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Central Plains Grain Farm Truck Fleet & Marketing Patterns

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Disclaimer

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ABSTRACT

A survey of farm operators in the Central Plains Region, including Illinois, Indiana, Iowa, Kansas, and Nebraska, was conducted to gather information about transportation of crops, the inventory and characteristics of farmer-owned truck fleets, and on-farm storage capacity. The objective of the study is to provide information about the farm truck inventory and marketing patterns in the Central Plains. There is no other source for this information, and it should be unique and complementary to other farm-to-market information and national commodity flow publications. Farmers may use the results for their own investment and productivity assessments. Local and regional planners and policy makers can use the information to calibrate travel demand and freight flow models for investment and asset management choices and to estimate pavement impacts. Survey results indicate that the 5-axle semi is the most common truck configuration within the study area and that single-axle and tandem-axle truck ownership will decline in the future in favor of 5-axle and 7-axle configurations. On-farm storage is concentrated on larger farms in terms of average capacity, but the storage per bushel harvested is inversely related to farm size. The average distance to the first-choice delivery point was 14.92 miles.

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INTRODUCTION

Agriculture, including traditional grain markets and value-added activities such as food processing, biofuels production, and specialty grains, plays a large role in the economy of Central Plains states. In this report references to the Central Plains region includes the states of Illinois, Indiana, Iowa, Kansas and Nebraska. The 2017 Agricultural Census shows that farms in these states had crop sales of $44.7 billion (U.S. Department of Agriculture, 2022). The survey developed as part of this study queried producers in all five states regarding truck use and marketing patterns for corn and soybeans during the 2019 crop year. The survey to Kansas producers added questions regarding wheat shipments during the 2019 crop year.

Background and Objective

Farm-generated truck movement is defined as the initial movement of grain from field to market delivery point in the distribution chain. This market delivery point may be an elevator, feedlot, or processor, and the move may include an interim movement to an on-farm storage facility. The grain distribution chain is complex with delivery timing and points influenced by factors such as market pricing signals, storage alternatives, global markets, and farm manager market expectations. It is especially important to understand the transportation patterns and trends for these farm truck shipments in making investment and policy decisions related to rural and agriculture-centric economies. National commodity transport data sources, such as the Commodity Flow Survey and Freight Analysis Framework, do not account for this farm-generated grain traffic (U.S. Department of Transportation, Bureau of Transportation Statistics, 2022).

The objective of this study is to partially fill the information gap for the farm truck inventory and grain marketing patterns in the Central Plains. Collecting truck and trip information directly from farm operators is vital for understanding patterns and trends in farm-generated grain traffic. This traffic is not otherwise inventoried in national data sources, so it is the responsibility of individual states or other entities to collect and/or estimate farm-generated grain traffic. As state and local decision makers consider infrastructure investments, policy changes, and traffic operations it is especially important to better understand the farm-generated grain traffic patterns and trends for this key local and widely dispersed freight generator. The information collected in this study should be unique and complementary to other farm-to-market studies (Baumel, 1996; Tolliver et al., 2005) and national commodity flow publications. Results will prove useful to a wide array of groups. Farmers may use the results for their own investment and productivity assessments. Local and regional planners can utilize the information in calibrating travel demand and freight flow models for investment and asset management choices. In addition, policy makers will be able to consider this information when making infrastructure and industry related decisions.

Background on State Production Trends

Within the Central Plains region, 219 million tons of corn and 50 million tons of soybeans were produced in 2019. Kansas produced 9.8 million tons of wheat in 2019. Since 2000, this represents a 39% increase in corn production and a 19% increase in soybean production on a tonnage basis. Wheat production in Kansas has increased by 6% from 2000 to 2019. The shipment of each of these commodities begins with a common factor – the initial farm-to-market or farm to storage shipment, which occurs via truck transportation. Since 2000, there have been some changes in truck technology as well as configurations used by producers. Moreover, the marketing network has changed from a wide network of small country elevators to more shipments consolidated at subterminal elevators or processors located within each state. The result of this, even in the absence of production increases, is increases in the ton-miles of these commodities shipped from the field to the initial destination.

As described above, there have been significant increases in corn, soybean, and wheat production within the Central Plains region since 2000. This is due to multiple factors ranging from improvements in seed varieties to farming technology and input quality and types. Over the past two decades, each of the states showed a positive trend in terms of total production of corn and soybeans, although individual year outliers are present due to weather-related impacts.

Production of corn and soybeans in Illinois from 1999 to 2019 is shown in Figure 1. Corn production in Illinois increased from 1.4 billion bushels in 1999 to 2.2 billion in 2019. Soybean production in Illinois increased from 443 million bushels in 1999 to 683 million bushels in 2019. The combined production of corn and soybeans grew by roughly 56% over the past two decades.

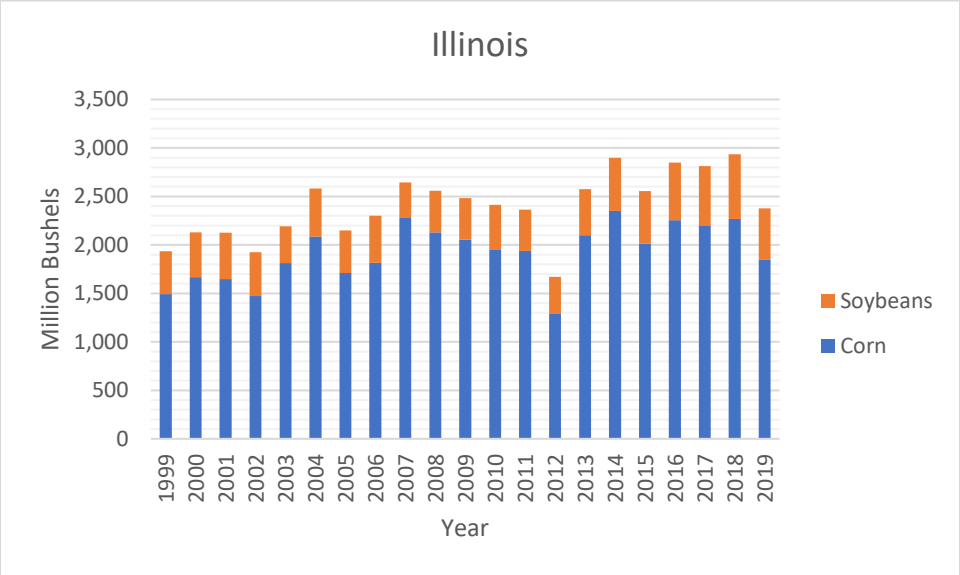

Figure 1. Illinois Grain Production Trend

Production of corn and soybeans in Indiana from 1999 to 2019 is shown in Figure 2. Corn production in Indiana increased from 748 million bushels in 1999 to 815 million bushels in 2019. Soybean production in Indiana increased from 216 million bushels in 1999 to 273 million bushels in 2019. The combined production of corn and soybeans in Indiana grew by 13% over the same timeframe.

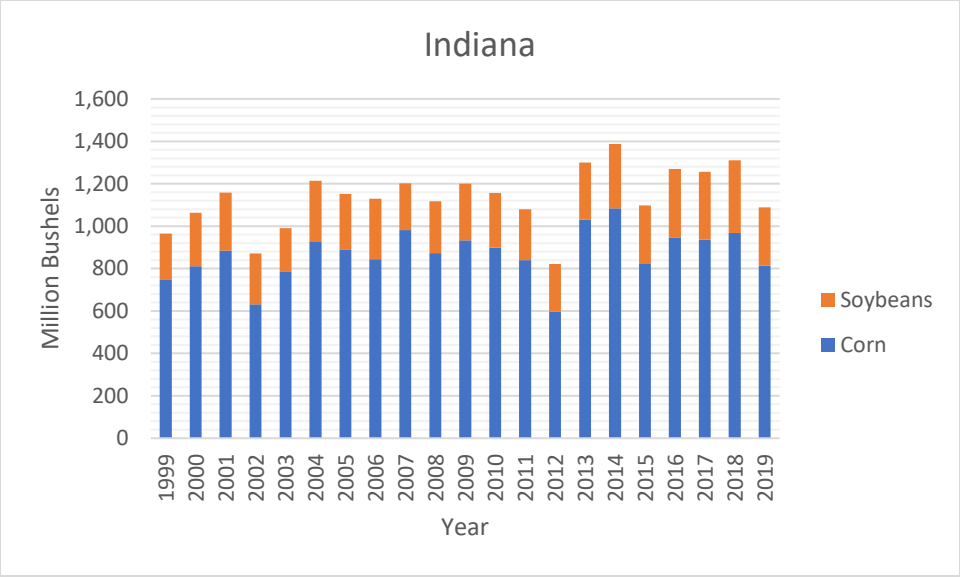

Figure 2. Indiana Grain Production Trend

Production of corn and soybeans in Iowa from 1999-2019 is shown in Figure 3. Corn production in Iowa increased from 1.8 billion bushels in 1999 to 2.6 billion bushels in 2019. Soybean production in Iowa increased from 478 million bushels in 1999 to 502 million bushels in 2019. The combined production of corn and soybeans in Iowa grew by 36% from 1999-2019.

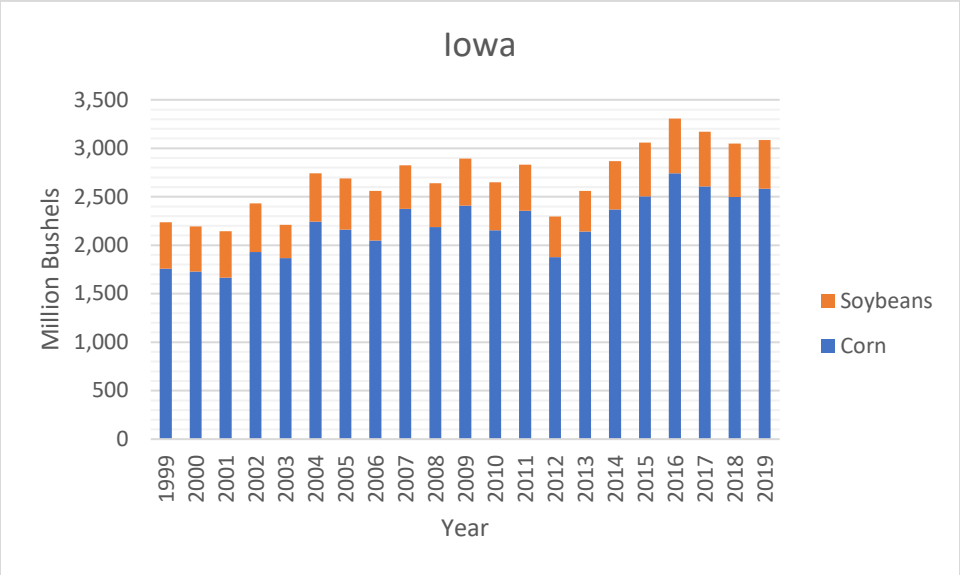

Figure 3. Iowa Grain Production Trend

Production of corn and soybeans in Kansas from 1999 to 2019 is shown in Figure 4. Corn production in Kansas increased from 420 million bushels in 1999 to 801 million bushels in 2019. Soybean production in Kansas increased from 81 million bushels in 1999 to 186 million bushels in 2019. Wheat production decreased from 432 million bushels in 1999 to 348 million bushels in 2019. The combined production of corn, soybeans, and wheat in Kansas grew by 43% from 1999 to 2019.

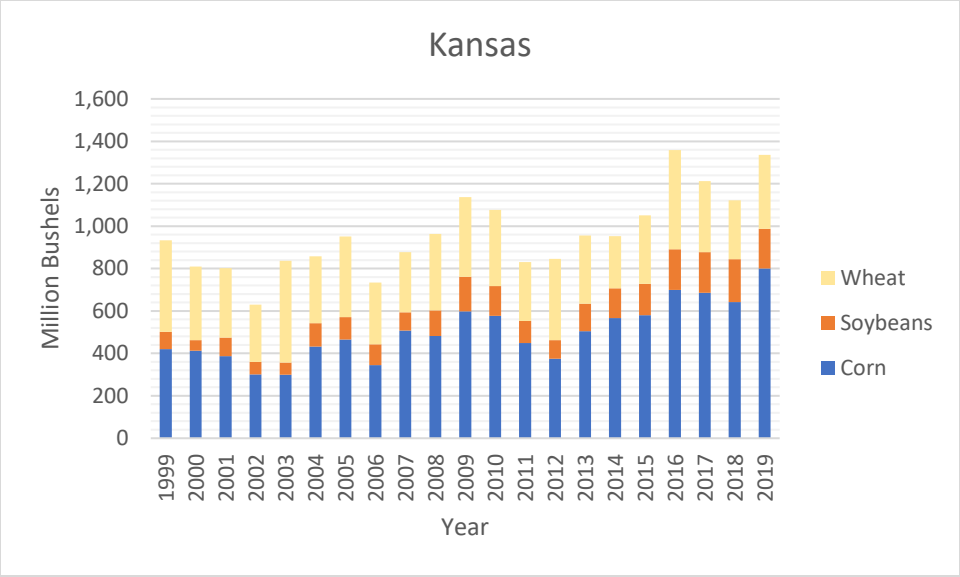

Figure 4. Kansas Grain Production Trend

Production of corn and soybeans in Nebraska from 1999 to 2019 is shown in Figure 5. Corn production in Nebraska increased from 1.2 billion bushels in 1999 to 1.7 billion bushels in 2019. Soybean production in Nebraska increased from 181 million bushels in 1999 to 283 million bushels in 2019. The combined production of corn and soybeans in Nebraska grew by 56% from 1999 to 2019.

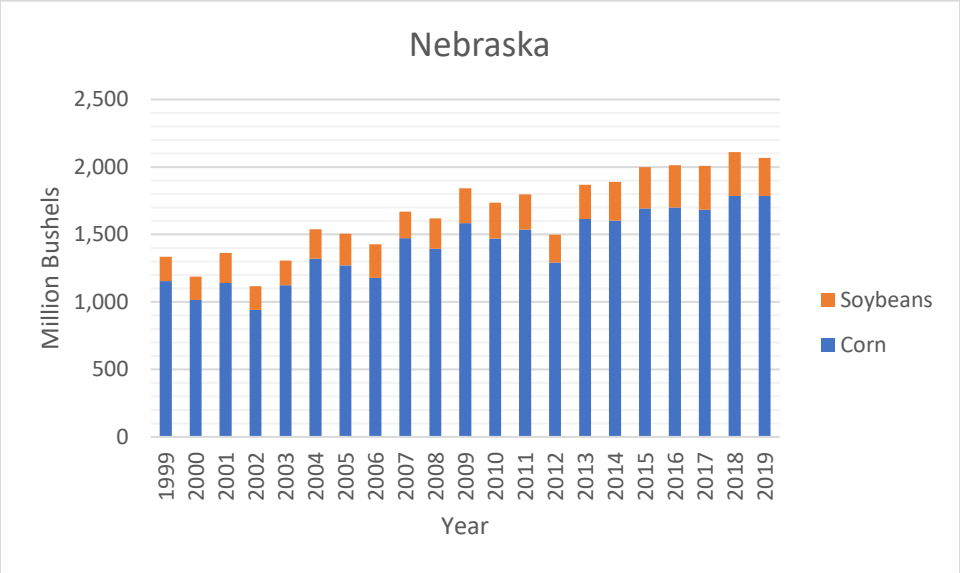

Figure 5. Nebraska Grain Production Trend

As the above figures show, total production of the combined commodities has increased in all states over the last 20 years. The ultimate result of this is additional ton-miles of farm-based grain shipments generated at the farm or point of production.

METHOD AND DATA

The survey method was used to collect the data needed for the study. The survey instrument was designed by the National Agricultural Statistics Service (NASS) with input from the Upper Great Plains Transportation Institute (UGPTI). The survey consisted of six major topic areas: (1) crop production and marketing, (2) farm grain truck fleet and inventory, (3-5) farm-generated transportation of winter wheat, corn, and soybeans, and (6) select farm operation characteristics. Information regarding corn and soybean production and marketing were collected for Illinois, Indiana, Iowa, Kansas, and Nebraska, while winter wheat data were collected for Kansas only.

Mail and Phone Surveys

The survey process was a two-phase system. An initial mail survey was distributed to a sample of farmers in the NASS contact database. A follow-up mailing was distributed to non-respondents. Following the second survey mailing, Computer-assisted telephone interviewing (CATI) was used to contact non-respondents. Limited field enumeration was used in select cases where mail and CATI were unsuccessful. In addition, NASS developed and conducted training for the telephone survey. A stratified non-probability quota sample was used to select the farmers from the population for the survey. The number of surveys collected, overall and from within each of the state strata, was deemed sufficiently large to approximate random selection so generalizations could be made about the larger population within the budget and time constraints. In addition, NASS personnel's expertise with agricultural survey issues and data quality control contributes to a strong likelihood that the sample is representative of the larger population. Although random influences cannot be ruled out within this sample technique, confidence intervals are shown since the large regional sample is assumed to have normal probability distributions. NASS estimated sample sizes to achieve a coefficient of variation of 5% for each of the states. The target sample sizes are shown in Table 1.

Table 1. Sample Size by State

State	Count
Illinois	850
Indiana	1,000
Iowa	750
Kansas	1,250
Nebraska	800
Total	4,550

The survey and mail sample were designed to collect data for a representative sample of corn and soybean producers in Illinois, Indiana, Iowa, and Nebraska, and corn, soybean, and wheat producers in Kansas. The farms surveyed may produce one or more of these commodities. The sample for the survey was derived from the larger population of farms that reportedly grew at least one of the major wheat, corn, and soybean crops based on the County Agricultural Production Survey (CAPS). This group is defined as the eligible farm population that comprised the potential survey candidates. CAPS is a federally required submission used for federal farm program management at all jurisdictions. A random sample of 4,550 farms was drawn from the eligible population.

SURVEY RESULTS

The survey was conducted during the summer of 2020. Data were provided for analysis beginning in February 2021. A total of 4,550 surveys were mailed during summer 2020 with an initial response of 756 surveys returned. Follow up methods including personal and computer assisted telephone and mobile telephone surveys resulted in an additional 1,224 responses for a total of 1,980 responses or a 43.5% response rate. Illinois had the largest response rate of 55.3% with 470 total responses. Kansas had the lowest response rate of 31.1% with 389 responses. The remaining states had response rates ranging from 43.5% to 48.3%.

Respondent Profile

Survey respondents were asked to indicate whether they produce any of the commodities that are the focus of this study (Table 2). Only respondents in Kansas were asked whether they produce wheat, and 99% of respondents indicated that they do produce wheat. Respondents indicating that they produced corn varied across the states, with the highest percentages in Iowa, Nebraska, and Illinois and the lowest in Kansas. Respondents indicating soybean production were highest in Iowa, Illinois, and Indiana with the lowest in Kansas.

Table 2. Respondents Reporting Crop Production, by State and Commodity

State	Wheat	Corn	Soybeans
Iowa	n/a	95%	91%
Illinois	n/a	95%	88%
Indiana	n/a	85%	90%
Kansas	99%	64%	60%
Nebraska	n/a	91%	79%
Overall	99%	85%	82%

n=1,980

The respondent farm size averaged 1,047 harvested acres of corn, soybeans, and wheat in 2019. Respondents were grouped by farm size; defined as (1) less than 300 harvested acres, (2) 301-750 harvested acres, (3) 751-1,500 harvested acres, and (4) 1,501 or greater harvested acres. Of the respondents who reported total harvested acres, 12% are in farm group 1 with an average of 148 harvested acres, 24% are in farm group 2 with an average of 514 harvested acres, 25% are in farm group 3 with an average of 1,057 harvested acres, and 39% are in farm group 4 with an average of 2,606 harvested acres (Table 3).

Table 3. Farm Group Characteristics

Farm Group	Count	Percent	Average Harvested Acres
300 acres or fewer	210	12%	148
301 to 750 acres	438	24%	514
751 to 1,500 acres	458	25%	1,057
1,501 acres or more	719	39%	2,606

Marketing Patterns

Farm markets vary substantially across respondents because transportation for these major grains can simply be a short haul to on-farm storage or a longer haul to an elevator, feedlot, or processor facility. The transportation resources consumed do show some patterns for individual commodities. In addition, responses to on-farm storage questions provide some insight into the timing of grain deliveries. Overall regional marketing patterns are useful. In addition, insight is provided in the market patterns among state and farm group strata.

On-Farm Storage

On-farm storage for corn, soybeans, or wheat was confirmed by respondent farms (Table 4). Among the states, Kansas had the lowest reported average on-farm storage capacity weighted by harvested acres and Indiana the largest. The storage ratio measured in bushels of on-farm storage per harvested acre ranged from 36 bushels in Kansas to 104 bushels in Indiana.

Table 4. Corn, Soybean, and Wheat Storage Capacity, by State

State	Storage Ratio, Bushels per Harvested Acre*	Average On-Farm Storage, Bushels*
Iowa	101	92,415
Illinois	89	97,786
Indiana	104	110,838
Kansas	36	41,130
Nebraska	78	87,918

*Weighted by Harvested Acres

The storage capacity density, measured in terms of bushels produced per harvested acre (including corn and soybeans in Iowa, Illinois, Indiana, and Nebraska, and corn, soybeans, and wheat in Kansas), was inversely related to farm size with the exception of farm group 2 (Table 5). The storage capacity volume, however, is greater for the larger farms. Average on-farm storage was 196,272 bushels for farms of 1,501 acres or greater. The smallest farms averaged 50,297 bushels of storage capacity.

Table 5. Corn, Soybean, and Wheat Storage Capacity, by Farm Group

State	n	Share in Farm Groups	Average Storage Ratio, Bushels per Harvested Acre*	Average On-Farm Storage, Bushels*
300 acres or fewer	210	12%	339	50,297
301 to 750 acres	438	24%	86	44,021
751 to 1,500 acres	458	25%	81	86,200
1,501 acres or more	712	39%	75	196,272

*Weighted by Harvested Acres

On-farm storage is concentrated in the larger farms in terms of average capacity. In terms of flexibility, however, the smaller farms appear to be more able to adapt when increased on-farm storage is needed (Table 5). For the smallest farms, the ratio of storage capacity bushels per harvested acre was 339. The largest farms have an average of 75 bushels of on-farm storage for each harvested acre.

The role of on-farm storage is important in understanding farm-generated crop traffic. On-farm storage provides an easily accessible option to delay grain delivery beyond the harvest season. Farmers were asked about the share of their crop production delivered directly to a market from the field at harvest time. Table 6 outlines the variations in field to market percentages by commodity and farm group size. Wheat producers were only surveyed in Kansas, and all reported marketing percentages by farm group size are specific to that state. Wheat shipments in Kansas directly from field to market represent 89% to 98% of the total, depending on farm size, with the largest percentages in farm groups 2 and 3. As outlined in Table 4, Kansas has the lowest average on-farm storage capacity, which may help to explain the high field to market percentages. For corn and soybean movements from field to market, all five states are represented.

Table 6. Crop Delivery from Field to Market, by Farm Group

Commodity	Farm Group	n	Average	Standard Error	95% Confidence Limit	
Wheat	300 acres or fewer	16	91%	5%	81%	100%
	301 to 750 acres	50	98%	1%	97%	99%
	751 to 1,500 acres	59	97%	1%	95%	99%
	1,501 acres or more	99	89%	2%	85%	94%
Corn	300 acres or fewer	78	79%	4%	71%	88%
	301 to 750 acres	397	84%	2%	81%	88%
	751 to 1,500 acres	413	77%	2%	73%	80%
	1,501 acres or more	643	68%	2%	65%	71%
Soybeans	300 acres or fewer	72	78%	5%	68%	87%
	301 to 750 acres	397	66%	2%	63%	70%
	751 to 1,500 acres	420	56%	2%	53%	60%
	1,501 acres or more	696	53%	1%	50%	55%

Corn shipments from field to market range from 68% in the largest farm group to 79% – 84% in the smaller farm group. The percentage of soybean shipments direct from field to market is lower across all farm strata as compared with wheat and corn shipments, and are inversely related to farm size strata.

Regional Markets

Farmers were asked to describe their corn, soybean, and wheat marketing patterns in 2019. For wheat harvested, farmers reported that as of May 1, 2019, about 4% of bushels produced remained in on-farm storage with the largest share (91%) transported to elevators (Table 7). A small share (2%) was hauled to processors. For soybeans, of the 2019 crop sold at the time of the survey, 72% was moved to elevators and 11% to processors (Table 9). Farmers were less likely to use on-farm storage for soybeans than for corn and more likely to use storage for soybeans than for wheat. Of the corn grown during 2019, 61% was sold to an elevator, while 15% of the 2019 corn crop was held in on-farm storage. Feed use accounted for about 8% for corn, with the largest share being used for feed on their own farms (Table 8).

Table 7. Regional Markets for Wheat Produced in 2019				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	91%	1%	89%	92%
Processor	2%	1%	0%	4%
Feed Lot	1%	0%	0%	1%
Feed Own	1%	0%	0%	1%
Storage	4%	1%	2%	6%
Other	2%	1%	1%	4%

Table 8. Regional Markets for Corn Produced in 2019				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	61%	1%	59%	63%
Processor	15%	1%	13%	16%
Feed Lot	4%	0%	3%	5%
Feed Own	4%	0%	3%	4%
Storage	15%	1%	14%	17%
Other	1%	0%	1%	2%

Table 9. Regional Markets for Soybeans Produced in 2019				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	72%	1%	70%	73%
Processor	11%	1%	10%	13%
Feed Lot	0%	0%	0%	1%
Feed Own	0%	0%	0%	1%
Storage	13%	1%	11%	14%
Other	3%	0%	2%	4%

Markets, State Strata

Kansas farmers reported the same share of wheat delivered to elevators compared to the regional market average (Table 10). The share of the 2019 wheat held on-farm at the time of the survey and the feed use was also the same as the regional market average.

Table 10. Regional Markets for Wheat Produced in 2019, Kansas				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	91%	1%	89%	92%
Processor	2%	1%	0%	4%
Feed Lot	1%	0%	0%	1%
Feed Own	1%	0%	0%	1%
Storage	4%	1%	2%	6%
Other	2%	1%	1%	4%

Statistics for regional markets for corn produced in 2019 in Iowa, Illinois, Indiana, Kansas, and Nebraska are presented in Tables 11 to 15. All five states sold a smaller share of their 2019 crops to elevators compared with the regional average. Among the five states, Kansas marketed the largest share of corn to elevators compared with the other four states. Kansas also had the smallest share of corn held on-farm

compared with Iowa, Illinois, Indiana, and Nebraska. This is consistent with Kansas having the lowest average on-farm storage capacity of the five states studied (Table 4). The figures are smaller than the regional average for Kansas and larger than the regional average for the other four states. Kansas had the largest share, 16% (Table 14), for feed on their own farms, whereas Iowa had the lowest share of feed of 4% (Table 11). The feed share for corn in Kansas is double the regional average.

Table 11. Regional Markets for Corn Produced in 2019, Iowa				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	53%	2%	48%	57%
Processor	26%	2%	21%	30%
Feed Lot	1%	1%	-1%	2%
Feed Own	3%	1%	2%	5%
Storage	15%	2%	12%	19%
Other	1%	0%	0%	2%

Table 12. Regional Markets for Corn Produced in 2019, Illinois				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	69%	2%	66%	72%
Processor	8%	1%	5%	10%
Feed Lot	1%	0%	0%	1%
Feed Own	2%	0%	1%	3%
Storage	19%	1%	16%	22%
Other	2%	1%	1%	3%

Table 13. Regional Markets for Corn Produced in 2019, Indiana				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	58%	2%	54%	62%
Processor	17%	2%	13%	20%
Feed Lot	5%	1%	3%	7%
Feed Own	3%	1%	2%	4%
Storage	16%	2%	13%	19%
Other	2%	1%	0%	3%

Table 14. Regional Markets for Corn Produced in 2019, Kansas				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	70%	2%	66%	74%
Processor	5%	1%	3%	8%
Feed Lot	9%	2%	6%	12%
Feed Own	7%	1%	4%	10%
Storage	8%	1%	5%	10%
Other	1%	1%	0%	3%

Table 15. Regional Markets for Corn Produced in 2019, Nebraska				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	55%	2%	51%	59%
Processor	18%	2%	14%	22%
Feed Lot	5%	1%	3%	7%
Feed Own	5%	1%	2%	7%
Storage	17%	2%	13%	20%
Other	1%	1%	0%	2%

Statistics for regional markets for soybeans produced in 2019 in Iowa, Illinois, Indiana, Kansas, and Nebraska are presented in Tables 16 to 20. Iowa and Indiana sold a smaller share of their 2019 crops to elevators compared with the regional average. Among the five states, Kansas marketed the largest share of soybeans to elevators compared with the other four states (Table 19). Kansas also had the smallest share of soybeans held on-farm compared with Iowa, Illinois, Indiana, and Nebraska, and the share is equal to that of corn. The shares of soybeans held on-farm are smaller than the regional average for Kansas and bigger than the regional average for the other four states. Iowa, Kansas, and Nebraska had 0% feed on their own farms (Table 16, 19, 20), whereas Illinois and Indiana had less than 1% share of feed (Table 17, 18). All the feed shares for soybeans are lower than the regional average.

Table 16. Regional Markets for Soybeans Produced in 2019, Iowa				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	67%	2%	63%	70%
Processor	15%	2%	11%	19%
Feed Lot	0%	0%	-1%	1%
Feed Own	0%	0%	0%	1%
Storage	14%	2%	10%	17%
Other	4%	1%	2%	6%

Table 17. Regional Markets for Soybeans Produced in 2019, Illinois				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	74%	1%	72%	77%
Processor	4%	1%	3%	6%
Feed Lot	0%	0%	0%	0%
Feed Own	1%	0%	0%	1%
Storage	16%	1%	13%	19%
Other	5%	1%	3%	7%

Table 18. Regional Markets for Soybeans Produced in 2019, Indiana				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	66%	1%	63%	68%
Processor	16%	2%	13%	20%
Feed Lot	1%	0%	0%	2%
Feed Own	0%	0%	0%	1%
Storage	13%	2%	10%	16%
Other	3%	1%	2%	5%

Table 19. Regional Markets for Soybeans Produced in 2019, Kansas				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	82%	2%	79%	86%
Processor	7%	2%	4%	11%
Feed Lot	0%	0%	0%	0%
Feed Own	0%	0%	0%	1%
Storage	8%	2%	5%	11%
Other	2%	1%	0%	3%

Table 20. Regional Markets for Soybeans Produced in 2019, Nebraska				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	76%	2%	73%	79%
Processor	12%	2%	8%	17%
Feed Lot	0%	0%	0%	1%
Feed Own	0%	0%	0%	1%
Storage	10%	2%	6%	13%
Other	1%	1%	0%	2%

Markets, Farm Group Strata

Farm group 1, including farms with fewer than 300 acres, held 0% share of wheat in storage, which is lower than the regional average. These farm storage practices may be related to specialty or small-scale milling operations that tend to have limited on-site inventory or to individual farmer decisions to hold inventory multiple years. Wheat that grades with higher milling quality characteristics has historically garnered a premium during years where weather or other factors lead to below average crop quality. The corn market is also somewhat different from the region as these farms utilize a 6% share of corn for feed which is 1.5 times the regional average. These smaller farms also report storing more of their corn and less of their soybean crop relative to the regional averages.

Table 21. Regional Markets for Wheat Produced in 2019, Farm Group I				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	98%	2%	94%	102%
Processor	0%	0%	0%	0%
Feed Lot	0%	0%	0%	0%
Feed Own	2%	2%	0%	5%
Storage	0%	0%	0%	0%
Other	4%	4%	0%	11%

Table 22. Regional Markets for Corn Produced in 2019, Farm Group I				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	79%	3%	73%	85%
Processor	10%	2%	5%	14%
Feed Lot	4%	1%	1%	7%
Feed Own	6%	2%	2%	9%
Storage	16%	3%	10%	21%
Other	4%	1%	1%	7%

Table 23. Regional Markets for Soybeans Produced in 2019, Farm Group I				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	94%	2%	90%	97%
Processor	5%	2%	1%	9%
Feed Lot	1%	1%	0%	3%
Feed Own	0%	0%	0%	0%
Storage	12%	3%	7%	17%
Other	2%	1%	0%	5%

Farm group 2, which includes farms sized 301 to 750 harvested acres, was like the regional averages in its wheat marketing. This group did report selling a larger share of each commodity to elevators compared with the regional average. With 99% of wheat, 75% of corn, and 89% of soybeans marketed at the elevator, the shares are 8 percentage points higher for wheat and 14 and 17 percentage points higher than the regional average for corn and soybeans, respectively (Table 24, Table 25, and Table 26).

Table 24. Regional Markets for Wheat Produced in 2019, Farm Group 2				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	99%	1%	96%	101%
Processor	0%	0%	0%	0%
Feed Lot	0%	0%	0%	0%
Feed Own	0%	0%	0%	0%
Storage	3%	2%	0%	8%
Other	4%	3%	0%	10%

Table 25. Regional Markets for Corn Produced in 2019, Farm Group 2				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	75%	2%	71%	78%
Processor	11%	1%	8%	14%
Feed Lot	4%	1%	2%	5%
Feed Own	6%	1%	4%	8%
Storage	17%	1%	14%	20%
Other	1%	0%	0%	2%

Table 26. Regional Markets for Soybeans Produced in 2019, Farm Group 2				
Market	**Average**	**Standard Error**	**95% Confidence Limit**	
Elevator	89%	1%	86%	92%
Processor	8%	1%	6%	11%
Feed Lot	1%	0%	0%	1%
Feed Own	1%	0%	0%	1%
Storage	13%	1%	10%	16%
Other	3%	1%	1%	5%

Farms between 751 and 1,500 acres comprise the operations in farm group 3. Like group 2, this group also reported selling a larger share of each commodity to elevators compared with the regional average. With 97% of wheat, 73% of corn, and 85% of soybeans marketed at the elevator, the shares are 6 percentage points higher for wheat and 12 and 13 percentage points higher than the regional average for corn and soybeans, respectively (Table 27, Table 28, Table 29). Elevators are the primary market for each commodity. Corn has the greatest market diversification (Table 28).

Table 27. Regional Markets for Wheat Produced in 2019, Farm Group 3

Market	Average	Standard Error	95% Confidence Limit	
			Lower	Upper
Elevator	97%	1%	95%	99%
Processor	0%	0%	0%	0%
Feed Lot	2%	2%	0%	6%
Feed Own	1%	1%	0%	2%
Storage	3%	2%	0%	7%
Other	0%	0%	0%	1%

Table 28. Regional Markets for Corn Produced in 2019, Farm Group 3

Market	Average	Standard Error	95% Confidence Limit	
			Lower	Upper
Elevator	73%	2%	69%	76%
Processor	19%	2%	16%	23%
Feed Lot	3%	1%	2%	5%
Feed Own	4%	1%	2%	5%
Storage	16%	1%	14%	19%
Other	2%	1%	1%	3%

Table 29. Regional Markets for Soybeans Produced in 2019, Farm Group 3

Market	Average	Standard Error	95% Confidence Limit	
			Lower	Upper
Elevator	85%	1%	83%	88%
Processor	13%	2%	10%	16%
Feed Lot	1%	0%	0%	1%
Feed Own	1%	0%	0%	1%
Storage	15%	1%	12%	17%
Other	2%	1%	1%	4%

Farm group 4 includes the largest operations among the respondent farms, at least 1,501 acres. These operations are like the regional market distributions. Farm group 4 sells slightly more than the regional average share of its wheat, corn, and soybeans to elevators. Group 4's own feed use is slightly lower than the regional average for corn and similar for wheat and soybeans. Wheat shows a greater market distribution variability, considering the standard errors. Figures for each commodity market sales share exceed the regional 95% confidence intervals (Table 30, 31, 32).

Table 30. Regional Markets for Wheat Produced in 2019, Farm Group 4				
Market	Average	Standard Error	95% Confidence Limit	
			Lower	Upper
Elevator	92%	2%	88%	96%
Processor	6%	2%	1%	10%
Feed Lot	0%	0%	0%	0%
Feed Own	1%	0%	0%	1%
Storage	6%	2%	2%	9%
Other	2%	1%	0%	5%

Table 31. Regional Markets for Corn Produced in 2019, Farm Group 4				
Market	Average	Standard Error	95% Confidence Limit	
			Lower	Upper
Elevator	67%	1%	64%	70%
Processor	21%	1%	18%	23%
Feed Lot	6%	1%	5%	7%
Feed Own	3%	0%	2%	4%
Storage	20%	1%	18%	22%
Other	1%	0%	1%	2%

Table 32. Regional Markets for Soybeans Produced in 2019, Farm Group 4				
Market	Average	Standard Error	95% Confidence Limit	
			Lower	Upper
Elevator	79%	1%	76%	82%
Processor	19%	1%	16%	21%
Feed Lot	0%	0%	0%	1%
Feed Own	0%	0%	0%	1%
Storage	17%	1%	15%	19%
Other	5%	1%	4%	7%

Grain Transportation Vehicle Inventory

Between 1963 and 2002, the U. S. Department of Transportation sampled private and commercial truck registrations in each state to compile a national public database. The database offered estimated truck characteristics in a five-year cycle. It was released as the Vehicle Inventory and Use Survey (VIUS) and had widespread use by government, academia, and businesses in assessing policy and investment decisions. The database offered a source to profile a state's vehicle fleet using information such as vehicle registration numbers, model year (or fleet age), truck axle configuration, truck body type, and business activity (such as agriculture or manufacturing). The survey was discontinued in 2002 because of budget restrictions so the information provided here offers insight, missing since 2002, into the region's grain truck fleet. VIUS data collection resumed in 2021 and the survey data are expected to be released in 2023.

The farm-owned grain truck fleet is comprised of five main truck types: single-axle, tandem-axle, tridem-axle, 5-axle semi, and the 7-axle semi or Rocky Mountain Double (RMD). Many more types and combinations are used, but not in sufficient quantity for analysis.

The single-axle truck, used to deliver grain from farm to elevator, was for decades the industry standard. It provided sufficient utility for small farms in the Central Plains. The single-axle truck (Figure 6) is agile and serves as a multiple use vehicle. However, the single-axle truck is not efficient for moving grain long distances. A survey conducted by the Upper Great Plains Transportation Institute in 1984 estimated that the farm truck fleet was 80% single-axle trucks (Griffin, Wilson, & Casavant, 1984). The same survey found that the average trip to market was 12 miles. A study by the Upper Great Plains Transportation Institute in 2000 estimated that 52% of the farm fleet was single-axle trucks and 25% were tandems (Tolliver, Berwick, & Vachal, 2005). Only 9% of the fleet was 5-axle or other type of semi-truck. The problem with the single-axle truck is that it is small and the regulatory weight limit provides for a relatively small payload compared with other truck types. This severely limits any size economies for grain truck transport. The federal bridge formula[1] limits this truck because of its relatively short wheelbase. Other factors that reduce the desirability of the single-axle farm truck is that it is expensive to buy if purchased new relative to its payload. It is also expensive to operate as the fuel economy per mile is equal to or less than some larger truck types.

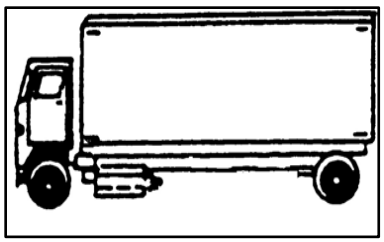

Figure 6. Single-Axle Truck

The tandem-axle truck (Figure 7) increases payload weight by adding an axle. The federal regulation for the interstate system and on most state highways limits the tandem-axle truck to 34,000 pounds on the tandem-axle. The gasoline powered tandem-axle truck served as a transition from the single-axle farm truck to the semi widely in use today. The GVW (gross vehicle weight) of the tandem-axle truck is 46,000 pounds, depending on the spread of the axles and the width of the front tires.

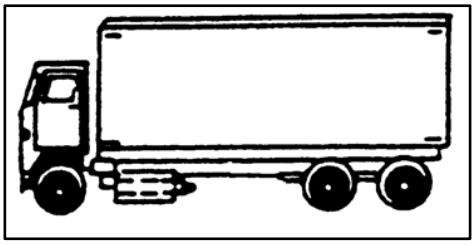

Figure 7. Tandem-Axle Truck

A third truck type represented in the survey is the tridem-axle single unit truck (Figure 8). This truck provides the agility of a single unit truck but adds an axle for increased payload. A tridem-axle with the front and rear axle centers set at a length of 8 feet can weigh 42,000 pounds compared with a tandem-axle at 34,000 pounds. This higher weight allows for larger payloads, making this truck both agile and efficient. The federal bridge formula restricts the tridem to a GVW of 56,000 pounds on the interstate.

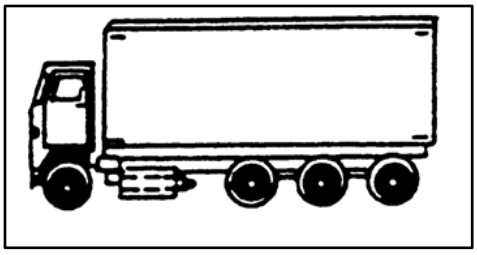

Figure 8. Tridem-Axle Truck

Differences exist among tandems and even tridem trucks. Some have gasoline powered engines that lack power. Producers have found that a pre-owned over-the-road diesel powered semi-truck could be converted economically into a box and hoist truck for farm use. These converted trucks are adequately powered, agile, and efficient for use as a farm truck. The cost of converting a pre-owned semi-tractor into a box and hoist truck is comparable to buying a new single-axle or tandem gas-powered truck.

[1] W=500 [(LN/N-1+12N+36)
W=The maximum weight in pounds that can be carried on a group of two or more axles to the nearest 500 pounds
L=The spacing in feet between the outer axles of any two or more consecutive axles
N=The number of axles being considered

The 5-axle semi is the most commonly used truck in the United States (Figure 9). The truck consists of two groups of tandem-axles and a steering axle. The grain trailer of a 5-axle semi can be made of either steel or aluminum or some combination. The trailer is usually a double hopper, which allows for gravity flow unloading out the bottom, or is equipped with a hydraulic cylinder that lifts the trailer for gravity flow out the back. The truck is allowed to operate at a GVW of 80,000 pounds on the interstate system and most state highways if the distance between the extreme axles is at least 51 feet. Even though the empty weight of a 5-axle semi is greater than that of any previously mentioned straight truck, the payload is considerably more. The payload of a 5-axle semi is usually more than 52,000 pounds, and can be higher depending on the type of tractor and trailer. Many tractor and trailer types result in the 5-axle semi configuration; however, the payloads may vary. A semi with the condo sleeper or a steel trailer adds weight to the unit and reduces payload. A tractor called a day-cab or no sleeper semi-tractor pulling an aluminum trailer is the lowest weight 5-axle semi, providing for the biggest payload. These units may weigh as little as 22,000 pounds, allowing for up to a 58,000-pound payload.

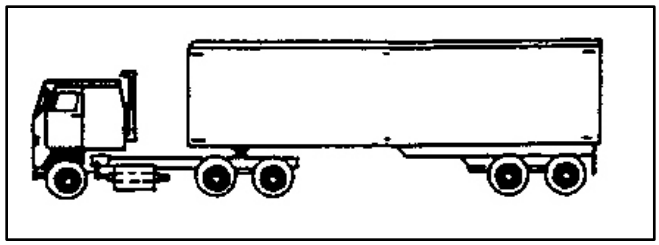

Figure 9. 5-Axle Semi Truck

The 7-axle semi or Rocky Mountain Double (Figure 10) is typically allowed to operate at a GVW of 105,500 pounds if it is at least 78 feet from the front axle to the extreme back axle. This truck is not allowed on the Interstate System at more than 80,000 pounds. The payload of the RMD depends on the unit. A day-cab tractor with aluminum trailers may allow for a 75,000-pound payload.

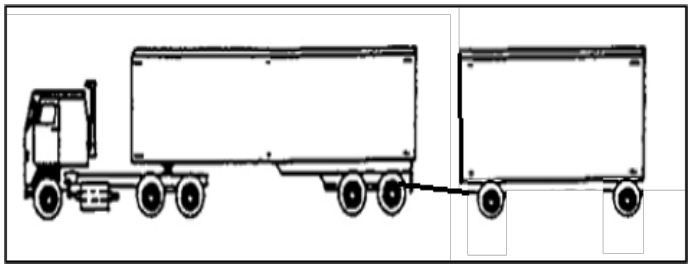

Figure 10. 7-Axle Semi or RMD (Rocky Mountain Double).

Farm Truck Ownership

The most commonly owned truck in the five-state Central Plains region is the 5-axle semi. Responses show that the 5-axle semi comprises about 56% of all trucks reported, followed by the tandem-axle truck with 18.8% and the single-axle with 12% (Table 33). The tridem-axle and 7-axle semi-trucks were the least owned among producers, representing 3.8% and 3.6%, respectively.

Table 33. Regional Total Trucks Reported

Truck Type	Number	Percentage
Single-Axle	5,340	12.0%
Tandem-Axle	8,382	18.8%
Tridem-Axle	1,705	3.8%
5-Axle Semi	24,952	56.0%
7-Axle Semi	1,608	3.6%
Other Truck Types	2,604	5.8%

Looking at the truck types by state there is some variation (Table 34). The 5-axle semi has the highest share of the truck fleet in Iowa, Illinois, Indiana, Kansas, and Nebraska with 63.5%, 49.6%, 66.3%, 45.2%, and 54.9% share, respectively. In all five states, the tandem-axle truck is the second most popular, representing 14.5% to 23.0% share of the fleet. According to respondents, the single-axle truck makes up 21.5% of the fleet in Kansas, which is third, and the tandem-axle is second at 23.0%. The 5-axle semi is

first at 45.2%. The single-axle is third-most reported with 8.1% in Iowa, 13.8% in Illinois, 10.3% in Indiana, 21.5% in Kansas, and 8.7% in Nebraska.

Table 34. Truck Type Owned, by State					
Truck Type	**Iowa**	**Illinois**	**Indiana**	**Kansas**	**Nebraska**
Single-Axle	8.1%	13.8%	10.3%	21.5%	8.7%
Tandem-Axle	14.5%	22.3%	14.7%	23.0%	19.5%
Tridem-Axle	3.6%	3.2%	2.4%	4.4%	5.8%
5-Axle Semi	63.5%	49.6%	66.3%	45.2%	54.9%
7-Axle Semi	5.4%	2.4%	4.1%	3.3%	3.0%
Other Truck Types	4.9%	8.7%	2.3%	2.7%	8.2%

Examining fleet truck count data does not tell the whole story because traffic is ultimately a key factor. Truck miles or truck use by state is a better measure of farm truck activity (Table 35). The 5-axle semi is the most heavily used truck in all states surveyed, based on truck miles reported. The 5-axle semi accounts for 71.6% of the miles in Iowa, followed by Indiana, Nebraska, Illinois, and Kansas with 66.6%, 51.6%, 49.6%, and 48.3%, respectively.

Table 35. Truck Annual Mileage Share in State, by Truck Type					
Truck Type	**Iowa**	**Illinois**	**Indiana**	**Kansas**	**Nebraska**
Single-Axle	5.0%	9.0%	12.6%	20.6%	7.1%
Tandem-Axle	10.3%	19.6%	8.0%	14.1%	13.8%
Tridem-Axle	2.0%	3.4%	1.9%	6.9%	5.0%
5-Axle Semi	71.6%	49.6%	66.6%	48.3%	51.6%
7-Axle Semi	10.4%	15.9%	5.5%	8.8%	5.7%
Other Truck Types	0.7%	2.4%	5.3%	1.3%	16.7%

The 5-axle semi is the truck of choice on larger farms (Table 36). The 5-axle semi makes up more than 70% of fleets among farms with 1,501 acres or more and 59.9% of farms with 751 acres or more. The tandem-axle truck is second most owned among the larger farms while the single-axle truck is most owned among farms with 300 acres or fewer.

Table 36. Truck Fleet Owned, by Farm Size				
	Farm Group			
	1	**2**	**3**	**4**
Truck Type	**300 Acres or Fewer**	**301 to 750 Acres**	**751 to 1,500 Acres**	**1,501 Acres or Greater**
Single-Axle	25.2%	17.4%	11.8%	4.7%
Tandem-Axle	27.2%	21.2%	20.4%	13.5%
Tridem-Axle	1.0%	8.0%	1.7%	2.8%
5-Axle Semi	38.6%	38.6%	59.9%	70.9%
7-Axle Semi	1.9%	3.3%	2.4%	5.4%
Other Truck Types	6.2%	11.5%	3.8%	2.7%

Producers reported that the 5-axle semi is used most by all farm groups except for group 1, that is farms with 300 acres or fewer (Table 37). Although single-axle trucks are most often owned by farmers with 300 acres or fewer, the 5-axle semi is most heavily used for hauling grain to market. The tandem-axle is second in use among farm groups with 751 to 1,500 acres and with 1,501 acres or more. These larger

farms reported using the tandem truck more frequently, in annual truck miles, than the tridem-axle truck. All farm sizes report that the 7-axle semi or the RMD is used more than the tridem except for the groups of farms with 301 to 750 acres.

Table 37. Annual Truck Miles, by Truck Type and Farm Group				
	Farm Group			
	1	2	3	4
Truck Type	300 Acres or Fewer	301 to 750 Acres	751 to 1,500 Acres	1,501 Acres or Greater
Single-Axle	32.1%	18.0%	6.4%	1.7%
Tandem-Axle	25.1%	15.7%	12.5%	12.4%
Tridem-Axle	0.0%	8.2%	1.5%	2.0%
5-Axle Semi	31.7%	45.0%	69.5%	60.4%
7-Axle Semi	8.5%	4.9%	5.9%	20.2%
Other Truck Types	2.6%	8.0%	4.2%	3.4%

Farm Truck Use

The 7-axle truck is reported to have the most annual miles per unit at 9,164 miles (Table 38). This level of mileage, which is 2.4 times greater than the 5-axle average annual mileage, may explain this fleet investment decision as typified by heavier use in longer hauls of a producer's grain or in likely custom hauling activity. The 7-axle is also reportedly used more for custom hauling than any of the other truck types. Tandem-axle trucks reportedly have the least average annual miles at 2,264 miles. The order of truck types and use follows the order of efficiency among truck types. The truck type with the largest payload is most appropriate for hauling loads the longest distances. Therefore, larger farms with large-payload trucks may have more flexibility to efficiently haul past the first option of delivery to maximize revenue.

Table 38. Regional Annual Truck Miles, by Truck Type and Farm Group					
Truck Type	n	Average Annual Miles	Standard Error	95% Confidence Interval	
				Lower	Upper
Single-Axle	177	2,272	343	1,596	2,948
Tandem-Axle	288	2,264	225	1,822	2,707
Tridem-Axle	64	2,622	279	2,067	3,178
5-Axle Semi	897	3,891	188	3,521	4,260
7-Axle Semi	79	9,164	5,287	0	19,672
Other Truck Types	29	3,203	840	1,528	4,877

Producers reported the use of their trucks based on hauling their own grain, custom hauling for others, and other uses. Other uses included hauling crop inputs, feed for livestock, and other needs around the farm. The 5-axle semi was reported to be used 94.8% of the time for hauling the producers' own grain. The tridem, tandem, and single-axle also were used for hauling owners' grain at 90.9%, 94.1%, and 79.9%, respectively (Table 39).

Table 39. Regional Truck Average Annual Use for Hauling Own Grain by Truck Type					
Truck Type	n	Haul Own Grain Share in Annual Use	Standard Error	95% Confidence Interval	
				Lower	Upper
Single-Axle	177	79.9%	2.9%	74.2%	85.6%
Tandem-Axle	288	94.1%	1.2%	91.8%	96.5%
Tridem-Axle	64	90.9%	2.9%	85.0%	96.7%
5-Axle Semi	897	94.8%	0.5%	93.8%	95.9%
7-Axle Semi	79	94.7%	1.9%	90.8%	98.5%
Other Truck Types	29	92.4%	4.7%	82.8%	100.0%

Producers reported the use of their trucks for custom hauling for others and, except for the 7-axle semi, this was a small percentage (Table 40). The 7-axle was reportedly used 4.5% of the time in custom hauling. Producers reported using their 5-axle semis for custom hauling 2.7% of the time.

Table 40. Regional Truck Average Annual Custom Use by Truck Type					
Truck Type	n	Custom Haul Share in Annual Use	Standard Error	95% Confidence Interval	
				Lower	Upper
Single-Axle	177	2.3%	1.0%	0.3%	4.4%
Tandem-Axle	288	1.6%	0.6%	0.5%	2.8%
Tridem-Axle	64	3.7%	2.1%	0.0%	7.9%
5-Axle Semi	897	2.7%	0.4%	1.9%	3.5%
7-Axle Semi	79	4.5%	1.8%	0.8%	8.2%
Other Truck Types	29	0.7%	0.7%	0.0%	2.1%

Respondents reported using their single-axle trucks 17.8% of the time for uses other than hauling their own grain or custom hauling. This truck is agile and handy for hauling small loads around the farm. The tandem and tridem were reported to be used for other uses 4.3% and 5.5% of the time, respectively. The 5-axle and 7-axle reported 2.5% and 0.8% for other uses. Other uses include hauling agricultural inputs such as seed and fertilizer and for other uses around the farm (Table 41).

Table 41. Regional Truck Average Annual Other Use by Truck Type					
Truck Type	n	Other Haul Share in Annual Use	Standard Error	95% Confidence Interval	
				Lower	Upper
Single-Axle	177	17.8%	2.8%	12.3%	23.3%
Tandem-Axle	288	4.3%	1.0%	2.2%	6.3%
Tridem-Axle	64	5.5%	2.2%	1.1%	9.8%
5-Axle Semi	897	2.5%	0.4%	1.8%	3.2%
7-Axle Semi	79	0.8%	0.6%	0.0%	2.1%
Other Truck Types	29	6.9%	4.7%	0.0%	16.5%

Farm Truck Fleet: Current and Future Investments

The type and number of trucks owned in 2020, as reported by respondents, is listed in Table 42. For respondents reporting ownership of common truck types, an average 1.42 single-axle and 1.47 tandem-axle trucks were included in their fleet. The average farm ownership was highest among the 5-axle semi, at an average 1.78 per farm. A relatively small number of producers, 29, reported owning other truck types, where 79 producers owned 7-axle RMDs. With the average number per farm at 1.80, this indicates that many of these producers own more than one.

Table 42. Regional Number of Trucks Owned in 2020

Truck Type	n	Number of Trucks Owned	Standard Error	95% Confidence Interval	
				Lower	Upper
Single-Axle	177	1.42	0.06	1.30	1.54
Tandem-Axle	288	1.47	0.05	1.36	1.57
Tridem-Axle	64	1.36	0.10	1.16	1.57
5-Axle Semi	897	1.78	0.07	1.64	1.92
7-Axle Semi	79	1.52	0.09	1.34	1.70
Other Truck Types	29	1.80	0.16	1.48	2.12

Farm operators estimate they will own same number of single-axle farm trucks in 2024 as they own in 2020 (Table 43). The trend is also slightly different for the tandem-axle truck. Respondents indicate that they plan to increase the number of 5-axle semi-trucks by 6%. The average number of tridem trucks will increase in 2024.

Table 43. Regional Number of Trucks to be Owned in 2024

Truck Type	n	Average Number of Trucks to Be Owned in 2024	Standard Error	95% Confidence Interval	
				Lower	Upper
Single-Axle	177	1.42	0.08	1.27	1.57
Tandem-Axle	288	1.46	0.06	1.33	1.58
Tridem-Axle	64	1.45	0.12	1.21	1.68
5-Axle Semi	897	1.89	0.08	1.73	2.05
7-Axle Semi	79	1.40	0.12	1.15	1.65
Other Truck Types	29	1.73	0.18	1.37	2.10

The number of trucks leased in the regional farm fleet is small (Table 44). Farmers lease equipment for a couple of reasons. The first is that leasing is an alternative to bank financing. Second, lease payments are tax deductible. The recent tax advantage of the Section 179 depreciation schedule allows producers to deduct the purchase price of equipment in a single year, with some limits. This provision gives ownership an advantage over leasing (Internal Revenue Service, 2015). Producers have clearly chosen ownership over leasing.

Table 44. Regional Number of Trucks Leased in 2020					
Truck Type	n	Number of Trucks Leased	Standard Error	95% Confidence Interval	
				Lower	Upper
Single-Axle	177	0.00	0.00	0.00	0.00
Tandem-Axle	288	0.00	0.00	0.00	0.00
Tridem-Axle	64	0.00	0.00	0.00	0.00
5-Axle Semi	897	0.02	0.00	0.01	0.02
7-Axle Semi	79	0.00	0.00	0.00	0.00
Other Truck Types	29	0.70	0.66	0.00	2.03

The number of trucks leased in 2020 is a very small percentage of the truck fleet and that is projected to continue into 2024 based on respondents' truck fleet investment plans. The economic conditions and tax laws provide no advantage at the present time for leasing over owning. Leasing becomes more attractive when it is difficult to finance equipment and tax laws provide a tax savings for leasing.

Table 45. Regional Number of Trucks to be Leased in 2024					
Truck Type	n	Average Number of Trucks to Be Leased in 2024	Standard Error	95% Confidence Interval	
				Lower	Upper
Single-Axle	177	0.00	0.00	0.00	0.00
Tandem-Axle	288	0.00	0.00	0.00	0.00
Tridem-Axle	64	0.00	0.00	0.00	0.00
5-Axle Semi	897	0.00	0.00	0.00	0.00
7-Axle Semi	79	0.00	0.00	0.00	0.00
Other Truck Types	29	0.30	0.63	0.00	1.56

Farm-to-Market Trips

Maturation in agriculture has been typified by farm consolidation and elevator industry rationalization as firms seek to adopt new technologies and gain efficiencies while competing with a rather homogeneous product in a global grain market. It is reasonable to expect an increase in the average distance for farm-generated grain movements because farm size and distance between elevator industries have increased over recent decades. In addition, production pattern changes and policy incentives have created opportunities for local processing investments in industries such as ethanol and biofuels. On average, major crops were hauled 14.92 miles to the first-choice delivery point and 21.53 miles to the second-choice in the Central Plains region for marketing the 2019 crop (Table 46). About one in seven miles was on unpaved roads for the first-choice delivery point. Only about one mile of the average trip is on interstates. The largest share of the trip occurs on state roads, with one in two miles on state roads. Respondents reported that 41% of their average delivery miles to each of the first- and second-choice delivery points is on local roads.

Table 46. Regional Market Road Type Miles for 2019 Grain Delivery				
Road Type	Average Miles	Standard Error	95% Confidence Interval	
			Lower	Upper
First-Choice Delivery Point				
Interstate	0.77	0.11	0.55	0.99
State 4-Lane Paved	1.10	0.11	0.87	1.32
State 2-Lane Paved	6.77	0.25	6.28	7.26
Local Paved	4.10	0.15	3.81	4.39
Local Unpaved	2.18	0.10	1.98	2.38
Total	14.92			
Second-Choice Delivery Point				
Interstate	2.17	0.34	1.50	2.85
State 4-Lane Paved	1.66	0.23	1.21	2.12
State 2-Lane Paved	10.88	0.54	9.83	11.94
Local Paved	4.93	0.28	4.38	5.47
Local Unpaved	1.89	0.15	1.58	2.19
Total	21.53			

Road Use in Farm Grain Delivery

Figure 11 provides a summary of the road distances traveled to the first-choice delivery point for wheat, corn, and soybean crops in the Central Plains region for marketing of the 2019 crop. These distances are weighted by the bushels produced for each respective crop. The second-choice delivery points are two to six miles farther than the first-choice delivery point. Respondents reported an average length of haul for wheat of 12.9 miles, of which 4.7 miles, or 36%, were on unpaved roads.

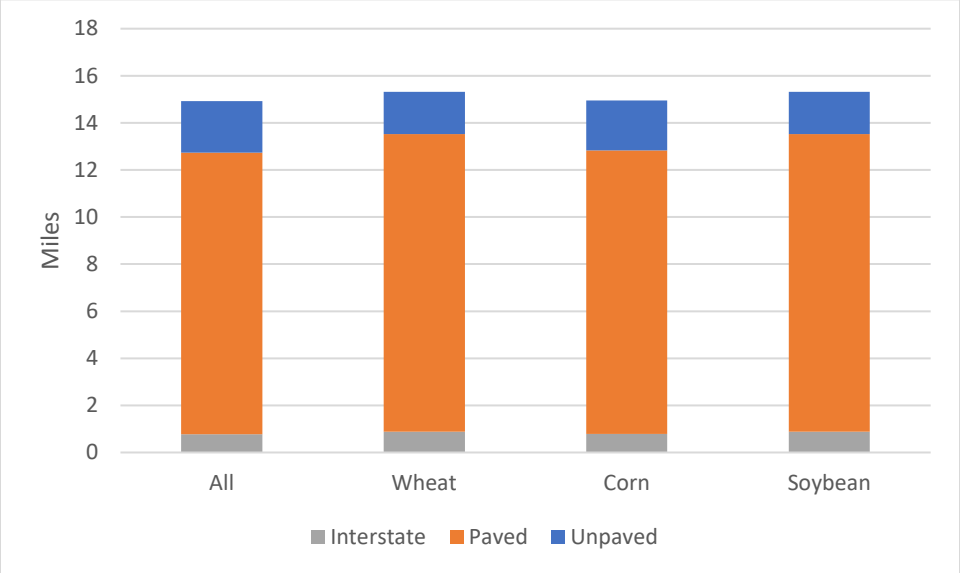

Figure 11. Regional Road Use for the First-Choice Delivery Point

Soybeans have the longest average trip to the first point delivery choice at 15.3 miles. About 12% of the distance is on unpaved roads (Table 49). The share of unpaved roads in the average corn trip of 14.9 miles is 14% and in the average wheat trip of 12.9 miles is 36.2% (Table 48, Table 47). Differences in the surface type distribution within road networks in Central Plains states in conjunction with production

volumes by state may explain these differences. Considering the road groups, interstates are lightly used in the delivery of grain to its first-choice delivery point, accounting for less than one mile in a crop delivery trip. State 2-lane and 4-lane paved roads account for 34.4%, 53.8%, and 54.9% of the average trip distance for wheat, corn, and soybeans, respectively. The remaining 63.9%, 41.9%, and 39.4% of mileage occurs on the local road systems. The distance to the second-choice delivery point is farther for each commodity. The second-choice deliveries tend to include a smaller share of travel on unpaved roads, with a similar allocation between state and local roads.

Table 47. Regional Market Road Type Miles for 2019 Wheat Delivery

Road Type	Average Miles	Standard Error	95% Confidence Interval	
			Lower	Upper
First-Choice Delivery Point				
Interstate	0.13	0.11	0.00	0.34
State 4-Lane Paved	0.78	0.28	0.24	1.33
State 2-Lane Paved	3.72	0.48	2.78	4.66
Local Paved	3.58	0.42	2.75	4.41
Local Unpaved	4.66	0.35	3.97	5.35
Total	12.87			
Second-Choice Delivery Point				
Interstate	0.85	0.85	0	2.54
State 4-Lane Paved	0	0.02	0	0.02
State 2-Lane Paved	7.03	1.36	4.32	9.75
Local Paved	3.46	0.63	2.20	4.71
Local Unpaved	3.76	0.49	2.78	4.74
Total	15.10			

Table 48. Regional Market Road Type Miles for 2019 Corn Delivery

Road Type	Average Miles	Standard Error	95% Confidence Interval	
			Lower	Upper
First-Choice Delivery Point				
Interstate	0.79	0.13	0.54	1.04
State 4-Lane Paved	1.11	0.13	0.85	1.38
State 2-Lane Paved	6.85	0.29	6.29	7.41
Local Paved	4.08	0.17	3.75	4.40
Local Unpaved	2.12	0.11	1.90	2.34
Total	14.95			
Second-Choice Delivery Point				
Interstate	1.97	0.69	1.31	2.63
State 4-Lane Paved	1.73	0.34	1.22	2.24
State 2-Lane Paved	10.20	0.26	9.09	11.30
Local Paved	4.96	0.56	4.35	5.57
Local Unpaved	1.93	0.31	1.57	2.29
Total	20.79			

Table 49. Regional Market Road Type Miles for 2019 Soybean Delivery				
Road Type	Average Miles	Standard Error	95% Confidence Interval	
			Lower	Upper
First-Choice Delivery Point				
Interstate	0.89	0.14	0.62	1.16
State 4-Lane Paved	1.17	0.15	0.89	1.46
State 2-Lane Paved	7.23	0.31	6.62	7.84
Local Paved	4.23	0.17	3.90	4.56
Local Unpaved	1.80	0.10	1.61	2.00
Total	15.32			
Second-Choice Delivery Point				
Interstate	2.03	0.40	1.25	2.82
State 4-Lane Paved	1.36	0.26	0.84	1.88
State 2-Lane Paved	10.87	0.75	9.40	12.34
Local Paved	5.27	0.34	4.59	5.94
Local Unpaved	1.37	0.13	1.10	1.63
Total	20.90			

Road Use in Farm Delivery, by State

Kansas was the only state where respondents were asked about wheat deliveries. Respondents reported an average first-choice delivery distance of 12.87 miles (Table 50). A very small proportion of this distance occurred on interstate highways or state 4-lane paved roads. The majority occurred on local road systems and state 2-lane paved road systems.

Table 50. Wheat Market Road Type Miles for 2019 Grain Delivery, Kansas				
Road Type	Average Miles	Standard Error	95% Confidence Interval	
			Lower	Upper
First-Choice Delivery Point				
Interstate	0.13	0.11	0.00	0.34
State 4-Lane Paved	0.78	0.28	0.24	1.33
State 2-Lane Paved	3.72	0.48	2.78	4.66
Local Paved	3.58	0.42	2.75	4.41
Local Unpaved	4.66	0.35	3.97	5.35
Total	12.87			

Indiana had the longest average corn trip to the first-choice delivery point at 16.7 miles, though not substantially larger than the other surveyed states. The trip distance was similar among Iowa, Illinois, Nebraska, and Kansas at 14.91, 14.22, 14.60, and 13.66 miles, respectively. Nebraska and Kansas had the largest proportion of unpaved road miles for corn shipments with 28% and 33% of miles on local gravel roads. Illinois and Indiana reported the smallest share on gravel roads with 4% and 3% of miles on local gravel roads. Regarding local road use, Iowa, Kansas, and Nebraska reported similar local road use percentages ranging from 47.4% to 49.7% of first-choice delivery miles on local roads. Indiana had the lowest reported local road use at 29.9% but reported the highest state road use at 64%. Use of interstate highways for first-choice deliveries were the highest in Illinois, Indiana, and Iowa with 10.1%, 6.2%, and

5.4% of miles via the Interstate System. Additional details about the road type in corn delivery is provided in Figure 12, Table 51, Table 52, Table 53, Table 54, and Table 55.

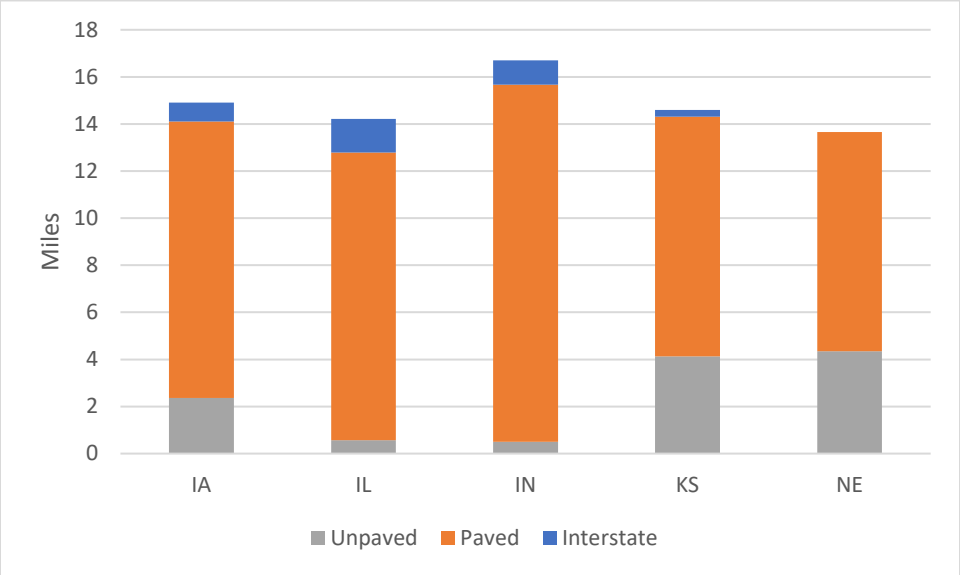

Figure 12. Road Type for Corn Delivery, by State

Table 51. Corn Market Road Type Miles for 2019 Grain Delivery, Iowa				
Road Type	**Average Miles**	**Standard Error**	**95% Confidence Interval**	
			Lower	**Upper**
First-Choice Delivery Point				
Interstate	0.80	0.28	0.25	1.35
State 4-Lane Paved	1.54	0.38	0.78	2.29
State 2-Lane Paved	5.29	0.57	4.18	6.41
Local Paved	4.92	0.49	3.95	5.89
Local Unpaved	2.36	0.20	1.96	2.76
Total	14.91			

Table 52. Corn Market Road Type Miles for 2019 Grain Delivery, Illinois				
Road Type	**Average Miles**	**Standard Error**	**95% Confidence Interval**	
			Lower	**Upper**
First-Choice Delivery Point				
Interstate	1.43	0.38	0.68	2.18
State 4-Lane Paved	0.55	0.19	0.19	0.92
State 2-Lane Paved	6.61	0.59	5.45	7.77
Local Paved	5.06	0.32	4.43	5.70
Local Unpaved	0.57	0.09	0.39	0.75
Total	14.22			

Table 53. Corn Market Road Type Miles for 2019 Grain Delivery, Indiana				
Road Type	Average Miles	Standard Error	95% Confidence Interval	
			Lower	Upper
First-Choice Delivery Point				
Interstate	1.03	0.29	0.46	1.59
State 4-Lane Paved	1.98	0.36	1.27	2.70
State 2-Lane Paved	8.70	0.65	7.42	9.99
Local Paved	4.49	0.32	3.86	5.12
Local Unpaved	0.50	0.12	0.28	0.73
Total	16.70			

Table 54. Corn Market Road Type Miles for 2019 Grain Delivery, Kansas				
Road Type	Average Miles	Standard Error	95% Confidence Interval	
			Lower	Upper
First-Choice Delivery Point				
Interstate	0.29	0.15	0.00	0.57
State 4-Lane Paved	0.52	0.23	0.06	0.98
State 2-Lane Paved	6.53	0.71	5.12	7.94
Local Paved	3.13	0.38	2.38	3.87
Local Unpaved	4.13	0.44	3.26	5.00
Total	14.60			

Table 55. Corn Market Road Type Miles for 2019 Grain Delivery, Nebraska				
Road Type	Average Miles	Standard Error	95% Confidence Interval	
			Lower	Upper
First-Choice Delivery Point				
Interstate	0.00	0.01	0.00	0.00
State 4-Lane Paved	0.67	0.20	0.27	1.06
State 2-Lane Paved	6.52	0.65	5.24	7.80
Local Paved	2.12	0.30	1.53	2.71
Local Unpaved	4.35	0.31	3.75	4.95
Total	13.66			

As with corn shipments, Indiana reported the longest first-choice trip for soybean shipments at 17.75 miles. Iowa reported the second longest first-choice trip distance of 15.64 miles. Illinois, Kansas, and Nebraska reported similar trip distances of 13.99, 13.14, and 14.83 miles, respectively. Nebraska and Kansas reported the highest proportion of gravel miles for the first-choice delivery of 26.0% and 28.2%, respectively. Illinois and Indiana reported the lowest gravel proportion at 3.5% and 2.9%, respectively. Road classification use reported for soybean shipments mirrors that of corn shipments. Local roads comprised a larger proportion of the average miles in Iowa, Kansas, and Nebraska (47.1%, 51.1%, and 44.4%) and a smaller proportion in Illinois and Indiana (38.8% and 27.8%). State highway mileages represented 44% of the total miles in Iowa, 50.1% in Illinois, 67.8% in Indiana, 47.0% in Kansas, and 55.1% in Nebraska. Illinois and Iowa had the largest proportion of average miles on interstate highways

with 11.1% and 8.9%, respectively. Additional details about the road type in soybean delivery is provided in Figure 13, Table 56, Table 57, Table 58, Table 59, and Table 60.

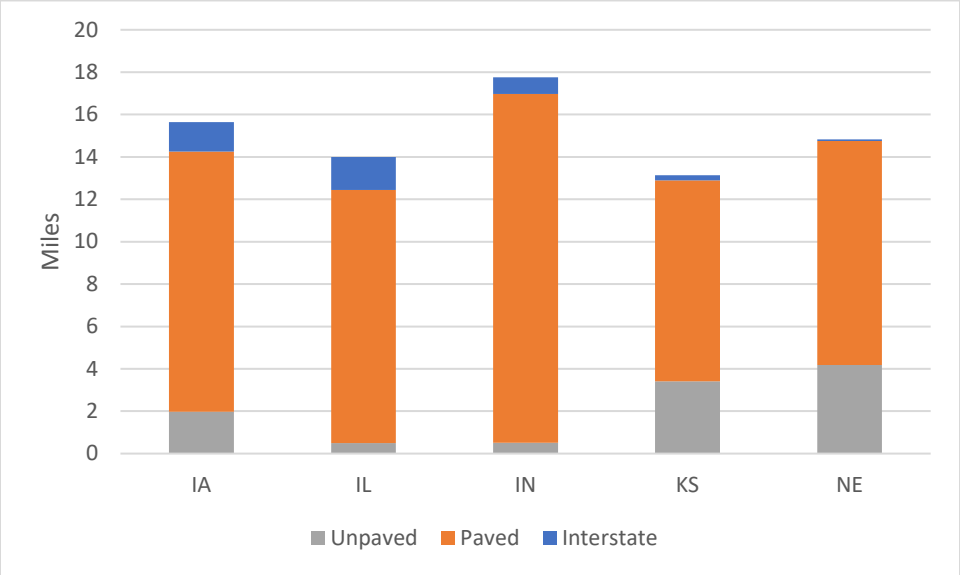

Figure 13. Road Type for Soybean Delivery, by State

Table 56. Soybean Market Road Type Miles for 2019 Grain Delivery, Iowa				
Road Type	**Average Miles**	**Standard Error**	**95% Confidence Interval**	
			Lower	**Upper**
First-Choice Delivery Point				
Interstate	1.39	0.36	0.68	2.11
State 4-Lane Paved	1.45	0.37	0.72	2.18
State 2-Lane Paved	5.43	0.64	4.18	6.68
Local Paved	5.39	0.52	4.36	6.42
Local Unpaved	1.98	0.19	1.60	2.37
Total	15.64			

Table 57. Soybean Market Road Type Miles for 2019 Grain Delivery, Illinois				
Road Type	**Average Miles**	**Standard Error**	**95% Confidence Interval**	
			Lower	**Upper**
First-Choice Delivery Point				
Interstate	1.55	0.41	0.75	2.36
State 4-Lane Paved	0.39	0.16	0.09	0.70
State 2-Lane Paved	6.62	0.63	5.38	7.87
Local Paved	4.94	0.33	4.29	5.60
Local Unpaved	0.49	0.09	0.31	0.66
Total	13.99			

Table 58. Soybean Market Road Type Miles for 2019 Grain Delivery, Indiana				
Road Type	Average Miles	Standard Error	95% Confidence Interval	
			Lower	Upper
First-Choice Delivery Point				
Interstate	0.78	0.25	0.30	1.27
State 4-Lane Paved	2.17	0.37	1.44	2.89
State 2-Lane Paved	9.87	0.66	8.57	11.17
Local Paved	4.42	0.29	3.85	4.99
Local Unpaved	0.51	0.11	0.29	0.73
Total	17.75			

Table 59. Soybean Market Road Type Miles for 2019 Grain Delivery, Kansas				
Road Type	Average Miles	Standard Error	95% Confidence Interval	
			Lower	Upper
First-Choice Delivery Point				
Interstate	0.25	0.15	0.00	0.54
State 4-Lane Paved	0.74	0.31	0.12	1.36
State 2-Lane Paved	5.43	0.65	4.15	6.71
Local Paved	3.31	0.37	2.59	4.04
Local Unpaved	3.41	0.37	2.67	4.14
Total	13.14			

Table 60. Soybean Market Road Type Miles for 2019 Grain Delivery, Nebraska				
Road Type	Average Miles	Standard Error	95% Confidence Interval	
			Lower	Upper
First-Choice Delivery Point				
Interstate	0.08	0.06	0.00	0.20
State 4-Lane Paved	0.74	0.32	0.10	1.37
State 2-Lane Paved	7.43	0.81	5.82	9.03
Local Paved	2.40	0.34	1.73	3.06
Local Unpaved	4.18	0.31	3.56	4.80
Total	14.83			

Truck Type Characteristics, Trips from Field to On-Farm Storage or Market

Farmers were asked to describe their farm truck fleet use specific to wheat, corn, and soybean movements. The high use of the 5-axle semi in farm-to-market trips in the region is first discussed in the farm truck fleet section of this report. Other commonly reported truck types were the single-axle and tandem trucks. Number of trucks in the fleet, as discussed earlier, does not provide a good metric for understanding the actual use of these trucks in grain marketing. For example, in Iowa, single-axle trucks represent 8% of the farm truck fleet but account for only 5% of the annual miles traveled for the fleet. Therefore, understanding the annual miles traveled as well as the typical truck type trip for farmers in the region is useful for planning and operational analysis. The specification here for the grain fleet is to define the individual truck types used for the three major crops during the 2019 harvest season. Key descriptors were defined as bushels per load, loaded weight, empty weight, and one-way distance to delivery point.

Regional Truck Type Characteristics

The average trip distance and loaded weight by truck type in the Central Plains region is shown in Table 61. The 5-axle semi, which represents 50% or more of the share of annual mileage in the Central Plains region, has the longest average trip distance of 22.23 miles. The 7-axle semi has the next longest at 19.57 miles. The truck configuration with the shortest average trip distance is the single-axle configuration with an average trip distance of eight miles. The average loaded weight increases across all truck configurations. The fleet average for a single-axle truck is 26,029 pounds. The reported average loaded weight for tandem- and tridem-axle trucks is similar at 47,445 and 58,109 pounds, respectively. Additionally, the reported weight of 5-axle and 7-axle configurations is similar as well with 80,668 and 82,851 pounds, respectively. Depending on the jurisdiction where these configurations are operated, gross vehicle weight restrictions may be more limiting than the bridge formula, which would result in lower reported weights in these configurations.

Table 61. Farm Truck Fleet Distance and Loaded Weights

Truck Type	Average Distance	Standard Error	Average Loaded Weight	Standard Error
Single-Axle	8.00	0.82	26,029	1,578.51
Tandem-Axle	11.85	0.64	47,445	1,641.49
Tridem-Axle	13.36	1.68	58,109	3,884.26
5-Axle Semi	22.23	5.77	80,668	468.27
7-Axle Semi	19.57	1.61	82,851	1,366.73

Variations in average loaded weight by truck type and commodity are shown in Figure 14 and Table 62. Single-unit trucks, with the exception of the single-axle configuration, have higher average loaded weights for corn than soybean or wheat shipments. Combination truck configurations were similar across commodity types.

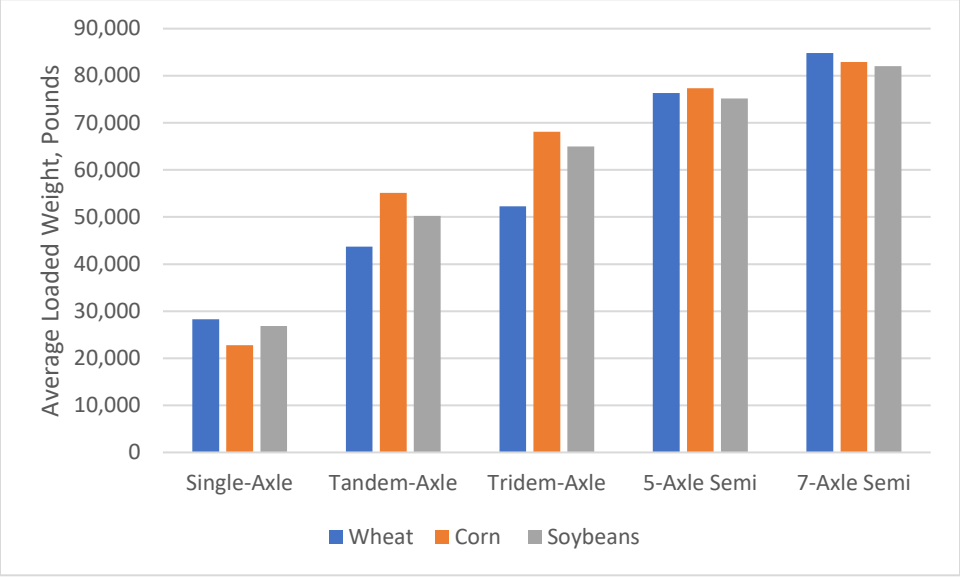

Figure 14. Average Loaded Weight by Truck Type and Commodity

Table 62. Average Loaded Weight, by Commodity									
	Wheat			Corn			Soybeans		
Truck Type	N	Mean	Standard Error	N	Mean	Standard Error	N	Mean	Standard Error
Single-Axle	23	28,284	4,525	78	22,799	2,291	79	26,867	2,750
Tandem-Axle	37	43,712	4,559	209	55,128	1,969	200	50,200	1,944
Tridem-Axle	9	52,279	6,213	35	68,076	2,414	31	64,953	2,425
5-Axle Semi	117	76,300	1,779	790	77,364	568	728	75,162	694
7-Axle Semi	5	84,800	1,538	58	82,913	883	56	82,047	831

Producers were asked to report the average tare or empty weight of their trucks by configuration. The average single-axle empty weight ranged from 8,236 to 10,269 pounds. Tandem-axle trucks had smaller variation in empty weights from 17,528 to 18,789. Tridem-axle trucks had greater variation in empty weights, which is likely due to the differences in trucks under this configuration category. Some tridem-axle trucks are converted tandem-axle vehicles with a drop axle added while others may be converted semi tractors. The 5-axle and 7-axle truck empty weights would also vary depending on the trailer type and construction material.

Table 63. Average Empty Weight, by Commodity									
	Wheat			Corn			Soybeans		
Truck Type	N	Mean	Standard Error	N	Mean	Standard Error	N	Mean	Standard Error
Single-Axle	23	10,269	1,544	79	8,236	865	79	9,622	992
Tandem-Axle	37	17,528	1,403	200	18,789	678	200	17,662	681
Tridem-Axle	10	18,063	1,446	49	15,151	1,630	45	19,907	1,148
5-Axle Semi	128	25,515	845	851	24,623	249	802	24,449	240
7-Axle Semi	5	28,258	606	56	27,110	365	55	26,912	367

In addition to loaded and empty truck weights, producers were asked about the payload capacity in bushels for the three commodities included in this study (Table 64). Bushel payloads are consistent across commodities except for corn payload in the single-axle configuration and wheat in the 7-axle semi configuration. The 7-axle configuration may be due to GVW restrictions on the Kansas highway system (Kansas Highway Patrol, 2018).

Table 64. Truck Type Average Bushels per Load, by Commodity									
	Wheat			Corn			Soybeans		
Truck Type	N	Mean	Standard Error	N	Mean	Standard Error	N	Mean	Standard Error
Single-Axle	23	388	26	78	437	27	79	329	33
Tandem-Axle	37	651	26	209	617	43	200	633	16
Tridem-Axle	10	659	31	49	628	55	45	632	34
5-Axle Semi	128	931	7	851	922	76	803	1,034	19
7-Axle Semi	5	980	22	58	1,202	189	58	1,287	200

With regard to trip distance, the 5-axle semi had the longest reported average trip distance for all commodities with the exception of 7-axle semi shipments of soybeans (Figure 15). For single-axle trucks, the longest reported average trip distance was 8.41 miles for wheat and 5.51 miles for corn shipments. Average wheat distances for the tandem-axle configuration was the shortest at 8.56 miles and soybeans the longest at 10.63 miles. For the 5-axle semi, wheat shipments had the shortest average trip distance of 14.73 miles, and corn had the longest with 23.83 miles. One notable exception in the 7-axle configuration average trip distance was wheat shipments, which had a lower reported average trip distance than corn or soybean trips. As described above, since only Kansas reported wheat shipments in the survey, existing truck size and weight restrictions may limit the potential gains from utilizing this truck configuration (Table 65).

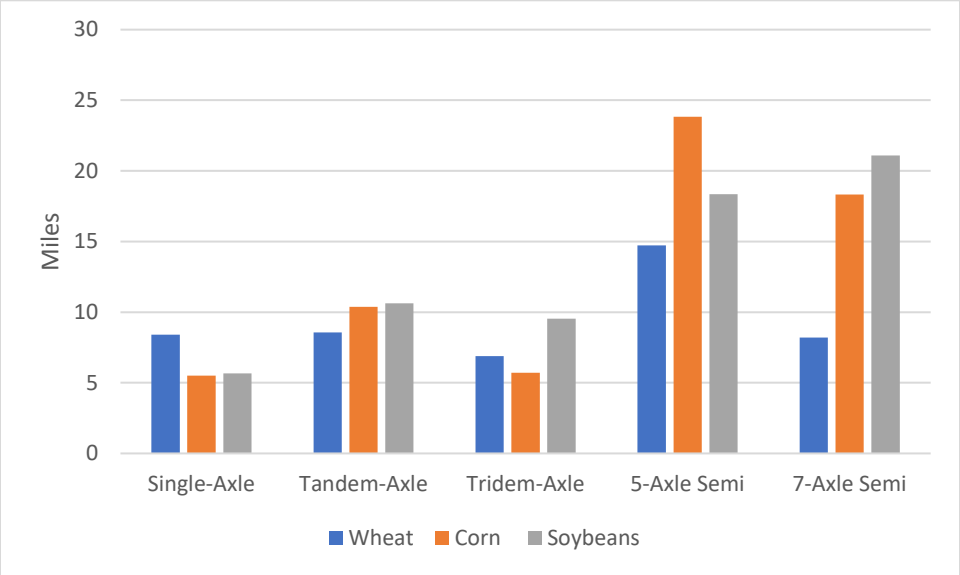

Figure 15. Average Trip Distance, by Truck Type and Commodity

Table 65. Truck Type Average Trip Distance, by Commodity

	Wheat			Corn			Soybeans		
Truck Type	**N**	**Mean**	**Standard Error**	**N**	**Mean**	**Standard Error**	**N**	**Mean**	**Standard Error**
Single-Axle	23	8.41	1.52	78	5.51	0.91	79	5.67	0.81
Tandem-Axle	37	8.56	1.50	209	10.38	0.80	200	10.63	0.83
Tridem-Axle	10	6.88	0.87	49	5.71	1.14	45	9.53	1.18
5-Axle Semi	128	14.73	1.10	850	23.83	6.28	800	18.36	0.54
7-Axle Semi	5	8.20	0.62	58	18.32	1.66	58	21.10	1.61

Truck Type Characteristics, by Farm and State Strata

It is important to consider the farm group and state strata for the truck trip descriptors to identify differences that should be considered as a way to calibrate application of the survey findings in case studies or other sub-region analyses. To simplify analysis and presentation of differences, only the 5-axle semi-truck farm trip load weights and trip distances were analyzed with regard to the size and geographic strata. In addition, due to limited observations for corn and soybean shipments, Montana farm truck trips are omitted in this analysis to minimize potential sample size bias in the means tests.

Within the farm group strata, the average loaded weight of wheat shipments using a 5-axle semi-truck configuration ranged from 80,843 to 82,424, and there was a positive relationship between farm size and average loaded weight (Table 66). For 5-axle semi-trucks, the average trip distance for wheat shipments ranged from seven miles in farm group 1 to 16.71 miles in farm group 4 (Table 67). Farm groups 2 and 3 reported similar trip distances for wheat shipments at 13.41 and 11.73 miles, respectively.

Table 66. Wheat Trip 5-Axle Loaded Weight, by Farm Group

Farm Group	N	Mean	Standard Error	95% Confidence Limit	
				Lower	Upper
300 acres or fewer	5	80,043	994	78,224	83,776
301 to 750 acres	21	80,940	967	78,923	82,958
751 to 1,500 acres	29	81,374	1,354	78,601	84,148
1,501 acres or more	62	82,424	717	80,990	83,858

Table 67. Wheat Trip 5-Axle Average Distance, by Farm Group

Farm Group	N	Mean	Standard Error	95% Confidence Limit	
				Lower	Upper
300 acres or fewer	7	7.00	2.19	1.63	12.37
301 to 750 acres	23	13.41	1.61	10.06	16.75
751 to 1,500 acres	32	11.73	1.68	8.29	15.18
1,501 acres or more	66	16.71	2.30	12.11	21.32

In Kansas, the average 5-axle loaded weight was 81,837 pounds (Table 68) and the average 5-axle trip distance was 14.34 miles. The remaining states were not surveyed with respect to wheat transportation.

Table 68. Wheat Trip 5-Axle Loaded Weight, by State

State	N	Mean	Standard Error	95% Confidence Limit	
				Lower	Upper
Iowa	0				
Illinois	0				
Indiana	0				
Kansas	117	81,837	536	80,776	82,897
Nebraska	0				

Table 69. Wheat Trip 5-Axle Distance, by State

State	N	Mean	Standard Error	95% Confidence Limit	
				Lower	Upper
Iowa	0				
Illinois	0				
Indiana	0				
Kansas	128	14.34	1.32	11.73	16.94
Nebraska	0				

Within the farm group strata, the average loaded weight of corn shipments using a 5-axle semi-truck configuration ranged from 79,820 to 80,869 pounds (Table 70). The average trip distance in this configuration ranged from 14.19 miles for farm group 2 to 29.79 miles for farm group 4. Except for farm group 2, there is a positive relationship between average corn trip distance and farm size (Table 71).

Table 70. Corn Trip 5-Axle Loaded Weight, by Farm Group

Farm Group	N	Mean	Standard Error	95% Confidence Limit	
				Lower	Upper
300 acres or fewer	909	80,059	1,820	76,274	83,845
301 to 750 acres	360	79,820	558	78,716	80,925
751 to 1,500 acres	369	79,845	421	79,013	80,676
1,501 acres or more	549	80,869	266	80,345	81,393

Table 71. Corn Trip 5-Axle Average Distance, by Farm Group

Farm Group	N	Mean	Standard Error	95% Confidence Limit	
				Lower	Upper
300 acres or fewer	909	15.55	3.61	8.99	23.83
301 to 750 acres	360	14.19	0.95	12.32	16.06
751 to 1,500 acres	369	16.07	0.90	14.31	17.84
1,501 acres or more	549	29.79	12.80	4.63	54.94

Within the state strata, the average loaded weight of corn shipments using a 5-axle semi-truck configuration ranged from 78,308 pounds in Illinois to 82,649 pounds in Nebraska (Table 72). The average trip distance in this configuration ranged from 14.37 miles in Kansas to 40.79 miles in Indiana (Table 73).

Table 72. Corn Trip 5-Axle Loaded Weight, by State

State	N	Mean	Standard Error	95% Confidence Limit	
				Lower	Upper
Iowa	137	80,948	298	80,359	81,538
Illinois	173	78,308	324	77,667	78,949
Indiana	211	80,223	461	79,314	81,132
Kansas	123	80,204	619	78,978	81,431
Nebraska	146	82,649	560	81,541	83,758

Table 73. Corn Trip 5-Axle Distance, by State

State	N	Mean	Standard Error	95% Confidence Limit	
				Lower	Upper
Iowa	147	16.59	1.11	14.39	18.79
Illinois	190	17.13	1.13	14.90	19.35
Indiana	231	40.79	23.60	0.00	87.29
Kansas	131	14.37	1.33	11.74	17.01
Nebraska	151	14.76	0.88	13.03	16.50

Within the farm group strata, the average loaded weight of soybean shipments using a 5-axle semi-truck configuration ranged from 79,040 to 82,380 pounds (Table 74). The average trip distance in this configuration ranged from 12.54 miles for farm group 1 to 18.29 miles for farm group 4, showing a positive relationship between average soybean trip distance and farm size (Table 75).

Table 74. Soybean Trip 5-Axle Loaded Weight, by Farm Group

Farm Group	N	Mean	Standard Error	95% Confidence Limit	
				Lower	Upper
300 acres or fewer	909	79,822	992	77,738	81,906
301 to 750 acres	360	79,040	592	77,867	80,213
751 to 1,500 acres	369	82,380	3,289	75,896	88,865
1,501 acres or more	549	80,432	270	79,901	80,963

Table 75. Soybean Trip 5-Axle Average Distance, by Farm Group

Farm Group	N	Mean	Standard Error	95% Confidence Limit	
				Lower	Upper
300 acres or fewer	909	12.54	2.64	7.11	17.96
301 to 750 acres	360	14.65	0.93	12.82	16.48
751 to 1,500 acres	369	18.02	1.02	16.02	20.02
1,501 acres or more	549	18.29	0.83	16.66	19.91

Within the state strata, the average loaded weight of soybean shipments using a 5-axle semi-truck configuration ranged from 78,240 pounds in Illinois to 83,299 pounds in Indiana (Table 76). The average trip distance in this configuration ranged from 15.86 miles in Kansas to 19.14 miles in Indiana (Table 77).

Table 76. Soybean Trip 5-Axle Loaded Weight, by State

State	N	Mean	Standard Error	95% Confidence Limit	
				Lower	Upper
Iowa	127	80,477	313	79,858	81,096
Illinois	163	78,240	321	77,605	78,874
Indiana	224	83,299	3,152	77,087	89,511
Kansas	98	79,129	698	77,744	80,514
Nebraska	116	80,895	733	79,444	82,346

Table 77. Soybean Trip 5-Axle Distance, by State

State	N	Mean	Standard Error	95% Confidence Limit	
				Lower	Upper
Iowa	135	17.63	1.28	15.09	20.17
Illinois	184	15.86	1.08	13.74	17.98
Indiana	246	19.14	0.88	17.42	20.86
Kansas	109	15.65	1.83	12.01	19.28
Nebraska	126	17.07	1.40	14.29	19.84

SUMMARY

The objective of this study was to provide information about farm truck inventory and grain marketing patterns in the Central Plains. There is no other source for this information, and this study should be unique and complementary to other farm-to-market information and national commodity flow publications. Farmers may use this information for investment and productivity assessments. Local and regional planners and policy makers can use the information in calibrating travel demand and freight flow models for investment and asset management choices.

The survey of farm operators in this Central Plains region was conducted to gather information about transportation of crops, the inventory of the farmer-owned truck fleet, and on-farm storage capacity. Survey design and implementation was a collaboration of the Upper Great Plains Transportation Institute at North Dakota State University and the National Agricultural Statistics Service of the U.S. Department of Agriculture.

Average on-farm storage capacity for the three commodities ranged from 41,130 bushels to 110,838 bushels among the states surveyed. The storage capacity density, measured by farm as bushels produced per harvested acre (including corn, soybeans, and wheat), was inversely related to the farm size. Storage capacity volume, however, is substantially greater for the larger farms. Average on-farm storage was 196,272 bushels of corn, soybean, and wheat capacity for farms of 1,501 acres or more. The smallest farms averaged only 50,297 bushels of capacity for the three commodities.

The on-farm storage is concentrated on the larger farms in terms of average capacity. In terms of flexibility, however, the smaller farms appear to be more able to adapt when increased on-farm storage is needed. For the smallest farms, the ratio of storage capacity bushels per harvested acre was 339, where the largest farms have an average of 75 bushels of on-farm storage for each harvested acre. The difference in the storage density may be related to expectations for yield among commodities.

On-farm storage provides an easily accessible option for delaying grain delivery beyond the harvest season. Farmers were also asked to identify the share of the crop delivered directly to market from the field at harvest time. Responses, weighted by bushels produced, showed 91% of wheat 95% CI [89%, 92%] and 61% of corn 95% CI [59%, 63%] was delivered directly to market. The average share of soybeans delivered directly to market from the field was 72%, 95% CI [70%, 73%].

The most owned and operated truck in the five-state area reported by survey respondents is the 5-axle semi. The 5-axle semi accounted for 56% of all trucks reported followed by the tandem-axle truck with more than 19% and then the single-axle with 12%. The tridem and 7-axle semi were least owned among producers, representing 3.8% and 3.6%, respectively.

In the current survey, producers reported that the 5-axle semi is used most by all farm groups. Even though more single-axle trucks are owned by farmers with 300 acres or less, the 5-axle semi is used more for hauling to market. The tandem gets second most use by all farm groups.

The 5-axle semi was reported to be used 95% of the time by producers hauling their own grain, followed by the tridem, tandem, and single-axle with 91%, 94%, and 80%, respectively.

Farmers estimate that single-axle and tandem-axle truck ownership will decline in the future while 5-axle and 7-axle semi ownership will increase. Ownership of tridem-axle trucks is expected to remain constant.

It is reasonable to expect an increase in the average distance for farm-generated grain movements because farm size and distance between elevators has increased over time. In addition, production pattern changes and policy incentives have created opportunities for local processing investments in industries such as ethanol and biofuels. On average, the major crops were hauled 14.92 miles to the first-choice delivery point and 21.53 miles to the second choice in the Central Plains region in marketing the 2019 crop. About 14% of miles were on unpaved roads for the first-choice point. Less than one mile of the average trip is attributed to interstates. The largest share of the trip is on state roads, with one in two miles on state roads. Respondents reported that 42% of their average delivery miles to each of the first- and second-choice points is on local roads.

In comparing the trip distances to the Tolliver study, note that even though there has been rationalization in the elevator industry, the number of large shuttle elevators has more than doubled since 2005. This provides more options to farmers and perhaps shorter distance to the first or second delivery choice for some than was available in 2005 when hauling to shuttle facilities.

The average wheat trip to the first-choice delivery point was 12.87 miles. Gravel road miles accounted for 36% of the total mileage for wheat deliveries to the first-choice destination. The average wheat trip to the second-choice delivery point was 15.10 miles with a smaller proportion occurring on gravel roads (24%).

Indiana had the longest average corn trip to the first-choice delivery point at 16.7 miles, though not substantially larger than the other surveyed states. The trip distance was similar among Iowa, Illinois, Nebraska, and Kansas at 14.91, 14.22, 14.60, and 13.66 miles, respectively. Nebraska and Kansas had the largest proportion of unpaved road miles for corn shipments with 28% and 33% of miles on local gravel roads. Illinois and Indiana reported the smallest share on gravel roads with 4% and 3% of miles on local gravel roads. Regarding local road use, Iowa, Kansas, and Nebraska reported similar local road use percentages ranging from 47.4% to 49.7% of first-choice delivery miles on local roads. Indiana had the lowest reported local road use at 29.9% but reported the highest state road use at 64%. Use of interstate highways for first-choice deliveries was highest in Illinois, Indiana, and Iowa with 10.1%, 6.2%, and 5.4% of miles via the Interstate System.

As with corn shipments, Indiana reported the longest first-choice trip for soybean shipments at 17.75 miles. Iowa reported the second longest first-choice trip distance of 15.64 miles. Illinois, Kansas, and Nebraska reported similar trip distances of 13.99, 13.14, and 14.83 miles, respectively. Nebraska and Kansas reported the highest proportion of gravel miles for first-choice delivery of 26.0% and 28.2%, respectively. Illinois and Indiana reported the lowest gravel proportion at 3.5% and 2.9%, respectively. Road classification use reported for soybean shipments mirrors that of corn shipments. Local roads comprised a larger proportion of the average miles in Iowa, Kansas, and Nebraska (47.1%, 51.1%, and 44.4%) and a smaller proportion in Illinois and Indiana (38.8% and 27.8%). State highway mileages represented 44% of the total miles in Iowa, 50.1% in Illinois, 67.8% in Indiana, 47.0% in Kansas, and 55.1% in Nebraska. Illinois and Iowa had the largest proportion of average miles on interstate highways with 11.1% and 8.9%, respectively.

The average loaded weight shows the expected trend across commodities; larger trucks are associated with heavier loaded weights. The average loaded weight for a single-axle truck ranges from 22,799 pounds for corn to 28,284 pounds for wheat. The fleet average for single-axle trucks is 26,029 pounds. The 5-axle semi, which is attributed with more than half of the annual farm truck miles, ranges in loaded weight from 75,162 pounds for soybeans to 77,364 pounds for corn. Overall, the average loaded weight for a 5-axle semi is 80,668 pounds. The average loaded weight for the tandem truck is 47,445 pounds.

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