NORTH DAKOTA STRATEGIC FREIGHT ANALYSIS

AGRICULTURAL SECTOR

Summary Report

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INTRODUCTION

Agriculture represents an important industry to the state of North Dakota. Farm production, food processing, and transportation and distribution of agricultural products accounted for nearly 13 percent of North Dakota's total economic output in 1997.[1] This compares to an average of 5 percent of output for agricultural activities nationwide.[2] Moreover, at least 30 percent of business proprietors in the state were agriculture-related in 1997, compared to 8 percent nationwide. Because of the important role played by agriculture in the state's economy, small improvements in the competitiveness of the state's agricultural sector can result in major economic gains for North Dakota.

Efficient transportation is vital to the continued and improved competitiveness of North Dakota's agricultural sector. In the increasingly global economy, transportation improvements will allow North Dakota's agricultural and value-added producers to compete in expanding markets and to maintain their positions in traditional markets.

However, many external factors will influence the ability of the state's agricultural sector to compete in new, emerging, and traditional markets. These factors include changing rail technologies and operational practices, the merger activity sweeping the nation and the way legislators respond to such activity, the speed at which continued globalization of the world economy occurs, and vertical integration of firms strategic to North Dakota's agricultural economy. The changes create an environment of uncertainty and opportunity for agricultural

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[1]Economic Development and Finance. *The Economic Performance and Industrial Structure of the North Dakota Economy*, May 2000.

[2]Ibid.

production and processing firms in the state and for North Dakota. North Dakota firms and the state must have the necessary information and analysis to participate in the process of change which will continue.

As an attempt to provide some of the information that will enable North Dakota firms and policymakers to make better decisions, this project addresses four transportation issues, which are critical to the future of the state's agricultural sector: (1) the impact of 110-car shuttle trains on the marketing of grains, (2) the impact of heavier cars on light-density rail lines, (3) the changing trend in the use of truck/rail container intermodal transportation for marketing North Dakota products, and (4) the role played by logistics factors in determining the optimal location of value-added facilities. The following will provide a summary of the analysis of each of these issues.[3]

THE IMPACT OF 110-CAR SHUTTLE TRAINS ON GRAIN MARKETING

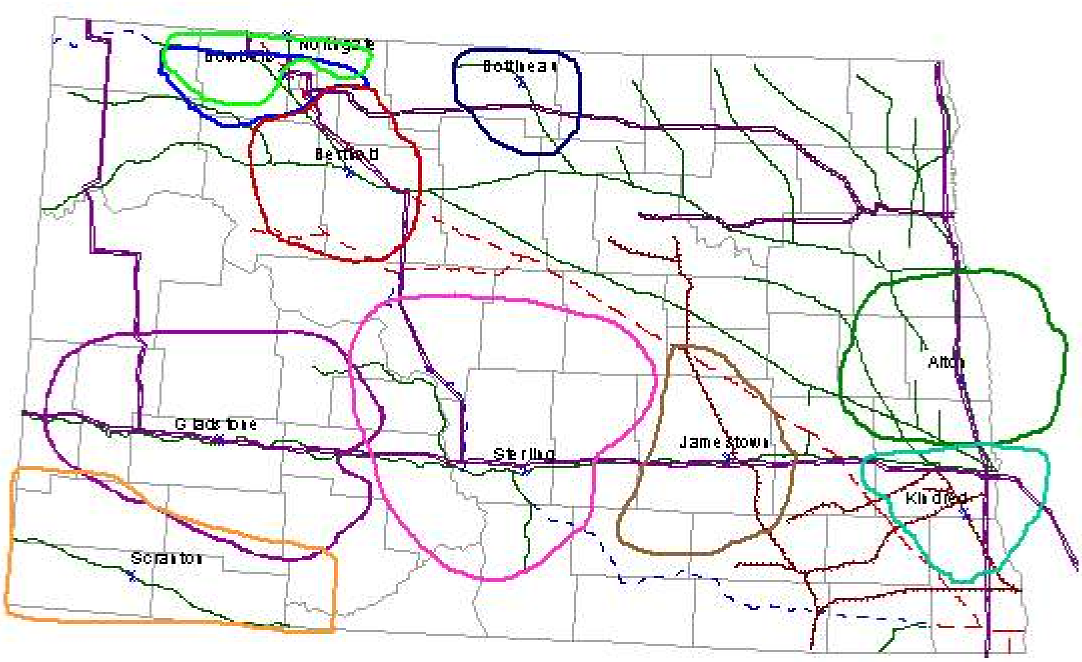
The local grain industry in North Dakota includes 440 elevators; two Class I rail carriers; three short line railroads; several local processors; 3,858 rail miles; 106,514 road miles; and thousands of farmers. In looking to the future of North Dakota's local grain industry infrastructure it is important to (1) view our local infrastructure as a part of global grain marketing network (2) determine, with the best current knowledge, what resources our segment of that much larger network will require, and (3) rationally allocate available resources to

[3]Separate publications exist for each issue. These publications are MPC 01-127.1, "Intermodal Highway/Rail/Container Transportation and North Dakota;" MPC 01-127.2, "Logistical Factors Influencing the Success of Value-Added Processing Facilities;" MC 01-127.3, "Shuttle Trains;" and MPC 01-127.4, "Heavier Loading Rail Cars."

maximize returns to our segment of the network. Shuttle rail rates are, in today's grain industry, the railroad's most competitive rate. Shuttle rates are available to shippers equipped to meet specific volume, transaction, and operational commitments. Investment in shuttle facilities and the ability of these facilities to use the more competitive rates in attracting grain has the potential to strongly influence future local grain flow patterns. As these local grain flow patterns adjust to new market signals, demands on the local grain gathering system must be addressed. The objective of this study was to provide a market-based synopsis of the potential impact of shuttle train shipments on North Dakota's local grain industry. Secondary objectives are to (1) profile the local grain procurement network, (2) develop alternative network scenarios to analyze the influence of shuttle trains, and (3) provide framework for understanding the longer-term implications of shuttle trains for North Dakota's grain processing industry, infrastructure, and rural communities.

Facility infrastructure requirements, economic incentives, investment requirements, and financing packages are unique to each shuttle venture. Based on an earlier Upper Great Plains Transportation Institute study, a $6 million green field facility required approximately a 10 million bushel handle for profitable returns. Discussions with grain companies and railroads suggest a target of 12 to 15 million bushels for a shuttle facility. This bushel requirement compares to the current average annual handle of 1.2 million bushels for the North Dakota elevator population, and an average annual handle of 5.6 million bushels for the state's largest elevators. Therefore, redistribution of bushels in the local elevator industry seems imminent.

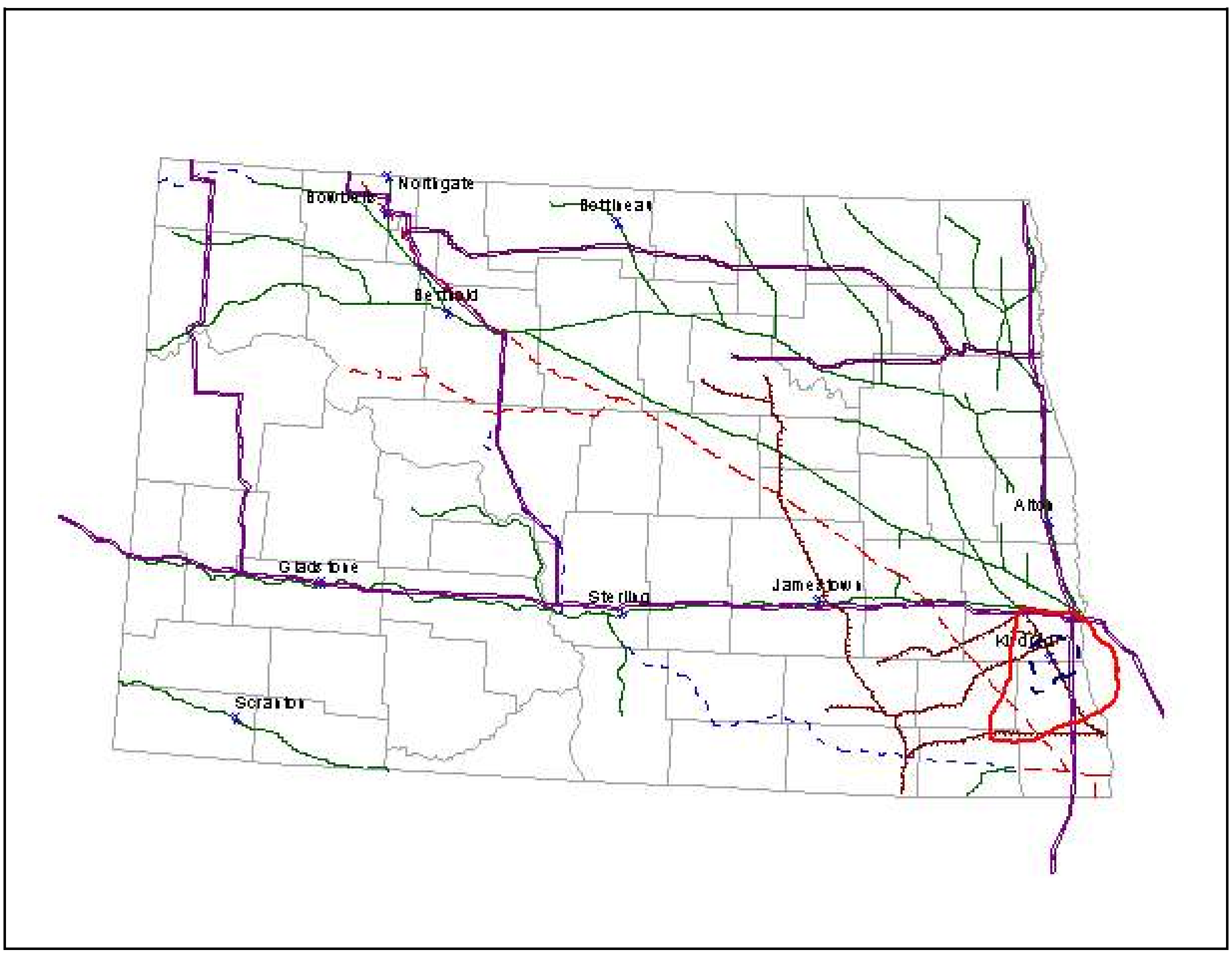
Spatial analysis was used to estimate producer delivery patterns for alternative rail rate and producer truck cost scenarios. Grain production and draw area spans were used as quantitative measures in discussing the delivery patterns. An economic decision model was employed to illustrate the impact of changes in elevator rail rates and producer trucking costs on the relative competitiveness of local processors. HRS wheat, durum, barley, and corn were considered in this economic analysis of shuttle rail rates on the local grain marketing. In the base case, wheat, the area included in the 10 shuttle facility boundaries accounted for approximately 45 percent of the total North Dakota land area. Regarding production, approximately 88.6 million bushels of HRS wheat and 32.9 million bushels of durum were contained in the estimated shuttle draw areas.



Base Case Shuttle Draw Estimates (HRS Wheat and Durum)

The 10 draw areas encompassed approximately 38 percent of North Dakota HRS wheat production and 39 percent of the state's durum production. In the cases of barley and corn, shuttle facilities have the potential to accumulate 26.5 million bushels (24 percent of average North Dakota production) and 14.2 million bushels (19 percent of average North Dakota production), respectively, based on the estimated draw areas.

Considering these four crops, the 10 shuttle facility draw areas have the potential to originate about 162 million bushels. In relative terms, 2 percent of the elevators may originate up to 32 percent of the average annual production of wheat, barley, and corn. This market share of



Shuttle Draw Area for Corn

North Dakota production translates to an average 16.5 million bushels per facility. This potential concentration of bushels has implications for local roads, short line railroads, bridge infrastructure, local processors, local communities, and the North Dakota elevator industry. The rate advantage available to the shuttle-equipped facility has implications for producers, elevators, local processors, rural communities, and local and state governments. Just as unit train rates were instrumental in redefining local grain flow patterns in the 1980, shuttle train rates also have the potential to dramatically influence local grain distribution patterns. As grain is transferred among markets and modes, a new pattern of grain flows will be established in the local grain market. This pattern will determine infrastructure employment for local grain market, and provide signals for decision makers in establishing policy and distributing limited resources to maximize returns to the user group.

THE IMPACT OF HEAVIER CARS ON LIGHT DENSITY RAIL LINES

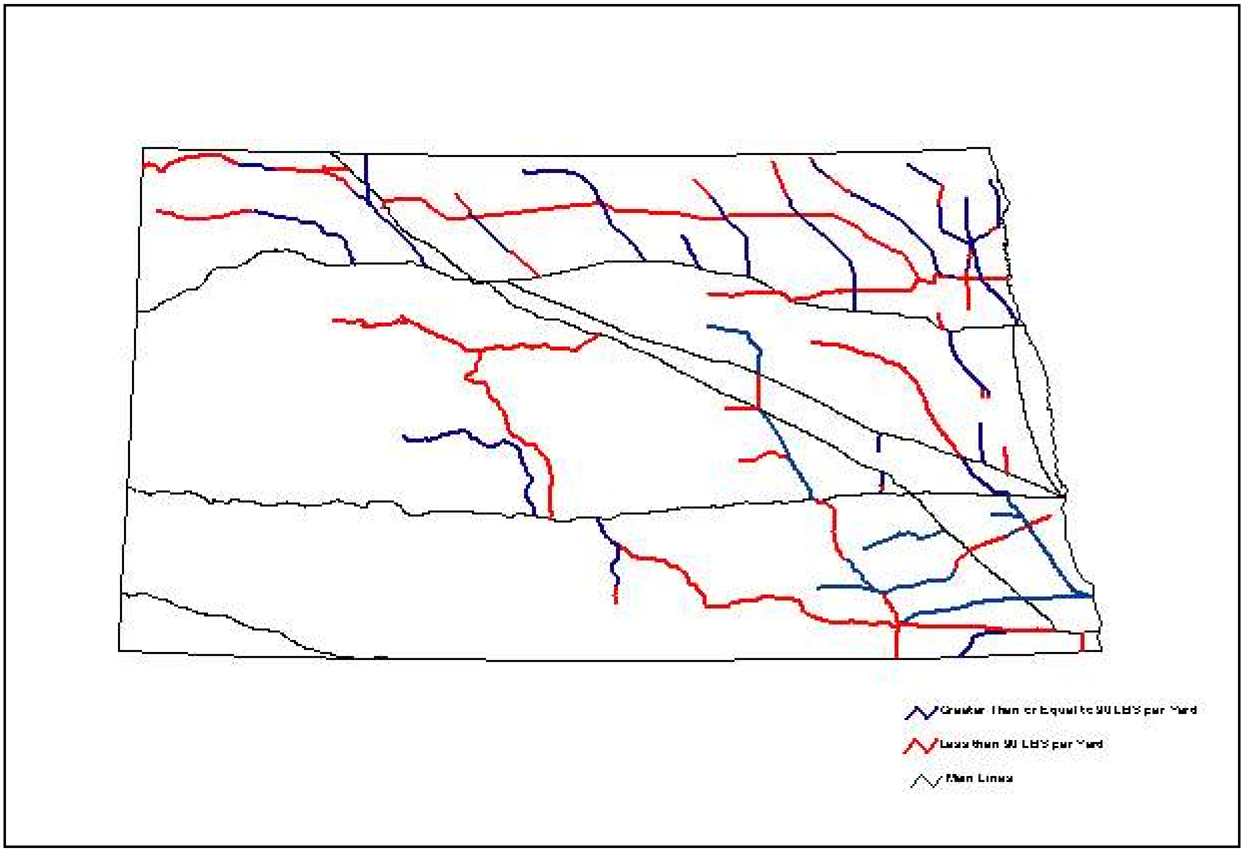
North Dakota's grain producers rely on an efficient rail system to move their products to export and domestic markets. In the 1999-2000 crop year, approximately 69 percent of all North Dakota grains and oilseeds transported to export and domestic markets were transported by rail.

A recent shift to larger grain hopper cars may threaten the viability of the state's light-density branch line network. The old industry standard of 263,000-pound cars capable of hauling 100 tons of grain is being replaced with 286,000-pound cars capable of hauling 111 tons of grain. Many light-density branch lines can not handle these larger cars, as they have light rail in place, shallow or poor ballast, and/or deferred tie maintenance. Although it is possible to load the larger rail cars at lighter weights or operate at lower speeds on such lines, railroads operating over such lines eventually will face a decision between upgrading and abandoning lines that can not handle the 286,000-pound cars at full weight.

This study simulates the impacts of handling larger rail cars on many types of rail lines, models the decision process used by railroads in deciding whether to upgrade such lines or abandon them, estimates the costs of upgrading rail lines that are unlikely to be upgraded, and estimates generalized highway impacts, which could result from the abandonment of non-upgraded lines.

In simulating the impacts of handling larger rail cars on different types of rail lines, the study estimates that rail lines that have rail in place, which is less than 90 pounds per yard, are likely to need some form of upgrading to handle the larger rail cars. More than 1,200 miles of rail line in North Dakota have rail that is less than 90 pounds per yard. The costs of upgrading all the lines are estimated to range between $258 million and $324 million, excluding costs of bridge upgrading.

In modeling the railroad decision process on whether to upgrade lines with light rail to handle the larger cars, it was shown that railroads are likely to rank investment alternatives based on their internal rates of return. In estimating the internal rate of return to an upgrading investment, railroads are likely to use a maximum of an eight-year time frame for evaluating the benefits to upgrading. Moreover, the internal rate of return to the upgrading investment will depend on the proximity of the rail line to competitors' rail lines, actions taken by competitors in



North Dakota Lines with Light Rail

terms of upgrading their rail lines, ability of trucks to serve destination markets directly, location of new shuttle train facilities, operational cost savings resulting from the upgrade, service improvements from the upgrade, and the cost of upgrading.

A numerical illustration of originating traffic levels where railroads are more likely to upgrade lines shows that at current revenue splits, and in most cases, short lines are unlikely to make the investment upgrade while Class I railroads may find it beneficial to upgrade at traffic levels as low as 35 to 40 cars per mile.[4] The illustration shows that a larger revenue share for

[4]This is only the case when the Class I has competition in close proximity. In cases where the Class I railroad does not have competition in close proximity, the railroad is unlikely to upgrade the branch line at any traffic levels, since the railroad can maintain its traffic without serving the branch line.

short lines or a loan guarantee program that extends the length of loan terms available to short lines could increase the likelihood of upgrading lines with light rail on short-line systems.

Finally, the study estimates generalized highway impacts that would result from eliminating rail lines with various traffic thresholds. The study shows that the generalized highway impacts resulting from eliminating rail lines are small in comparison to the rail upgrading costs (Table 1). If all rail lines with less than 35 cars per mile originated and less than 90 pound per yard rail are eliminated (895.5 miles), and if highway impacts are realized in perpetuity, the total highway impacts may exceed $41 million, but the cost of upgrading these lines would exceed $191 million. Similarly, if all lines with less than 150 cars per mile originated and less than 90 pound per yard rail are eliminated (1,202.3 miles) and highway impacts are realized in perpetuity, the total highway impacts may exceed $73 million, but the cost of upgrading these lines would exceed $257 million.[5] Thus, a state-funded subsidy to upgrade all such potentially abandoned lines does not appear to be warranted. However, some subsidy may be justified on specific lines.

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[5]These upgrading costs do not consider the costs of upgrading bridges. The need for upgrading bridges to handle heavy rail cars is case specific. Thus, it is beyond the scope of this study to estimate bridge upgrading costs.

Table 1: Comparison of Total Highway Impacts and Upgrading Costs (Assumption that Highway Costs are Realized in Perpetuity – 6 percent Discount Rate)

Traffic Level Where Lines are Abandoned	Estimated Incremental Hwy Maint. Cost if All Traffic is on Rural Principal Arterials	Estimated Incremental Hwy Maint. Cost if all Traffic is on Rural Minor Arterials	Total Miles Abandoned (Turnouts)	Total Upgrading Cost to Prevent Abandonment[6]
Less than 35 Cars per Mile	$17,055,700	$41,213,283	895.5 (280)	$191,697,500
Less than 40 Cars per Mile	$22,439,133	$54,221,783	1080.7 (343)	$231,490,500
Less than 100 Cars per Mile	$28,125,633	$67,962,600	1187.5 (384)	$254,573,500
Less than 150 (200) Cars per Mile	$30,579,933	$73,893,150	1202.3 (391)	$257,810,500

INTERMODAL TRUCK/RAIL CONTAINER TRANSPORTATION FOR NORTH DAKOTA PRODUCTS

This study provides a snapshot of truck/rail container intermodal shipping in and out of North Dakota. Cost estimates for an intermodal facility were presented. The study also revealed benefits of intermodal transportation and problems associated with intermodal shipping to and from North Dakota because there is no intermodal facility located in North Dakota. The study analyzed potential and existing intermodal traffic through review of other studies, survey and examination of the Commodity Flow Survey from the U.S. Department of Commerce.

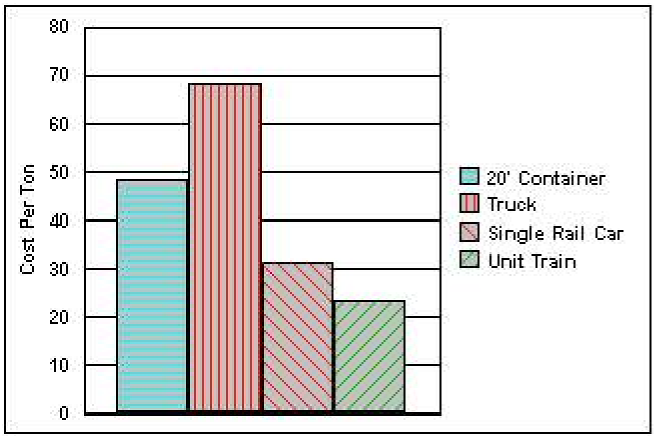
The Commodity Flow Survey conducted by the Commerce Department was analyzed to estimate possible container shipments from North Dakota. The CFS survey displayed that North Dakota shipped an estimated 88 million tons by all modes in 1997. The Commodity Flow Survey estimated that the portion of all freight that was truck/rail intermodal was 1.1 percent

[6]Assumes an upgrading cost of $205,000 per mile.

nationally. If North Dakota's truck/rail intermodal freight potential was the same as the national trend, then it could be estimated that North Dakota could have a potential of more than 48,000 TEUs or 20-foot containers for truck/rail intermodal shipments. Factors determining the proportion of shipments that could use truck/rail intermodal include the type of freight, distance to an intermodal facility, rates for shipments, lift costs, or total landed costs of shipments. However, because North Dakota's farmers are searching for new ways to market and identity-preserved commodities, larger portions of the agricultural products are being shipped directly from the farmer or marketing company in much smaller lots or in containers or semi-trailers.

Because of North Dakota's natural resource-based economy, some adjustments must be made to the CFS numbers. Products such as coal and petroleum traditionally do not use truck/rail intermodal service. Thus, an estimation of potential shipments should eliminate the coal and petroleum-based shipments. When ruling out this freight, only 53.3 percent of the freight was eligible for truck rail intermodal leaving North Dakota. The next step was to use only the portion of identified freight movements that were shipped adequate distance to best use the economies of rail. Only movements of more than 500 miles were used, which was 17.5 percent. Using this method it was estimated that more than 490,000 tons of freight potentially could move in containers over truck/rail intermodal. The estimated shipments could equate to more than 24,500 containers annually if intermodal loading facilities were available along with acceptable rates and service levels.

Lower transportation costs are realized with container intermodal shipping by using each mode for the portion of the trip for which it is best suited. Agricultural products are not eliminated because there is evidence that many agriculture products are being shipped in smaller lots as identity-preserved products. Such products would likely used truck/rail intermodal service. The following figure shows land cost comparisons shipping from Fargo to Tacoma. The truck costs represent a 100 percent backhaul. This means the cost is only attributable one way. Trucking is more costly by 42 percent at $68 per ton. The transloading charges would increase it another $12 per ton, the intermodal option is much less costly.



Transportation Cost Comparisons of Soybeans from Fargo, N.D., to Tacoma, Wash.

A survey developed for the study identified containers now being shipped in and out of the state. This survey asked about a company's freight and expected growth. The survey results estimates that 8,999 containers leave the state annually (Table 1). The southeast portion of the state represented some 63 percent of all traffic and more than 90 percent of all truck/rail container intermodal traffic. Two main factors contributing to the majority of container traffic originating in the southeast are location of an intermodal loading facility, and the size and number of businesses located in Cass County and surrounding areas. The south central area of the state identified the next most traffic. There were many more respondents from southeastern and south central North Dakota than from the rest of the state. Of the 195 respondents, 85 were from southeastern North Dakota and 28 were from south central North Dakota.

Table 2. Intermodal Survey: State Totals

Outbound Business	Number	Eastbound	Westbound
Export			
Rail Car	100	0%	100%
Trucks	2954	61%	39%
Containers	8011	65%	35%
Domestic			
Rail Car	1416	55%	45%
Trucks	32162	57%	43%
Containers	988	50%	50%
Inbound Business	Number	Eastbound	Westbound
Import			
Rail Car	104	50%	50%
Trucks	2064	61%	39%
Containers	813	50%	50%
Domestic			
Rail Car	1034	50%	50%
Trucks	19162	64%	36%
Containers	0	0%	0%

A spreadsheet model was developed to estimate costs associated with starting an intermodal loading facility in North Dakota. The model in this study has many useful features. Costs can be estimated for different equipment configurations and sizes of facilities. The base case estimated and investment of more than $2 million and operating expense at more than $400,000 annually. Sensitivity analysis provided insight into investment decisions where proportions of annual operating costs increased at a much lower rate than proportionally larger investment costs. This leads to the conclusion that under-investing may limit capacity of the loading facility limiting potential of handling larger volumes.

The survey indicates that most potential container intermodal traffic would originate in the southeast portion of North Dakota, therefore the greatest potential exists for a successful facility in that area. The truck/rail container intermodal shipping problem in North Dakota is circular in nature. Problems exist in the form of rates and service. Rates are high and service levels low because there is no volume, and there is no volume because rates are high and service levels are low.

LOGISTICAL FACTORS INFLUENCING LOCATION

One of the greatest challenges Upper Great Plains rural communities face in competing to attract value-added processing and manufacturing ventures is a lack of transportation options. Because of the lack of transportation options, location decisions are especially important for value-added processing and manufacturing ventures building in North Dakota. This study examines factors that influence the optimal location of such facilities in North Dakota.

Company investment decisions are based on profit-maximizing goals. As North Dakota competes for these investment dollars, logistical advantages, such as land values and labor costs, may be nullified by logistical disadvantages, such as freight rates and intermodal access. It is important to identify and understand these factors to help improve North Dakota’s competitive position.

When considering a business venture, other than a clear product and market definition (including the total size of the market, as well as the number and size of competitors); the next most important consideration is to define a network for the product. The network design should take into account the number, size, and location of suppliers, producers, distributors, wholesalers, and retailers.

Specific factors to examine when considering the location of one particular component of the network, for example, a value-added processing facility, include:

(1) Labor climate

(2) Transportation availability

(3) Proximity to markets/customers

(4) Quality of life

(5) Taxes/Industrial development incentives

(6) Supplier networks

(7) Land costs/utilities

(8) Company preference

A number of important factors described above can be examined easily in a linear programming spreadsheet model to help make a location decision. These factors include the availability and cost of raw materials, capacity and operating costs of the proposed processing facilities/plants, transportation costs to ship from raw material sources to the plants and from the plants to the customers, and customer demand. One example of such a model is presented.

The objective of the model was to minimize total costs subject to four constraints: (1) each customer region's demand must be met; (2) for each supply source, raw material supply capacities can not be exceeded; (3) for each plant, the capacity of the plant can not be exceeded; and (4) for each plant, the amount of raw materials transported to the plant should equal the amount of product that is transported from the plant (i.e., there can not be more output than input).

Case studies were used to illustrate the model and consider the problem of whether to locate a new processing plant in northwest, south central, north central, or northeast North Dakota. This case study assumed a raw material supply was available in northeast, northwest, and southeast North Dakota, as well as in central Montana, to serve a proposed plant. It also assumed the amount and cost of raw material supply available are equal at each location. The case study further assumed that for each proposed plant, the plant capacity, fixed costs, and operating costs would be equal. These are all changeable in the model to reflect specific product information for different applications.

The first inputs needed for the model are the transportation costs to ship from each raw material supply source to each proposed plant, as well as the plant capacity and fixed/operating costs. The particular costs used in this case study are illustrated in Table 2, and are on a per hundredweight basis.

Table 2. Costs to Ship from Raw Material Supply Sources to Plants (Case 1)

Raw materials to plants		*Costs to ship from raw material source x to plant y*			
	RM Price	NW ND	S. Central ND	N. Central ND	NE ND
NE ND	11.00	1.5500	0.7000	0.7000	0.1000
NW ND	11.00	0.6000	0.6000	0.6000	0.8000
SE ND	11.00	1.7000	0.6500	0.8000	0.5000
Central MT	11.00	2.7000	2.8000	2.8000	2.8500
Plant Capacity (units/yr)		15,000,000	15,000,000	15,000,000	15,000,000
Plant Fixed Costs		4,000,000	4,000,000	4,000,000	4,000,000
Plant Operating Costs		18.200	18.200	18.200	18.200

The second set of inputs to the model were costs to ship from each proposed plant to each customer, as well as an estimate of the customer demand. The information used in this case study is displayed in Table 3.

Table 3. Costs to Ship from Plants to Customers and Customer Demand (Case 1)

Plants to customers		*Costs to ship from plant y to customer z*			
	Demand	NW ND	S. Central ND	N. Central ND	NE ND
Los Angeles	3,313,000	5.5100	5.6000	6.3000	6.4600
Dallas	3,444,000	5.0000	3.9000	4.5000	3.9700
Chicago	3,210,000	3.4400	2.7500	2.7000	2.4300
Baltimore	1,238,000	6.3900	5.4200	5.3500	5.2700
Seattle	2,350,000	3.9300	4.3000	4.5000	4.8800
TOTAL	13,555,000				

The first decision part of the model considers the supply available at each raw material supply source and the volume to ship from each source to each plant. In the case study example in Table 4, the model recommended shipping 13,555,000 units from the supply source in northeast North Dakota to a plant located in northeast North Dakota.

Table 4. Volume to Ship from Raw Material Supply Sources to Plants (Case 1)

Raw materials to plants		*Volume to ship from raw material source x to plant y*				
	Supply Avail.	NW ND	S. Central ND	N. Central ND	NE ND	Total Shipped
NE ND	15,000,000	0	0	0	13,555,000	13,555,000
NW ND	15,000,000	0	0	0	0	0
SE ND	15,000,000	0	0	0	0	0
Central MT	15,000,000	0	0	0	0	0
TOTALS		0	0	0	13,555,000	13,555,000

The second decision part of the model considered the volume to ship from each plant to each customer. The case study model in Table 5 recommended making all shipments to customers from the northeast North Dakota plant.

Table 5. Volume to Ship from Plants to Customers (Case 1)

Plants to customers	*Volume to ship from plant y to customer z*				
	NW ND	S. Central ND	N. Central ND	NE ND	Total Shipped
Los Angeles	0	0	0	3,313,000	3,313,000
Dallas	0	0	0	3,444,000	3,444,000
Chicago	0	0	0	3,210,000	3,210,000
Baltimore	0	0	0	1,238,000	1,238,000
Seattle	0	0	0	2,350,000	2,350,000
TOTALS	0	0	0	13,555,000	13,555,000

Given the above decisions from the case study model, total costs for the proposed plant are $8,580,287 annually. The model estimated the lowest annual total costs for northeast North Dakota of all locations considered.

The model described in the previous case studies can be a useful tool helping in location decisions for a processing facility. It considers a number of important factors, such as transportation costs, raw material availability and cost, as well as costs associated with proposed plants. In addition, inputs to the model can be changed easily to allowing for many different scenarios. The model can demonstrate the benefits of a location over another based on factors such as available freight rates and land or labor costs. However, making a final decision, many other factors must be considered.

CONCLUSION AND RECOMMENDATIONS

This study provides a great deal of information to policymakers and participants in North Dakota's agricultural economy. As a result of examining the four major issues, several policy implications follow:

- State and local policymakers should consider the location of shuttle train facilities and the location of light rail lines (those less than 90 pounds per yard) in making future highway investment decisions. Highway maintenance costs will increase in areas where new shuttle facilities are located and in areas where light rail is abandoned as a result of an industry shift to larger rail cars.
- A loan guarantee program that eliminates risk to lenders from making long-term loans is likely to improve the viability of some North Dakota rail lines as maintenance and upgrades are required.
- Incremental highway maintenance costs resulting from an industry switch to larger rail cars do not appear to be large enough to justify a statewide subsidy for upgrading rail lines. This does not preclude such subsidies on specific line segments.
- According to a shipper survey performed in this study, an intermodal facility in southeast North Dakota appears to have the greatest traffic potential of any location in the state.
- Policymakers may want to encourage those developing an intermodal facility to locate such a facility near an interstate highway, as such a location would minimize highway impacts from such a facility.
- New value-added processing facilities should take into account labor climate, transportation availability, proximity to markets, quality of life, taxes, supplier locations,

and land costs in making location decisions, as these factors can have an important impact on logistics costs.

- The draw area for the shuttle facilities is estimated to be a 60-miles radius. Where shuttle facilities are built, truck traffic over local and state roads in the draw area would significantly increase, requiring additional investment in maintenance and or upgrades for local and state highways.
- Effort should be extended by the N.D. Department of Transportation to work with the grain industry in location decisions for shuttle facilities to ensure the infrastructure is adequate to handle the additional truck traffic.