	100	928	UP
Concordia	AgMark LLC	115	4,750	BNSF
Coolidge	Scoular Company	110	2,300	BNSF
Dodge City	ADM Grain	104	1,880	BNSF
Downs	Scoular Grain	110	1,500	UP, KYLE
Ensign	Dodge City Coop Exchange	112	2,301	BNSF, CVR
Frankfort	Farmers Coop	110	4,200	UP
Garden City	WindRiver Grain LLC	110	4,856	BNSF
Glen Elder	AgMark LLC	110	1,200	UP, KYLE
Hanover	Farmers Coop Assn	110	522	UP
Haviland	Farmers Cooperative Co.	100	1,300	UP
Hugoton	United Plains Ag LLC	110	2,360	BNSF, CVR
Hutchinson	ADM Grain (Elevator I)	110	5,800	UP, BNSF
Hutchinson	ADM Grain (Elevator J)	108	18,300	BNSF
Kansas City	Bartlett River Rail	75	10,000	UP, BNSF
Kansas City	ADM/Farmland Fairfax	60	8,700	UP, BNSF
Kansas City	ADM Gowmark Wolcott	65	2,300	UP
Liberal	Conestoga Energy	100	2,400	UP
Milan	MKC Grain Elevator	under	construction	BNSF
New Cambria	ADM Grain, Elev. A	110	2,057	UP
Ogallah	Castle Rock Marketing	103	568	UP
Plains	Collingwood Grain	100	3,000	UP
Pratt	Scoular Company	110	1,800	UP
Salina	Cargill	112	32,000	UP, BNSF, KO
Salina	Scoular Company	110	11,047	UP, BNSF
Salina	ADM Collingwood (Term. A)	110	2,000	UP
Salina	Cargill	110	32,000	UP, BNSF, KO
Sharon Springs	United Plains Ag LLC	110	1,800	UP
Topeka	Cargill Gordon Unit	110	27,000	UP, BNSF, KCS
Topeka	Cargill AgHorizon	75	12,055	UP, BNSF, KCS
WaKeeney	Castle Rock Marketing	100	550	UP
Wellington	Scoular Company	110	2,280	BNSF
Wichita	Bartlett Grain	110	10,340	UP, BNSF, WTA
Wichita	Gavilon Grain LLC	110	22,549	UP, BNSF, KO
Wright	Right Coop	120	2,943	BNSF

Source: KDOT State Rail Plan, 2017.