Agribusiness and Applied Economics Report No. 799 **September 2020**

Estimating Rail and Truck Carrier Operation Cost for Transporting North Dakota Grain Freight, 2015-2017: Estimate for Input-Output Analysis

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ACKNOWLEDGMENTS

The authors wish to extend their appreciation to Frayne Olson for his help with conceptualization of grain handling and transportation especially with local shipments.

The authors wish to extend special recognition to David Roberts and Siew Lim in the Department of Agribusiness and Applied Economics at NDSU for contributions reviewing and editing the report. Their efforts improved the quality of the report.

Thanks are also extended to Edie Nelson, Department of Agribusiness and Applied Economics, for her help with document preparation and publishing.

The authors assume responsibility for any errors of omission, logic, or otherwise. Any opinions, findings, and conclusions expressed in this publication are those of the authors and do not necessarily reflect the view of the Department of Agribusiness and Applied Economics, North Dakota State University, or the study sponsors.

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EXECUTIVE SUMMARY

This project was part of a much larger study evaluating the economic contribution of North Dakota agriculture to the state. Specifically, the larger study is first-ever comprehensive measure of the agricultural industry's role in the North Dakota economy. The contribution of all sectors that make up the agriculture industry including crop and livestock production, grain handling and marketing, transportation, processing, farm input and machinery manufacturing are included in the comprehensive study. Previous studies focused on major crops like wheat and soybeans while others looked at disparate parts of the agriculture industry for example processing. This study estimates transportation carrier cost (operational) for hauling major North Dakota grain to local, domestics, and ports for export. Results in this study and that of other sectors mentioned above will be used in an input-output analysis to determine the contribution of agriculture to North Dakota. Transportation carriers buy inputs hence make expenditures locally in order to transport freight including hauling North Dakota grain. This study is an attempt to capture the operational cost associated with grain transport.

Transportation adds value to agriculture by moving commodities from production areas to consumption centers domestically and ports for exports. Transportation shippers rely on three principal modes to haul commodities to market including rail, trucks (highways), and barge (waterways). Due to the lack of direct access to navigable waterways, grain producers and shippers in North Dakota dependent heavily on rail transportation for shipment to longer distance export ports (e.g. Pacific Northwest) and domestic markets (e.g. Minneapolis-St Paul). Transportation carriers purchase inputs and related resources locally associated with hauling commodities. This study is concerned with estimating operational cost of transportation associated with the shipment of 11 main grains produced in North Dakota. The Uniform Rail Costing System (URCS) available from the Surface Transportation Board (STB) facilitates estimation of railroad operational cost associated with grain shipments. For trucking cost, the amount paid for grain shipping was used to approximate trucking operational costs following Dybing (2012).

Results show that on average from 2015 to 2017, transportation carriers spent about $723 million on operational cost to haul principal grain commodities produced in North Dakota. Truck carriers and railroads annually spent $600 million (83%) and $124 million (17%), respectively, on operational cost to haul North Dakota grain to local and out-of-state destinations on average over the three-year period. Amongst all 11 commodities, transportation cost associated with the haulage of corn represents about 46% of overall cost of transporting commodities on average between 2015 and 2017. Three principal commodities including corn (46%), spring wheat (14%), and soybean (12%) represent close to 73% of total transportation cost on average.

In terms of counties, Richland ($48.2 million) and Cass ($47.5 million) counties dominate transportation carrier operational cost on average from 2015 to 2017. Both counties combined account for approximately 14% of transportation carrier operational cost. The county with the third highest operational cost, Stutsman ($31 million), has average transportation carrier

operational cost $17 million lower than Cass county. The five counties including Richland (7%), Cass (7%), Stutsman (4.3%), Barnes (4.2%), and LaMoure (3.8%) makeup more than a quarter (26%) of operational cost for rail and truck carriers on average from 2015 to 2017.

Estimating Rail and Truck Carrier Operation Cost for Transporting North Dakota Grain Freight, 2015-2017

Elvis Ndembe, Dean A. Bangsund, and Nancy M. Hodur[1]

INTRODUCTION

This report is part of a much larger study evaluating the economic contribution of agriculture to the state of North Dakota. Specifically, the larger study is first-ever comprehensive measure of the agricultural industry's role in the North Dakota economy. The contribution of all sub-sectors that make up the agriculture industry including crop and livestock production, grain handling and marketing, transportation, processing, and farm input and machinery manufacturing are included in the comprehensive study. Previous studies focused on individual major crops like wheat and soybeans while others looked at disparate parts of the agriculture industry for example processing of pulse crops. The main objective of this study is to estimate rail and truck carrier operational cost for hauling major North Dakota grain to local, domestics, and ports for export consistent with previous contribution studies. Cost estimates in this study and that of other sectors mentioned above facilitate estimation of an input-output analysis to determine the contribution of agriculture to North Dakota. Trucking and rail carriers incur cost hiring the necessary inputs to operate and transport freight including hauling North Dakota grain. This study is an attempt to capture the operational cost associated with grain transport.

BACKGROUND

The United States General Accountability Office (GAO 2003) has indicated that the economic vitality of the U.S. is largely dependent on the security, availability and dependability of its transportation system[2]. Specifically, an effective transportation system adds value to agriculture by moving agricultural commodities (e.g. bulk grain) from rural production regions to domestic centers for consumption or further processing and to ports for export. Grain elevators improve the effectiveness of the transportation system to transport commodities by helping to gather grains from different origins (on-farm) to fewer locations and the subsequent haulage to domestic destinations and ports for export.

Agricultural shippers depend on truck, rail, and barge (waterways) to haul grains. However, barge transportation is only directly accessible to shippers in close proximity to navigable waterways (e.g. Mississippi, Columbia and Snake). Hence, grain shippers like those in North

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[1] Ndembe and Bangsund are Research Scientists and Hodur is Director, Center for Social Research, North Dakota State University.

[2] Government Accountability Office (GAO). Freight Railroads: Industry Health has Improved but Concerns about Competition and Capacity Should be Addressed, October, GAO-07-94, Pg 14. 2006.

Dakota rely on truck and rail services. Rail has a cost advantage over truck in moving bulk commodities especially for longer distances, so rail is the preferred means to ship grains longer distances especially out-of-state destinations (e.g. Pacific Northwest), whereas shorter local North Dakota shipments are most cost effectively made by truck particularly from on-farm origins to local destinations (e.g. ethanol plants, feedlots). In addition to peculiar transportation characteristics, North Dakota produces large volumes of bulk grain making transportation even more important to agriculture in the state. In fact, North Dakota is the top U.S. producer of several commodities including spring and durum wheat, sunflower seed, canola, flaxseed, dried edible beans and peas according to the USDA National Agricultural Statistical Service (USDA-NASS).

DATA

Crop production volumes were obtained from the North Dakota Land Model, while information on grain flow, including proportion for in state and out-of-state destination markets by mode (truck and rail), collected by the North Dakota Public Service Commission (NDPSC) was obtained from the Upper Great Plains Transportation Institute (UGPTI). The Surface Transportation Board's (STB) Uniform Rail Costing System (URCS) facilitated an estimate of transportation cost incurred by railroads in moving grain. Truck rates (price paid by shippers) to ship grain by truck was obtained from the United States Department of Agriculture (USDA), Grain Truck and Ocean Rate Advisory (GTOR). Grain elevator location information was available from the North Dakota Public Service Commission grain elevator listing. Highway and rail network geographic information data were available from the U.S Department of Transportation's, Bureau of Transportation Statistic's National Transportation Atlas Database (NTAD).

Grain Production

North Dakota produces a large volume of agricultural grains, most of which are shipped to out-of-state destinations. Despite the availability of annual grain flow data for grain originating in North Dakota to major destinations from the NDPSC, this study assigned grain flow based on grain production. Grains flow from on-farm locations to the final destination in two main ways. One way is for producers to haul grain on-farm directly to final destinations (such as processor, feedlot, and port). The second means is for producers to haul grain from on-farm locations to local grain elevators and from local grain elevators will subsequently ship to final destinations.

The choice of grain production volume to assign grain flow is reasonable because it facilitates adjustments for seed use, direct shipments from on-farm locations to final destinations and other related changes that might affect volume and flow. Using secondary grain flow data, which represents movements originating from elevators might underestimate or overestimate the volume of grain due to storage and carryover from one growing season to the next. For example, based on the 2016-2017, North Dakota elevator marketing report published by UGPTI, grain

elevator storage was about 400,372 thousand bu., however, close to 956,294 thousand bu. of grain shipped to end users and only 80,883 thousand was transshipped to North Dakota grain elevators. These changes and effect of carryover would diminish if the period of analysis were longer. However, this study uses a three-year period (2015-2017) which is relatively short, lending further support for the use of production volume.

Table 1 shows total tonnage of grain produced in North Dakota from 2015 to 2017 based on North Dakota Land Model. Corn was the largest crop in terms of average tonnage of grain produced while lentil was the least produced. North Dakota produced close to 12 million tons of corn and just above 130 thousand tons of lentil, average from 2015 through 2017. Barley had the largest decline (-61%) in production while dry edible beans (50%) had the largest increase in production on average for the three-year period. Overall, 7 out of 11 commodities declined in production from 2015 to 2017. Since this study uses production volume to assign grain flow by destination and mode, changes in annual production have a direct effect on rail and truck carrier operational cost. Appendix A shows average production (tables and maps) by commodity for the three-year period from 2015 to 2017 for each commodity by county.

Table 1: Average Grain Production and Percentage Change, North Dakota 2015-2017

Commodity	Average Tons (000)	Change Production (%)
Corn	11,638	32
Spring Wheat*	8,559	-36
Soybean	6,774	29
Durum Wheat	1,317	-26
Canola	1,296	-6
Barley	1,064	-61
Dry Edible Peas	520	-26
Sunflower Seed	489	-40
Dry Edible Beans	452	50
Flax	181	-65
Lentil	133	2
Data Source: North Dakota Land Model		

**Spring wheat includes hard red spring and winter wheat*

Grain Flow

Historically, most grain produced in North Dakota ships to out-of-state markets. However, the development and growth of the ethanol and biofuel industry has affected the relative amount of grain (e.g. corn and soybean) flowing locally while increase in export demand (e.g. China) has also affected the relative volume of commodities moving to the Pacific Northwest (PNW). Table 2 shows the proportion of commodities shipped by destination market based on the summary published annually by the Upper Great Plains Transportation Institute (UGPTI). The publication by UGPTI relies on grain movement database from the NDPSC. All licensed grain elevators in North Dakota are required to provide information on grain shipments to the NDPSC for regulatory purposes.

Table 2: Average Percentage by Destination for North Dakota Grain, 2015-2017						
	Destination (%)					
Commodity	Duluth-Superior	Midland-Southwest	Minnesota-Wisconsin	North Dakota	Other	Pacific Northwest
Soybean	0	3	7	6	14	70
Corn	0	3	5	20	19	53
Spring Wheat	3	9	18	8	29	33
Dry Edible Peas	0	37	7	11	27	18
Lentil	8	8	8	60	8	8
Canola	2	1	27	43	22	6
Durum Wheat	23	18	24	17	13	4
Dry Edible Beans	0	36	13	7	42	2
Flax	0	0	8	64	27	1
Sunflower Seed	0	0	12	60	27	1
Barley	1	4	55	29	11	0
Source: Upper Great Plains Transportation Institute (UGPTI)						

A general observation in Table 2 is that between 2015 and 2017, on average, the largest proportion of major crops including soybean, corn, spring wheat, and barley are shipped to out of state destinations while minor crops like flax, sunflower, lentil, and canola have North Dakota as the primary final destination. Some other minor crops like dry edible peas and dry edible beans respectively have Midland-Southwest (Gulf) and "Other" (unspecified out-of-state) regions as major final destinations. Soybean (70%) shipment to Pacific Northwest (PNW) represents the highest proportion amongst the major crops while among the minor crops; flax (64%) shipment to North Dakota destinations is the largest. Overall, averaged from 2015 to 2017, 70 percent of North Dakota grains are destined for out-of-state destinations with the remaining (30%) destined for North Dakota.

Grain Transportation

The dominance of out-of-state markets (70%) and longer distances of some commodity destination markets (e.g. PNW) points to likely dominance of rail services over trucks. North Dakota shippers have no direct access to barge on navigable waterways to compete with rail transport. Railroads are more cost effective than trucks for shipping bulk commodities over longer distances. Moreover, the 40-ton weight limitation on highways limits the capacity of trucks to take advantage of the economies of shipment size found in rail services. Technological changes in rail grain logistics have revolutionized grain transportation. Shuttle trains (100 or more railcars) have increased the volume of grain hauled in a single movement. Burlington

Northern introduced the shuttle technology in the Northern Plains region in the 1990s (NDDOT 2007)[3].

The two Class I railroads responsible for all out-of-state grain movements in North Dakota have requirements that shippers must meet to participate in their shuttle programs. BNSF defines a shuttle train as 110 covered hopper cars, each with a capacity of 111 tons, and a shuttle elevator as having enough track capacity to accept 110 cars and load and unload them in 15 hours up to three times per month without clogging the main line (NDDOT 2007). The other class I railroad. the, SOO Line, a U.S subsidiary of Canadian Pacific Railroad (CP), refers to shuttle trains as "efficiency trains" and defines them as trains with 100 cars and efficiency elevators as those that can load 100 cars within a 24-hour period without disruption to the main line. In general, railroads offer four different services including single-car (1 to 5 railcars), multi-car (6 to 49 railcars), unit-train (50 to less than 75 railcars), and shuttle (75 or more railcars). Table 3 summarizes the proportion of grain transported by rail (single-car, multi-car, unit, and shuttle) and truck to all destination markets for 2015 through 2017.

Table 3: Average Modal Share Grain Transportation, North Dakota, 2015-2017

	Mode (%)				
Commodity	Single-Car	Multi-Car	Unit	Shuttle	Truck
Barley	28	14	5	0	53
Canola	10	6	5	0	78
Corn	5	6	6	54	29
Dry Edible Beans	48	9	0	0	43
Dry Edible Peas	57	10	2	0	31
Durum Wheat	40	24	15	0	20
Flax	6	3	0	0	91
Spring Wheat	9	10	8	53	20
Lentil	57	10	2	0	32
Soybean	3	4	7	72	15
Sunflower Seed	4	0	0	0	96
Source: Upper Great Plains Transportation Institute (UGPTI)					

The average proportion by commodity transported by the different modes in Table 3 similarly reflects reporting in Table 2. Most major grain commodities produced in North Dakota are destined for out-of-state market destinations. Major grains like corn, spring wheat, and soybean are destined for exports via Pacific Northwest ports. The highest proportion of corn, spring wheat, and soybean in Table 3 moves by shuttle rail service. Specifically, shuttle is a specialized service and often requires large volume of commodities to meet rail carrier requirements as

[3] Burlington Northern (BN) merged with Atchison, Topeka and Santa Fe railway (AT&SF) to become Burlington Northern Santa Fe (BNSF) after 1996.

described previously. For context, a single shuttle train with 110 railcars of 111-ton capacity requires nearly 12,210 tons of wheat (407,000 bushels).

In general, truck dominates the transport of minor commodities like sunflower, flax, and canola (Table 3). This is intuitive given that most of the minor commodities are destined for local markets (truck is most cost effective for shorter distances). Few minor commodities including lentil, dry edible beans, and peas move by single-car rail services (Table 3). Single-car rail services also dominate the transport of durum wheat.

Uniform Rail Costing System (URCS)

The Interstate Commerce Commission (ICC) developed the Uniform Rail Costing System (URCS) for regulatory purposes (e.g. rate reasonableness). URCS estimates the total variable cost for hauling commodities by rail. The estimated cost represents the expense incurred by railroads for transporting different types of commodities (e.g. grain) with user-defined inputs[4]. There are nine basic user defined movements (input) features required to estimate the total variable cost of a railroad movement. The mandatory user defined inputs are divided into three main groups including movement segment (railroad, distance, segment type), freight car characteristics (number of freight cars, type of freight car, freight car ownership), shipment characteristics (tons per car, type of commodity, and shipment size).

The first input of the movement segment (drop down menu) allows users to select one of the seven class I railroads making the shipment followed by the distance of the movement. The two class I railroad serving North Dakota grain shippers are BNSF and Soo-Line[5]. Movement segment represents where the railroad is retained in the movement from origination to termination. Calculations in this report use the originate and terminate segment which represents one railroad hauling grain from one origin to a destination without transferring freight to another railroad. Railroad distances are represented by the largest grain elevator (origin) in each county to major destinations for North Dakota grains (Table 2). ArcGIS Network Analysts was used to estimate distances.

The first input for freight car characteristic is the number of railcars while the second is a drop down menu for the freight car type. The covered hopper option was used for all calculations. Covered hoppers are the most popular railcar type used in rail grain shipment. Since there was not sufficient information about railcar ownership, railroad owned car option was used in all calculations (assumed).

The last group of inputs in URCS calculations is tons per car. Railroads previously used 100-ton covered hopper cars. However, because of innovations related to track composition, the weight

[4] The cost incurred by railroads for moving grain is different from the cost incurred by grain elevators or the price elevators pay to ship grain by rail.

[5] Class I railroads are those having annual operating revenues of at least $433.2 million according to the Association of American Railroads (AAR). Soo-Line is a U.S subsidiary of Canadian Pacific (CP)

limit and load per car has increased substantially. In the 1970s, a significant portion of rail branch lines were limited to gross car weights of 220,000 pounds, which permitted net loads of 70 to 80 tons (NDDOT 2007). Presently, Class I railroad main line tracks are able to support 286,000-pound cars, enabling freight loads of between 110 and 115 tons. Some railroads operate 315,000-pound cars with corresponding net loads of 125 tons in particular corridors.

Moreover, grain characteristics including density often vary, consequently the load per railcar. The railroad waybill sample published annually by the STB contains railroad shipment data including (origin and destination regions, tons shipped, number of cars). The rail waybill data is from a stratified sample of all rail shipments during a given year. Table 4 is average rail ton per car (load) for commodities originating in North Dakota between 2015 and 2017.

Table 4: Average Tons per Rail Car Shipment, North Dakota 2015-2017	
Commodity	Tons per Rail Car
Barley	95
Canola, Soybean	107
Corn	106
Dry Edible Beans and Peas	96
Flaxseed, Lentils	96
Sunflower Seed	90
Spring and durum wheat	104
Source: Surface Transportation Board Waybill Sample	

The next couple of inputs is drop down menu for commodities (we use “grains” for all calculations) and shipment size (single, multiple, unit). Single car service involves movement of five or less railcars, multiple (less than 49 railcars), and unit (less than 75 railcars). Shuttle services (75 railcars or more) reflected an adjustment to unit shipments.

Using Trucking Rates to Estimate Truck Cost

The U.S trucking industry, unlike railroads is very competitive. Competition stems from the less concentrated nature of the industry given the large number of firms. Additionally trucking is has significantly lower fixed costs compared to railroads. Starting a trucking firm is relatively easy. All an individual needs is to purchase and register a truck to begin operation. Unlike railroads, which are required to provide operational and financial information to the Surface Transportation Board (regulatory purposes), no such requirements exist for trucking firms[6]. This makes it difficult to obtain operational information for trucking industry.

The lack of operational and cost information and the segmentation of the industry as a whole into truckload (TL) and less than truck load (LTL) sectors has led to the development of truck costing

[6] Ndembe, Elvis. 2016. “Derived demand for grain freight transportation, rail-truck competition, and mode choice and allocative efficiency.” Published Dissertation, North Dakota State University. 2016.

models aimed at estimating truck rates. Berwick and Dooley (1997) on of the earliest attempts used an economic engineering truck cost model approach to estimate the trip cost of trucking movements while assuming that truck cost is representative of truck rate paid for specific haulage. More recently, Dybing (2012) developed a similar approach by making improvements to the Berwick and Dooley (1997) model. He justified the use of truck cost to approximate rates on an assumption of the trucking industry being perfectly competitive (Price = Marginal Cost).

According to Dybing (2012), there are two general ways of describing truck cost[7]. A firm owning and operating a private fleet views the cost of truck services as the long-run marginal cost of the trip, including operating cost and the opportunity cost of capital. On the other hand, for a firm using for-hire trucking services, trucking cost is the price paid for hauling freight between an origin and destination. This study uses the latter definition. Trucking cost is the total dollar value, based on truck rates that grain shippers pay to ship grain. Trucking rates represent truckload movements related to the 40-tons limit for trucks on highways (payload of 26.6 tons). Although some grain shippers (e.g. grain elevators) may own a private fleet, there was not sufficient information to make that consideration. Moreover, a survey conducted for the larger study including transportation related questions, did not yield sufficient insight to make determination on truck ownership.

Grain Elevator Locations

Grain elevators enhance the efficiency of the grain supply chain by gathering grain from different locations (e.g. on-farm origin) to fewer locations subsequently moving grain processing, and consumption locations as well as to export ports by rail, truck, and barge (where accessible)[8]. Several factors contribute to the location of elevators with both grain production and access to transportation considered two of the most important. Grain elevators are widely distributed in North Dakota owing to the variety and volume of crops produced[9]. Figure 1 shows licensed grain elevators by county in North Dakota.

[7] Dybing, Alan, G. 2012. “Estimation of increased traffic on highways in Montana and North Dakota due to oil development and production.” Published Thesis, North Dakota State University. 2012.
[8] Ndembe, Elvis and Bitzan, John. 2018. Grain freight elevator consolidation, transportation demand, and the growth of shuttle facilities. Research in Transportation Economics, Vol 71, 54-60.
[9] Elevator definitions describe the number of rail cars an elevator can load without requiring switching. Track space for 1 to 5 rail cars (single car elevator), 6 to 49 rail cars (multi-car elevator), 50 to 75 cars (unit train elevator) , and 100 or more rail cars (shuttle train elevator).

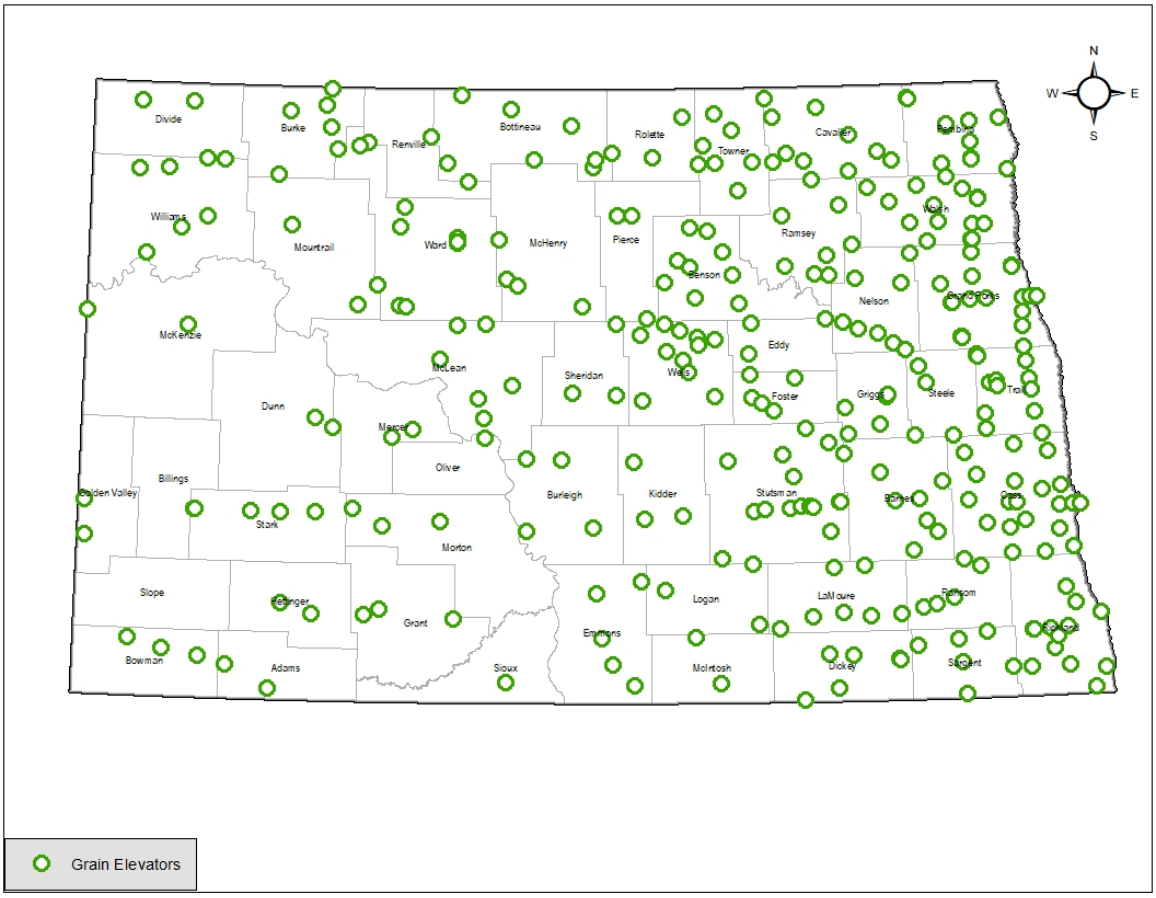

Figure 1: Licensed Grain Elevators by County, North Dakota, 2015-2017

A larger proportion of North Dakota grain elevators are located in the eastern part of the state based on data from the NDPSC. For example, from 2015 to 2017, 60% of the 284 licensed grain elevators grain shipment information, was located in the eastern part of North Dakota (Crop Reporting Districts, 3, 6, and 9), while the western most CRDs (1, 4, and 7) had the least number of elevators (17%). CRDs in the central part of the state (CRD 2, 5, and 8) had the remaining 23% of the grain elevators in North Dakota[10]. All elevators have access to truck services. In terms of rail service capacity or the number of railcars elevators can handle, 42% of the elevators are single-car, 19% are multi-car, 19% are unit, and 20% are shuttle elevators. Figure 2 shows North Dakota transportation network (major highways and railroads).

[10] Crop reporting districts encompass several counties

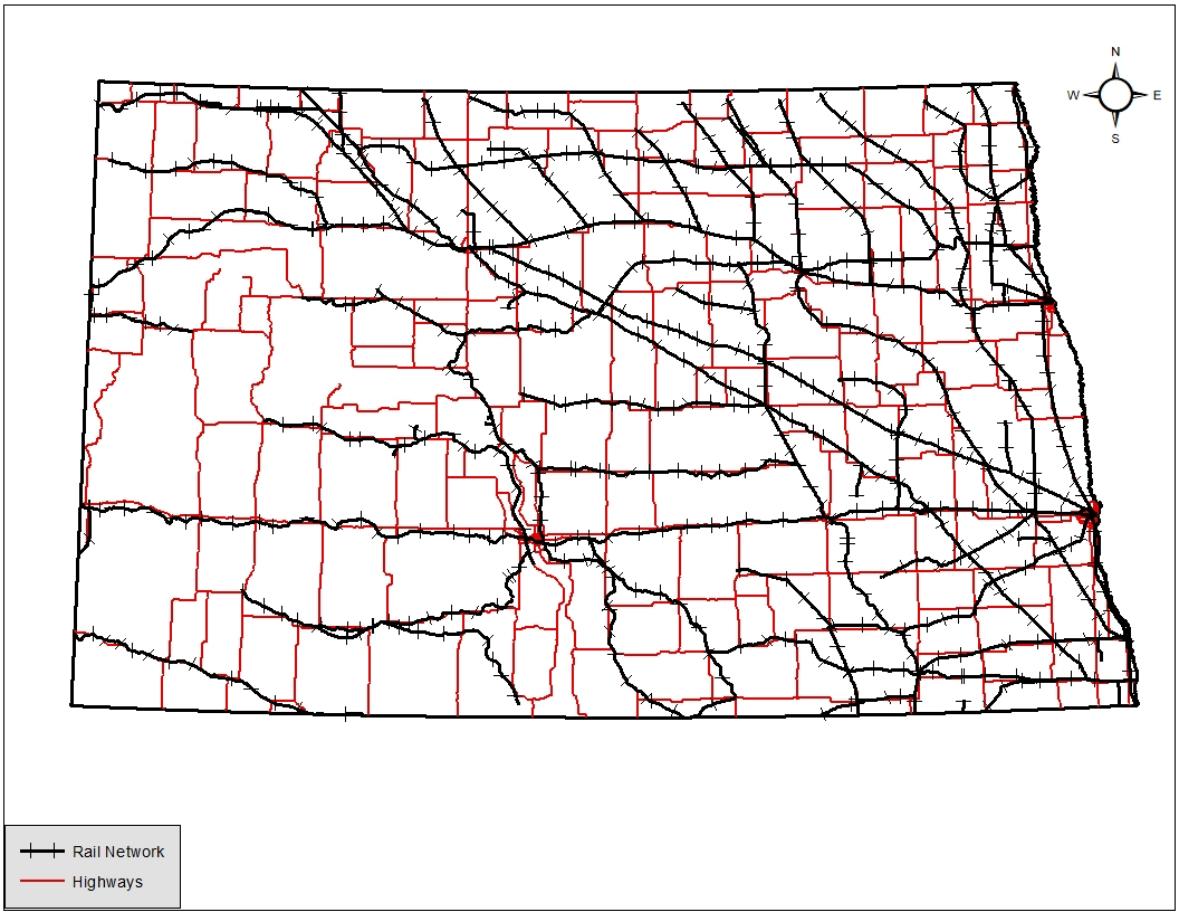

Figure 2: North Dakota, Highway and Rail Network

Highway and Rail Networks

North Dakota has a multimodal freight transportation system supported by highways, air, and rail networks. Grain is bulky, heavy and low value commodity, making it unsuitable for air transport. North Dakota has a total of 27,685 miles of federal, state, and county with an additional 461 miles and 875 miles classified in the primary highway freight system and national highway freight network respectively (NDDOT 2017). Two major interstate highways, I-94 and I-29 run through the state. There are 3,330 rail miles in North Dakota. BNSF and Soo-Line control close to 65% of rail miles. Four shortline railroads, including Dakota Missouri & Western (389 miles), Dakota Northern Railroad (48 miles), Northern Plains Railroad, Inc. (342 miles), and Red River Valley and Western Railroad (546 miles) own the remaining (35%).

METHODS

The flow chart in Figure 3 illustrates the process used to calculate transportation cost for shipping North Dakota grains. The process begins with grain production by county obtained from the North Dakota Land model. Commodity volumes are adjusted for shrinkage of 1%. For three of the commodities (durum, spring wheat, and flax), the amount of grain entering marketing channel from each county is net (deducting) of certified seed or grain for seed. The deduction for these three commodities relied on expert opinion. Grain producers have to buy a different seed variety for planting each year (bin runs for seeds are not permitted due to proprietary nature of new seed varieties). Figure 3 illustrates the process involved in calculating cost incurred by transportation carriers (railroads and trucking firms) in hauling North Dakota grain.

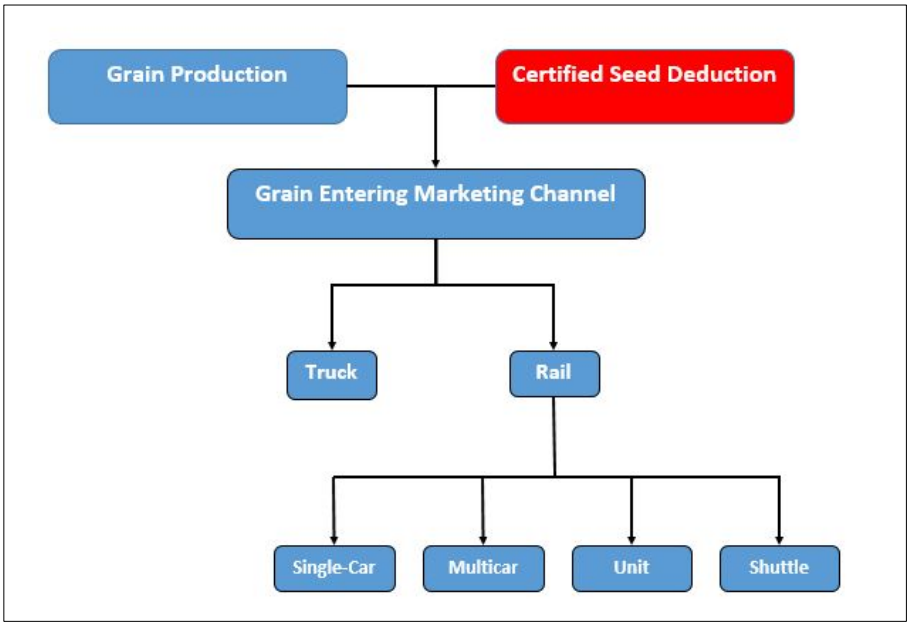

Figure 3: Flow Chart, Grain Transportation Cost Calculation Process

Three steps summarize the process involved in calculating cost incurred by transportation carriers. These include:

1. Historically, there are six principal destinations for North Dakota grains including the local North Dakota market (Table 2). The amount of produced grain shipped to each destination, is the average proportion in Table 2 (obtained from NDPSC and UGPTI reports) multiplied by grain entering the marketing channel from each county.

2. The next step is estimating the modal share for grain shipped to the six principal destinations. Multiplying grain by destination obtained above (1) by modal percentages in Table 3 gives the modal share of commodity from each county to all six principal destinations. Rail and truck are the two main transportation modes. However, rail involves four service types. These include single-car (1-5 railcars), multicar (6-49 railcars), unit (between 50 and less than 75 cars) and shuttle (75 or more railcars)

services. Rail carrier operational costs estimates for this study in URCS (described earlier) uses the maximum number of rail cars in each service type to calculate rail cost.

3. Transportation costs are for rail and truck share by destination. Cost estimates depend on transportation output (ton-miles). A ton-mile describes one ton (volume) of freight carried one mile (distance). For trucking, truck rates per ton-miles for three distance categories published by UGPTI, total output of actual shipments facilitate estimation of total truck cost by county. URCS generates cost incurred by railroads in moving grain for different service types. Costs per ton-mile by service together with actual rail shipments enable calculation of total rail cost by county. Report next presents direct and implied assumptions in truck and rail cost estimation.

Direct and Implied Assumptions

Assumptions were made for final grain destination (in state vs out-of-state) movement and mode (rail and truck) in calculating cost involved in transporting grain. Shipment distance among other factors (e.g. commodity volume and density) directly affect the cost incurred by transportation carriers (rail) or rate paid for transportation services (truck). Three broad categories describe market destinations for North Dakota grain (a) out-of-state (Duluth-Superior, Midland-SW, MN-WI, and PNW), (b) non-specific domestic destinations (Other), and (c) in-state (ND). Knowledge of origin and destination facilitates shipment distance calculation.

A city in each of the four out-of-state destinations for North Dakota grain serves as a destination point to enable estimation of rail and truck distances. The destination cities and regions are Duluth, MN (Duluth-Superior); Minneapolis-St Paul, MN (MN-WI); New Orleans, LA (Midland-SW), and Portland, OR (PNW). All four selected cities are major export ports. The "Other" destination represents unidentified out-of-state destinations. Rail and truck distances for "Other" (known local origin and unknown destination) represents average rail and truck distances for the other four out-of-state destinations.

The NDPSC grain movement databases provides origin-destination and modal information for out-of-state grain shipment destinations. However, NDPSC database does not provide destinations for in state (local shipment) which complicates the analysis since shipment distance is a principal determinant of transportation cost. For this reason, a process was developed and used to ascertaining destinations for local grain shipment using local commodity processors. The steps involved in the process are as follows:

1. Identify local major processing plants (location) by commodity
    a. For example, in the case of corn, the location of all five-ethanol plants and one high fructose corn syrup plant in the state are identified. Identification process repeated for each commodity.

2. A centroid or central point determined based on location of grain processors identified in (1) serve as local destination for grain shipment. Local rail and truck distances by commodity therefore represent movements from largest capacity grain elevator in each county to identified central point or centroid. Figure 4 shows local

assigned shipment points. Wheat (spring wheat and durum), soybean (canola), sunflower seed and lentil have similar assigned destinations.

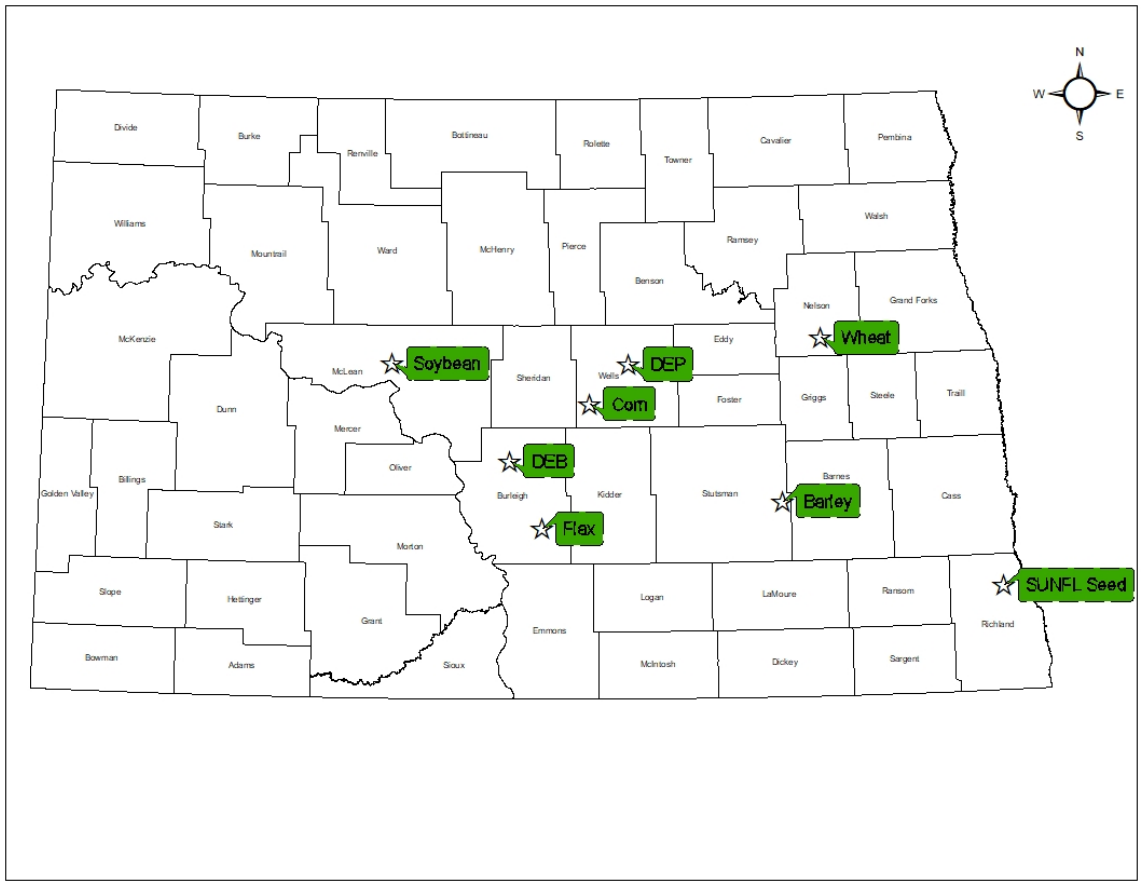

Figure 4: Assigned Local Grain Shipment Destinations

3. The procedure in (2) was the most objective approach relative to other assignment methods like all-or-nothing. In all-or-nothing assignment, using corn as an example, the distances from all local grain elevators to the five likely destinations are calculated. The entirety of grain from the largest elevator would go to the processing plant in closest proximity (shortest distance). Another option was to assign shipments proportionately to capacity of a processing plant. Both of these options were likely to understate or overstate shipping distances. Figure 4 shows assigned local shipment destination for all commodities under consideration.

Table 5 shows the average rail and truck distance by commodity for in state and out-of-state shipments. Distances for in state rail shipments indicates that lentil (290 miles) was hauled the longest distance by rail locally while barley (174 miles) shipments were moved the shortest distance by rail locally. However, for local truck movements, corn shipments represent the shortest distance on average (111 miles) while spring wheat hauled by truck is shipped the furthest by truck (324 miles).

Table 5: Average Distance of Grain Haulage North Dakota, 2015-2017				
	In-State (ND)		**Out-of-State**	
	Miles			
Commodity	Rail	Truck	Rail	Truck
Barley	174	247	982	937
Canola	261	224	944	898
Corn	184	111	1,269	1,231
Dry Edible Bean	166	164	1,288	1,151
Dry Edible Pea	254	137	1,298	1,175
Durum	261	182	1,101	999
Flax	268	136	912	907
Lentil	290	162	1,167	1,025
Soybean	162	203	1,267	1,183
Spring Wheat	219	324	1,083	982
Sunflower Seed	267	227	912	906

Out-of-state shipments are hauled considerably longer distances on average, reflecting the location of major destinations for North Dakota grain shown previously (Table 2). For example, the average transportation distances for dry edible beans, dry edible peas, corn and soybeans represent the longest rail and truck distances on average. The largest proportion of these commodities are destined for export ports that are significant distances from North Dakota. Both rail (912 miles) and truck (906 miles) haulage distances for sunflower represented the shortest rail and truck distance on average to out-of-state destinations.

Estimating Transportation Carrier Operational Cost

This study estimates truck and rail carrier operational costs-using transportation output (ton-miles). One ton-mile describes a ton of freight hauled for one mile. As mentioned previously, grain shipper rates are used as proxy to estimate truck carrier operational cost due to lack of reliable cost information on truck operation. Operational cost estimate for rail are estimated using URCS. This study uses average annual grain truck rates for three different distance ranges obtained from UGPTI. Development of truck rates involved national and regional surveys of grain shippers conducted by UGPTI on behalf of USDA and published on USDA's Grain Truck and Ocean Rate Advisory (GTOR) after adjustment.

Truck rates represents trucks with 40 tons gross weight (statutory weight limit for commercial trucks on highways) and long haul distances over 200 miles. Based on truck with 40 tons gross weight, the payload (actual commodity weight) is 55,000 pounds or 26.6 tons. Truck rates from represent truck rates per loaded mile. An estimate of truck rates per ton-mile includes dividing rates per loaded mile by the payload. Dividing truck rate per ton-mile by the general Gross Domestic Product price deflator (GDPPD) provides rates in 2016 base prices. Table 6 shows truck rates per loaded mile for three main distance ranges from 2015 to 2017. Trucks rates per loaded mile are relatively lower for longer distances for all three years.

Table 6: Average Truck Rate per Loaded Mile, North Dakota, 2015-2017			
Mile Range	2015	2016	2017
1 to 99	3.85	4.20	4.5
100 to 249	3.03	3.13	3.11
250 or more	2.71	2.71	2.85
Source: Upper Great Plains Transportation Institute			

Rail cost estimated with URCS used shipment distances and other related user defined inputs described previously (URCS subsection). URCS rail operational cost are based on commodity and commodity characteristic (load per car) and service types (single car, multi car, unit, and shuttle). This report assumes that the entirety of operational cost for trucking remains in the state. However, for rail, operation cost for out-of-state shipments are proportioned based on the distance or output (ton-miles) undertaken within North Dakota (rail network distance from largest grain elevator in each county to ND boundary). All calculated operation cost for shipments destined for local markets (within North Dakota boundary) remain in North Dakota by assumption.

Figure 5 depicts assumption made for transportation carrier operation cost calculation by mode while Table 7 shows the average in state distance (proportioned) for out-of-state shipments. The link "*ARD"* and "*ATD*" represents rail and truck movement from grain elevator to out-of-state destinations. The link "A*R"* is portion of rail movement considered in calculating total rail operation cost while the dotted portion of the link, "*RD"* is part of rail movement not considered in estimating operation cost for railroads. However, for truck, the entire link (highway distance and associated output), represented by "*ATD"* is included in calculating operation cost for trucking (inclusion of part of shipments beyond border).

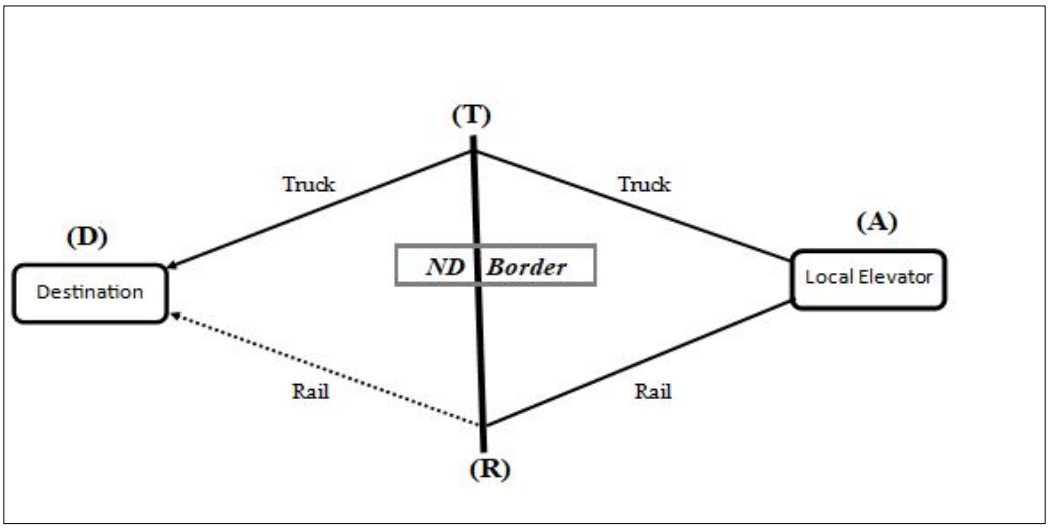

Figure 5: Out-of-State Rail and Truck Shipment Cost Calculation

Table 7: Average In-State Rail Distance for Out-of-State Shipments, North Dakota, 2015-2017	
Commodity	**Average Rail Distances**
Lentil	250
Soybean	205
Corn	203
Spring Wheat	196
Dry Edible Beans	196
Durum	155
Canola	151
Dry Edible Peas	145
Barley	106
Sunflower Seed	51
Flax	51

Both approaches to calculate transportation carrier operation cost in Figure 4 above rely on two assumptions.

1. Truck operators hired and paid for all operation inputs in the state (e.g. for repairs, salaries).

2. For rail, given the privately owned nature of railroads and the fact that networks span more than one state or region, it is assumed that railroads expenditures for operational inputs (e.g. for repairs and salaries for local employees) would be proportionate to the size or length of its network locally in which grain is shipped.

Table 7 shows that lentil has the longest proportioned rail distance on average while sunflower and flax haulage are the shortest distance by rail from largest capacity grain elevator in each county to the North Dakota border. The next section shows estimated transportation carrier operation cost.

RESULTS

This section provides estimate for truck and rail carrier operation cost for hauling major North Dakota grain for the three years period from 2015 to 2017. Summary results breakdown by mode, county, commodity, and destination (in state and out-of-state) markets are presented next while detailed results are provided in the Appendix. Table 8 shows transportation cost by year and mode from 2015 to 2017 while Figure 6 shows total carrier cost make up for rail and truck. From 2015 to 2017 on average, transportation carriers spent an estimated $723 million in operation to haul North Dakota grain.

Table 8: Total Transportation Carrier Operation Cost Grain Shipping North Dakota, 2015-2017

	Total Transportation Cost ($000)			
Mode	2015	2016	2017	**Average Total**
Truck	**579,323**	**606,092**	**616,746**	**599,720**
Rail	**115,808**	**133,186**	**121,477**	**123,490**
Shuttle	55,571	82,063	67,232	68,289
Single Car	33,766	30,160	32,464	32,130
Multicar	17,341	13,048	13,932	14,774
Unit	9,130	7,914	7,850	8,298
Total	**695,131**	**736,277**	**738,223**	**723,210**

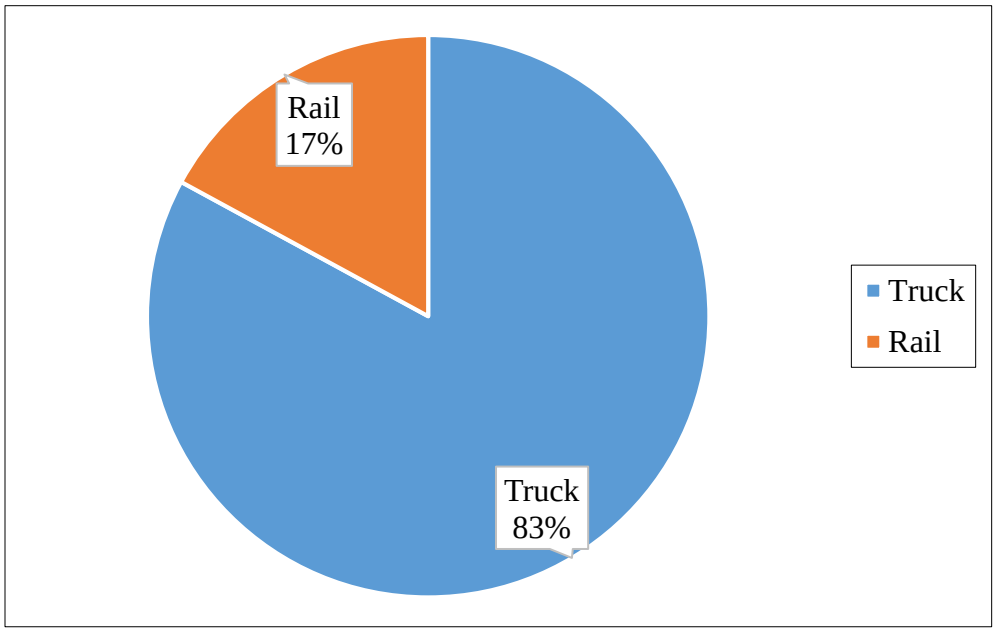

Figure 6: Transportation Carrier Operation Cost by Mode

Overall, on average, trucking represents about 83% ($600 million) of total carrier operation cost involved in transporting North Dakota grains with the remaining 17% ($124 million) associated with rail transportation. In terms operational cost for truck transportation, shippers paid about $600 million to transport grain on average from 2015 to 2017, (recall shipping cost was used as proxy for trucking operational cost). Railroads incurred an estimated $124 million on operational cost on average from 2015 to 2017 in transporting North Dakota grain by rail (recall rail cost estimates for out-of-state shipments represent in-state portion of shipment cost). Railroads use four different service types for shipping freight (explained earlier). Figure 7 shows a breakdown of rail operation cost for all four services types involved in shipping North Dakota grain by rail.

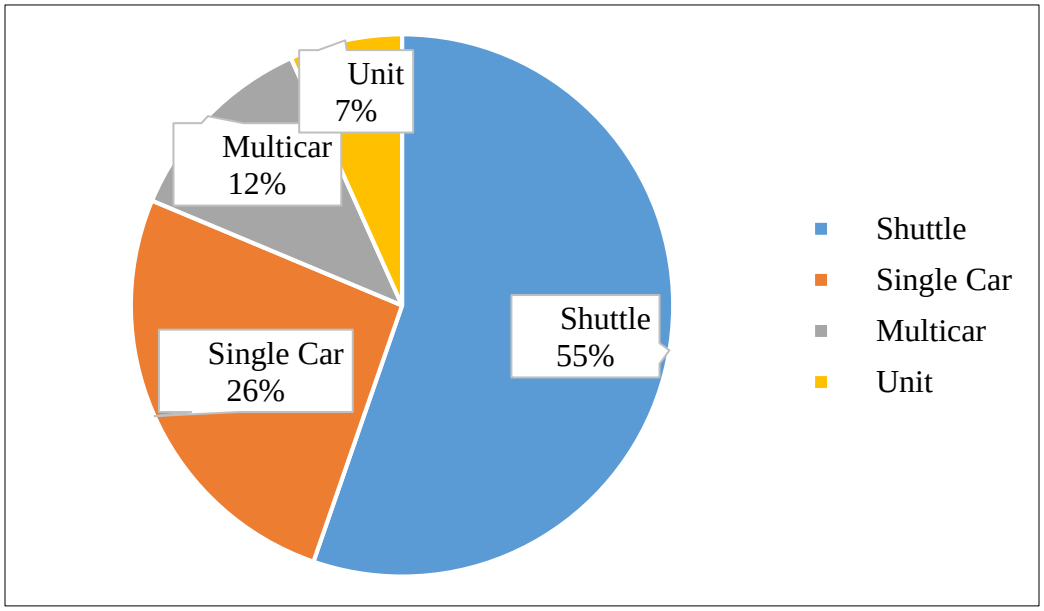

Figure 7: Rail Operation Cost by Service Type

Shuttle (55%) and single (26%) rail services dominate rail operation cost from 2015 to 2017. The other two-rail services, multicar and single car, complete the remaining 19% of operational cost for rail. The composition of carrier operational cost has remained similar from year-to-year. Truck transportation makeup 83% (2015), 82% (2016), and 84% (2017) of operation cost with the corresponding 17% (2015), 18% (2016), and 16% (2017) involved with rail operation cost associated with grain shipments.

Table 9 shows average carrier cost by commodity for each of the eleven commodities under consideration while Figure 8 is the percentage breakdown (flax and lentil not shown). Transportation carrier operation cost associated with hauling North Dakota grain on average from 2015 to 2017 ranged from an estimated $3.3 million for lentil to $336 million for corn. Trucking carriers cost in general are higher than rail for all commodities on average as observed similarly in Table 8. Corn represents the largest modal operation cost amongst all commodities. Rail operational cost for hauling corn represents 32% of all rail cost on average for the three year period ending in 2017. Corn transportation operation cost by truck represents about 49% of all trucking cost on average from 2015 to 2017. Flax and lentil respectively represent the lowest rail

and truck transportation operation cost. Table 10 and Figure 9 show average transportation carrier operation cost by county from 2015 to 2017.

Table 9: Average Transportation Carrier Operation Cost by Commodity North Dakota, 2015-2017			
	Average Cost ($000)		
Commodity	**Rail**	**Truck**	**Overall Average**
Corn	39,521	296,629	336,151
Spring Wheat	31,272	75,151	106,422
Soybean	26,312	61,660	87,972
Canola	1,886	58,485	60,371
Barley	6,226	24,945	31,171
Dry Edible Bean	2,048	26,320	28,369
Durum	11,510	12,100	23,610
Sunflower Seed	295	21,064	21,359
Dry Edible Pea	2,893	14,185	17,079
Flax	120	7,331	7,451
Lentil	1,408	1,850	3,257

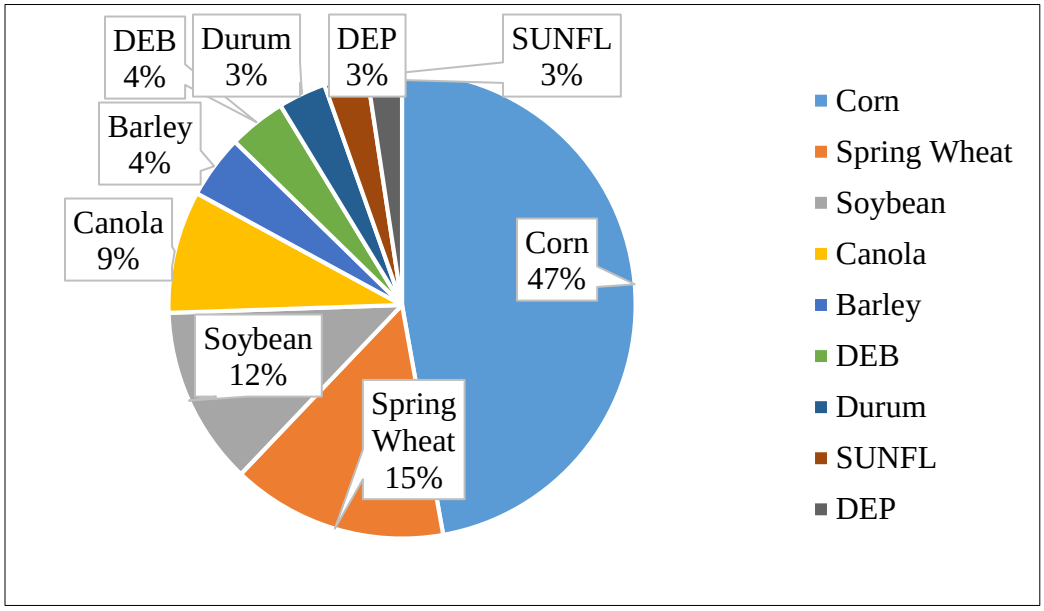

Figure 8: Average Transportation Carrier Operation Cost by Commodity

Average rail operation cost to haul North Dakota grain from 2015 to 2017 ranged from about $116,000 for Billings County to close to $7.6 million for Cass County. For trucking, the amount trucking operators spent on operation to haul North Dakota grain by county ranged from close to $485,000 for Billings County to about $41 million for Richland County. Overall, average operation cost for transportation carriers to haul North Dakota grain range from about $600,000 for shipments originating from Billings county to above $48 million for commodities from Richland County.

Table 10: Average Transportation Carrier Operation Cost by County, North Dakota, 2015-2017					
	Average Cost ($000)			**Average Cost ($000)**	
County	**Rail**	**Truck**	**County**	**Rail**	**Truck**
Adams	412	4,405	McLean	3,648	17,817
Barnes	5,070	25,034	Mercer	744	3,732
Benson	2,536	12,723	Morton	1,082	6,095
Billings	116	485	Mountrail	2,489	10,747
Bottineau	4,018	15,773	Nelson	1,654	7,584
Bowman	305	1,823	Oliver	587	2,876
Burke	1,688	7,638	Pembina	2,957	11,631
Burleigh	1,671	8,129	Pierce	1,617	7,516
Cass	7,568	39,926	Ramsey	2,550	14,458
Cavalier	3,558	20,305	Ransom	2,622	14,354
Dickey	3,287	19,999	Renville	2,036	9,717
Divide	2,814	6,438	Richland	7,520	40,700
Dunn	1,185	3,422	Rolette	1,186	6,338
Eddy	965	4,972	Sargent	3,599	18,449
Emmons	2,117	13,696	Sheridan	1,365	5,281
Foster	1,629	8,717	Sioux	374	1,625
Golden Valley	727	1,640	Slope	491	2,249
Grand Forks	3,874	20,017	Stark	1,385	5,300
Grant	943	4,913	Steele	2,601	14,756
Griggs	1,421	7,649	Stutsman	4,680	26,365
Hettinger	2,265	7,883	Towner	2,158	11,233
Kidder	741	3,470	Trail	3,634	19,119
LaMoure	4,421	23,140	Walsh	2,832	14,154
Logan	1,021	4,544	Ward	3,164	16,009
McHenry	1,715	10,059	Wells	3,044	16,329
McIntosh	1,263	6,482	Williams	4,699	9,442
McKenzie	1,447	2,565			

Appendix B and Appendix C respectively show total carrier operational cost for each commodity and for all counties. Modal operational cost costs are also likely to vary by grain shipment destination. Table 11 summarizes carrier operation cost by commodity for in-state and out-of-state shipments with Figure 10 and Figure 11 respectively showing that for in state and out-of-state shipments for all counties.

Overall, operational cost for hauling commodities destined for the North Dakota market represent 7% of overall cost on average with the remaining 93% associated with out-of-state shipments. This is reasonable given that most out-of-state domestic destinations including export ports are significant distance from North Dakota. Moreover, the largest proportion of the major crops (e.g. soybean, wheat, corn) are destined for out-of-state destinations.

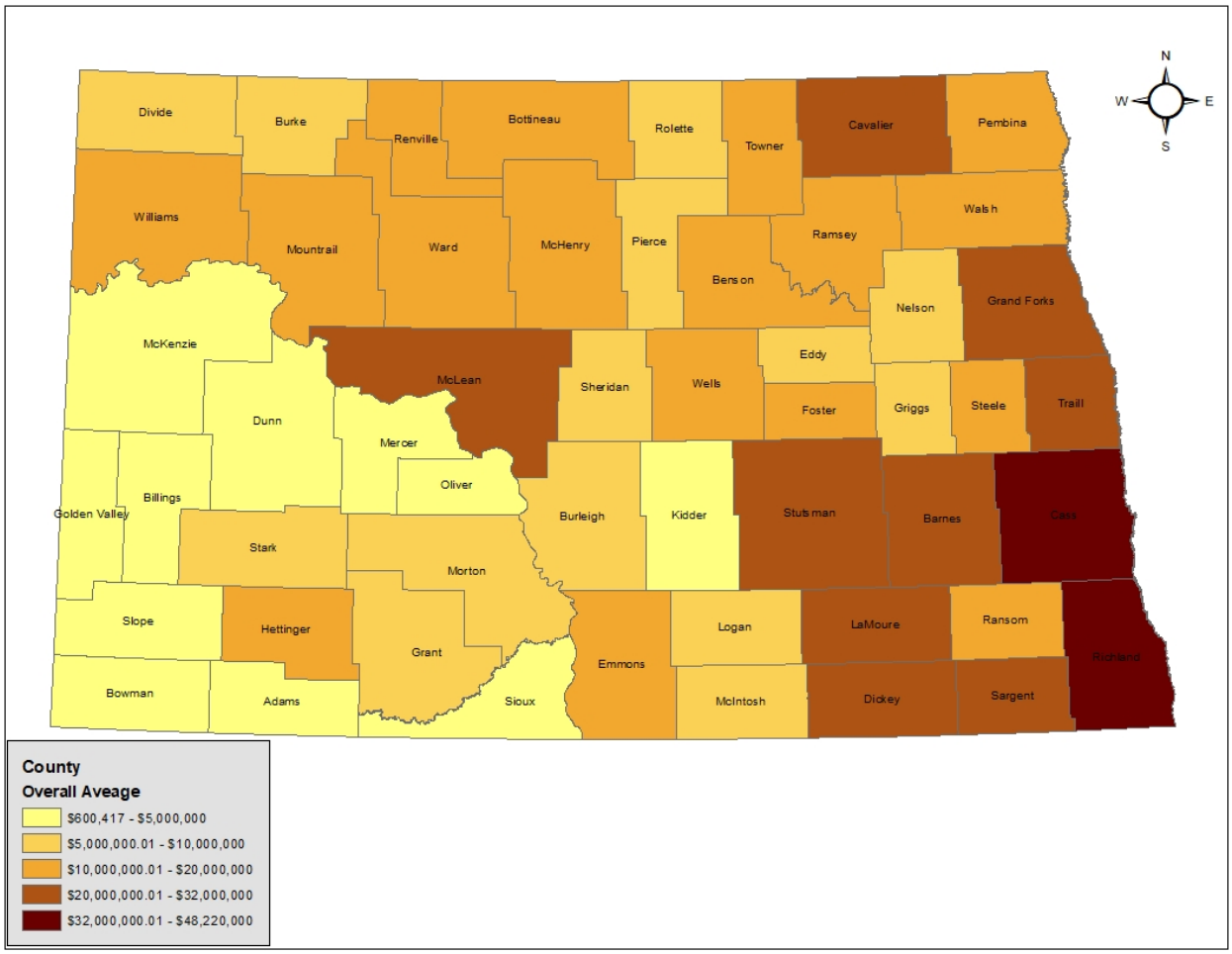

Figure 9: Overall Average Transportation Carrier Operation Cost by County, North Dakota, 2015-2017

Similar to results in Table 9, carrier operational cost to transport corn is the largest amongst all commodities for both in-state and out-of-state shipments. Rail cost makes-up 34% ($18 million) while trucking represents the remaining 66% of total in-state transportation cost. Similarly, truck dominates out-of-state transportation carrier cost. Trucking carriers' cost represents 84% ($565 million) while railroad cost makes-up 16% ($106 million) on average between 2015 and 2017. Recall that railroad operation cost only represents the portion of output (ton-miles) undertaken within North Dakota boundary (Figure 3). The cost to carriers to transport corn is the largest amongst all commodities and for the two groups of destinations (Table 11).

Transportation carriers' operational expenditures or cost for shipments for North Dakota bound shipments range from $49,000 to ship from Adams County to about $1.4 million for Richland County grain shipments. For shipments destined for out-of-state markets, transportation carriers cost range from about $252,000 to ship grain from Billings County to approximately $23 million to ship grains from both Richland and Cass County. Appendix C shows total transportation cost by county.

Table 11: Average Transportation Carrier Cost for In-State and Out-of-State Shipments by Commodity, 2015-2017				
	North Dakota		**Out-of-State**	
Commodity	**Average Cost ($000)**		**Average Cost ($000)**	
	Rail	Truck	Rail	Truck
Corn	6,902	8,494	32,619	288,135
Spring Wheat	3,045	1,027	28,227	74,124
Soybean	1,120	421	25,192	61,239
Canola	980	11,035	906	47,450
Barley	1,811	2,688	4,415	22,258
Dry Edible Bean	297	337	1,751	25,984
Durum	2,220	621	9,290	11,480
Sunflower Seed	221	7,399	74	13,665
Dry Edible Pea	472	194	2,421	13,991
Flax	80	1,803	39	5,528
Lentil	891	444	517	1,406

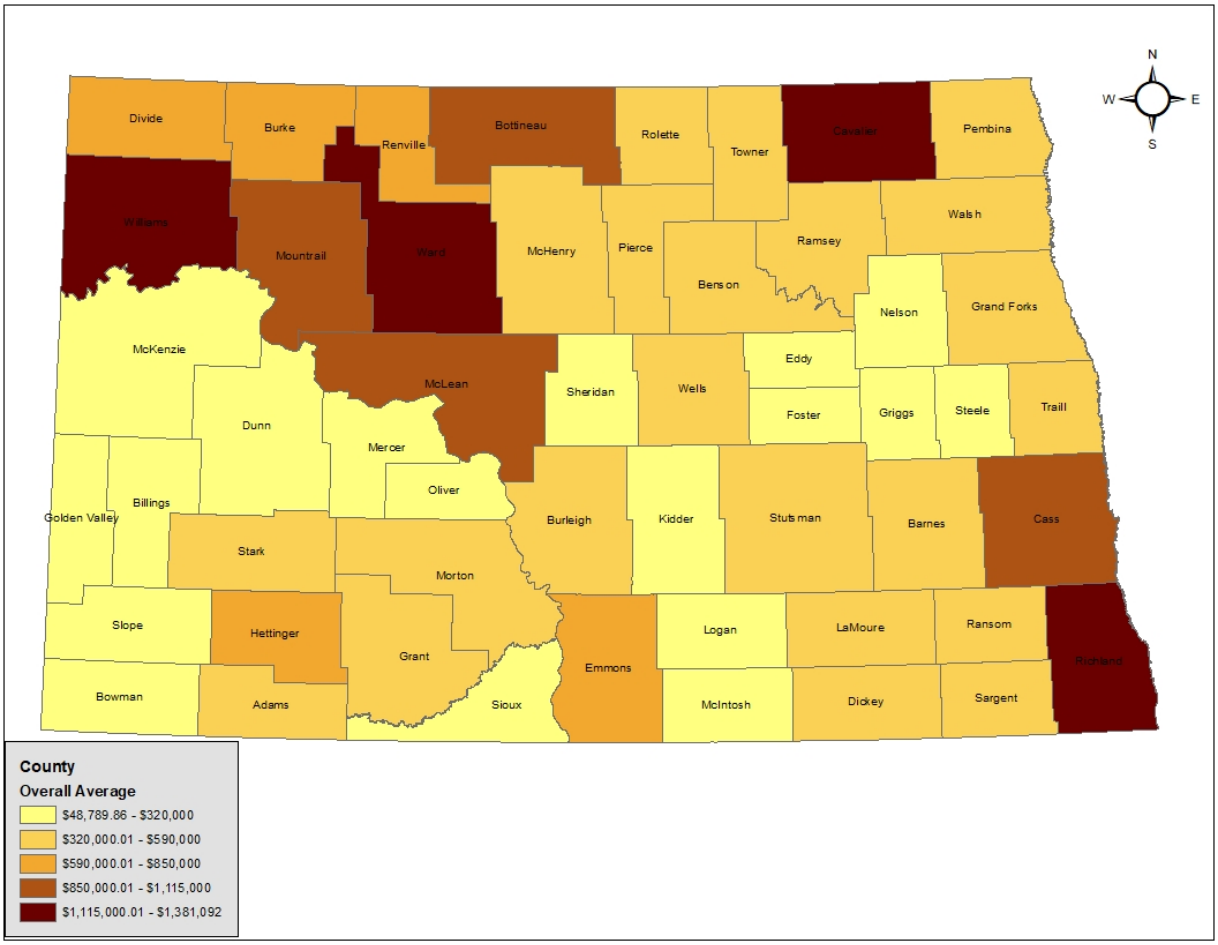

Figure 10: Average Transportation Carrier Cost, In-State Shipments, North Dakota, 2015-2017

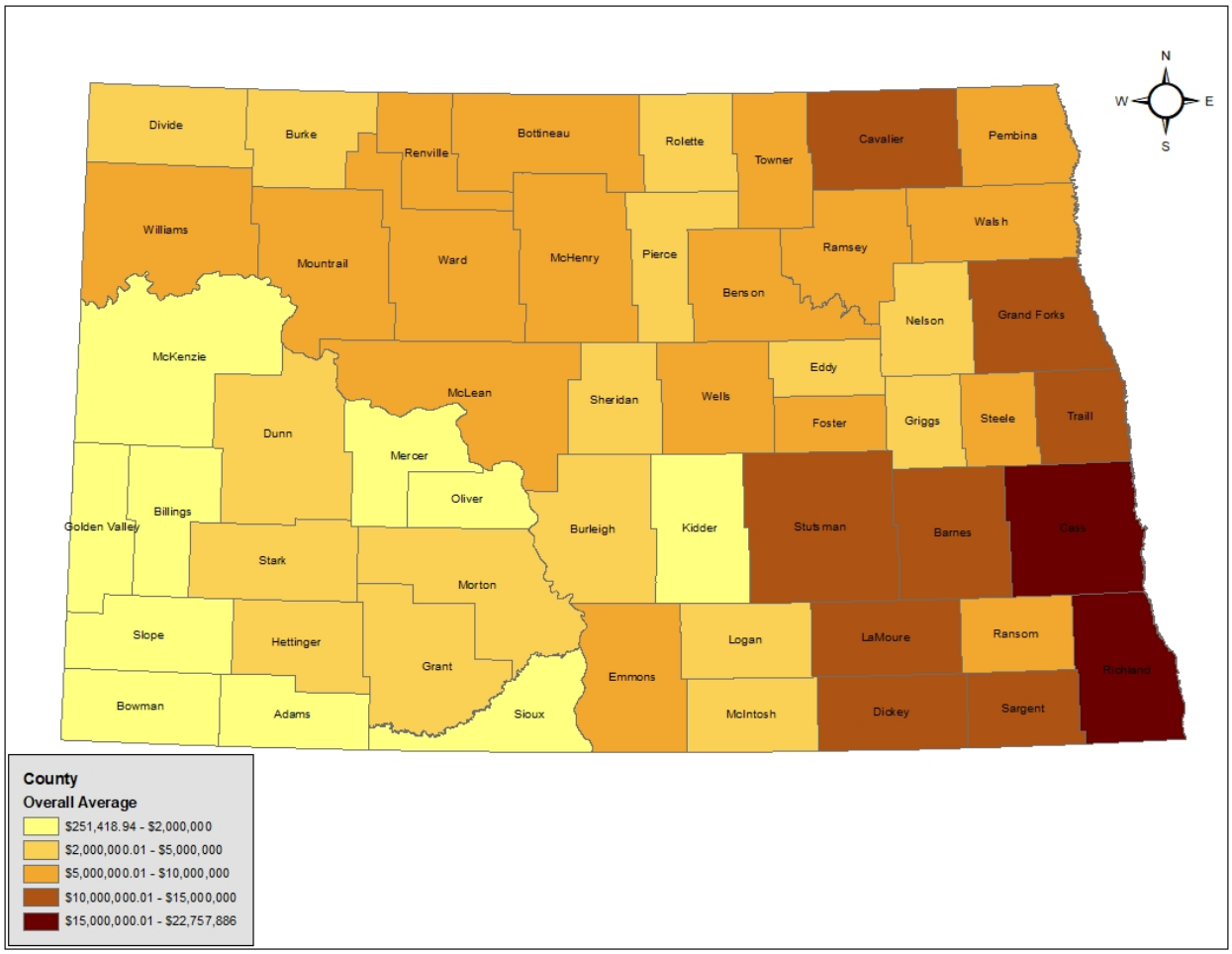

Figure 11: Average Transportation Carrier Cost, Out-of-State Shipments, North Dakota, 2015-2017

LIMITATIONS

Data availability is the principal limitation of this study. Description of the main limitations are:

1. Lack of local origin-destination data
    a. The grain movement data from the NDPSC provides information on grain shipment from North Dakota. Despite providing information on principal out-of-state destinations, specific destinations for local shipments (North Dakota markets) are unavailable. This limits the ability to calculate shipment distance an important determinant of transportation cost.

    b. Attempts to obtain confidential rail waybill sample data, an alternative to determine actual local destinations at least for rail shipments was abandoned after learning of the lengthy process involved and that there were no assurances of timely data delivery from the STB (agency that collects rail data for regulatory purposes). Moreover, rules on disclosure and use of the data would reduce its capacity to refine cost estimates for this study.

2. The Uniform Rail Costing System (URCS)
    a. Railroads' operation costs can be described as joint costs. Rail carriers haul a variety of commodities using the same track. Because the cost of hauling a large variety of commodities on the same track is joint, hence separating transportation cost for individual commodities is beyond the scope of this study. Hence, critics of URCS have suggested that the estimated total and variable cost from URCS does not reflect the actual cost for moving freight. However, there is widespread acknowledgment that until another system is developed, URCS is the best available existing rail costing methodology.

3. Lack of trucking operational cost
    a. This study uses what shippers pay to ship grain to estimate total truck cost of shipping North Dakota grain due to the lack of viable truck costing system similar to URCS for rail costing.

These limitations necessitated the use of several assumptions (explained previously) to facilitate calculations of transportation cost involved in North Dakota grain shipment, hence the contribution of transportation to agriculture.

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APPENDIX A: LAND MODEL GRAIN PRODUCTION BY COUNTY

Table A1: Barley Tonnage Production North Dakota, 2015-2017				
County	**2015**	**2016**	**2017**	**Average**
Adams	1,879	1,521	1,150	**1,516**
Barnes	25,492	23,407	14,451	**21,117**
Benson	88,087	66,958	48,829	**67,958**
Billings	1,618	2,625	1,103	**1,782**
Bottineau	154,898	78,351	35,473	**89,574**
Bowman	3,882	2,331	1,247	**2,487**
Burke	21,780	12,817	7,719	**14,106**
Burleigh	47,546	23,924	14,620	**28,697**
Cass	46,405	31,150	25,342	**34,299**
Cavalier	83,105	31,804	29,235	**48,048**
Dickey	5,375	7,447	3,502	**5,441**
Divide	13,322	7,986	3,836	**8,381**
Dunn	6,203	4,440	2,000	**4,215**
Eddy	22,317	18,304	9,050	**16,557**
Emmons	36,246	11,577	4,644	**17,489**
Foster	33,843	24,726	10,964	**23,178**
Golden Valley	0	0	0	**0**
Grand Forks	28,629	16,833	11,776	**19,079**
Grant	3,301	1,066	530	**1,632**
Griggs	23,357	14,063	12,349	**16,590**
Hettinger	6,713	2,176	1,919	**3,603**
Kidder	26,850	13,285	10,704	**16,946**
LaMoure	6,535	6,964	1,584	**5,028**
Logan	24,700	19,973	6,380	**17,018**
McHenry	33,130	22,050	17,637	**24,272**
McIntosh	10,708	8,970	1,515	**7,064**
McKenzie	15,505	13,963	2,059	**10,509**
McLean	23,678	19,344	9,175	**17,399**
Mercer	14,947	16,712	6,398	**12,686**
Morton	19,063	15,729	3,724	**12,839**
Mountrail	20,193	9,212	2,265	**10,557**
Nelson	32,667	21,729	17,309	**23,902**
Oliver	5,689	6,930	2,930	**5,183**
Pembina	14,251	9,032	7,773	**10,352**
Pierce	39,019	27,764	30,618	**32,467**
Ramsey	124,334	76,921	62,754	**88,003**
Ransom	2,933	3,132	0	**2,022**
Renville	86,826	53,119	21,274	**53,740**
Richland	12,049	3,375	2,390	**5,938**
Rolette	37,918	22,014	12,342	**24,091**
Sargent	0	2,711	2,680	**1,797**
Sheridan	38,935	35,415	15,577	**29,976**
Sioux	0	0	0	**0**

Slope	2,716	4,302	1,387	**2,802**
Stark	8,780	10,459	1,617	**6,952**
Steele	19,072	14,771	17,310	**17,051**
Stutsman	28,722	23,444	12,286	**21,484**
Towner	42,701	27,761	13,436	**27,966**
Trail	44,019	25,848	30,881	**33,583**
Walsh	33,927	16,826	17,401	**22,718**
Ward	53,004	30,297	13,468	**32,257**
Wells	47,527	32,135	22,638	**34,100**
Williams	46,573	24,274	11,606	**27,484**

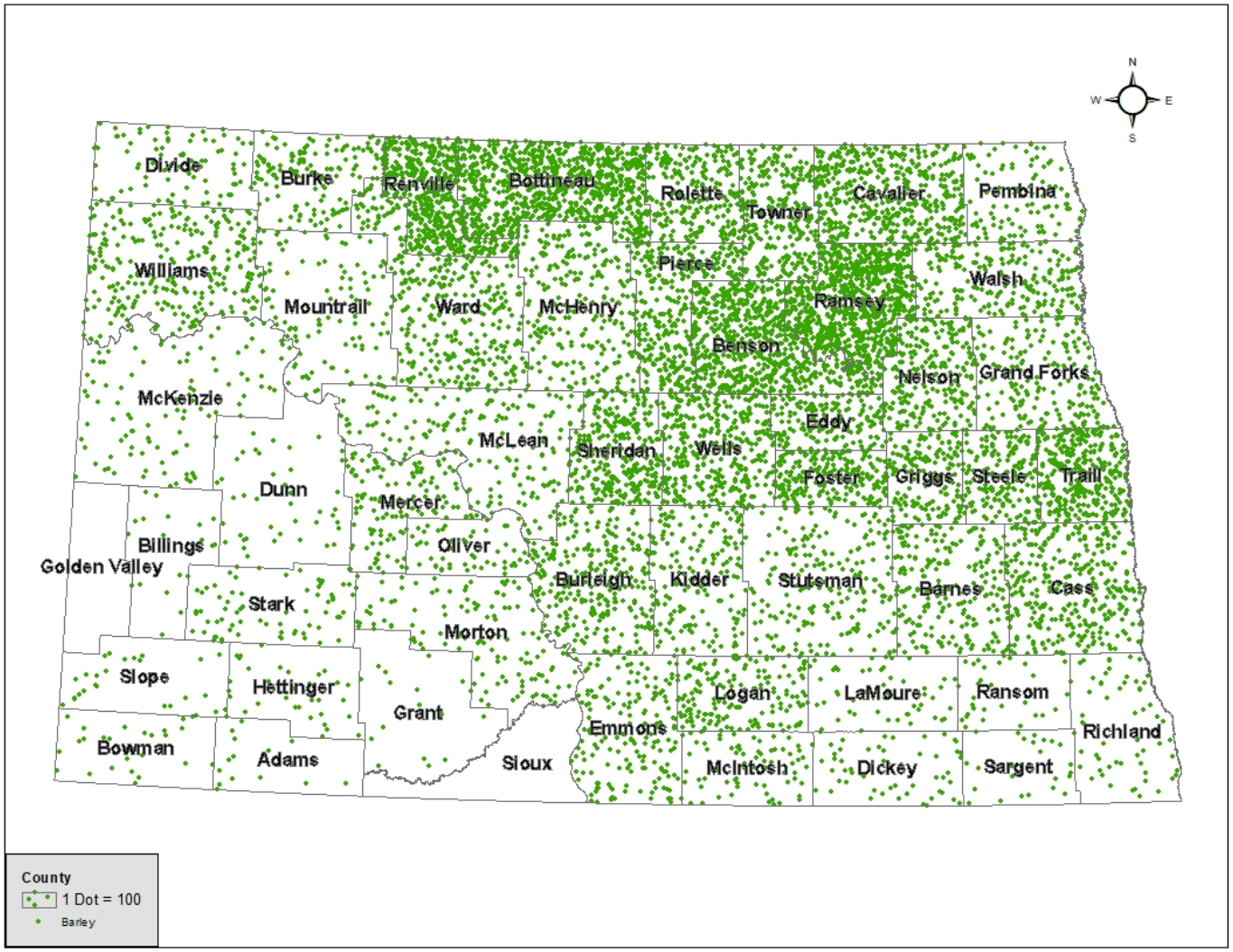

Figure A1: Barley Average Tonnage Production North Dakota, 2015-2017

Table A2: Canola Tonnage Production, North Dakota, 2015-2017				
County	**2015**	**2016**	**2017**	**Average**
Adams	17,716	10,746	8,548	**12,337**
Barnes	0	0	0	**0**
Benson	8,336	7,501	9,847	**8,561**
Billings	2,255	1,099	455	**1,269**
Bottineau	74,302	89,501	76,038	**79,947**
Bowman	6,078	3,226	1,477	**3,594**
Burke	76,053	70,495	61,885	**69,478**
Burleigh	7,638	13,653	8,068	**9,786**
Cass	0	0	0	**0**
Cavalier	257,522	252,870	276,078	**262,157**
Dickey	0	0	0	**0**
Divide	26,171	32,862	30,373	**29,802**
Dunn	6,703	5,799	5,415	**5,972**
Eddy	2,116	2,721	2,705	**2,514**
Emmons	0	1,597	1,235	**944**
Foster	947	0	1,223	**723**
Golden Valley	1,667	2,773	1,817	**2,086**
Grand Forks	1,626	1,424	2,606	**1,885**
Grant	5,237	4,807	2,672	**4,239**
Griggs	0	0	0	**0**
Hettinger	67,533	60,752	25,403	**51,229**
Kidder	1,811	4,128	3,608	**3,182**
LaMoure	0	0	0	**0**
Logan	508	869	0	**459**
McHenry	41,955	52,208	45,726	**46,630**
McIntosh	913	0	0	**304**
McKenzie	8,105	5,838	5,735	**6,559**
McLean	78,458	88,354	63,203	**76,672**
Mercer	12,456	14,525	8,460	**11,814**
Morton	2,477	4,005	1,999	**2,827**
Mountrail	91,108	92,933	77,787	**87,276**
Nelson	13,353	13,842	17,609	**14,935**
Oliver	3,238	4,434	2,286	**3,319**
Pembina	4,032	5,167	7,189	**5,463**
Pierce	24,336	29,439	25,916	**26,563**
Ramsey	49,651	51,484	58,549	**53,228**
Ransom	0	0	0	**0**
Renville	60,746	63,039	56,902	**60,229**
Richland	0	0	0	**0**
Rolette	65,197	52,372	59,909	**59,159**
Sargent	0	0	0	**0**
Sheridan	15,664	21,328	16,477	**17,823**
Sioux	0	0	0	**0**

Slope	7,773	7,441	6,184	**7,133**
Stark	20,405	19,734	7,003	**15,714**
Steele	0	0	0	**0**
Stutsman	1,134	3,397	2,548	**2,360**
Towner	91,610	82,676	91,638	**88,641**
Trail	0	0	0	**0**
Walsh	29,741	27,330	34,916	**30,663**
Ward	93,008	107,141	83,519	**94,556**
Wells	1,847	3,705	4,875	**3,476**
Williams	27,129	31,771	33,063	**30,655**

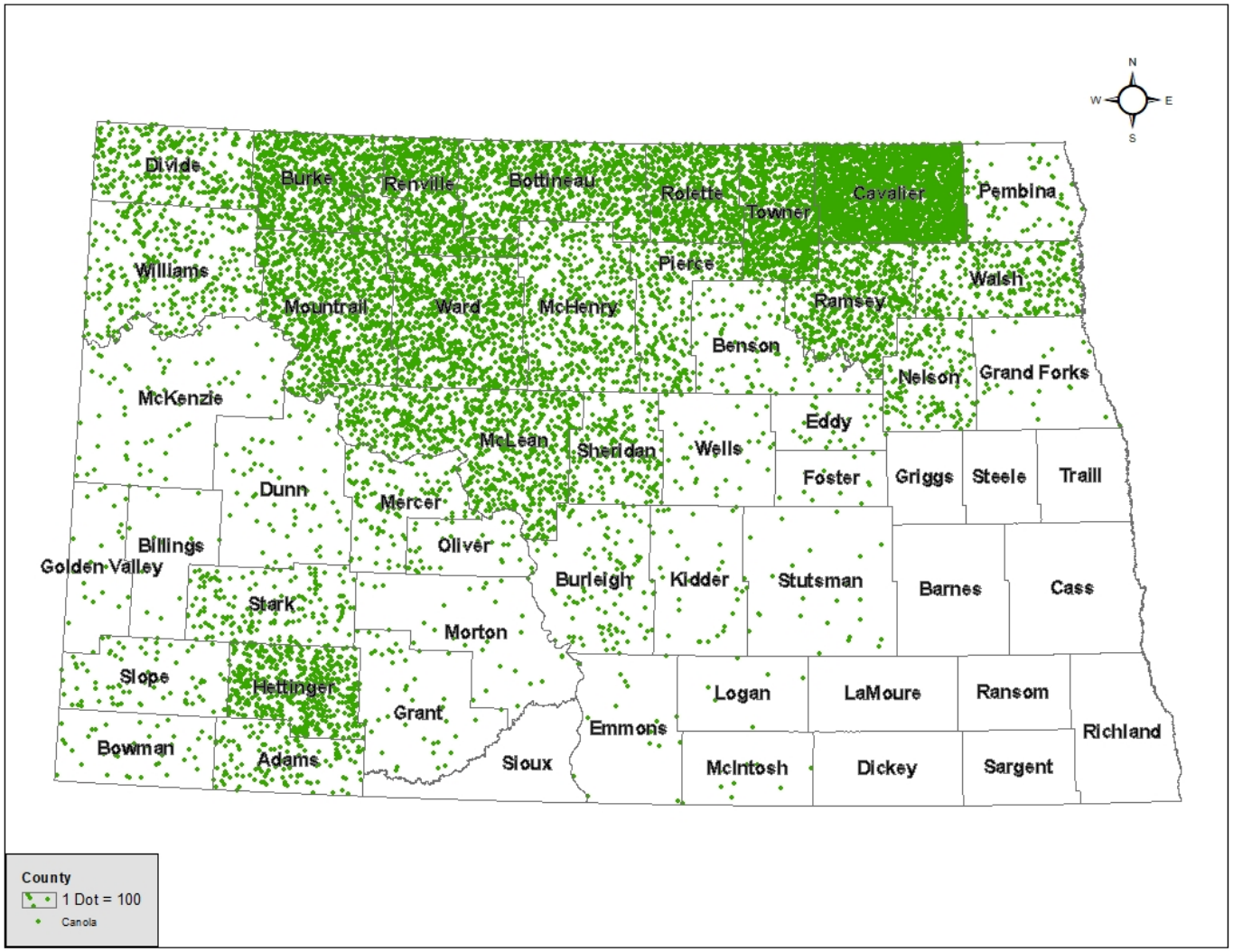

Figure A2: Canola Average Tonnage Production North Dakota, 2015-2017

Table A3: Corn Tonnage Production North Dakota, 2015-2017				
County	**2015**	**2016**	**2017**	**Average**
Adams	49,874	75,832	33,644	**53,117**
Barnes	565,483	934,326	774,368	**758,059**
Benson	145,936	248,507	223,352	**205,931**
Billings	0	0	0	**0**
Bottineau	59,182	134,792	97,666	**97,213**
Bowman	0	0	0	**0**
Burke	0	0	0	**0**
Burleigh	88,798	252,410	169,047	**170,085**
Cass	929,355	1,517,221	1,252,342	**1,232,973**
Cavalier	13,352	36,230	38,183	**29,255**
Dickey	530,040	856,090	658,206	**681,445**
Divide	0	0	0	**0**
Dunn	26,758	42,357	28,946	**32,687**
Eddy	77,966	129,492	115,148	**107,535**
Emmons	228,464	452,106	308,088	**329,553**
Foster	175,565	303,731	223,788	**234,361**
Golden Valley	5,397	3,716	8,001	**5,705**
Grand Forks	329,334	517,580	446,249	**431,054**
Grant	81,273	130,923	42,944	**85,047**
Griggs	105,256	177,939	139,896	**141,030**
Hettinger	50,194	73,306	54,634	**59,378**
Kidder	38,194	72,136	68,154	**59,495**
LaMoure	637,696	920,425	692,171	**750,097**
Logan	58,041	122,636	116,512	**99,063**
McHenry	107,613	212,837	146,039	**155,496**
McIntosh	121,012	200,435	148,023	**156,490**
McKenzie	0	0	0	**0**
McLean	148,247	271,163	207,780	**209,063**
Mercer	40,966	59,264	37,818	**46,016**
Morton	73,732	136,903	64,581	**91,739**
Mountrail	4,230	10,743	15,096	**10,023**
Nelson	64,732	122,127	106,781	**97,880**
Oliver	35,183	58,728	45,406	**46,439**
Pembina	86,902	136,028	140,472	**121,134**
Pierce	63,709	116,915	77,694	**86,106**
Ramsey	134,930	262,800	233,369	**210,366**
Ransom	365,469	533,615	452,183	**450,422**
Renville	13,196	36,031	28,074	**25,767**
Richland	1,135,698	1,419,208	1,401,764	**1,318,890**
Rolette	10,502	26,989	20,538	**19,343**
Sargent	496,148	703,458	613,595	**604,400**
Sheridan	47,046	72,220	60,729	**59,998**
Sioux	24,247	38,189	28,989	**30,475**

Slope	0	0	0	**0**
Stark	52,552	56,469	28,918	**45,980**
Steele	266,339	449,428	367,507	**361,091**
Stutsman	561,161	977,529	788,684	**775,791**
Towner	35,156	75,692	70,450	**60,433**
Trail	424,398	592,141	492,485	**503,008**
Walsh	107,256	200,255	216,640	**174,717**
Ward	48,124	111,159	65,466	**74,916**
Wells	220,486	398,027	396,733	**338,416**
Williams	0	0	0	**0**

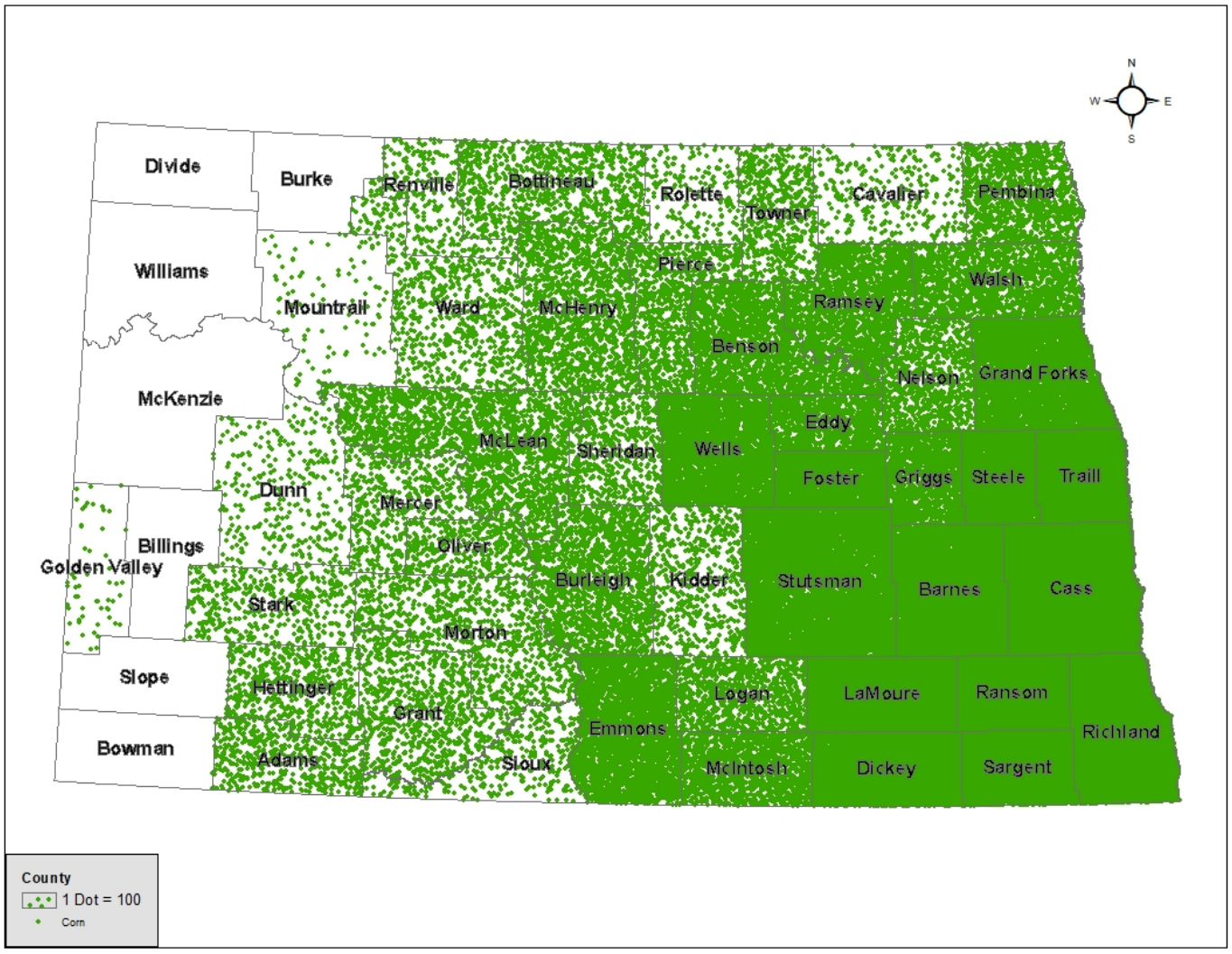

Figure A3: Corn Average Tonnage Production North Dakota, 2015-2017

Table A4: Dry Edible Bean Tonnage Production North Dakota, 2015-2017				
County	**2015**	**2016**	**2017**	**Average**
Adams	0	0	0	**0**
Barnes	6,703	8,444	11,944	**9,030**
Benson	25,444	35,725	38,067	**33,079**
Billings	0	0	0	**0**
Bottineau	0	0	0	**0**
Bowman	0	0	0	**0**
Burke	0	0	0	**0**
Burleigh	5,771	4,215	8,593	**6,193**
Cass	5,522	7,356	13,445	**8,775**
Cavalier	14,089	7,376	13,802	**11,756**
Dickey	3,296	2,840	3,944	**3,360**
Divide	0	0	0	**0**
Dunn	0	0	0	**0**
Eddy	4,526	4,837	7,328	**5,564**
Emmons	-		1,576	**788**
Foster	2,004	2,443	6,356	**3,601**
Golden Valley	0	0	0	**0**
Grand Forks	20,647	70,586	79,312	**56,849**
Grant	-	-	-	**-**
Griggs	12,126	13,455	17,045	**14,209**
Hettinger	0	0	0	**0**
Kidder	0	0	0	**0**
LaMoure	8,384	7,188	7,849	**7,807**
Logan	0	0	0	**0**
McHenry	0	0	1,112	**371**
McIntosh	0	0	0	**0**
McKenzie	0	0	0	**0**
McLean	13,625	19,661	26,653	**19,980**
Mercer	1,120	0	2,928	**1,349**
Morton	0	0	0	**0**
Mountrail	0	0	0	**0**
Nelson	16,461	15,668	23,184	**18,438**
Oliver	2,673	1,997	2,051	**2,240**
Pembina	60,398	35,313	52,737	**49,483**
Pierce	4,381	5,802	5,465	**5,216**
Ramsey	19,271	27,254	26,505	**24,343**
Ransom	8,628	10,315	13,650	**10,864**
Renville	0	0	0	**0**
Richland	1,806	1,474	3,611	**2,297**
Rolette	893	0	1,266	**720**
Sargent	0	2,049	2,561	**1,537**
Sheridan	985	2,622	3,337	**2,315**
Sioux	0	0	0	**0**

Slope	0	0	0	**0**
Stark	0	0	0	**0**
Steele	38,136	47,303	58,464	**47,968**
Stutsman	9,182	11,531	22,322	**14,345**
Towner	17,077	14,089	18,339	**16,501**
Trail	30,565	34,710	39,977	**35,084**
Walsh	70,439	50,380	81,068	**67,296**
Ward	0	0	0	0
Wells	26,656	38,195	53,163	**39,338**
Williams	0	0	0	**0**

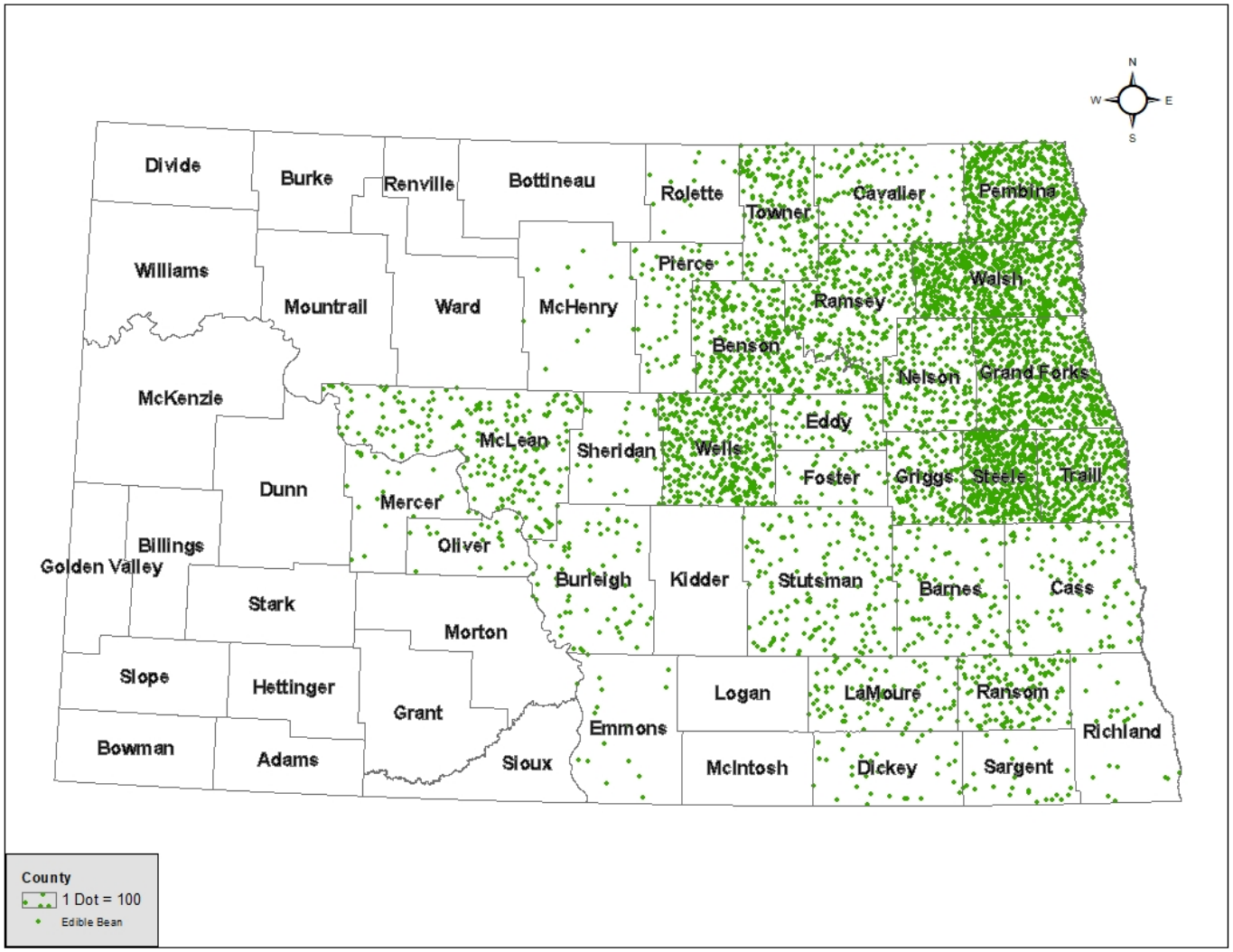

Figure A4: Dry Edible Bean (Field Bean) Average Tonnage Production North Dakota, 2015-2017

Table A5: Dry Edible Pea Tonnage Production North Dakota, 2015-2017				
County	**2015**	**2016**	**2017**	**Average**
Adams	6,125	4,850	2,526	**4,501**
Barnes	3,404	10,645	1,513	**5,187**
Benson	2,019	8,914	2,863	**4,599**
Billings	0	0	0	**0**
Bottineau	12,319	26,293	12,619	**17,077**
Bowman	9,665	6,439	5,013	**7,039**
Burke	14,261	26,033	22,584	**20,959**
Burleigh	6,909	11,503	8,595	**9,002**
Cass	0	2,056	0	**685**
Cavalier	1,692	10,449	15,538	**9,226**
Dickey	0	0	0	**0**
Divide	33,915	34,596	17,972	**28,828**
Dunn	1,653	4,437	1,639	**2,577**
Eddy	1,271	2,871	2,272	**2,138**
Emmons	5,148	4,132	2,144	**3,808**
Foster	0	2,928	2,053	**1,660**
Golden Valley	15,720	13,659	7,398	**12,259**
Grand Forks	1,226	1,332	1,743	**1,433**
Grant	4,476	1,218	79	**1,924**
Griggs	1,778	3,017	0	**1,598**
Hettinger	6,201	8,605	3,564	**6,123**
Kidder	5,638	5,678	2,159	**4,492**
LaMoure	0	1,740	0	**580**
Logan	1,800	3,882	1,074	**2,252**
McHenry	2,950	8,768	5,283	**5,667**
McIntosh	0	3,270	725	**1,332**
McKenzie	10,169	17,970	5,822	**11,320**
McLean	49,504	69,726	31,311	**50,180**
Mercer	6,183	9,722	3,093	**6,333**
Morton	1,810	2,894	977	**1,894**
Mountrail	71,803	67,527	31,216	**56,849**
Nelson	1,901	3,168	2,837	**2,635**
Oliver	5,953	4,823	2,016	**4,264**
Pembina	0	876	2,409	**1,095**
Pierce	4,748	11,438	4,066	**6,751**
Ramsey	0	1,268	2,559	**1,276**
Ransom	1,161	3,743	1,259	**2,055**
Renville	14,917	25,956	21,979	**20,951**
Richland	0	0	0	**0**
Rolette	7,679	8,214	4,992	**6,962**
Sargent	0	0	0	**0**
Sheridan	1,193	4,738	1,530	**2,487**
Sioux	0	0	0	**0**

Slope	12,044	6,623	4,704	**7,790**
Stark	8,803	6,864	3,012	**6,227**
Steele	0	0	0	**0**
Stutsman	12,478	14,178	6,430	**11,028**
Towner	1,539	4,977	2,346	**2,954**
Trail	0	0	0	**0**
Walsh	0	1,674	143	**606**
Ward	31,028	41,390	22,950	**31,789**
Wells	5,304	11,549	6,076	**7,643**
Williams	53,773	63,670	44,380	**53,941**

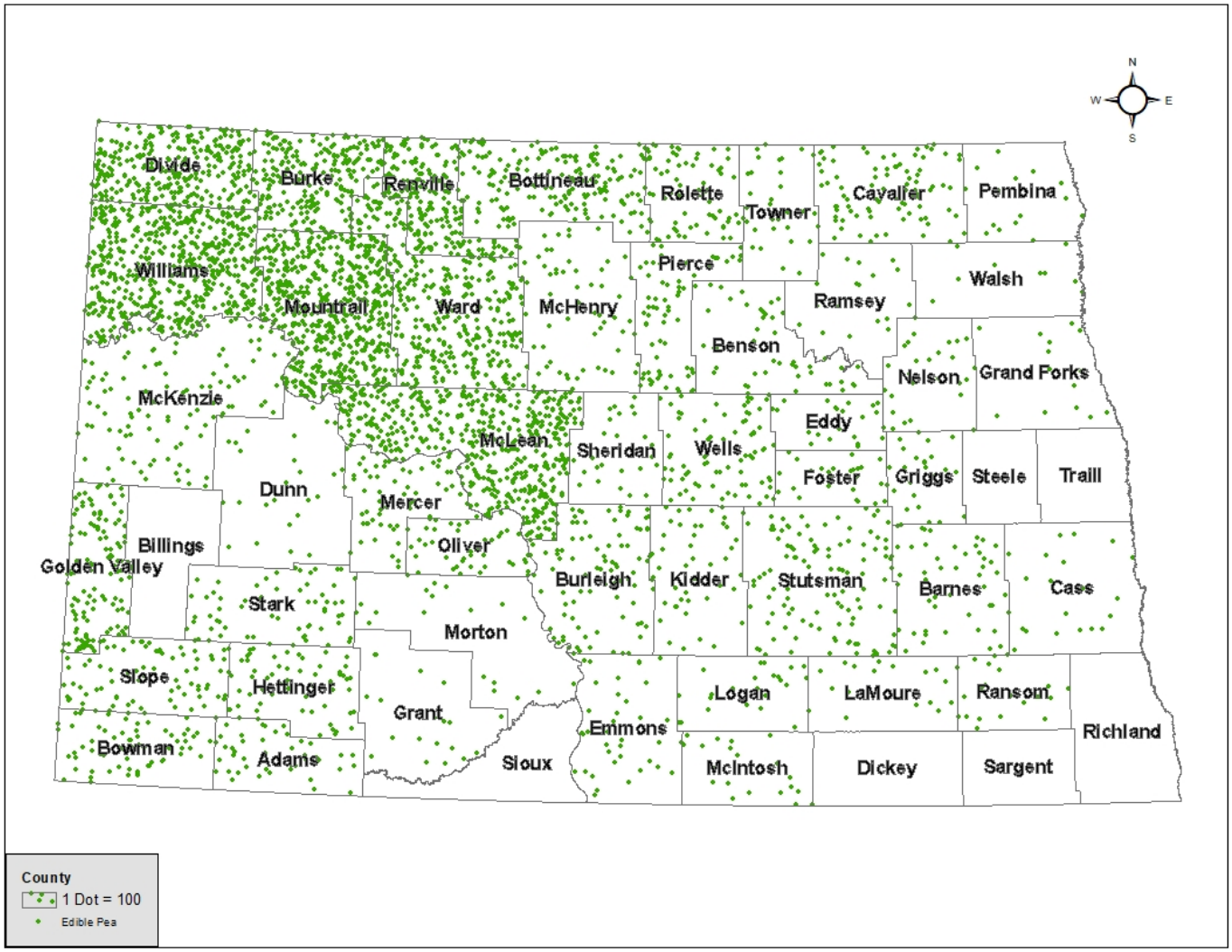

Figure A5: Dry Edible Pea (Field Pea) Average Tonnage Production North Dakota, 2015-2017

Table A6: Durum Tonnage Production North Dakota, 2015-2017				
County	**2015**	**2016**	**2017**	**Average**
Adams	19,530	16,374	10,209	**15,371**
Barnes	0	0	2,317	**772**
Benson	6,386	14,409	6,718	**9,171**
Billings	0	1,624	0	**541**
Bottineau	27,656	62,222	35,004	**41,627**
Bowman	41,129	28,680	22,002	**30,604**
Burke	65,995	99,925	64,060	**76,660**
Burleigh	18,589	35,496	26,515	**26,866**
Cass	0	2,361	2,632	**1,664**
Cavalier	24,252	15,150	17,438	**18,947**
Dickey	0	0	0	**0**
Divide	156,271	217,265	94,411	**155,982**
Dunn	2,537	6,665	4,514	**4,572**
Eddy	0	4,080	5,476	**3,185**
Emmons	5,594	5,557	0	**3,717**
Foster	4,423	7,219	6,875	**6,172**
Golden Valley	36,964	42,536	25,260	**34,920**
Grand Forks	3,212	1,390	0	**1,534**
Grant	2,422	1,465	214	**1,367**
Griggs	0	3,040	0	**1,013**
Hettinger	40,979	36,871	20,952	**32,934**
Kidder	0	8,803	5,707	**4,837**
LaMoure	0	0	0	**0**
Logan	4,129	3,782	2,888	**3,600**
McHenry	2,812	9,410	5,398	**5,873**
McIntosh	1,780	0	3,195	**1,658**
McKenzie	69,287	86,285	45,345	**66,972**
McLean	58,947	88,676	41,210	**62,944**
Mercer	3,478	7,761	6,557	**5,932**
Morton	9,206	12,331	3,718	**8,418**
Mountrail	95,724	134,899	44,399	**91,674**
Nelson	5,357	5,133	2,462	**4,317**
Oliver	0	2,740	731	**1,157**
Pembina	2,900	2,855	6,275	**4,010**
Pierce	8,462	16,453	14,185	**13,034**
Ramsey	6,444	5,504	9,766	**7,238**
Ransom	0	0	0	**0**
Renville	30,374	59,656	34,160	**41,397**
Richland	0	0	3,265	**1,088**
Rolette	15,210	16,880	16,985	**16,359**
Sargent	0	0	0	**0**
Sheridan	5,357	11,384	10,454	**9,065**
Sioux	0	0	0	**0**

Slope	50,098	23,578	18,658	**30,778**
Stark	36,208	38,917	17,117	**30,747**
Steele	0	3,677	2,886	**2,188**
Stutsman	7,150	11,062	8,761	**8,991**
Towner	20,464	14,951	23,468	**19,628**
Trail	0	0	0	**0**
Walsh	5,641	1,051	5,626	**4,106**
Ward	80,897	100,599	56,143	**79,213**
Wells	15,307	23,416	28,061	**22,261**
Williams	317,445	376,397	211,756	**301,866**

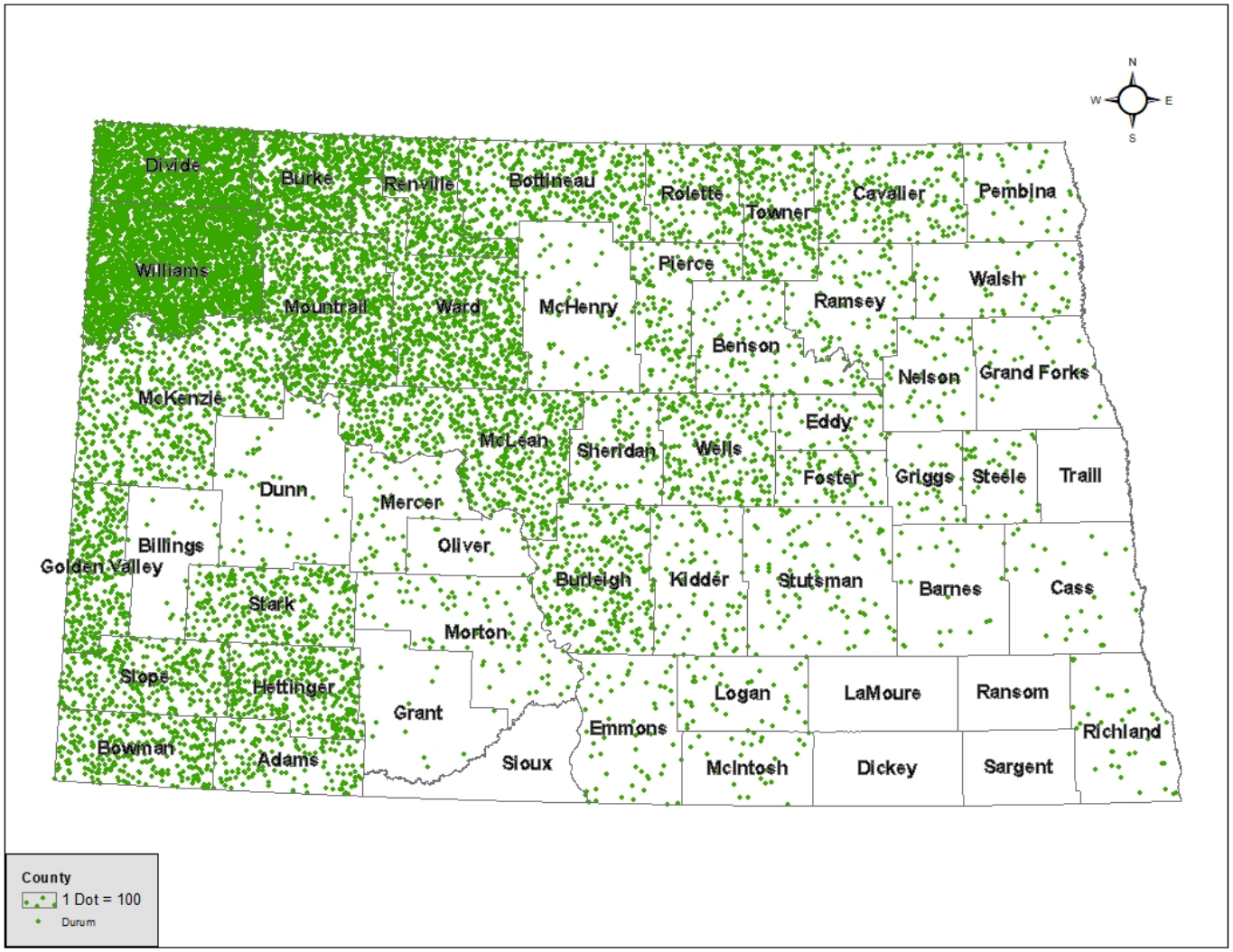

Figure A6: Durum Average Tonnage Production North Dakota, 2015-2017

Table A7: Flax Tonnage Production North Dakota, 2015-2017				
County	**2015**	**2016**	**2017**	**Average**
Adams	2,628	2,630	781	2,013
Barnes	0	0	0	0
Benson	1,922	1,961	508	1,464
Billings	0	0	0	0
Bottineau	8,587	6,406	3,148	6,047
Bowman	3,803	3,601	1,090	2,831
Burke	15,958	14,891	9,384	13,411
Burleigh	5,002	4,794	1,452	3,750
Cass	0	0	0	0
Cavalier	4,075	3,148	1,944	3,056
Dickey	0	0	0	0
Divide	14,177	12,052	9,962	12,064
Dunn	1,325	581	460	789
Eddy	806	0	0	269
Emmons	565	1,159	248	657
Foster	807	0	0	269
Golden Valley	621	0	0	207
Grand Forks	0	0	0	0
Grant	3,732	1,924	609	2,088
Griggs	0	0	0	0
Hettinger	7,155	5,687	1,296	4,712
Kidder	3,949	2,752	1,624	2,775
LaMoure	0	0	0	0
Logan	680	0	454	378
McHenry	10,000	7,905	1,571	6,492
McIntosh	0	620	0	207
McKenzie	3,746	1,971	1,427	2,381
McLean	21,230	21,267	6,632	16,376
Mercer	2,160	2,609	758	1,842
Morton	3,979	4,174	1,062	3,071
Mountrail	32,980	22,053	10,793	21,942
Nelson	2,044	1,349	0	1,131
Oliver	2,465	2,172	755	1,797
Pembina	0	0	0	0
Pierce	3,071	1,520	475	1,689
Ramsey	3,026	498	0	1,175
Ransom	0	0	0	0
Renville	13,315	13,037	7,448	11,266
Richland	0	0	0	0
Rolette	3,737	2,099	810	2,215
Sargent	0	0	0	0
Sheridan	6,829	8,181	1,768	5,593
Sioux	0	0	0	0

Slope	2,536	1,445	268	1,416
Stark	2,723	3,152	671	2,182
Steele	0	0	0	0
Stutsman	1,519	929	0	816
Towner	3,371	2,579	1,750	2,567
Trail	0	0	0	0
Walsh	1,026	1,093	0	706
Ward	46,369	37,298	14,347	32,672
Wells	957	1,320	0	759
Williams	6,659	6,607	4,020	5,762

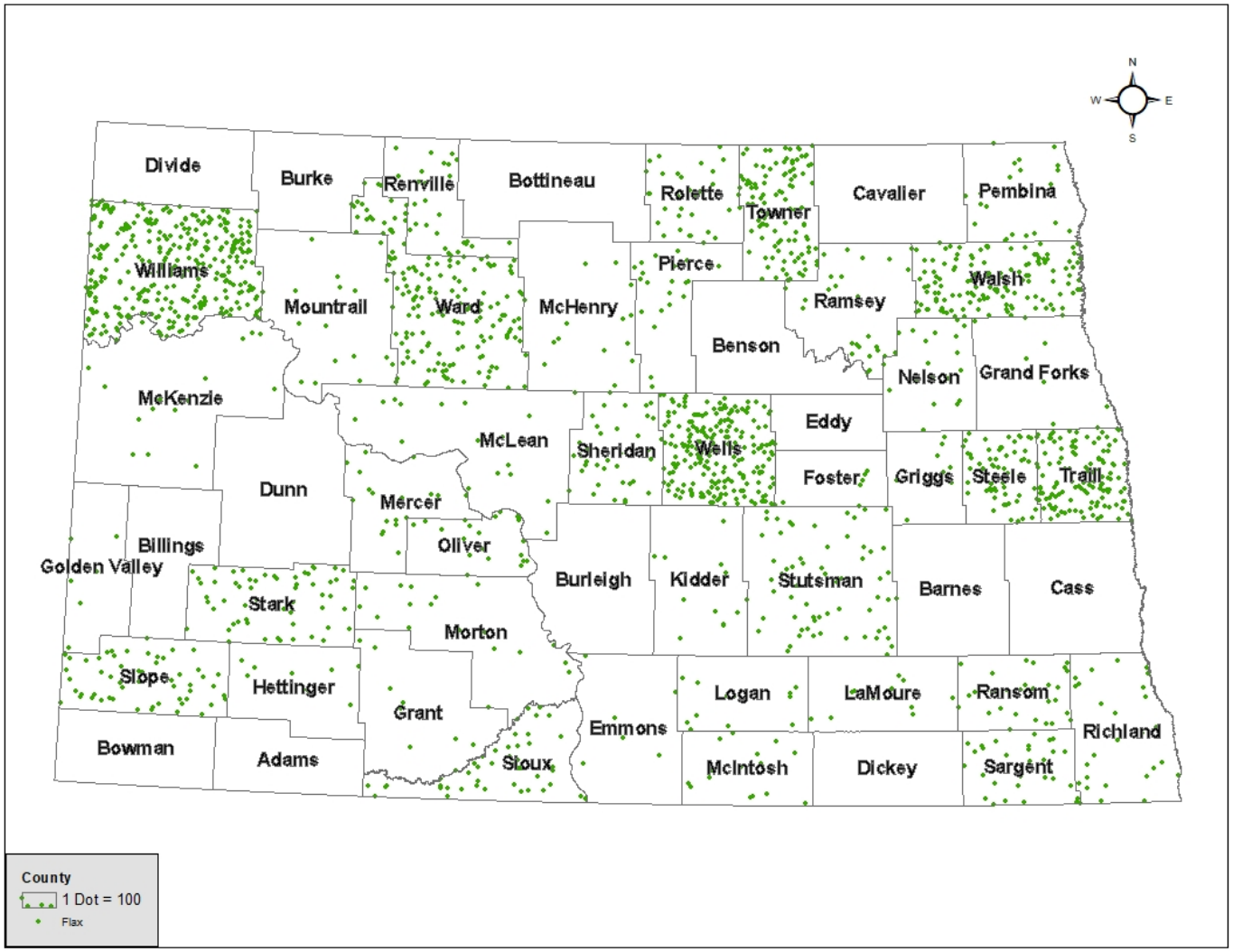

Figure A7: Flax Average Tonnage Production North Dakota, 2015-2017

Table A8: Spring Wheat Tonnage Production North Dakota, 2015-2017				
County	**2015**	**2016**	**2017**	**Average**
Adams	218,906	122,191	50,507	**130,535**
Barnes	188,715	187,609	119,729	**165,351**
Benson	228,891	201,848	191,668	**207,469**
Billings	49,035	27,563	16,597	**31,065**
Bottineau	384,393	369,896	319,092	**357,794**
Bowman	133,185	66,101	33,813	**77,699**
Burke	166,035	146,823	114,080	**142,313**
Burleigh	147,937	118,738	55,351	**107,342**
Cass	227,772	202,911	165,260	**198,648**
Cavalier	578,070	405,896	568,841	**517,602**
Dickey	45,151	43,722	20,505	**36,459**
Divide	132,965	68,152	57,431	**86,183**
Dunn	256,531	196,497	109,517	**187,515**
Eddy	65,638	63,096	57,161	**61,965**
Emmons	201,931	92,906	60,823	**118,553**
Foster	77,164	81,296	51,600	**70,020**
Golden Valley	65,525	36,313	15,959	**39,266**
Grand Forks	316,221	269,541	253,776	**279,846**
Grant	187,866	126,195	40,058	**118,039**
Griggs	125,760	110,591	101,255	**112,535**
Hettinger	437,471	315,476	138,897	**297,281**
Kidder	88,034	67,582	42,685	**66,100**
LaMoure	74,764	82,301	46,967	**68,011**
Logan	98,811	89,303	45,723	**77,946**
McHenry	206,768	221,987	136,350	**188,368**
McIntosh	128,123	117,507	57,015	**100,882**
McKenzie	93,232	78,975	41,909	**71,372**
McLean	425,224	411,313	234,570	**357,036**
Mercer	105,895	87,088	37,595	**76,859**
Morton	262,824	188,805	84,379	**178,669**
Mountrail	238,663	219,451	144,487	**200,867**
Nelson	192,691	181,491	180,499	**184,894**
Oliver	93,423	98,199	47,636	**79,753**
Pembina	401,801	272,409	365,931	**346,714**
Pierce	205,566	178,910	157,859	**180,778**
Ramsey	243,136	193,051	234,608	**223,598**
Ransom	72,223	75,444	48,683	**65,450**
Renville	196,985	192,993	158,669	**182,883**
Richland	112,257	112,073	86,994	**103,775**
Rolette	161,069	141,092	154,642	**152,268**
Sargent	63,923	48,594	32,235	**48,251**
Sheridan	143,632	137,314	93,069	**124,672**
Sioux	51,504	33,796	30,600	**38,633**

Slope	169,943	87,575	55,859	**104,459**
Stark	349,362	263,339	101,909	**238,203**
Steele	113,092	95,039	73,053	**93,728**
Stutsman	168,544	174,844	120,689	**154,693**
Towner	338,980	243,939	288,906	**290,608**
Trail	196,652	150,281	141,606	**162,846**
Walsh	369,421	262,894	325,344	**319,220**
Ward	452,353	435,067	325,046	**404,155**
Wells	286,204	282,773	206,816	**258,598**
Williams	103,970	61,364	47,901	**71,078**

***includes hard red spring and winter wheat*

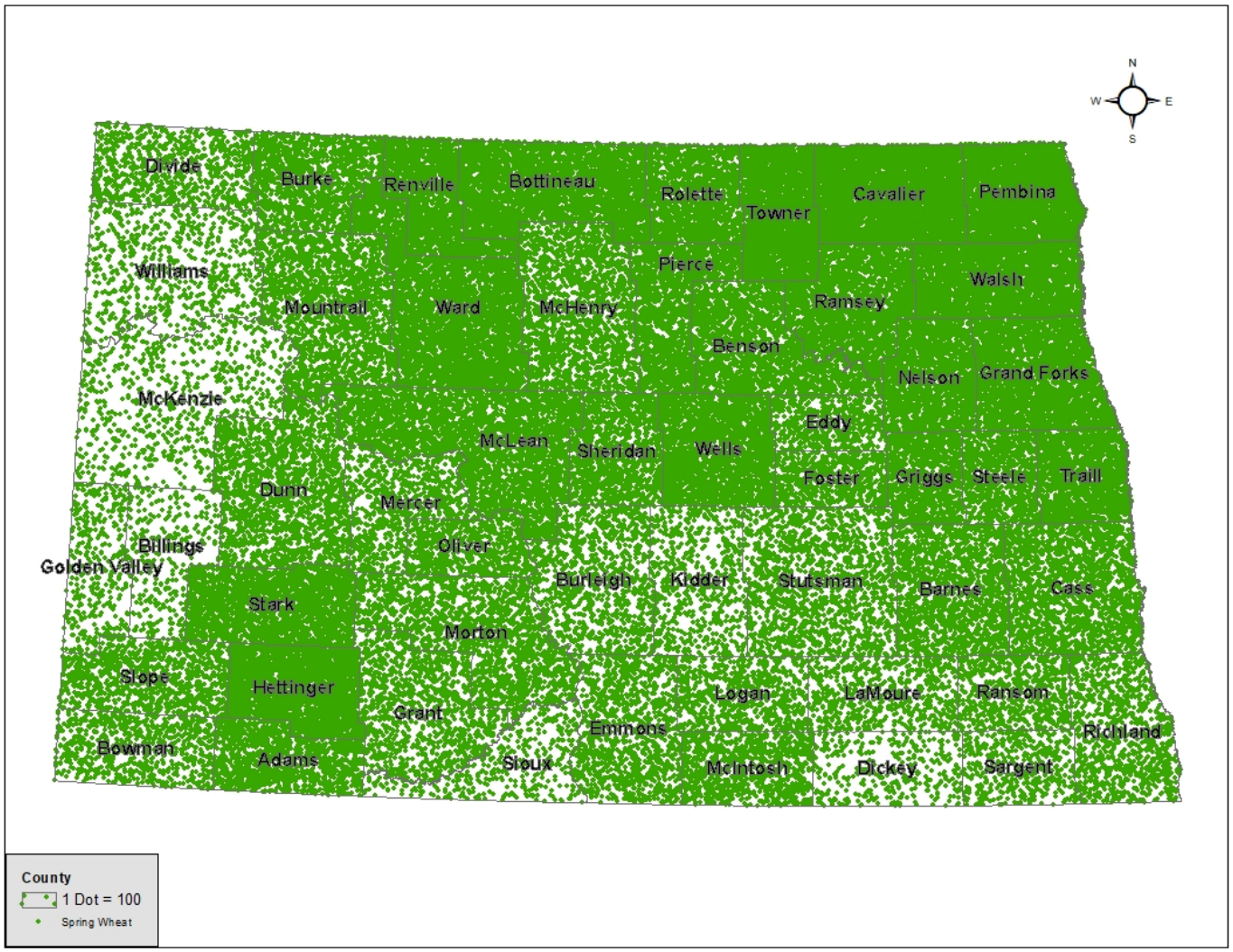

Figure A8: Spring Wheat Average Tonnage Production North Dakota, 2015-2017

Table A9: Lentil Tonnage Production North Dakota, 2015-2017				
County	**2015**	**2016**	**2017**	**Average**
Adams	0	0	492	**164**
Barnes	0	0	0	**0**
Benson	0	0	0	**0**
Billings	0	0	0	**0**
Bottineau	0	1,852	0	**617**
Bowman	0	671	1,112	**594**
Burke	0	2,788	1,336	**1,375**
Burleigh	0	0	0	**0**
Cass	0	0	0	**0**
Cavalier	0	0	0	**0**
Dickey	0	0	0	**0**
Divide	31,231	41,801	23,292	**32,108**
Dunn	0	0	1,144	**381**
Eddy	0	0	0	**0**
Emmons	0	0	720	**240**
Foster	0	0	0	**0**
Golden Valley	9,983	11,844	3,733	**8,520**
Grand Forks	0	0	0	**0**
Grant	0	0	0	**0**
Griggs	0	0	0	**0**
Hettinger	0	1,183	0	**394**
Kidder	0	2,503	810	**1,104**
LaMoure	0	0	0	**0**
Logan	0	2,334	1,736	**1,357**
McHenry	0	0	0	**0**
McIntosh	0	731	346	**359**
McKenzie	5,826	13,689	6,734	**8,750**
McLean	3,227	13,016	6,937	**7,726**
Mercer	0	0	0	**0**
Morton	0	0	0	**0**
Mountrail	1,370	3,643	2,882	**2,632**
Nelson	0	0	0	**0**
Oliver	0	0	0	**0**
Pembina	0	0	0	**0**
Pierce	0	0	0	**0**
Ramsey	0	0	0	**0**
Ransom	0	0	0	**0**
Renville	0	1,729	0	**576**
Richland	0	0	0	**0**
Rolette	0	0	0	**0**
Sargent	0	0	0	**0**
Sheridan	0	2,260	609	**956**
Sioux	0	0	0	**0**

Slope	0	2,500	0	**833**
Stark	1,033	706	1,545	**1,095**
Steele	0	0	0	**0**
Stutsman	0	0	0	**0**
Towner	0	0	0	**0**
Trail	0	0	0	**0**
Walsh	0	0	0	**0**
Ward	885	3,609	2,918	**2,471**
Wells	0	0	0	**0**
Williams	52,085	78,678	51,756	**60,840**

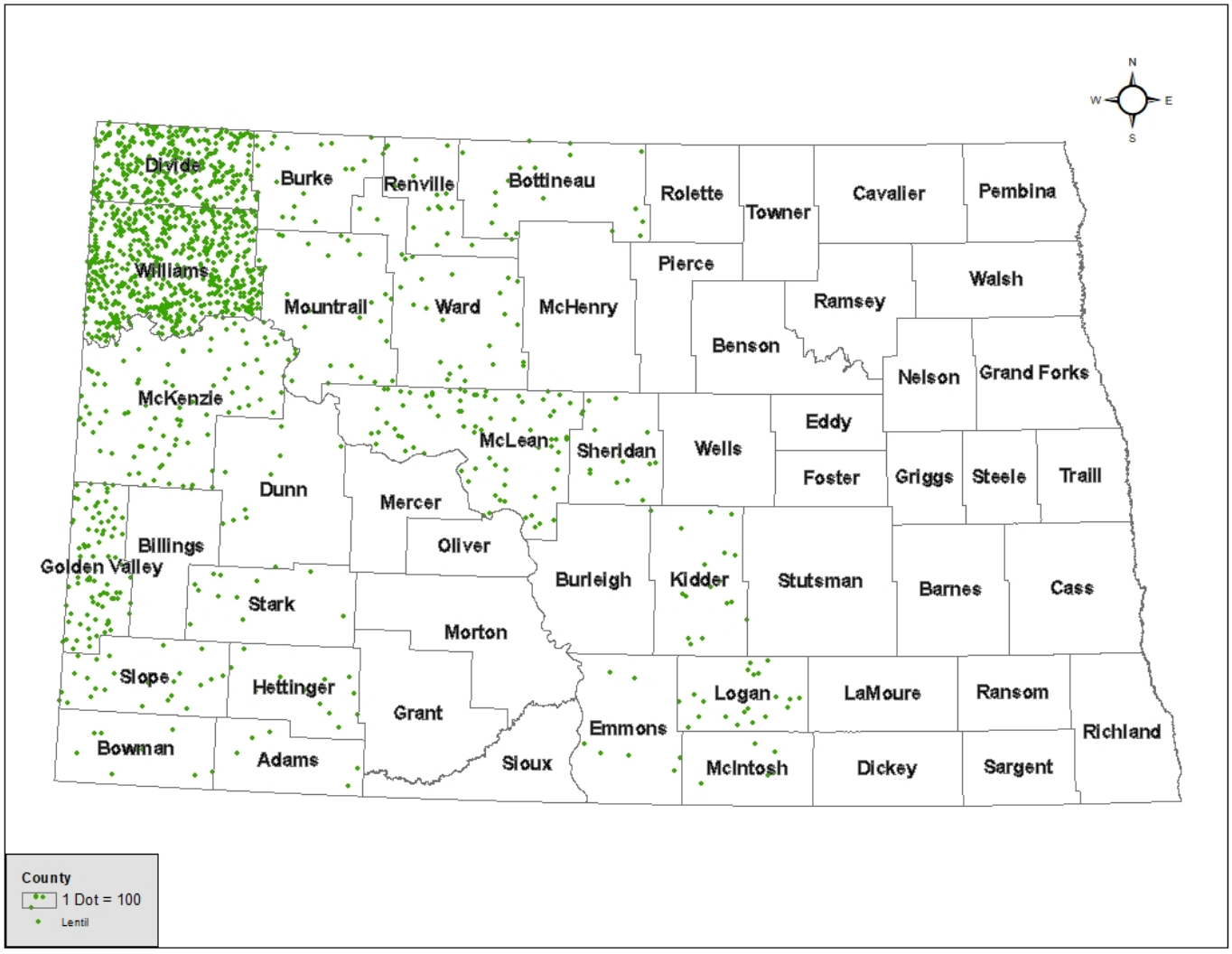

Figure A9: Lentil Average Tonnage Production North Dakota, 2015-2017

Table A10: Soybean Tonnage Production North Dakota, 2015-2017				
County	**2015**	**2016**	**2017**	**Average**
Adams	0	884	1,496	**793**
Barnes	386,227	489,853	433,768	**436,616**
Benson	136,166	208,207	200,036	**181,470**
Billings	0	0	0	**0**
Bottineau	133,634	232,860	273,697	**213,397**
Bowman	0	0	0	**0**
Burke	0	0	19,927	**6,642**
Burleigh	53,723	83,123	90,312	**75,719**
Cass	575,565	679,329	563,889	**606,261**
Cavalier	95,107	132,938	168,357	**132,134**
Dickey	194,180	260,874	240,967	**232,007**
Divide	10,518	9,669	13,565	**11,251**
Dunn	0	0	0	**0**
Eddy	61,886	87,960	89,048	**79,632**
Emmons	105,594	117,520	154,931	**126,015**
Foster	146,168	189,545	152,347	**162,687**
Golden Valley	0	0	0	**0**
Grand Forks	195,532	251,573	257,102	**234,736**
Grant	2,987	2,099	3,993	**3,026**
Griggs	116,950	159,894	127,685	**134,843**
Hettinger	2,524	-	2,812	**1,778**
Kidder	42,696	67,342	82,088	**64,042**
LaMoure	311,356	446,643	328,859	**362,286**
Logan	69,548	97,977	99,483	**89,003**
McHenry	95,899	158,476	148,162	**134,179**
McIntosh	101,801	134,431	116,598	**117,610**
McKenzie	0	0	0	**0**
McLean	73,025	116,070	132,981	**107,358**
Mercer	5,600	8,252	10,674	**8,175**
Morton	12,366	20,908	26,230	**19,834**
Mountrail	12,937	18,964	37,385	**23,095**
Nelson	103,420	137,104	148,878	**129,801**
Oliver	10,601	15,336	18,681	**14,872**
Pembina	151,257	186,479	194,019	**177,252**
Pierce	88,492	136,494	115,985	**113,657**
Ramsey	104,793	164,436	171,675	**146,968**
Ransom	147,758	202,980	188,987	**179,908**
Renville	60,952	102,503	111,817	**91,758**
Richland	345,613	434,846	405,076	**395,178**
Rolette	38,675	56,232	65,708	**53,538**
Sargent	177,695	264,916	247,381	**229,997**
Sheridan	59,891	91,664	77,927	**76,494**
Sioux	1,424	2,600	2,991	**2,338**

Slope	0	0	0	**0**
Stark	1,894	0	315	**737**
Steele	186,867	224,249	197,949	**203,022**
Stutsman	426,524	524,049	527,588	**492,720**
Towner	95,192	139,519	147,285	**127,332**
Trail	249,125	260,644	240,118	**249,962**
Walsh	106,503	132,931	151,927	**130,453**
Ward	122,131	182,743	173,167	**159,347**
Wells	166,637	263,269	251,973	**227,293**
Williams	8,636	5,444	5,818	**6,633**

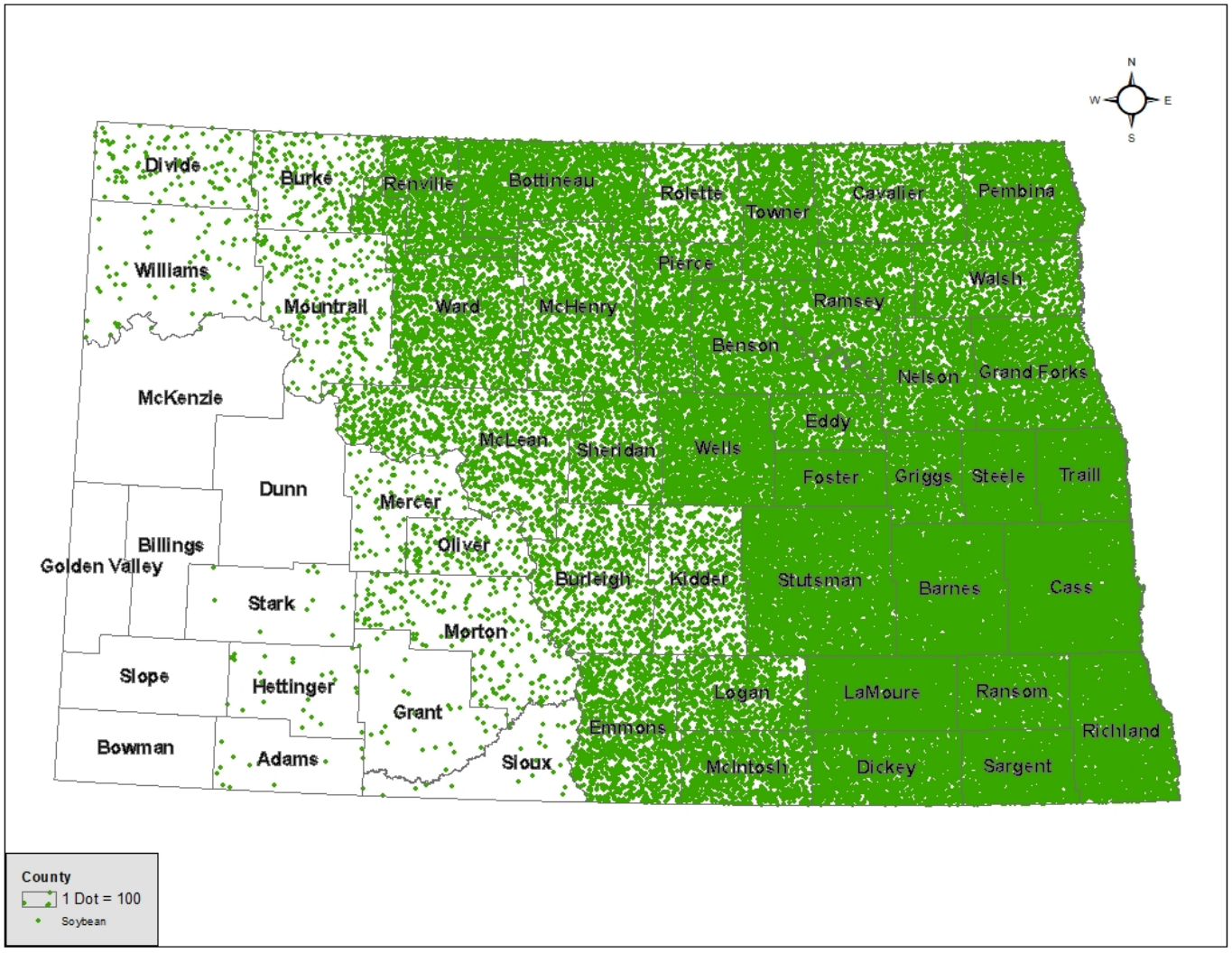

Figure A10: Soybean Average Tonnage Production North Dakota, 2015-2017

Table A11: Sunflower Seed Tonnage Production North Dakota, 2015-2017				
County	**2015**	**2016**	**2017**	**Average**
Adams	17,458	22,917	18,678	**19,684**
Barnes	4,310	1,740	0	**2,017**
Benson	0	3,036	2,121	**1,719**
Billings	2,178	2,237	1,998	**2,138**
Bottineau	31,722	17,760	2,791	**17,425**
Bowman	5,089	5,439	3,251	**4,593**
Burke	6,460	7,521	3,562	**5,848**
Burleigh	24,975	20,866	8,616	**18,152**
Cass	25,605	17,821	9,613	**17,680**
Cavalier	13,695	7,169	5,056	**8,640**
Dickey	3,429	2,452	1,185	**2,355**
Divide	2,114	1,743	2,071	**1,976**
Dunn	12,905	14,086	7,016	**11,336**
Eddy	0	6,527	3,635	**3,387**
Emmons	79,888	78,984	56,728	**71,867**
Foster	0	1,931	1,961	**1,298**
Golden Valley	5,245	5,516	1,363	**4,041**
Grand Forks	11,314	7,760	5,890	**8,322**
Grant	29,643	44,792	21,858	**32,098**
Griggs	1,350	1,368	0	**906**
Hettinger	19,789	26,327	14,522	**20,213**
Kidder	5,105	9,701	2,491	**5,766**
LaMoure	0	608	762	**457**
Logan	6,230	5,205	2,480	**4,638**
McHenry	4,034	3,204	0	**2,413**
McIntosh	15,817	15,026	13,215	**14,686**
McKenzie	0	0	0	**0**
McLean	18,912	10,781	6,034	**11,909**
Mercer	10,751	17,027	14,148	**13,975**
Morton	35,446	47,718	24,560	**35,908**
Mountrail	6,369	9,374	7,123	**7,622**
Nelson	398	2,020	0	**806**
Oliver	8,420	9,815	7,672	**8,636**
Pembina	8,533	5,115	1,469	**5,039**
Pierce	2,820	3,678	1,280	**2,593**
Ramsey	3,673	1,650	2,164	**2,496**
Ransom	1,078	2,705	0	**1,261**
Renville	17,047	12,747	5,186	**11,660**
Richland	7,057	8,830	1,526	**5,804**
Rolette	2,549	4,212	1,951	**2,904**
Sargent	1,633	2,365	0	**1,333**
Sheridan	2,617	4,118	3,503	**3,412**
Sioux	11,251	18,064	10,823	**13,379**

Slope	5,925	8,635	4,203	**6,254**
Stark	14,792	20,665	10,649	**15,369**
Steele	8,245	5,230	1,675	**5,050**
Stutsman	4,156	13,743	1,485	**6,461**
Towner	4,789	8,788	1,349	**4,975**
Trail	10,616	5,414	2,805	**6,278**
Walsh	4,691	3,314	3,154	**3,720**
Ward	21,790	26,265	12,265	**20,107**
Wells	2,994	7,329	4,968	**5,097**
Williams	1,575	2,971	4,444	**2,996**

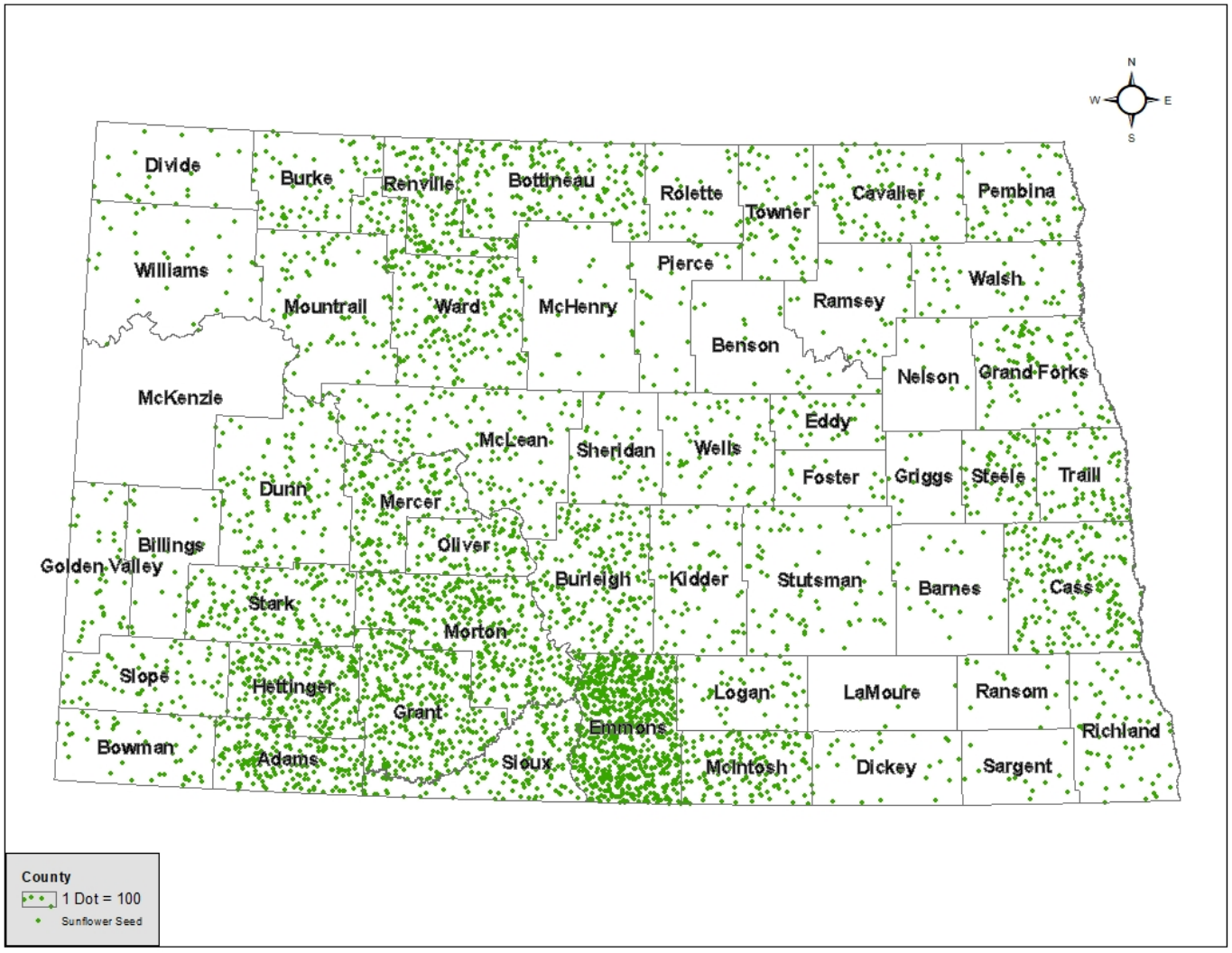

Figure A11: Sunflower Seed Average Tonnage Production North Dakota, 2015-2017

APPENDIX B: TOTAL TRANSPORTATION COST BY COMMODITY

Table B1: Barley Total Transportation Carrier Cost, North Dakota, 2015-2017						
	Rail ($000)			**Truck ($000)**		
County	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Adams	6	4	5	54	46	36
Barnes	78	57	511	431	386	248
Benson	406	240	546	2,013	1,554	1,175
Billings	11	14	13	46	78	34
Bottineau	874	341	1,517	4,101	2,138	999
Bowman	15	7	6	116	72	40
Burke	144	65	81	641	392	243
Burleigh	223	89	759	1,044	532	338
Cass	91	48	79	765	504	422
Cavalier	370	111	246	1,833	711	674
Dickey	17	19	97	99	137	67
Divide	99	46	88	421	262	131
Dunn	43	24	46	168	125	58
Eddy	80	51	340	468	386	199
Emmons	100	24	16	847	277	115
Foster	137	80	117	682	498	230
Golden Valley	0	0	0	0	0	0
Grand Forks	93	43	297	554	327	233
Grant	22	5	9	88	29	15
Griggs	65	31	91	294	176	155
Hettinger	47	12	121	179	61	55
Kidder	119	47	123	562	280	235
LaMoure	20	17	13	115	121	29
Logan	106	68	261	532	437	145
McHenry	170	88	286	823	559	463
McIntosh	45	30	18	228	194	34
McKenzie	137	94	154	484	451	69
McLean	132	83	48	628	528	258
Mercer	95	83	34	396	454	179
Morton	118	77	35	491	415	101
Mountrail	125	44	11	577	273	69
Nelson	139	72	66	681	459	380
Oliver	33	31	24	140	174	76
Pembina	61	30	28	304	195	172
Pierce	203	111	135	946	688	785
Ramsey	505	245	407	2,655	1,668	1,416
Ransom	8	7	0	50	53	0
Renville	546	258	112	2,464	1,562	645
Richland	22	5	3	195	54	38
Rolette	188	84	77	950	565	328
Sargent	0	6	6	0	48	48
Sheridan	202	144	65	902	831	379

Sioux	0	0	0	0	0	0
Slope	12	15	6	80	131	44
Stark	59	55	8	227	277	44
Steele	58	35	44	357	275	334
Stutsman	96	63	75	510	408	224
Towner	203	103	55	984	650	326
Trail	116	53	75	793	463	570
Walsh	143	56	110	709	354	378
Ward	287	127	58	1,404	826	380
Wells	229	122	97	1,073	733	536
Williams	350	140	106	1,522	827	412

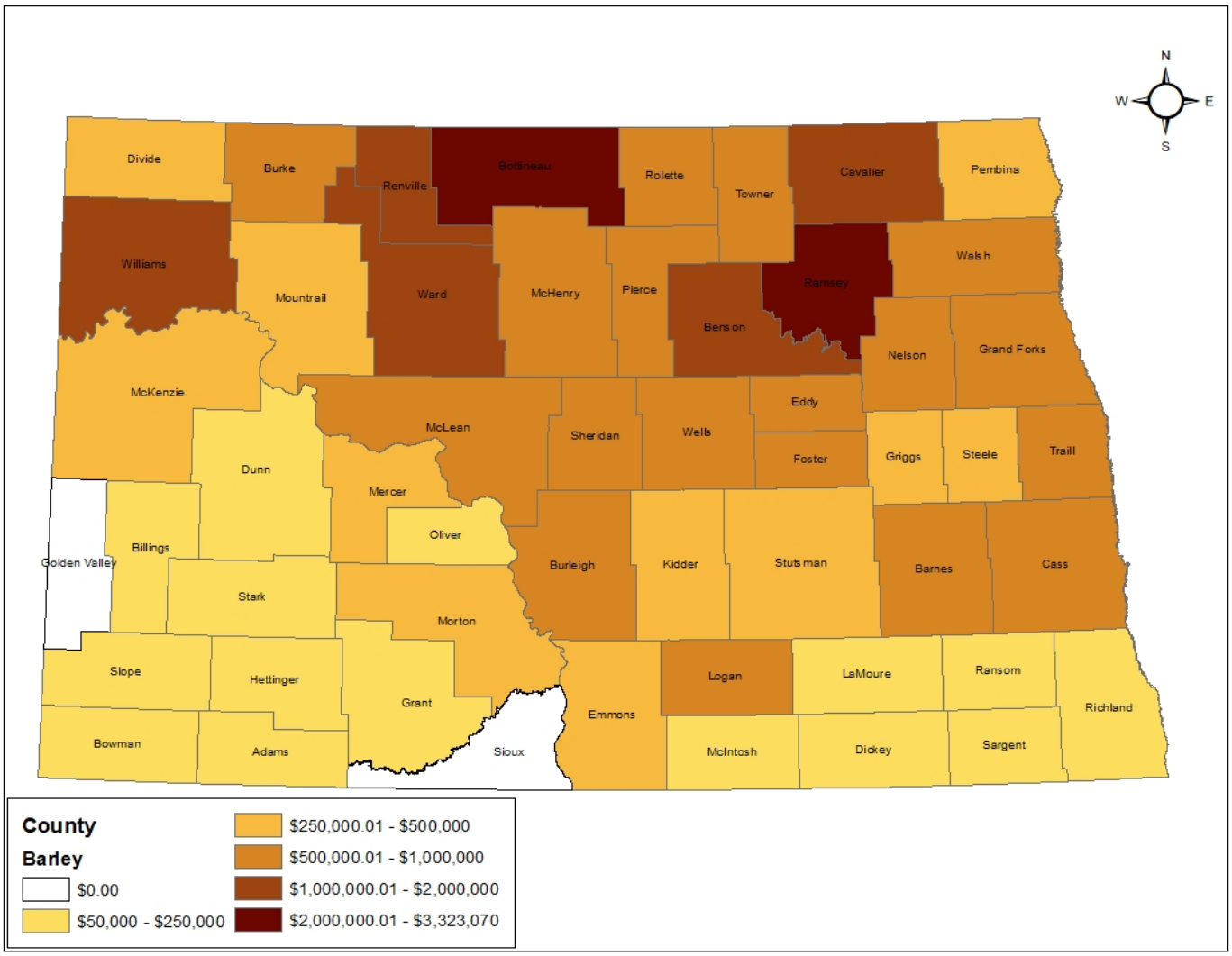

Figure B1: Barley Average Transportation Cost North Dakota, 2015-2017

Table B2: Canola Total Transportation Carrier Cost, North Dakota, 2015-2017						
	Rail ($000)			**Truck ($000)**		
County	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Adams	18	14	10	908	478	453
Barnes	10	0	0	0	0	0
Benson	4	10	12	366	280	448
Billings	105	2	1	111	47	23
Bottineau	7	143	116	3,597	3,704	3,825
Bowman	123	5	2	318	147	80
Burke	9	130	107	3,973	3,183	3,352
Burleigh	0	19	10	315	475	343
Cass	295	0	0	0	0	0
Cavalier	0	324	341	11,066	9,172	12,348
Dickey	48	0	0	0	0	0
Divide	12	68	59	1,461	1,600	1,758
Dunn	2	11	10	322	240	269
Eddy	0	3	3	87	94	116
Emmons	1	2	1	0	63	59
Foster	3	0	1	37	0	50
Golden Valley	1	6	4	87	125	98
Grand Forks	9	1	3	61	45	105
Grant	0	9	5	251	197	132
Griggs	118	0	0	0	0	0
Hettinger	2	119	47	3,225	2,503	1,255
Kidder	0	5	4	72	138	149
LaMoure	1	0	0	0	0	0
Logan	55	1	0	21	30	0
McHenry	1	77	64	1,977	2,116	2,229
McIntosh	17	0	0	35	0	0
McKenzie	113	14	13	441	276	323
McLean	20	143	97	3,786	3,641	3,161
Mercer	4	26	15	591	589	415
Morton	146	7	3	116	162	97
Mountrail	14	168	134	4,589	4,026	4,054
Nelson	5	16	19	538	466	737
Oliver	5	7	4	148	174	108
Pembina	30	7	9	165	177	307
Pierce	53	42	35	1,114	1,157	1,230
Ramsey	0	61	67	2,051	1,783	2,512
Ransom	95	0	0	0	0	0
Renville	0	112	96	3,096	2,769	3,011
Richland	83	0	0	0	0	0
Rolette	0	76	82	3,086	2,136	2,941
Sargent	22	0	0	0	0	0
Sheridan	0	33	24	694	804	754

Sioux	10	0	0	0	0	0
Slope	33	12	9	403	339	332
Stark	0	36	12	951	788	338
Steele	1	0	0	0	0	0
Stutsman	111	4	3	42	104	99
Towner	0	112	119	4,072	3,132	4,227
Trail	31	0	0	0	0	0
Walsh	128	32	39	1,209	930	1,477
Ward	2	167	122	4,546	4,541	4,223
Wells	48	5	6	81	138	221
Williams	18	64	62	1,528	1,562	1,927

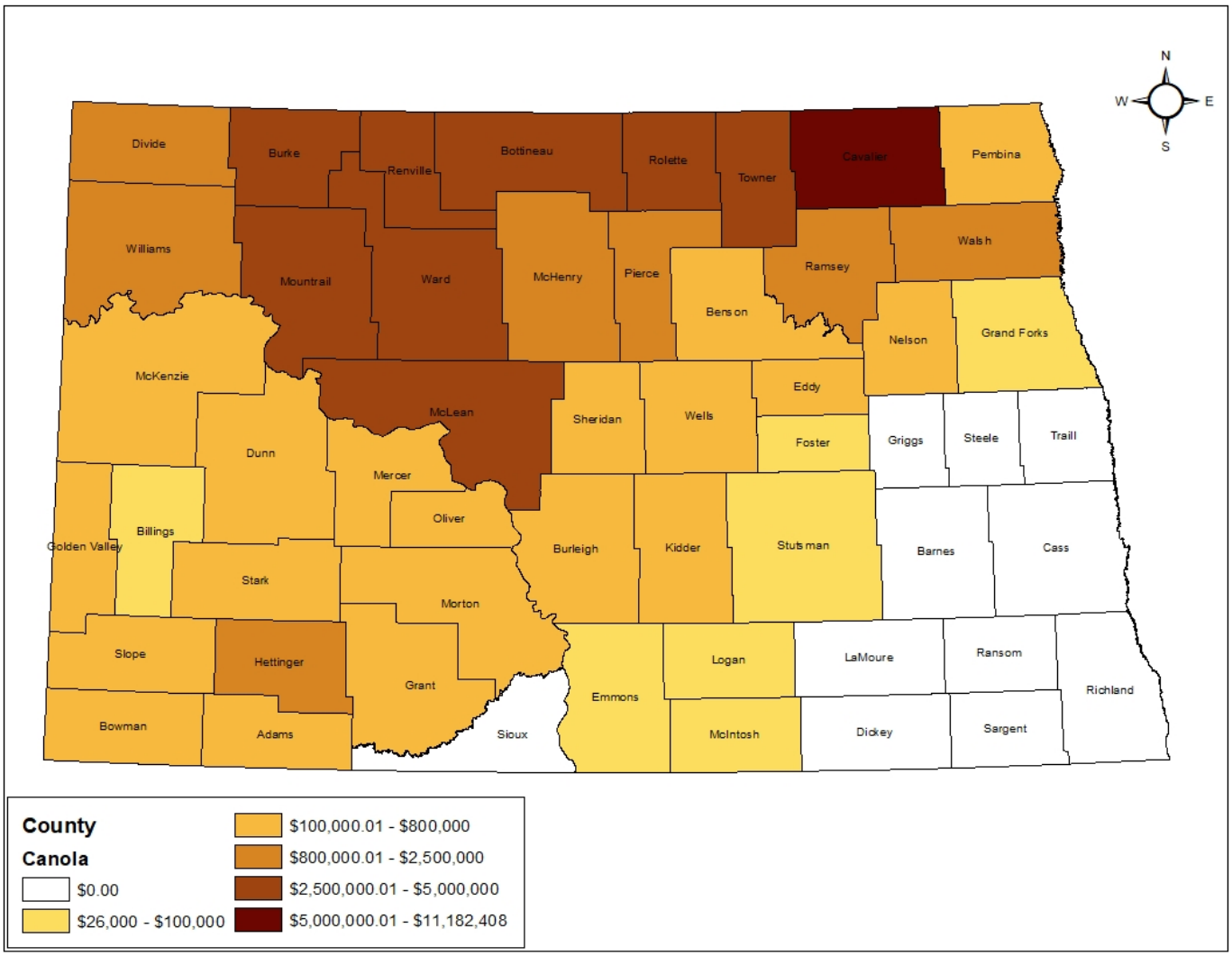

Figure B2: Canola Average Transportation Cost North Dakota, 2015-2017

Table B3: Corn Total Transportation Carrier Cost, North Dakota, 2015-2017						
	Rail ($000)			**Truck ($000)**		
County	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Adams	114	139	55	1,279	1,447	880
Barnes	1,781	3,219	2,624	15,193	19,571	21,735
Benson	421	719	666	4,011	5,283	6,439
Billings	0	0	0	0	0	0
Bottineau	197	438	331	1,642	2,871	2,835
Bowman	0	0	0	0	0	0
Burke	0	0	0	0	0	0
Burleigh	236	665	452	2,277	4,989	4,557
Cass	3,092	5,570	4,412	25,615	32,628	35,842
Cavalier	51	146	154	398	839	1,182
Dickey	1,659	2,897	2,131	14,571	18,359	18,834
Divide	0	0	0	0	0	0
Dunn	104	160	113	662	792	744
Eddy	201	358	321	2,132	2,765	3,324
Emmons	782	1,614	1,029	6,065	9,279	8,556
Foster	462	867	647	4,717	6,385	6,365
Golden Valley	13	7	16	138	69	207
Grand Forks	1,181	1,971	1,659	9,647	11,843	13,581
Grant	295	462	156	2,121	2,587	1,159
Griggs	318	580	449	3,373	4,667	4,739
Hettinger	195	277	213	1,257	1,382	1,405
Kidder	103	197	188	977	1,431	1,841
LaMoure	2,095	3,355	2,431	17,401	19,596	19,672
Logan	169	359	336	1,528	2,504	3,220
McHenry	270	513	369	2,912	4,439	4,156
McIntosh	368	621	446	3,217	4,138	4,121
McKenzie	0	0	0	0	0	0
McLean	460	840	667	4,001	5,597	5,870
Mercer	144	202	132	1,059	1,162	1,020
Morton	190	305	152	1,882	2,634	1,707
Mountrail	15	39	56	111	213	412
Nelson	203	399	350	1,833	2,694	3,163
Oliver	107	172	137	902	1,151	1,222
Pembina	338	555	569	2,658	3,235	4,439
Pierce	182	325	225	1,725	2,445	2,214
Ramsey	414	839	752	3,843	5,830	6,960
Ransom	1,219	1,961	1,608	10,107	11,509	12,992
Renville	43	111	91	361	749	799
Richland	4,289	5,982	5,558	33,055	32,261	41,872
Rolette	34	86	68	293	581	601
Sargent	1,815	2,853	2,377	13,988	15,500	17,882
Sheridan	149	251	217	1,224	1,457	1,674

Sioux	107	165	128	612	740	760
Slope	0	0	0	0	0	0
Stark	134	119	66	1,362	1,102	773
Steele	898	1,623	1,295	7,361	9,718	10,649
Stutsman	1,536	2,903	2,316	14,860	20,139	21,905
Towner	108	237	226	980	1,633	2,056
Trail	1,483	2,250	1,814	11,788	12,863	14,282
Walsh	384	753	810	3,154	4,575	6,612
Ward	126	274	170	1,295	2,281	1,841
Wells	571	1,058	1,089	5,854	8,234	11,180
Williams	0	0	0	0	0	0

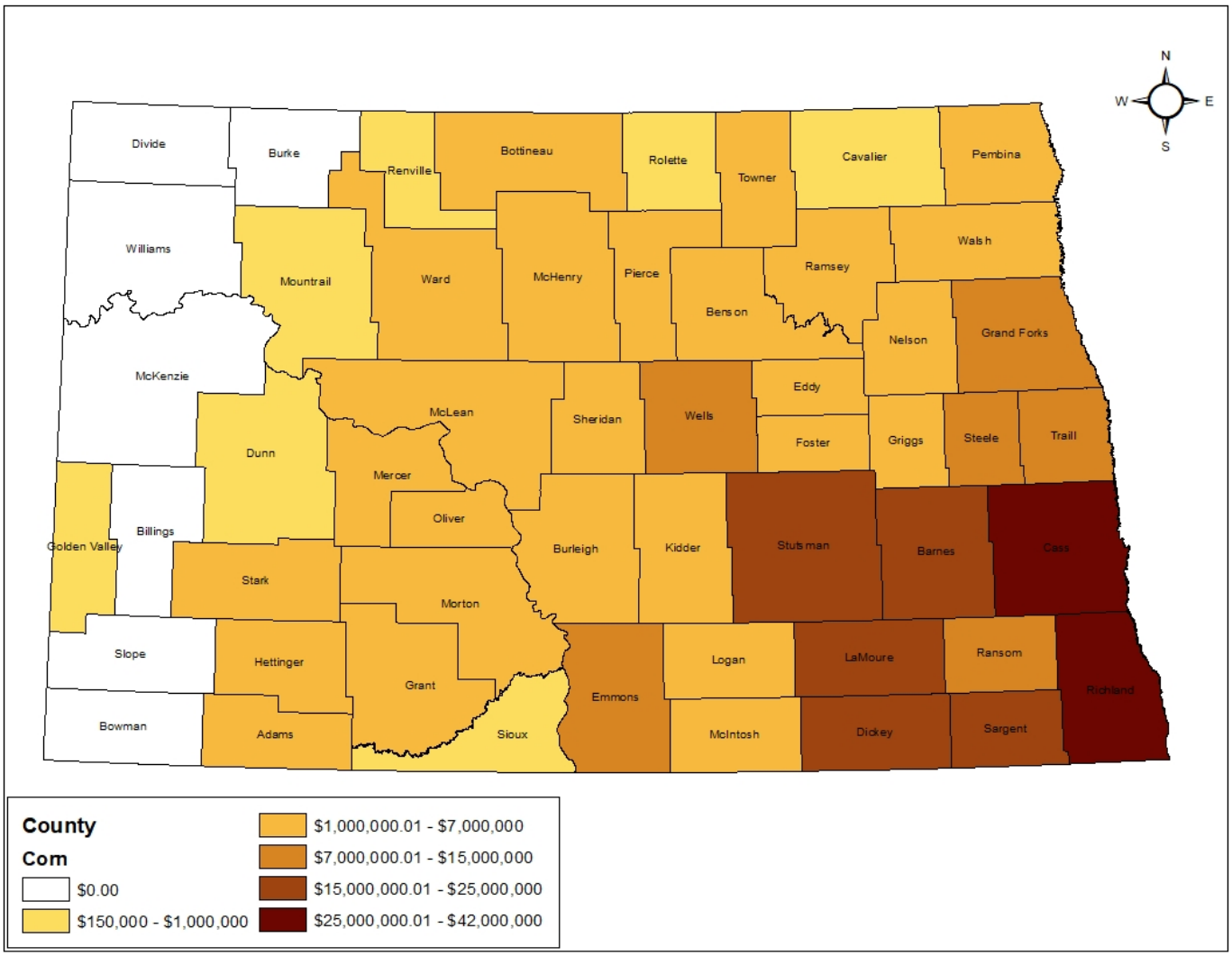

Figure B3: Corn Average Transportation Cost North Dakota, 2015-2017

Table B4: Dry Edible Bean Total Transportation Carrier Cost, North Dakota, 2015-2017						
	Rail ($000)			**Truck ($000)**		
County	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Adams	0	0	0	0	0	0
Barnes	24	25	40	289	424	588
Benson	127	149	177	1,198	1,969	2,056
Billings	0	0	0	0	0	0
Bottineau	0	0	0	0	0	0
Bowman	0	0	0	0	0	0
Burke	0	0	0	0	0	0
Burleigh	23	14	33	262	224	447
Cass	16	17	35	235	363	651
Cavalier	72	31	66	665	407	746
Dickey	9	6	10	141	142	193
Divide	0	0	0	0	0	0
Dunn	0	0	0	0	0	0
Eddy	17	15	26	208	260	386
Emmons	0	0	3	0	0	81
Foster	8	8	24	91	130	331
Golden Valley	0	0	0	0	0	0
Grand Forks	82	231	289	925	3,689	4,061
Grant	0	0	0	0	0	0
Griggs	43	40	56	455	586	727
Hettinger	0	0	0	0	0	0
Kidder	0	0	0	0	0	0
LaMoure	24	18	21	358	358	383
Logan	0	0	0	0	0	0
McHenry	0	0	5	0	0	61
McIntosh	0	0	0	0	0	0
McKenzie	0	0	0	0	0	0
McLean	73	89	135	664	1,124	1,494
Mercer	6	0	16	54	0	162
Morton	0	0	0	0	0	0
Mountrail	0	0	0	0	0	0
Nelson	73	58	96	758	842	1,222
Oliver	13	8	9	126	110	111
Pembina	298	145	241	2,849	1,951	2,858
Pierce	23	26	27	209	324	299
Ramsey	88	104	112	896	1,481	1,412
Ransom	27	27	40	369	514	667
Renville	0	0	0	0	0	0
Richland	4	3	8	75	71	170
Rolette	5	0	7	43	0	70
Sargent	0	5	7	0	100	122

Sheridan	5	12	17	46	143	179
Sioux	0	0	0	0	0	0
Slope	0	0	0	0	0	0
Stark	0	0	0	0	0	0
Steele	141	144	198	1,690	2,443	2,959
Stutsman	30	32	69	403	591	1,122
Towner	88	61	88	810	782	998
Trail	106	99	127	1,331	1,761	1,987
Walsh	329	196	351	3,261	2,725	4,296
Ward	0	0	0	0	0	0
Wells	121	148	229	1,247	2,091	2,854
Williams	0	0	0	0	0	0

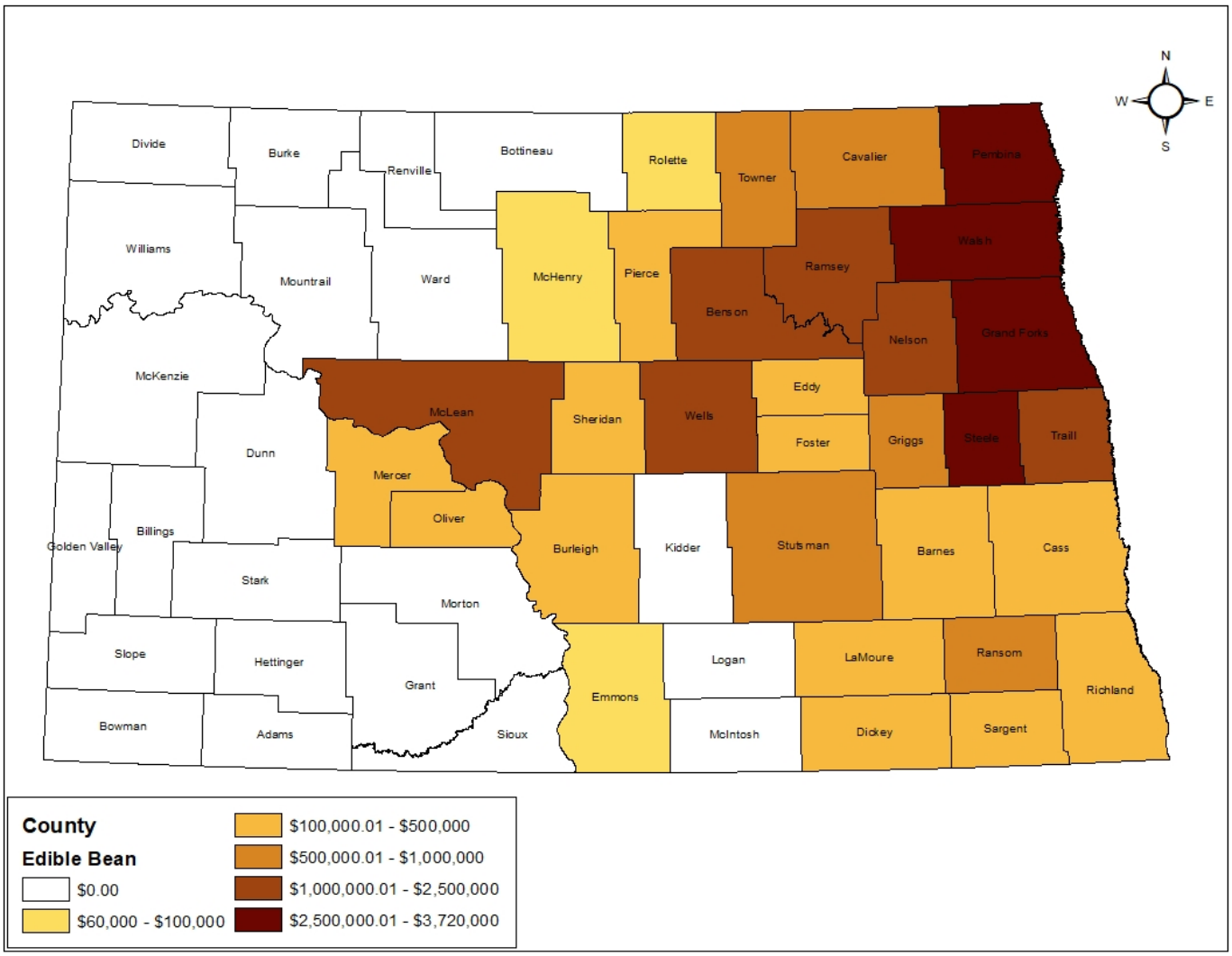

Figure B4: Dry Edible Bean (Field Bean) Average Transportation Cost North Dakota, 2015-2017

Table B5: Dry Edible Pea Total Transportation Carrier Cost, North Dakota, 2015-2017						
	Rail ($000)			**Truck ($000)**		
County	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Adams	12	11	9	187	148	72
Barnes	16	50	8	100	310	40
Benson	12	52	18	63	278	82
Billings	0	0	0	0	0	0
Bottineau	86	183	94	399	850	374
Bowman	21	17	20	297	199	143
Burke	97	179	165	469	856	681
Burleigh	32	55	48	209	348	238
Cass	0	9	0	0	59	0
Cavalier	11	67	110	54	331	455
Dickey	0	0	0	0	0	0
Divide	270	277	152	1,137	1,164	556
Dunn	12	33	14	50	133	45
Eddy	6	13	12	39	88	63
Emmons	18	15	10	154	123	59
Foster	0	14	11	0	89	57
Golden Valley	99	90	55	504	441	219
Grand Forks	6	7	10	37	40	49
Grant	30	8	1	138	37	2
Griggs	8	14	0	49	81	0
Hettinger	45	64	29	181	252	97
Kidder	26	27	12	170	170	59
LaMoure	0	7	0	0	50	0
Logan	8	17	6	54	116	30
McHenry	16	48	31	94	278	153
McIntosh	0	14	4	0	97	20
McKenzie	84	152	52	333	592	175
McLean	309	436	210	1,589	2,236	921
Mercer	40	64	23	195	307	89
Morton	10	16	6	56	90	28
Mountrail	515	483	238	2,323	2,186	922
Nelson	10	17	17	59	98	81
Oliver	33	27	13	185	150	57
Pembina	0	5	17	0	28	70
Pierce	29	70	27	150	360	117
Ramsey	0	7	16	0	39	73
Ransom	5	16	7	34	109	34
Renville	104	182	163	488	849	659
Richland	0	0	0	0	0	0
Rolette	50	53	35	247	263	147
Sargent	0	0	0	0	0	0

Sheridan	7	30	10	37	147	43
Sioux	0	0	0	0	0	0
Slope	28	19	19	353	195	129
Stark	49	40	20	274	214	86
Steele	0	0	0	0	0	0
Stutsman	51	59	31	370	418	174
Towner	9	30	15	49	157	68
Trail	0	0	0	0	0	0
Walsh	0	10	1	0	52	4
Ward	175	237	141	997	1329	675
Wells	27	59	34	165	357	171
Williams	359	437	323	1,806	2,149	1,374

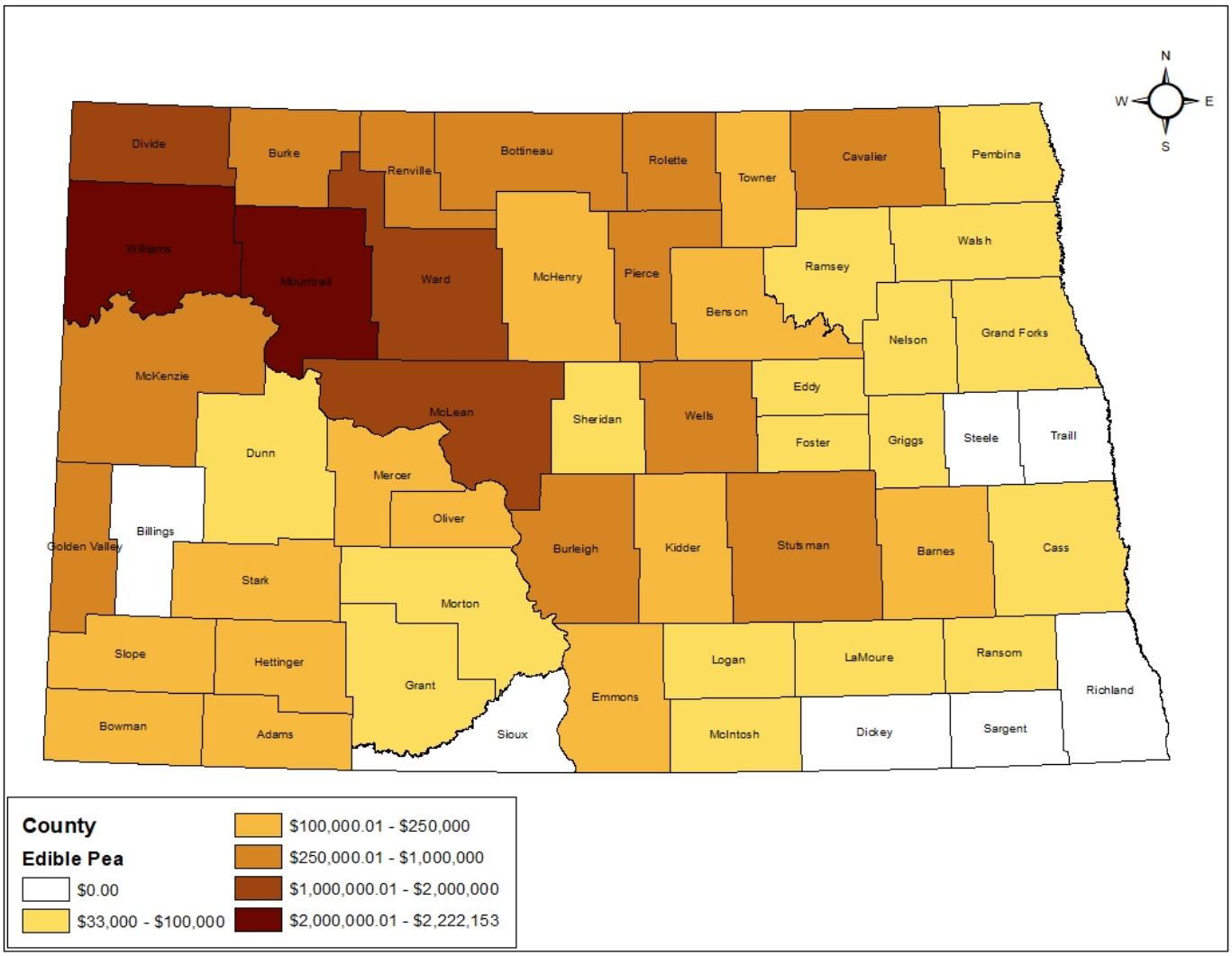

Figure B5: Dry Edible Pea (Field Pea) Average Transportation Cost North Dakota, 2015-2017

Table B6: Durum Total Transportation Carrier Cost, North Dakota, 2015-2017						
	Rail ($000)			**Truck ($000)**		
County	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Adams	67	51	75	173	153	100
Barnes	0	0	15	0	0	16
Benson	34	66	57	49	109	56
Billings	0	13	0	0	15	0
Bottineau	188	370	352	229	523	320
Bowman	165	107	132	371	275	220
Burke	548	763	752	597	939	636
Burleigh	111	188	276	146	274	224
Cass	0	4	8	0	14	18
Cavalier	121	61	136	181	112	143
Dickey	0	0	0	0	0	0
Divide	1,542	1,962	1,334	1,484	2,157	985
Dunn	23	55	58	21	59	42
Eddy	0	17	42	0	30	45
Emmons	25	23	0	44	44	0
Foster	22	32	57	32	53	55
Golden Valley	349	388	383	331	410	256
Grand Forks	11	4	0	22	9	0
Grant	21	12	3	21	13	2
Griggs	0	9	0	0	16	0
Hettinger	370	306	276	337	318	190
Kidder	0	43	52	0	65	44
LaMoure	0	0	0	0	0	0
Logan	23	19	25	31	29	24
McHenry	18	55	53	23	79	49
McIntosh	9	0	29	14	0	26
McKenzie	763	889	671	643	842	456
McLean	416	561	419	500	765	382
Mercer	28	58	85	30	68	61
Morton	71	89	48	78	108	35
Mountrail	769	970	511	844	1,223	432
Nelson	25	20	18	39	37	20
Oliver	0	18	9	0	23	7
Pembina	14	11	45	21	20	50
Pierce	55	94	142	68	132	123
Ramsey	29	21	69	48	40	77
Ransom	0	0	0	0	0	0
Renville	224	386	351	260	517	318
Richland	0	0	9	0	0	23
Rolette	90	84	132	125	138	151
Sargent	0	0	0	0	0	0
Sheridan	36	69	110	43	92	90

Sioux	0	0	0	0	0	0
Slope	329	155	164	441	222	183
Stark	301	303	226	308	339	160
Steele	0	10	14	0	24	21
Stutsman	31	41	73	51	77	68
Towner	113	71	216	159	116	198
Trail	0	0	0	0	0	0
Walsh	26	4	42	40	7	43
Ward	542	616	646	670	852	508
Wells	88	121	274	118	181	236
Williams	2,972	3,306	3,125	3,057	3,804	2,236

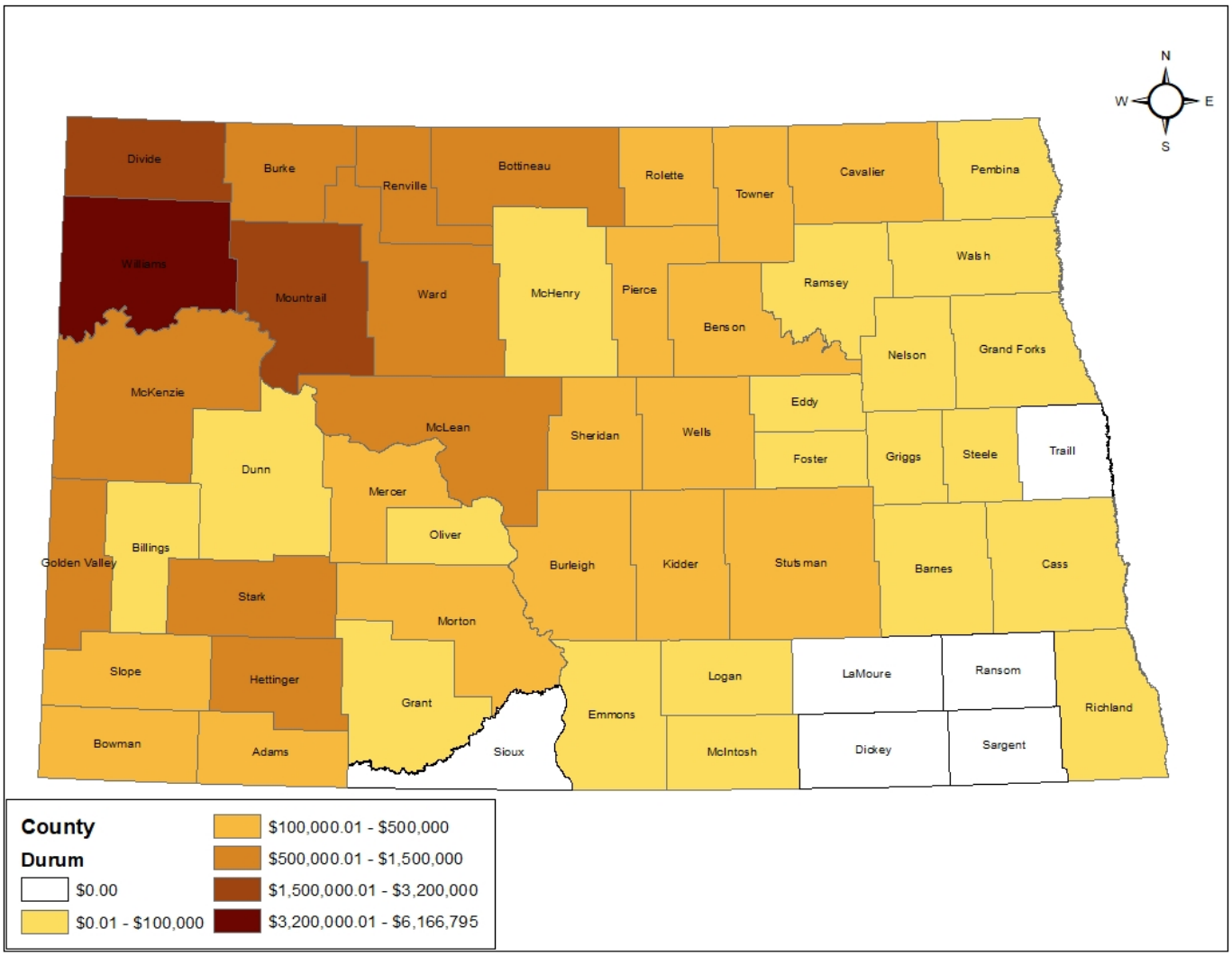

Figure B6: Durum Average Transportation Cost North Dakota, 2015-2017

Table B7: Flax Total Transportation Carrier Cost, North Dakota, 2015-2017						
	Rail ($)			**Truck ($)**		
County	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Adams	1	1	0	121	102	32
Barnes	0	0	0	0	0	0
Benson	1	1	0	83	73	20
Billings	0	0	0	0	0	0
Bottineau	7	4	2	395	252	132
Bowman	2	2	1	178	143	46
Burke	13	9	7	779	628	419
Burleigh	3	2	1	165	118	39
Cass	0	0	0	0	0	0
Cavalier	3	2	1	181	136	87
Dickey	0	0	0	0	0	0
Divide	13	8	8	725	529	472
Dunn	1	0	0	56	20	17
Eddy	1	0	0	33	0	0
Emmons	0	0	0	21	36	8
Foster	1	0	0	27	0	0
Golden Valley	0	0	0	25	0	0
Grand Forks	0	0	0	0	0	0
Grant	3	1	0	155	65	22
Griggs	0	0	0	0	0	0
Hettinger	5	3	1	280	195	48
Kidder	3	1	1	132	71	46
LaMoure	0	0	0	0	0	0
Logan	0	0	0	25	0	15
McHenry	7	4	1	417	272	58
McIntosh	0	0	0	0	16	0
McKenzie	3	1	1	182	83	63
McLean	15	10	4	888	730	243
Mercer	2	1	0	84	83	22
Morton	3	2	1	160	140	39
Mountrail	25	12	7	1,479	824	432
Nelson	1	1	0	78	42	0
Oliver	2	1	0	94	69	26
Pembina	0	0	0	0	0	0
Pierce	2	1	0	128	54	18
Ramsey	2	0	0	135	20	0
Ransom	0	0	0	0	0	0
Renville	11	8	5	626	529	322
Richland	0	0	0	0	0	0
Rolette	3	1	1	165	78	33
Sargent	0	0	0	0	0	0
Sheridan	6	5	1	256	249	60

Sioux	0	0	0	0	0	0
Slope	2	1	0	120	60	12
Stark	2	1	0	103	92	24
Steele	0	0	0	0	0	0
Stutsman	1	0	0	55	28	0
Towner	3	1	1	147	92	68
Trail	0	0	0	0	0	0
Walsh	1	1	0	49	48	0
Ward	35	20	9	1,990	1,334	530
Wells	1	1	0	37	46	0
Williams	6	4	3	339	287	190

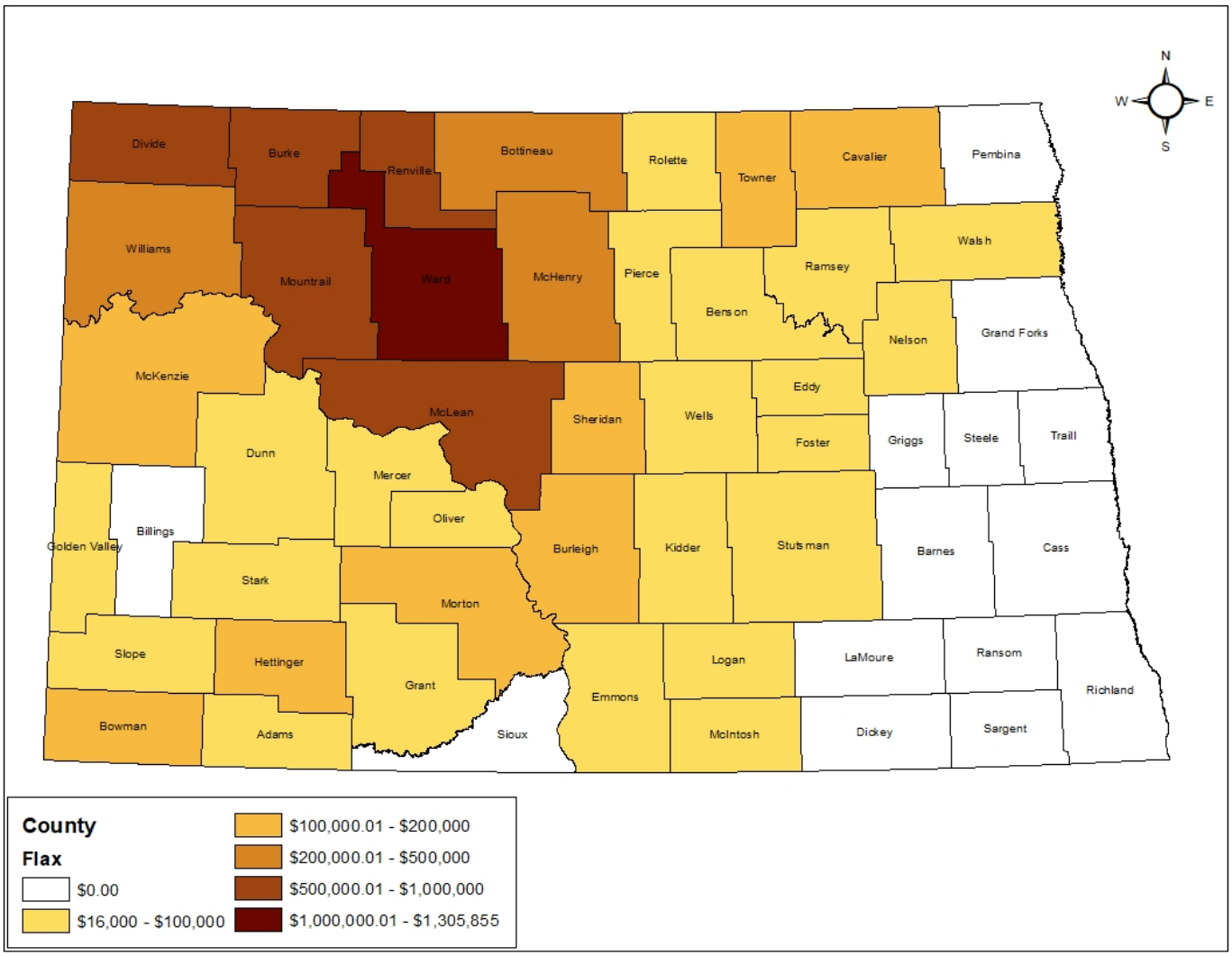

Figure B7: Flax Average Transportation Cost North Dakota, 2015-2017

Table B8: Spring Wheat Total Transportation Carrier Cost, North Dakota, 2015-2017						
	Rail ($)			**Truck ($)**		
County	**2015**	**2016**	**2017**	2,042	**2016**	**2017**
Adams	349	172	79	1,615	964	461
Barnes	616	587	384	2,114	1,381	981
Benson	780	636	658	432	1,586	1,747
Billings	151	80	53	3,708	207	143
Bottineau	1,588	1,410	1,332	1,242	3,041	3,042
Bowman	226	98	56	1,639	522	309
Burke	708	575	489	1,357	1,231	1,100
Burleigh	507	378	191	1,967	910	489
Cass	675	562	466	5,542	1,477	1,352
Cavalier	2,323	1,516	2,286	414	3,306	5,350
Dickey	143	132	64	1,333	340	180
Divide	689	323	298	2,330	578	563
Dunn	1,299	936	563	609	1,521	974
Eddy	210	191	184	1,865	506	524
Emmons	646	277	185	699	726	540
Foster	259	261	178	601	635	464
Golden Valley	253	129	65	2,887	285	146
Grand Forks	1,056	821	834	1,767	2,045	2,245
Grant	907	571	197	1,196	1,009	369
Griggs	398	324	316	3,907	914	946
Hettinger	2,239	1,509	718	780	2,394	1,210
Kidder	292	211	140	631	509	359
LaMoure	240	257	153	900	599	392
Logan	330	281	154	2,000	691	405
McHenry	721	712	476	1,171	1,821	1,285
McIntosh	423	370	190	895	918	508
McKenzie	444	337	200	4,088	638	389
McLean	1,761	1,568	977	997	3,327	2,209
Mercer	487	374	175	2,442	692	344
Morton	957	639	315	2,289	1,487	765
Mountrail	1,146	973	702	1,766	1,769	1,365
Nelson	669	582	615	874	1,414	1,593
Oliver	378	374	196	3,857	780	434
Pembina	1,583	993	1,435	1,957	2,214	3,429
Pierce	783	623	602	2,281	1,451	1,471
Ramsey	823	613	790	649	1,556	2,149
Ransom	241	237	158	1,877	571	417
Renville	826	740	667	1,017	1,548	1,473
Richland	363	346	271	1,574	868	753
Rolette	631	505	602	565	1,162	1,469
Sargent	222	160	109	1,340	365	272

Sheridan	641	581	417	461	1,094	845
Sioux	298	182	177	1,521	258	267
Slope	370	165	117	3,270	660	490
Stark	1,316	909	393	985	2,076	928
Steele	353	285	226	1,501	722	625
Stutsman	532	524	385	3,206	1,319	1,046
Towner	1,240	828	1,052	1,713	1,965	2,667
Trail	633	438	448	3,388	1,071	1,202
Walsh	1,368	901	1,188	4,268	2,048	2,884
Ward	1,603	1,412	1,152	2,636	3,468	2,989
Wells	986	914	722	1,033	2,216	1,863
Williams	406	215	188	2,042	514	464

***includes hard red spring and winter wheat*

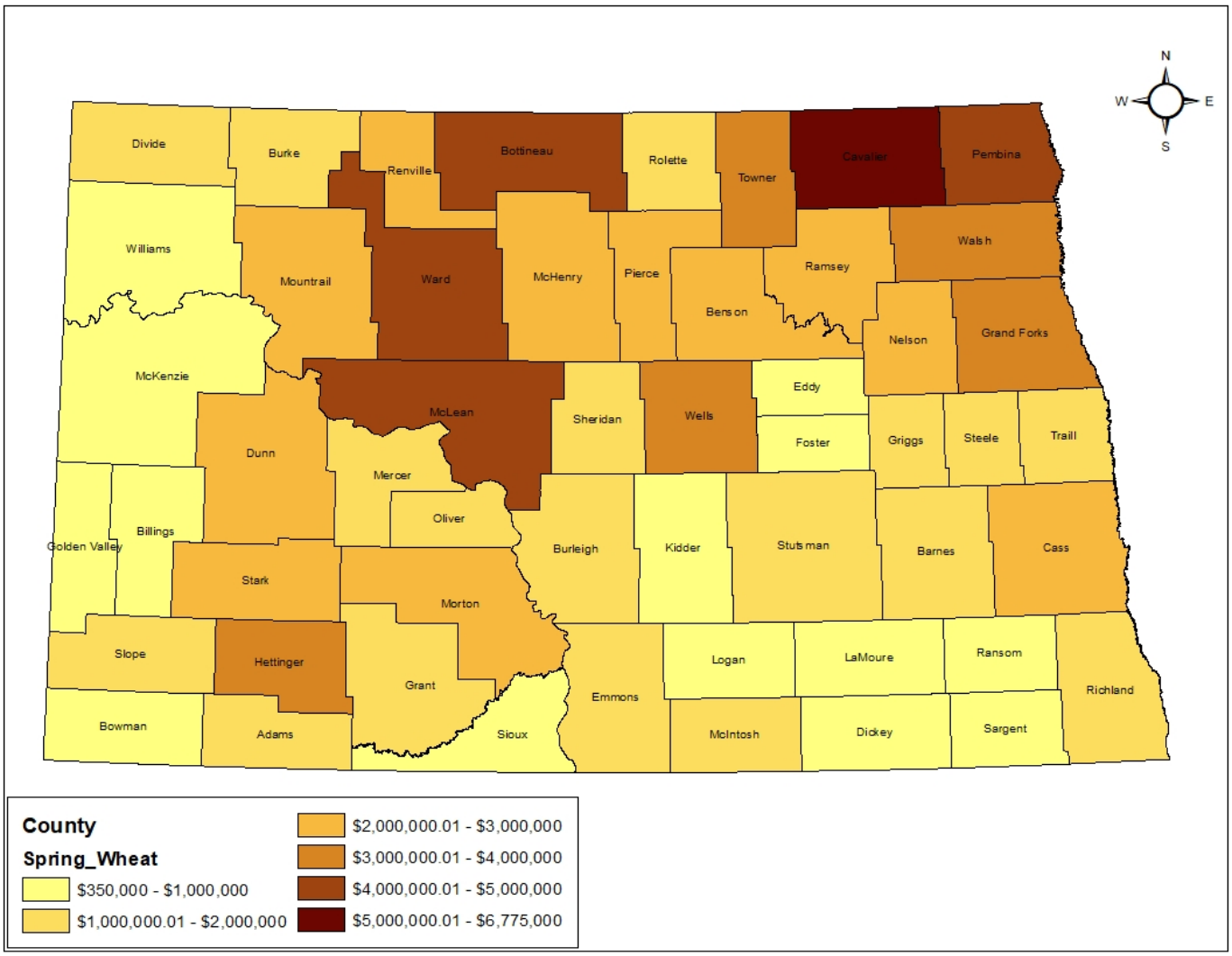

Figure B8: Spring Wheat Average Transportation Cost North Dakota, 2015-2017

Table B9: Lentil Total Transportation Carrier Cost, North Dakota, 2015-2017						
	Rail ($)			**Truck ($)**		
County	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Adams	0	0	5	0	0	7
Barnes	0	0	0	0	0	0
Benson	0	0	0	0	0	0
Billings	0	0	0	0	0	0
Bottineau	0	17	0	0	22	0
Bowman	0	7	12	0	9	16
Burke	0	25	13	0	36	18
Burleigh	0	0	0	0	0	0
Cass	0	0	0	0	0	0
Cavalier	0	0	0	0	0	0
Dickey	0	0	0	0	0	0
Divide	340	424	267	427	593	347
Dunn	0	0	14	0	0	15
Eddy	0	0	0	0	0	0
Emmons	0	0	7	0	0	9
Foster	0	0	0	0	0	0
Golden Valley	127	134	50	136	167	56
Grand Forks	0	0	0	0	0	0
Grant	0	0	0	0	0	0
Griggs	0	0	0	0	0	0
Hettinger	0	13	0	0	15	0
Kidder	0	20	7	0	27	9
LaMoure	0	0	0	0	0	0
Logan	0	20	16	0	29	22
McHenry	0	0	0	0	0	0
McIntosh	0	6	3	0	8	4
McKenzie	74	156	88	77	187	97
McLean	28	104	61	37	158	90
Mercer	0	0	0	0	0	0
Morton	0	0	0	0	0	0
Mountrail	13	32	28	16	45	37
Nelson	0	0	0	0	0	0
Oliver	0	0	0	0	0	0
Pembina	0	0	0	0	0	0
Pierce	0	0	0	0	0	0
Ramsey	0	0	0	0	0	0
Ransom	0	0	0	0	0	0
Renville	0	15	0	0	22	0
Richland	0	0	0	0	0	0
Rolette	0	0	0	0	0	0
Sargent	0	0	0	0	0	0
Sheridan	0	18	6	0	25	7

Sioux	0		0	0	0	0
Slope	0	28	0	0	35	0
Stark	12	7	18	13	9	21
Steele	0	0	0	0	0	0
Stutsman	0	0	0	0	0	0
Towner	0	0	0	0	0	0
Trail	0	0	0	0	0	0
Walsh	0	0	0	0	0	0
Ward	8	28	27	10	43	37
Wells	0	0	0	0	0	0
Williams	575	773	595	714	1,121	774

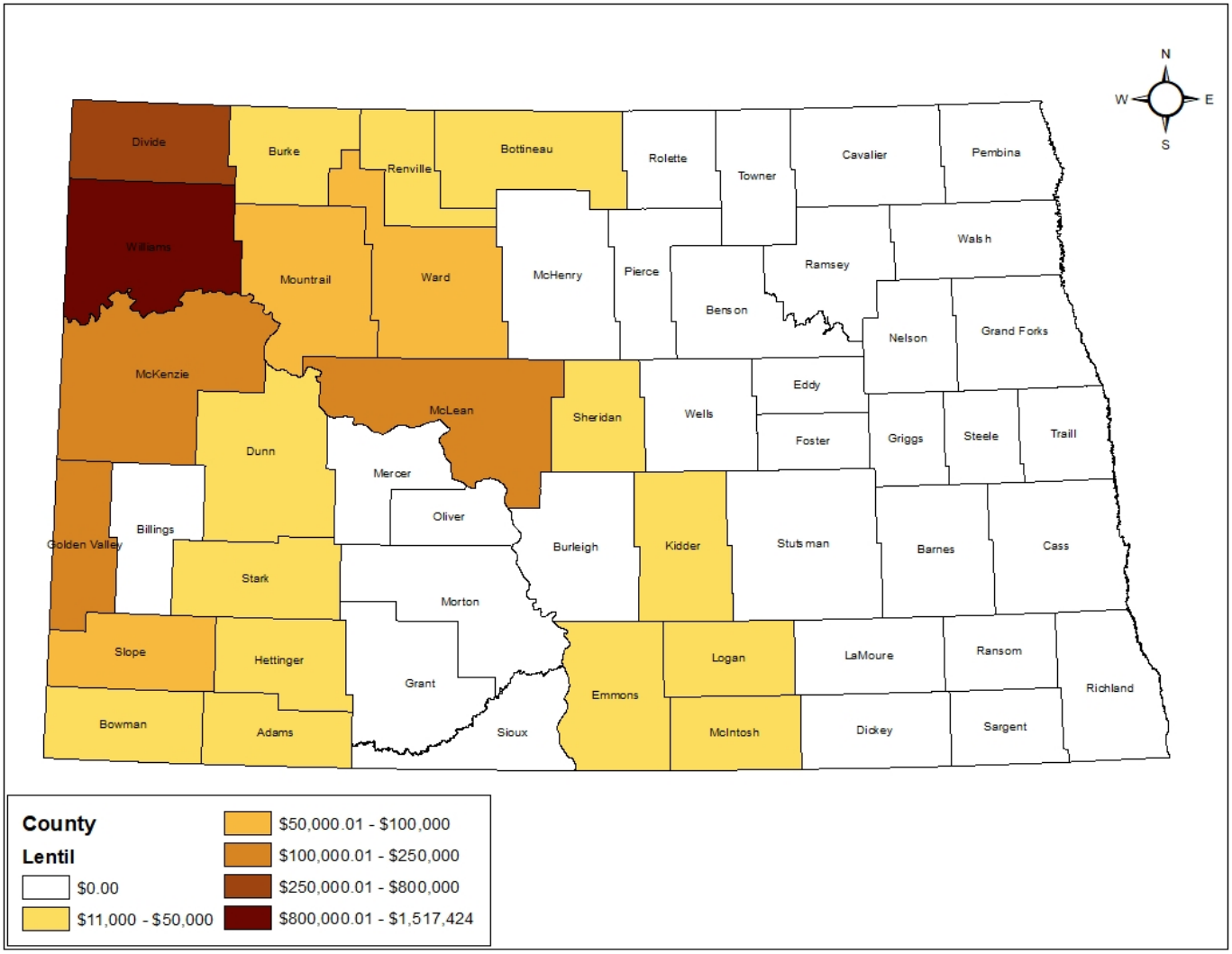

Figure B9: Lentil Average Transportation Cost North Dakota, 2015-2017

Table B10: Soybean Total Transportation Carrier Cost, North Dakota, 2015-2017						
	Rail ($)			**Truck ($)**		
County	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Adams	0	1	2	0	6	13
Barnes	1,515	1,809	1,851	3,779	3,658	4,138
Benson	454	664	688	1,372	1,590	1,947
Billings	0	0	0	0	0	0
Bottineau	495	811	1,020	1,357	1,786	2,675
Bowman	0	0	0	0	0	0
Burke	0	0	59	0	0	186
Burleigh	157	233	269	506	592	820
Cass	2,326	2,771	2,500	5,712	5,158	5,474
Cavalier	431	586	797	1,028	1,095	1,769
Dickey	725	974	974	1,942	1,991	2,348
Divide	39	33	50	102	70	125
Dunn	0	0	0	0	0	0
Eddy	205	284	307	628	679	876
Emmons	396	438	624	1,028	867	1,457
Foster	503	636	558	1,464	1,444	1,480
Golden Valley	0	0	0	0	0	0
Grand Forks	820	1,039	1,150	2,078	2,043	2667
Grant	12	8	16	28	15	36
Griggs	432	583	504	1,420	1,504	1,539
Hettinger	11	0	12	22	0	24
Kidder	131	198	261	405	484	751
LaMoure	1,285	1,844	1,482	3,096	3,390	3,187
Logan	222	302	331	672	718	930
McHenry	267	413	418	956	1195	1,422
McIntosh	339	436	413	994	997	1,103
McKenzie	0	0	0	0	0	0
McLean	264	398	499	718	861	1,256
Mercer	21	29	41	53	58	96
Morton	29	43	58	113	144	229
Mountrail	54	76	159	122	135	338
Nelson	385	500	592	1073	1,083	1501
Oliver	34	46	60	99	109	168
Pembina	691	834	951	1,662	1,564	2,079
Pierce	280	408	367	884	1,032	1,117
Ramsey	385	588	654	1095	1308	1,742
Ransom	608	842	853	1,476	1,550	1,844
Renville	214	335	389	603	764	1,061
Richland	1,594	2,026	2,069	3,591	3,465	4,122
Rolette	142	196	243	395	434	647
Sargent	809	1,204	1,222	1,806	2,061	2457

Sheridan	261	393	359	582	674	730
Sioux	7	12	15	13	18	26
Slope	0	0	0	0	0	0
Stark	4	0	1	17	0	3
Steele	744	883	844	1,897	1,737	1,959
Stutsman	1,462	1769	1,943	4132	3864	4,966
Towner	345	487	545	974	1,083	1,457
Trail	1,065	1,094	1,092	2,522	2,016	2,373
Walsh	459	548	707	1,132	1078	1572
Ward	352	480	512	1,195	1,347	1,625
Wells	547	802	872	1,660	1,987	2,424
Williams	16	8	9	81	38	51

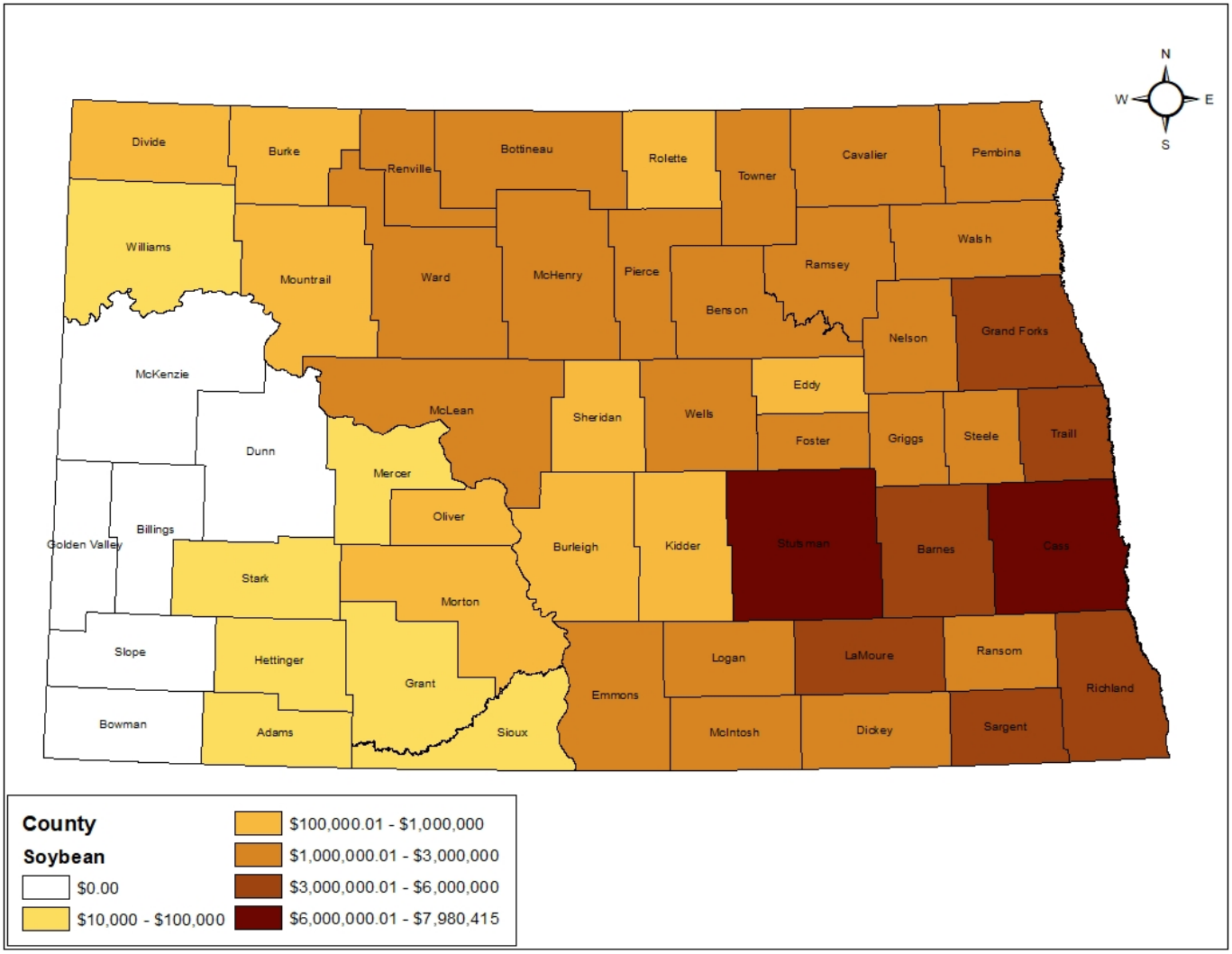

Figure B10: Soybean Average Transportation Cost North Dakota, 2015-2017

Table B11: Sunflower Seed Total Transportation Carrier Cost, North Dakota, 2015-2017						
	Rail ($)			**Truck ($)**		
County	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Adams	10	13	10	923	1110	1019
Barnes	2	1	0	159	57	0
Benson	0	2	1	0	119	91
Billings	2	1	1	110	103	104
Bottineau	22	10	2	1,567	793	140
Bowman	3	3	2	274	269	181
Burke	5	5	2	347	369	197
Burleigh	16	11	5	1,023	774	353
Cass	11	7	4	774	463	285
Cavalier	8	4	3	598	284	220
Dickey	2	1	1	122	77	41
Divide	2	1	2	122	93	123
Dunn	11	9	5	629	622	351
Eddy	0	3	2	0	229	141
Emmons	43	41	29	3,399	2,964	2,401
Foster	0	1	1	0	65	73
Golden Valley	4	4	1	277	268	75
Grand Forks	6	4	3	407	244	207
Grant	23	29	16	1,438	1,961	1,083
Griggs	1	1	0	56	52	0
Hettinger	16	17	11	965	1167	727
Kidder	3	5	1	202	345	98
LaMoure	0	0	0	0	17	24
Logan	4	3	1	246	182	97
McHenry	3	2	0	198	142	0
McIntosh	9	8	7	605	501	498
McKenzie	0	0	0	0	0	0
McLean	13	6	4	924	477	301
Mercer	8	11	10	513	734	689
Morton	26	29	16	1,632	1,980	1,153
Mountrail	5	6	5	326	435	374
Nelson	0	1	0	17	79	0
Oliver	6	6	5	374	389	345
Pembina	5	3	1	346	185	59
Pierce	2	2	1	132	159	60
Ramsey	2	1	1	153	62	89
Ransom	1	1	0	38	80	0
Renville	13	8	4	892	609	278
Richland	3	3	1	206	223	43
Rolette	2	2	1	120	179	93
Sargent	1	1	0	58	73	0

Sheridan	2	2	2	116	168	157
Sioux	10	13	8	498	732	489
Slope	4	5	3	321	439	237
Stark	11	13	7	697	890	514
Steele	4	2	1	291	161	58
Stutsman	2	6	1	146	422	51
Towner	3	5	1	217	365	61
Trail	5	2	1	362	164	96
Walsh	3	2	2	190	120	126
Ward	15	15	8	1,061	1,150	608
Wells	2	4	3	132	296	220
Williams	1	2	3	92	159	268

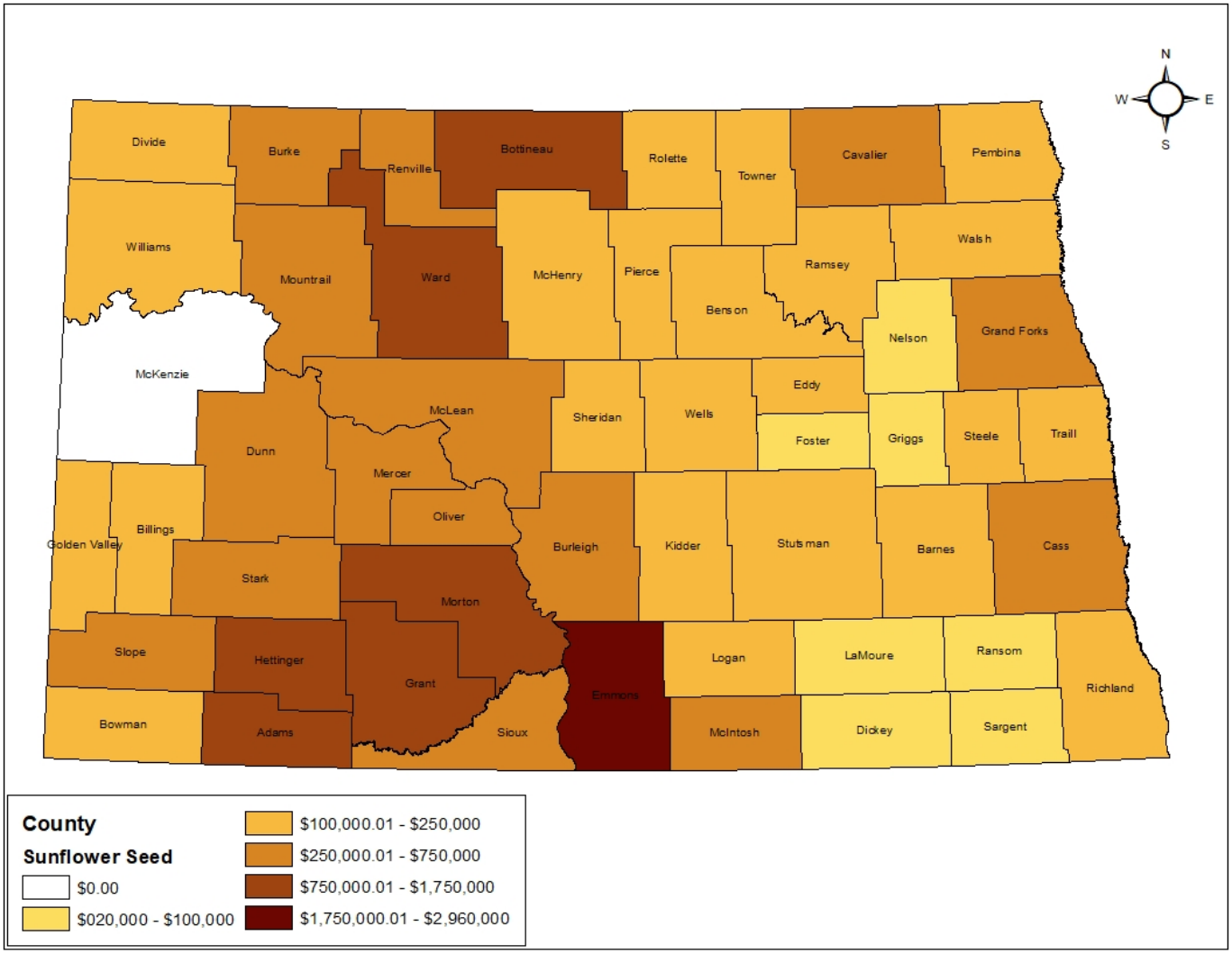

Figure B11: Sunflower Seed Average Transportation Cost North Dakota, 2015-2017

APPENDIX C: TOTAL TRANSPORTATION COST BY COUNTY

Table C1: Total Transportation Carrier Operation Cost by County, North Dakota, 2015-2017						
	Rail ($000)			**Truck ($000)**		
County	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**
Adams	577	407	250	5,687	4,455	3,072
Barnes	4,031	5,748	5,432	21,567	25,788	27,747
Benson	2,245	2,539	2,823	11,268	12,841	14,061
Billings	167	110	69	700	451	304
Bottineau	3,562	3,728	4,765	16,996	15,981	14,342
Bowman	439	246	230	2,797	1,636	1,036
Burke	1,638	1,750	1,676	8,445	7,635	6,833
Burleigh	1,317	1,654	2,043	7,302	9,236	7,848
Cass	6,210	8,990	7,504	35,067	40,667	44,043
Cavalier	3,685	2,848	4,140	21,546	16,394	22,975
Dickey	2,553	4,029	3,277	17,289	21,045	21,663
Divide	3,042	3,143	2,258	7,211	7,045	5,059
Dunn	1,504	1,229	822	4,239	3,513	2,515
Eddy	721	936	1,237	4,204	5,037	5,674
Emmons	2,011	2,435	1,904	13,423	14,379	13,285
Foster	1,393	1,898	1,595	7,748	9,298	9,105
Golden Valley	850	758	573	2,099	1,764	1,056
Grand Forks	3,256	4,121	4,244	16,620	20,284	23,148
Grant	1,323	1,105	402	6,005	5,913	2,820
Griggs	1,266	1,582	1,416	6,843	7,997	8,105
Hettinger	3,047	2,320	1,428	10,353	8,286	5,010
Kidder	678	753	791	3,299	3,520	3,591
LaMoure	3,663	5,497	4,101	21,602	24,131	23,686
Logan	862	1,070	1,130	4,009	4,736	4,889
McHenry	1,528	1,913	1,703	9,402	10,900	9,876
McIntosh	1,195	1,485	1,110	6,263	6,869	6,314
McKenzie	1,522	1,643	1,177	3,055	3,069	1,572
McLean	3,583	4,239	3,121	17,824	19,442	16,185
Mercer	852	848	531	3,970	4,148	3,078
Morton	1,407	1,206	634	6,971	7,160	4,154
Mountrail	2,815	2,803	1,850	12,677	11,127	8,436
Nelson	1,520	1,667	1,774	6,842	7,214	8,696
Oliver	611	692	457	2,943	3,130	2,554
Pembina	2,993	2,583	3,295	11,862	9,568	13,461
Pierce	1,589	1,701	1,560	7,312	7,801	7,433
Ramsey	2,301	2,479	2,869	13,158	13,786	16,431
Ransom	2,109	3,092	2,666	12,722	14,386	15,954
Renville	2,075	2,155	1,879	10,668	9,917	8,565
Richland	6,275	8,365	7,918	38,139	36,941	47,021
Rolette	1,226	1,087	1,246	6,999	5,536	6,480

Sargent	2,848	4,229	3,721	16,417	18,148	20,781
Sheridan	1,331	1,537	1,227	5,240	5,684	4,918
Sioux	421	371	329	1,584	1,749	1,542
Slope	755	400	318	3,238	2,081	1,428
Stark	1,921	1,482	752	7,221	5,788	2,890
Steele	2,197	2,982	2,623	12,581	15,081	16,605
Stutsman	3,742	5,402	4,895	22,069	27,370	29,655
Towner	2,223	1,934	2,319	11,597	9,976	12,126
Trail	3,408	3,936	3,557	18,507	18,338	20,511
Walsh	2,744	2,502	3,250	13,132	11,937	17,393
Ward	3,271	3,376	2,844	17,437	17,172	13,417
Wells	2,574	3,233	3,326	13,002	16,279	19,705
Williams	4,733	4,949	4,415	10,172	10,460	7,695