Transportation Research, Public Service & Education

MPC REPORT NO. 96-57

North Dakota Wheat Producer Marketing

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February 1996

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INTRODUCTION

Each year North Dakota producers market millions of bushels of grains and oilseeds. Over the past decade shipments marketed through the N.D. country elevator system have ranged from under 400 million bushels during the 1988-89 drought, to over 700 million bushels in 1992-93 following a record hard red spring (HRS) wheat harvest. North Dakota producers grow a wide array of agricultural commodities for both domestic and export markets. One of the greatest challenges producers face in profitably marketing their crops is that they are located long distances from both export positions and major domestic consuming regions. Thus, it is imperative that producers can rely on a progressive, competitive system for marketing their grain.

Recent years have housed an evolution of the N.D. agricultural industry. An obvious effect of the agricultural industry's adjustment to rapid advancements in technology and a more globalized market environment has been a change in the make-up of the N.D. farm

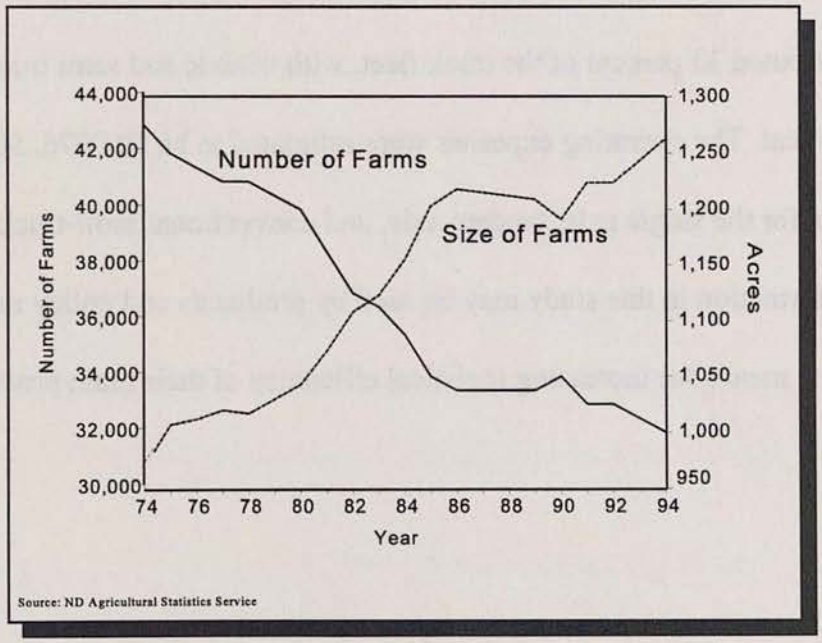

Figure 1. Number & Average Size of N.D. Farms

ABSTRACT

A 1995 survey of N.D. producers was conducted to gain insight into the farm-to-market logistical process. In assessing the process, this study was used to examine the factors that affect the marketing decision, the criteria used in the grain marketing decision, the make-up of the farm truck fleet, and the cost for a typical farm truck delivery. Although the elevator in closest proximity to the producer remains an important destination, producers are 24 percent less likely to deliver to the nearest elevator than they would have 15 years ago. Producers reported checking board prices at two and often a third elevator before making their delivery decision. Survey respondents hauled grain an average of 13.3 miles to their preferred elevator. This distance represents a 21 percent increase in length of haul to the preferred elevator, compared to distances reported in a 1980 survey of N.D. producers.

Because costs and characteristics of N.D. wheat producer deliveries are tied closely to their delivery equipment decisions, the report includes a breakdown of the fixed and variable cost components associated with operating single axle, tandem axle, and conventional semi trucks. For survey respondents, single axle trucks accounted for 57 percent of the truck fleet. Tandem axle trucks attributed 33 percent of the truck fleet, with tri-axle and semi trucks each accounting for about 4 percent. The operating expenses were estimated to be $0.0076, $0.0049, and $0.0039 per bushel mile for the single axle, tandem axle, and conventional semi-truck, respectively.

The information in this study may be used by producers and policy makers as they continue to seek means for increasing logistical efficiency of their grain production/marketing ventures.

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INTRODUCTION

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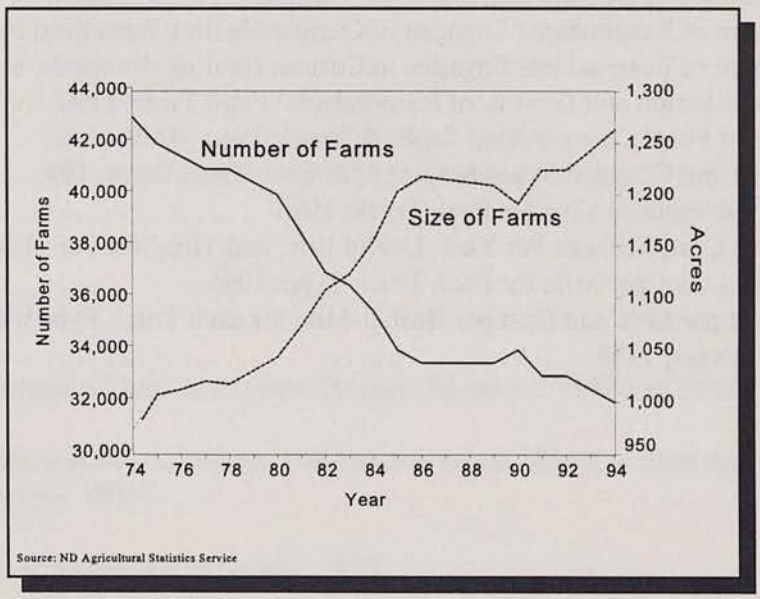

Figure 1. Number & Average Size of N.D. Farms

population. The number of farms in the state has declined over recent decades while the acres per farm have increased. In 1972 there were 44,000 farms with an average size of 950 acres. In 1994, 32,000 farms were counted, averaging 1,263 acres per site. Thus, between 1972 and 1994, the number of farms in North Dakota declined by one-fourth, and the average size of the remaining operations increased by more than one-third (North Dakota Agricultural Statistics). These trends suggest that there is a greater concentration of resources allowing for increased flexibility in investments and marketing.

Other adjustments by the agricultural industry can be observed by examining the N.D. country elevator system. This system allows producers to combine production resources to satisfy markets beyond the scope of individual competitive capabilities. Grain is characterized as a bulky, low-value commodity. Therefore, efficiencies can be gained and per-bushel costs lowered by spreading fixed costs across more bushels within a shipment. Just as larger farms allow producers more flexibility in investment and marketing, the elevators experience competitive gains when more grain is handled and larger shipments are originated. The N.D. country elevator system included 589 licensed sites in 1979, this number had declined to 484 by 1994 (Table 1). During the same time span the number of sites equipped to load unit trains (second behind barges as a low cost means for transporting grain) has expanded from a mere eight sites to more than 112. Thus, although the distances between facilities has increased as the number of sites has declined, distance to a unit train location has decreased for most producers.

Table 1. North Dakota Elevator Industry, 1979 vs. 1994

	1979	1994	Change
Number of Licensed Sites	589	484	(18)%
Market Share for the:			
5 Largest Volume Elevators	5%	12%	140%
150 Largest Volume Elevators	57%	81%	42%
Unit Train Facilities	8	112	1300%
Grain Handled, Avg. (bu.)	808,258	1,044,126	29%
Storage Capacity, Avg. (bu.)	244,000	508,300	108%
Sites with Storage Capacity of:			
less than 400,000 bu	89%	56%	(37)%
400,001 to 800,000	9%	26%	189%
800,001 +	2%	18%	800%

Source: Vachal, 1995.

Changes in the N.D. elevator system have affected producers across the state as loss of delivery sites and investments to upgrade other delivery sites have altered marketing options and distances to markets. Overall, the number of grain originating sites in the state's elevator population has declined by a quarter since 1980, from 568 to 424[1] sites. To make a blanket statement that loss of elevator sites has impacted regions equally would be erroneous. The changes have varied across the state, so a regional (by crop reporting district) illustration of changes in the elevator population is listed in Table 2. Boundaries for the regions are illustrated in Figure 3.

[1] This 424 total for the elevator population refers to the number of elevators reporting grain and oilseed shipments beyond the N.D. elevator system, not accounting for elevators with combined reports or only shipments to other N.D. elevators.

Table 2. Elevators Located in Each Crop Reporting District, 1980 & 1995

C.R.D.	Region	Number of Elevators *Share of State Total* 1980		1995		% Change 1980 vs 1995
1	NW	69	*12%*	41	*10%*	**(41)%**
2	NC	50	*9%*	34	*8%*	**(32)%**
3	NE	122	*21%*	98	*23%*	**(20)%**
4	WC	27	*5%*	18	*4%*	**(33)%**
5	C	54	*10%*	46	*11%*	**(15)%**
6	EC	91	*16%*	72	*17%*	**(21)%**
7	SW	40	*7%*	25	*6%*	**(38)%**
8	SC	32	*6%*	23	*5%*	**(28)%**
9	SE	83	*15%*	67	*16%*	**(19)%**
All		568		424		**(25)%**

The northwestern and southwestern regions of the state have experienced the most significant decline in elevator delivery sites over the past 15 years, as they lost 41 and 38 percent of their elevators, respectively. The central region of western North Dakota continues to house the fewest elevators among the nine regions. The three eastern regions of North Dakota lost smaller portions of their elevators than to the three western regions and two of the central regions, averaging only a 20 percent loss of elevator sites. C.R.D. 5, that encompasses counties in the center of the state, had the smallest decline in elevator numbers, losing only 15 percent of its elevators over the past 15 years.

Table 3. Bushels per Elevator by Region, 1980/81 & 1994/95, Bushels in 1,000

	1980/81			1994/95			
Region	Total Bushels	# of Elevators	Bushels per Elevator	Total Bushels	# of Elevators	Bushels Per Elevator	Change: Bu. Per Elevator
NW	41,942	69	608	91,367	41	2,228	**267%**
NC	32,879	50	658	49,478	34	1,455	**121%**
NE	94,203	122	772	97,642	98	996	**29%**
WC	12,540	27	464	19,721	18	1,096	**136%**
C	44,670	54	827	48,105	46	1,046	**26%**
EC	88,147	91	969	98,373	72	1,366	**41%**
SW	12,060	40	302	27,532	25	1,101	**265%**
SC	7,864	32	246	12,301	23	535	**118%**
SE	66,779	83	805	84,602	67	1,263	**57%**
All	**401,084**	**568**	**706**	**529,121**	**424**	**1,248**	**77%**

The per elevator volume handled among regions in North Dakota supports the premise that elevators are seeking economies associated with handling more bushels. Although the reduction in elevator numbers is not shared equally among regions, it appears that all regions have increased their per elevator volume handled. The increases range from a high of a 267 percent in the northwest region to a low of 26 percent in the central region. The vast range of change may be attributed to greater need for rationalization in some regions relative to others. It is important to note that the loss of elevator sites has many implications for producers, including effects on: elevator competition, market alternatives, producer delivery patterns, and overall efficiency of the grain marketing system. All of these have impacted producer profit margins.

Objective

Producers make the initial decision in the grain marketing chain. Thus, it is important to understand their marketing decisions. With an objective of operating profitably in a competitive, global market economy, agricultural producers continue to seek increased flexibility and efficiency. As the characteristics of farms and markets change, the producers' logistical decisions continue to evolve. A basic requirement of ensuring that the state's transportation infrastructure meets the needs of producers is understanding industry characteristics and trends.

The objective of this study is to profile the farmgate to market segment of N.D. wheat marketing industry, including:

- Discussing factors that may influence the marketing decisions of N.D. wheat producers,
- Establishing general criteria used in the grain marketing decision,
- Describing the current farm truck fleet,
- Updating farm truck costs, and
- Providing suggestions for ensuring that N.D. producers are provided with the information and infrastructure they require for managing the logistics of their operations.

Data

Three data sources were used to compile this report. The primary source for producer marketing and equipment information was a 1995 survey of N.D. wheat producers (Appendix C). Five-hundred and sixty-eight of the 631 questionnaires returned were usable, generating a response rate of 11 percent. In addition to marketing criteria, truck inventory and farm characteristics, producers were asked to specify the name and location of their first and second choices for elevator deliveries. Producers also ranked the service provided by the first

choice elevator. North Dakota Public Service Commission grain movement information was attached to survey responses so characteristics such as elevator size, bushels handled, and rail/truck use in marketing could be identified for the elevators listed by respondents. The final data source was a phone survey of auction companies, insurance agents, dealers, and equipment suppliers that handle farm and commercial trucks. Information collected through these calls was used in the estimation of truck costs.

This report contains five sections. The next section provides a description of North Dakota wheat producers' logistical environment, including production, storage, and use of alternative markets. An overview of the marketing decision and delivery patterns used by N.D. producers is provided next. The fourth section is devoted to the N.D. farm truck inventory. Current ownership, investment patterns since 1980, and truck use are discussed. In addition, the farm truck cost model developed in 1984 (Cassavant, et al) is revised and updated. The project summary completes the report.

Wheat Producer Marketing Profile

The wheat industry is a staple in the N.D. farm economy. In 1994 N.D. ranked first among the states as a spring wheat and durum wheat supplier, producing 50 and 78 percent of total U.S. spring wheat and durum, respectively. More than half the cropland harvested in N.D. during 1994 was seeded to wheat, with hard red spring wheat (H.R.S.) accounting for 42 percent of the acres harvested in N.D., and durum an additional 11 percent (North Dakota Agricultural Statistics Service). Thus, selecting N.D. wheat producers as the

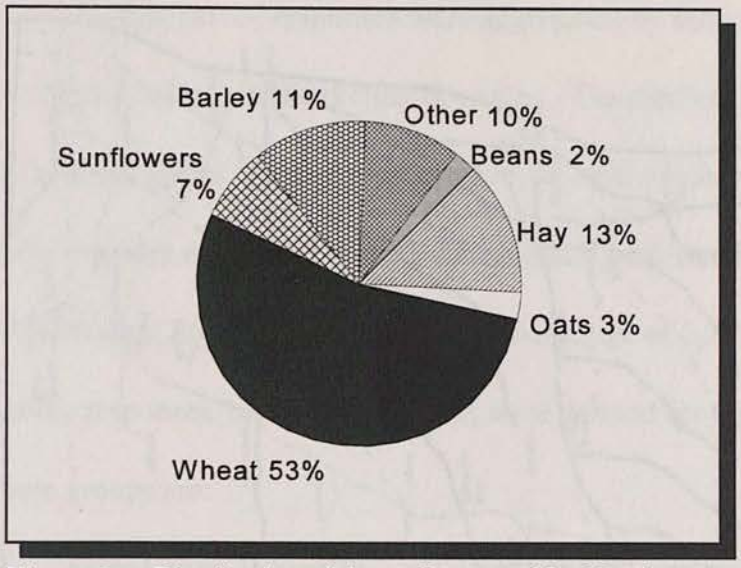

Figure 2. Distribution of Acres Harvested by North Dakota Producers, 1994

population for this survey provides a good base for collecting information regarding the logistical equipment and decisions for crops grown on a majority of the tillable land in North Dakota.

Distribution of Responses

The profile of producer wheat marketing is based on survey responses from across North Dakota. Surveys were returned from each of North Dakota's 53 counties, but the small sample size limits the reliability of county level summaries. Therefore, crop reporting district boundaries (C.R.D.) that divide the state into nine regions are the smallest aggregate level used for summaries. Response levels and definitions of the nine C.R.D. boundaries are illustrated in Figure 3. Survey responses were grouped by C.R.D. so comparisons of producer marketing patterns and truck ownership could be made for alternative regions.

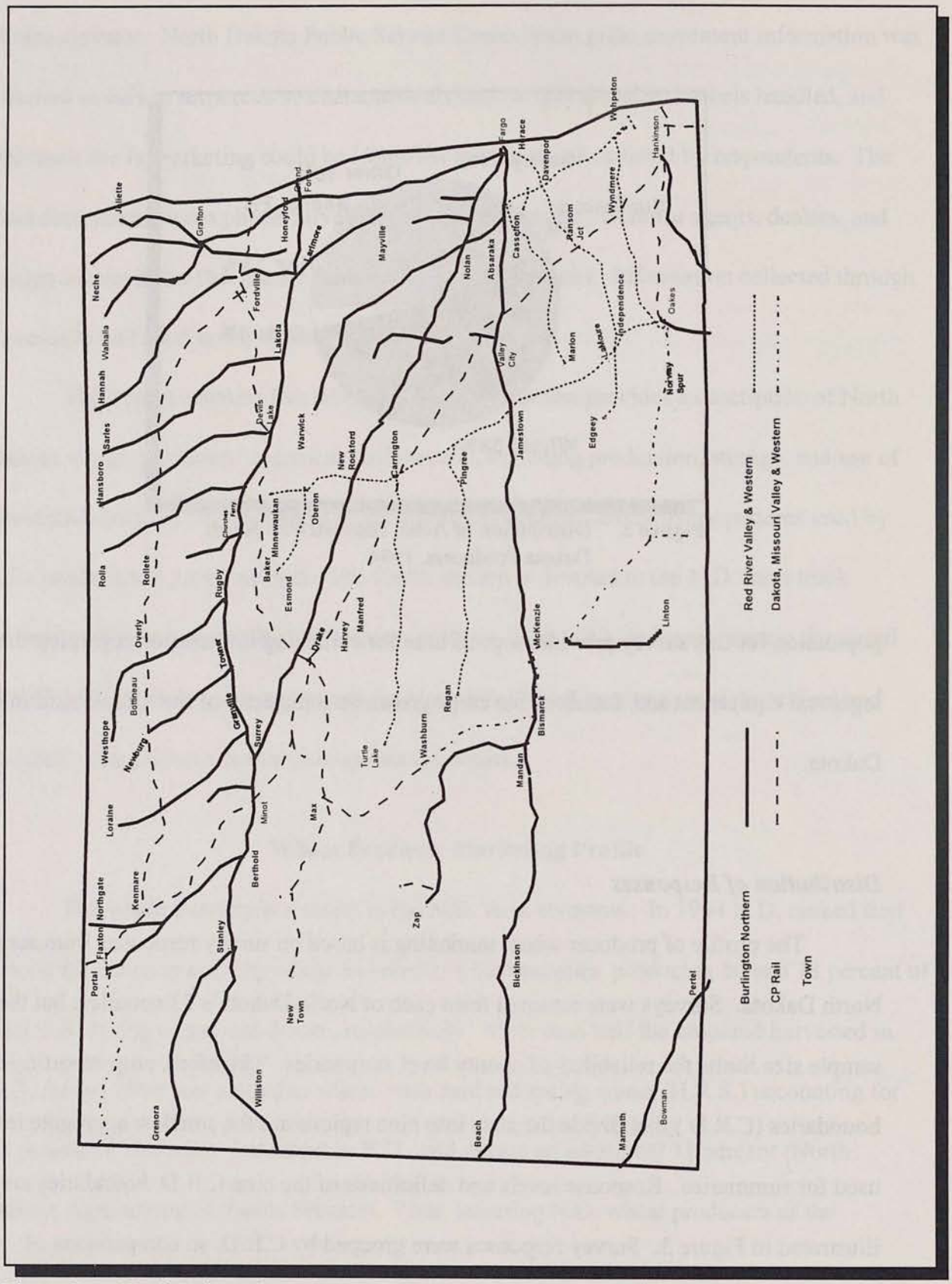

Figure 3. North Dakota Crop Reporting District (C.R.D.) Boundaries

Farm Size and Storage Capacities

In addition to location, survey responses were aggregated by farm size to determine if the number of acres farmed influences marketing decisions. The median[2] farm size was 1,300 acres for the response group. Farm size is equal to the total number of cropland acres in an operation, including both rented and owned. The median farm size for the survey is close to the N.D. Agricultural Statistics Service estimated average of 1,263 acres per farm. Three groups of survey responses, based on farm size, were defined for this study. The acre designations for these groups are:

Farm Group 1 (Small):	less than 800 acres
Farm Group 2 (Medium):	800 to 1,999 acres, and
Farm Group 3 (Large):	2,000 acres or more.

Each of these groups represents a segment of the response group that is sufficient for generating survey statistics and comparisons among farm groups in addition to the statewide summaries.

On average, the farms housed 51,005 bushels of storage. This average storage level is skewed by a few extremely large storage levels, therefore, the median storage capacity of 35,000 provides a more accurate estimate of a typical farm's storage. Among the farm groups, Small-Farms typically had 480 acres per farm and housed 12,000 bushels of storage. Medium-Farms rented or owned 1,265 acres of cropland, with storage for 32,000 bushels. Producers with large farms typically managed 2,727 acres of rented/owned cropland and

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[2] Median refers to the observation at the 50th percentile. Median size is used to minimize the effects of 'atypical' answers. For example, if yield of 10, 10, 20, 30 and 150 bushels are reported the mean or average would equal 44, and the median would equal 20. At the 20 bushel observation an equal number of observations are above and below the observation.

82,000 bushels of storage. Wheat is a staple in the seeding venue of most N.D. farms. The share of available acres seeded to wheat annually per farm varied little among farm sizes, according to survey respondants. Wheat was attributed 45, 45, and 50 percent of the acres for the small, medium, and large farms, respectively. Although the three farm groups have a wide range of resource and labor requirements, each requires successful management of logistical resources in a dynamic and competitive marketing system.

Table 4. Definition of Farm Population Sectors, Based on Acres Rented/Owned

		Survey Responses	Acres (Rented & Owned)	Bushels of Storage	% of Acres Wheat in 1995
				-Median -	
Small:	799 acres or less	204	480	12,000	45%
Medium:	800 to 1,999 acres	268	1,000	26,000	45%
Large:	2,000 acres or more	160	2,727	82,000	50%

Markets for Wheat

Logistical management encompasses the transportation, destination, and storage decisions that producers make for their operations. An important factor in understanding producer logistics is determining the importance of alternative markets. Four major markets were defined for the survey: (1) local elevators, (2) terminal markets, (3) N.D. Processors, and (4) domestic processors outside North Dakota. Wheat not delivered to one of these markets was included in an Other category. The primary delivery point specified under the Other category was 'Certified Seed Supplier,' in this case receivers would be other producers.

The distribution of grain deliveries among the alternative markets was based on 509 responses for H.R.S. and 194 answers for durum. The distribution of deliveries among the alternative H.R.S. (durum) markets was weighted by the number of H.R.S. (durum) acres harvested by the respondent. Local elevators were by far the most popular delivery points for N.D. producers as they accounted for 94 and 93 percent of H.R.S. and durum deliveries, respectively. N.D. processors were second on the list of choices for durum producers, receiving 4 percent of the durum deliveries. Small amounts of durum also were delivered to terminal markets beyond state borders and to other producers as seed. H.R.S. producers selected the Other market category 3 percent of the time and delivered small amounts to processors and terminal markets outside North Dakota.

Table 5. Delivery of Wheat to Alternative Markets, Weighted by Acres Harvested

	H.R.S. (n=509)	Durum (n=194)
Local Elevator	94%	93%
N.D. Processors	1%	4%
Terminal Market	1%	1%
Domestic Processors	1%	0%
Other (e.g. Certified Seed)	3%	1%

Factors Influencing Marketing Patterns

Many factors may influence the final delivery decisions of producers. In establishing the distribution of wheat deliveries among alternative markets, it is obvious that N.D. elevators are the primary market for N.D. wheat producers (Table 3). Thus, the producer's marketing decisions most often focus on logistical alternatives regarding farm to elevator deliveries. The marketing patterns/characteristics discussed in this section provide a base for identifying trends and predicting future transportation/logistical needs of producers.

Nine factors were defined as potentially important in the wheat marketing decision. To ascertain relative importance of each factor producers were asked to rate the importance of factors on a scale of one to five, with one labeled *not important* and five labeled *very important*. These factors included price, service, and locational characteristics (Table 6).

Based on this rating, the elevator board price was the most important factor in the producer marketing decision. It was rated *very important* by 77 percent of the survey respondents and was given an overall rating of 4.7. Grading/testing practices and quality of service were tied for second according to producer ratings. Both factors received ratings of 4.3 and were viewed as *very important* by 53 and 51 percent of the respondents, respectively. More than one-third of the respondents rated community loyalty as *very important*. Distance to the elevator and condition of the roads were viewed equally important, rated 3.7 by respondents. Offering additional services at an elevator, membership in a cooperative elevator, and location of an elevator near other business completed the ranking. These factors received ratings of 3.4, 3.2 and 2.6, respectively. Thus, while pricing and service are

the primary criteria for market selection it is evident that many other factors influence the producer wheat marketing decision (Table 6).

Table 6. Factors that may Influence the Wheat Marketing Decision

Factors:	Average Rating	Distribution of Responses 1 (Scale 1=not important to 5=very important)	2	3	4	5
1. Elevator Board Price	**4.7**	**0%**	**1%**	**4%**	**18%**	**77%**
2. Grading Practices & Testing Eqpt	4.3	0%	2%	14%	31%	53%
2. Quality of Service	**4.3**	**2%**	**1%**	**11%**	**35%**	**51%**
4. Local Community	3.9	6%	6%	19%	33%	37%
5. Distance to the Elevator	**3.7**	**5%**	**7%**	**28%**	**32%**	**29%**
5. Condition of the Roads	3.7	6%	6%	28%	34%	26%
7. Additional Services at the Elevator	**3.4**	**11%**	**11%**	**26%**	**30%**	**22%**
8. Farmers Cooperative	3.2	21%	9%	25%	21%	23%
9. Elevator is Near Other Businesses	**2.6**	**30%**	**17%**	**26%**	**16%**	**11%**

The importance of alternative factors was aggregated for each of the farm groups to determine if the marketing decision varies with farm size. Based on the results, importance of factors does not appear to be influenced by the number of acres farmed. Elevator board price, grading and testing equipment, and quality of service top the list of marketing factors for each farm group. Loyalty to a farmers cooperative and proximity of the elevator to other businesses were viewed least important in each group's wheat marketing decision (Table 7).

Table 7. Small, Medium, & Large Farm Group Rankings of Marketing Factors

Factors:	Small	Medium	Large
	- Farm Group Ranking -		
Elevator Board Price	**1st**	**1st**	**1st**
Grading Practices & Testing Eqpt	2nd	2nd	2nd
Quality of Service	**3rd**	**2nd**	**2nd**
Local Community	4th	7th	4th
Distance to the Elevator	**5th**	**4th**	**4th**
Condition of the Roads	5th	4th	4th
Additional Services at the Elevator	**5th**	**6th**	**7th**
Farmers Cooperative	8th	8th	8th
Elevator is Near Other Businesses	**9th**	**9th**	**9th**

In addition to defining the importance of marketing factors, wheat producers were asked to rate the adequacy of: local roads, elevator competition, custom trucking services, and market information (Table 8). Availability of market information, local roads, and competition among elevators were viewed more than adequate by most respondents.

Availability of custom trucking services met producer expectations during non-harvest periods, but custom hauling services were rated less than adequate during harvest. Although access to custom hauling services during harvest is somewhat limited, investment in resources to satisfy demand during this peak hiring season would likely increase unit costs for those providing custom hauling services because it may be difficult to employ the additional trucking resources during the non-harvest season. Less active resources would reduce efficiency and increase unit costs as fixed expenses would be spread over fewer bushels per truck. Moreover, due to the slim margins maintained by the custom hauling industry, such excess capacity could not be maintained.

Table 8. Adequacy of Factors that may Influence the Wheat Marketing Decision

Factors:	Average Rank	Distribution of Responses 1	2	3	4	5
		(Scale 1=not adequate to 5=very adequate)				
1. Custom Hauling During Harvest	**2.5**	**29%**	**22%**	**27%**	**13%**	**9%**
2. Non-Harvest Custom Hauling Services	3.0	22%	10%	24%	23%	20%
3. Competition among Local Elevators	**3.6**	**8%**	**8%**	**23%**	**34%**	**26%**
4. Local Road Conditions	3.6	4%	7%	31%	36%	22%
5. Availability of Market Information	**4.0**	**4%**	**4%**	**19%**	**36%**	**37%**

Producer ratings of factors in their wheat marketing environment also were aggregated at the C.R.D. level to determine if the adequacy of the factors varied among regions (Table 9). With the C.R.D. information, the adequacies regarding custom hauling services can be discussed on a regional basis. This regional discussion is valuable because

trucking services for farm-to-elevator deliveries often are purchased from within the local market. Producers in the northeastern, west central, and east central regions (C.R.D.'s 3, 4 and 6) experience problems hiring custom hauling services year-round, but the problem is more critical during harvest. In contrast, producers in the southcentral region (C.R.D. 8) rated custom hauling adequate year-round. Producers in other regions were satisfied with the availability of custom hauling services during non-harvest, but rated the availability during harvest as less than adequate. The competition among elevators, local road conditions, and availability of market information met the expectations of producers, as these factors received overall ratings between 3.3 and 4.3.

Table 9. Average Ratings for Factors that Influence the Wheat Marketing Decision, by C.R.D. *(Scale 1=not adequate to 5=very adequate)*

	Crop Reporting District								
	1	2	3	4	5	6	7	8	9
Factors:	NW	NC	NE	WC	C	EC	SW	SC	SE
1. Custom Hauling During Harvest	**2.4**	**2.7**	**2.5**	**2.0**	**2.4**	**2.4**	**2.6**	**3.0**	**2.5**
2. Non-Harvest Custom Hauling Services	3.3	3.5	2.8	2.5	3.2	2.6	3.4	3.3	3.1
3. Competition among Local Elevators	**3.3**	**3.8**	**3.8**	**3.7**	**3.9**	**3.8**	**3.3**	**3.3**	**3.5**
4. Local Road Conditions	3.6	3.6	3.8	3.7	3.6	3.5	3.6	3.5	3.6
5. Availability of Market Information	**3.9**	**3.9**	**4.0**	**3.5**	**4.0**	**4.3**	**4.1**	**3.7**	**4.0**

Delivery Patterns for Wheat

Characterizing the delivery patterns of wheat producers is important to understanding trends and establishing an agenda to support future marketing activities. The discussion of delivery patterns is comprised of two major sections: the farm-to-elevator movement and the inventory of farm trucks. The farm-to-elevator movement provides a base for defining the producer marketing area. The inventory of farm trucks is important because it provides information regarding the investment decisions that influence producer deliveries. A previous UGPTI report that characterized producer deliveries and truck investment was based on a 1980 survey of N.D. producers (Cassavant and Griffin). This study will be referenced to identify changes in producers deliveries and the farm truck inventory.

Farm to Elevator Movement

The initial step in wheat delivery is selecting a market. As discussed earlier, the market for a vast majority of N.D. wheat is a local elevator. To provide a broader insight into the elevator delivery decision, producers were asked to list information such as: the number of elevator board prices checked, distance of haul, road surfaces traveled, and monetary incentive required for longer distance deliveries. Summaries of survey responses characterize the elevator selection and grain delivery process.

It is evident that today's wheat producers have modified the marketing plan of pioneer days, when producers delivered to the closest market. Although distance is no longer the limiting factor it once was for producer marketing, it is still an important component in defining the producer marketing area and estimating delivery costs. Survey respondents

listed distance to their closest, preferred and second-choice elevators. Producers also specified distances they would travel to access markets offering higher prices. In addition, they were asked to segregate distances traveled on gravel and paved road surfaces to reach the preferred and second-choice elevators because marketing choices and delivery costs are influenced by road surfaces traveled.

Closest Market

Today's producers typically check board prices at two elevators and often a third before making a delivery decision. In many cases, these are the elevators that are in the closest proximity to the producer. About 53 percent of the respondents delivered to their closest elevator in 1995. This is 24 percentage points fewer than in 1980, when 67 percent of the survey respondents delivered to their closest elevator.

Although the closest elevator remains an important market for many producers, they traveled farther to deliver grain to their closest elevator in 1995 than they did 15 years ago, on average. With the rationalization of both the farm and elevator industries, the distance to the closest elevator has increased 17 percent over the past 15 years. Distance averaged 9.6 miles for survey respondents in 1995 compared to 8.2 miles in 1980.

A majority of the respondents for both the 1995 and the 1980 surveys were located six to 10 miles from an elevator. In comparing the distribution of distances to an elevator from respondents' farms between 1995 and 1980, there was a 37.6 percent decline in the share of producers located within two miles of an elevator (Table 10). Most of the shift in the distances was from the one- to two-mile radius to the 11-15 mile category between 1980

and 1995. In addition, there was a 4.8 percent increase in the share of producers who travel more than 25 miles to reach the nearest elevator.

Table 10. Distribution of Farm to Nearest Elevator Distances, 1980 & 1995

Miles to nearest elevator	1980	1995	Change
1-2	11.8%	7.4%	**(37.6)%**
3-5	26.8%	27.8%	**3.8%**
6-10	34.9%	36.5%	**4.6%**
11-15	15.7%	17.7%	**12.3%**
16-25	9.4%	9.2%	**(2.1)%**
over 25	1.4%	1.5%	**4.8%**
Responses	978	543	

Because there is a variation in the density of farms and elevators among the regions, it is important to discuss the regional distribution of respondants among alternative distance to market categories. Crop reporting districts in the east have the largest share of respondents located within five miles of an elevator (Table 11). This is not surprising as the eastern region (C.R.D.s 3, 6 and 9) accounts for over half, 56 percent, of the elevators in the state. Producers in the west central and southwestern regions report the largest share of producers who are located more than five miles from an elevator. The west central region has the fewest elevators among the regions, as its 18 elevators account for only 4 percent of the elevators in North Dakota. The 25 elevators in southwestern region account for about 6 percent of the state total.

Table 11. Regional Farm to Nearest Elevator Distances, 1980 & 1995

Table Segment I: Distance from Farm to Nearest Elevator in 1980

Miles to nearest elevator	- Region -									
	NW	NC	NE	WC	C	EC	SW	SC	SE	All
1-5	34.6%	41.9%	44.0%	17.2%	41.6%	64.5%	20.6%	24.2%	43.5%	38.6%
6-15	63.6%	51.6%	54.3%	47.7%	57.5%	35.6%	45.1%	51.8%	54.0%	50.6%
16+	1.9%	6.5%	1.7%	35.2%	0.9%	0.0%	34.3%	24.1%	2.6%	10.8%
Responses	107	93	116	105	108	149	102	83	115	978

Table Segment II: Distance from Farm to Nearest Elevator in 1995

Miles to nearest elevator	- Region -									
	NW	NC	NE	WC	C	EC	SW	SC	SE	All
1-5	25.4%	34.9%	48.7%	21.0%	26.0%	54.0%	20.7%	30.4%	40.4%	35.2%
6-15	60.0%	58.7%	50.4%	57.9%	59.3%	40.0%	55.5%	52.1%	53.2%	54.2%
16+	14.6%	6.4%	0.9%	21.0%	14.8%	6.0%	23.8%	17.4%	6.4%	10.7%
Responses	75	63	115	38	54	50	63	23	62	543

Table Segment III: Change in Farm to Nearest Elevator Distances, 1980 to 1995

Miles to nearest elevator	- Region -									
	NW	NC	NE	WC	C	EC	SW	SC	SE	All
1-5	(9)%	(7)%	5%	4%	(16)%	(10)%	0%	6%	(3)%	(3)%
6-15	(4)%	7%	(4)%	10%	2%	4%	10%	0%	(1)%	4%
16+	13%	0%	(1)%	(14)%	14%	6%	(10)%	(7)%	4%	0%

Comparing the distribution of farm to elevator distances for 1980 and 1995, central North Dakota has had the largest increase in the share of producers who travel more than 15 miles to reach the nearest elevator. In 1980 less than one percent of the respondants were more than 16 miles from an elevator, in 1995 almost 15 percent of the producers in the central region who responded to the survey were more than 16 miles from an elevator. The

northwest region also has had a substantial increase, in the share of survey respondants who travel more than 16 miles to reach the nearest elevator (13 percent).[3]

Delivery to Preferred Elevators

Distance to the nearest elevator is an indicator of elevator density and proximity of producers to a market, but for the purposes of characterizing grain deliveries and estimating truck costs, more important measures of producer hauling are the miles and roads traveled to make deliveries to the preferred and second-choice elevators. The preferred and second-choice elevators, that may or may not include the producer's closest elevator, define a producer's typical marketing area.

Survey respondents reported hauling grain an average of 13.3 miles to their primary elevator. Compared to 1980, this distance represents a 21 percent increase in length of haul to the Preferred Elevator. Although changes in elevator density may account for some of the increase in average length of haul over the past 15 years part of the increase may be attributed to fewer producers opting to deliver to the nearest market.

[3] A six-category distribution of the farm-to-nearest-elevator mileages, aggregated by C.R.D., is included in Appendix A.

Table 12. Distribution of Farm to Preferred Elevator Distances, 1980 & 1995

Miles to Nearest Elevator	Preferred Elevator			Second Choice Elevator		
	1980	1995	Change	1980	1995	Change
1-2	**9%**	**2%**	**(77)%**	**2%**	**1%**	**(50)%**
3-5	21%	18%	(15)%	8%	4%	(48)%
6-10	**32%**	**33%**	**4%**	**28%**	**19%**	**(33)%**
11-15	19%	21%	7%	25%	23%	(6)%
16-25	**13%**	**19%**	**48%**	**25%**	**30%**	**19%**
26-35	5%	2%	(55)%	7%	13%	75%
Over 35	**1%**	**5%**	**264%**	**4%**	**9%**	**118%**
# of Responses	967	436		833	415	

The most evident changes in the distance for deliveries to the preferred elevator are the fewer deliveries made within five miles and the increase in the share of deliveries that are over 35 miles. About 30 percent of the respondants traveled less than six miles to their preferred elevator in 1980, this share dropped to 20 percent in the 1995 survey. The six-to-15 mile deliveries are the most common for both surveys, accounting for 51 percent of the deliveries in 1980 and 54 percent in 1995. Ditribution of distances shifted away from the one-to-five mile category to the 16 to 25 mile category.

The trend for longer distances in deliveries is even more evident when producers bypass the preferred elevator to deliver to their second-choice elevator. In 1980 survey respondants reported an average haul of 16.1 miles to their second-choice elevator. The length of this haul has increased 28 percent, to 20.6 miles for 1995 respondants. As illustrated in Table 12, the distance for deliveries has shifted from one-to-15 miles to over 16

miles, compared to 1980 survey results. Only 5 percent of the 1995 respondants were within five miles of their second-choice elevator, compared to 10 percent of the 1980 respondants. The 11-to-15 mile range is the most common distance reported for both 1980 and 1995, accounting for 50 percent and 53 percent of the second-choice elevator delivery distances, respectively. Longer distance deliveries are more common in the 1995 survey as 22 percent report deliveries over 25 miles, doubling the share producers in the longer distance categories for the to 1980 survey responses. Trends in the distance to primary markets, that define a producer's marketing area, iIllustrate that more producers expect to deliver wheat to distant markets today than did 15 years ago.

Road Surfaces

Beyond distance, road surfaces are an important factor in producer delivery decisions and the cost of haul. Road surfaces affect delivery time, wear on grain delivery equipment, fuel efficiency, and vehicle maintenance requirements. On average, producers who reported the surface information traveled 4.7 miles on the gravel and 8.6 miles on paved roads to reach their Preferred elevator. Distances on gravel and paved surfaces increased to 6.2 and 14.5 miles, respectively, for the Second-Choice elevator. On average, producers travel 55 percent more miles to reach their Second-Choice elevator, compared to the Preferred. The

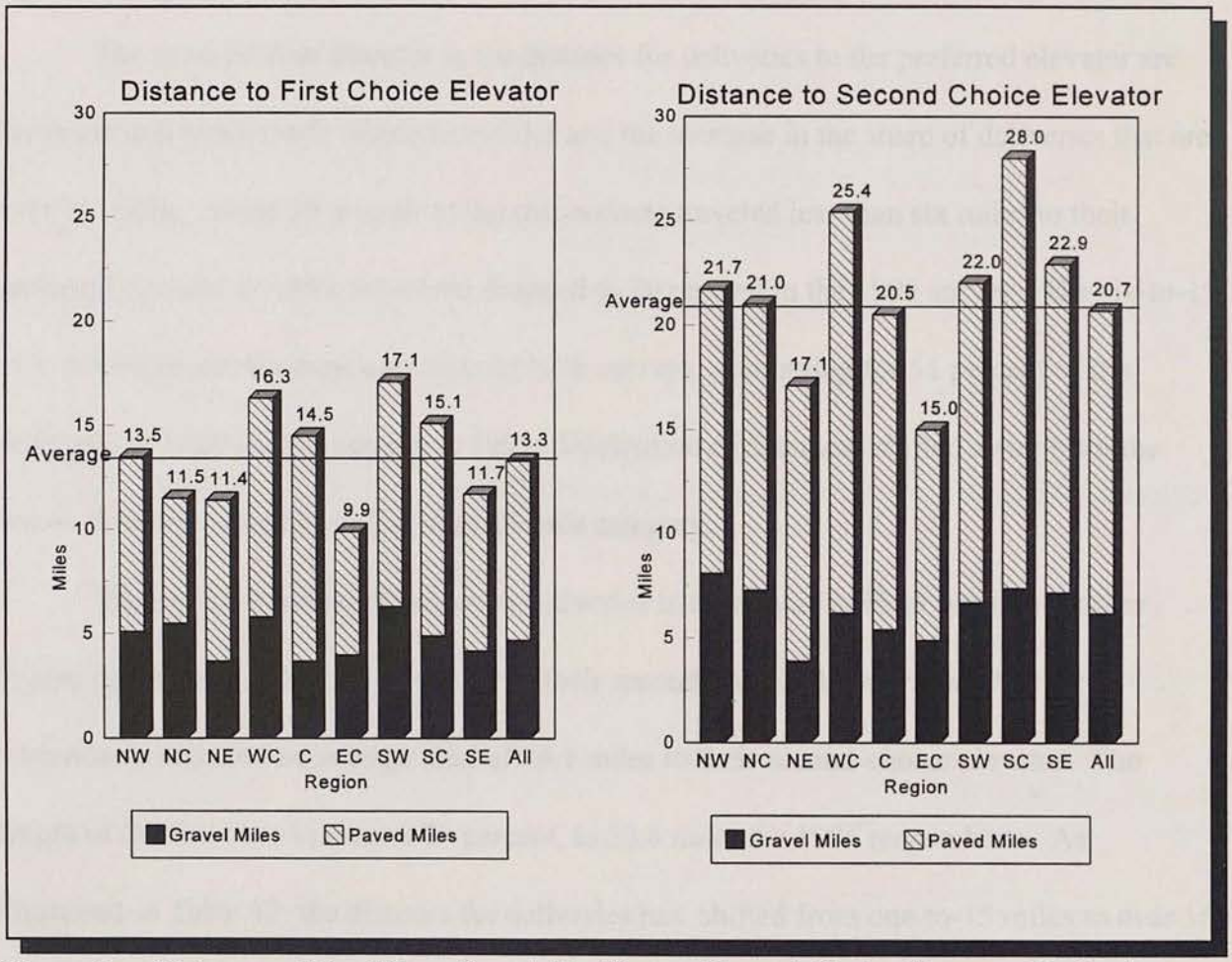

Figure 4. Distance and Road Type Traveled to First and Second Choice Elevators, By Region

distribution of the additional mileage attached to reaching the Second-Choice elevator does not follow the gravel/paved surface distribution for the haul to the first elevator. For miles to the second choice elevator, gravel miles are increased by about 32 percent compared to a 67 percent increase in paved miles. Therefore, as delivery distance increases, a larger share of the additional miles is attributed to paved road surfaces than gravel road surfaces. This suggests that delivery costs do not increase in proportion to mileage.

Monetary Incentive for Longer Haul

Producers make delivery decisions based on many factors, but the two most influential factors are market price and delivery costs. Thus, it is important to estimate how the producer marketing area is affected by board prices in alternative markets. Producers were asked to specify the number of miles they would haul wheat, beyond their Preferred Elevator to reach markets offering an additional 2 cents, 5 cents and 10 cents per bushel. On average, producers would travel 2.8 miles for 2 cents, 10 miles for 5 cents, and 24 miles for 10 cents per bushel.

Table 13. Monetary Incentive for Delivering Wheat Beyond the Preferred Elevator

Gain in Board Price:	Additional Miles Producer will Haul	Revenue per Mile for Additional Miles
2 cents/bushel	3	.7 cents
5 cents/bushel	10	.5 cents
10 cents/bushel	24	.4 cents

Producers require an additional 0.7 cents per mile to haul grain an additional 2.8 miles, compared to only 0.5 cents per mile and 0.4 cents per mile to haul grain an additional 10 and 24 miles, respectively (Table 12). Survey responses to this question support the premise that delivery costs do not increase in proportion to trip distance.

Custom Hauling Rates

Due to the seasonal nature of grain hauling and long distances to markets, farmers have considered hiring grain custom hauled. Survey respondents were asked to report the use of custom hauling services and describe of custom hauling service characteristics. These H.R.S. and durum rates and service characteristics were pooled to estimate a custom hauling rate function.

Custom Hauling Rate Function

Custom hauling rates for the survey respondents averaged 10.6 cents per bushel for a 28 mile haul, with an average load of 851 bushels. The model specified to estimate the custom rate function is as follows:

$$RPB = \beta_0 + \beta_1 DENSITY + \beta_2 BUCUST + \beta_3 DIST + \beta_4 DIST^2 + \beta_5 HAR$$

where:

	RPB	=	rate per bushel (cents)
	DENSITY	=	density of haul, bushels per load
	BUCUST	=	bushels hired custom hauled annually
	DIST	=	average length of haul, one-way distance
	$DIST^2$	=	distance of one-way haul squared
	HAR	=	indicator for haul made during the harvest season (1=September, October, November, 0=other months)

In this estimation, the average shipment distance is expected to have a positive parament estimate, as increased distance results in additional time spent traveling, increased fuel consumption and increased vehicle wear and tear. However, this increase in costs per bushel occurs at a decreasing rate with distance, as many costs such as bookkeeping, loading and unloading costs, etc. are a function of the number of shipments and not the shipment destance. Thus, distance squared is expected to have a negative sign in this estimation.

Bushels-per-load are expected to be negatively related to rate-per-bushel in this estimation, as additional bushels in a load provide for economies of lading. These economies are realized, as many costs (e.g. labor costs, clerical costs) are relatively fixed with respect to weight. Thus, unit cost per bushel decreases at a decreasing rate with increased weight. An inverse relationship also is expected between the variable that accounts for the number of bushels the producer hired custom hauled during 1994 and rate-per-bushel. An inverse relationship suggests that producers who hire custom-hauling for larger quantities of wheat may obtain a quantity discount.

Finally, the indicator that accounts for shipments made during the harvest season is expected to produce a parameter estimate with a positive sign, as custom truck rates are expected to be higher during this season of peak demand.

Table 14. Estimate of Custom Hauling Rate Parameters

Variable	Parameter Estimate	t-ratio	Sample Mean Value
Intercept	8.7366	6.935**	10.6
Density	-0.0012	1.927*	851.8
Annual Custom-Haul Hire	-0.0000006	1.791*	2395.2
Distance	0.1639	1.927**	28.3
Distance^2	-0.0007	2.916**	800.9
Harvest Indicator	1.7202	1.812*	

Adj. R^2 = .3046 F = 15.981 N = 171

***significant at the 5 percent level* **significant at the 10 percent level*

Parameter estimates for the custom rate function are listed in Table 14. About 32 percent of the variation in rate per mile is explained in this estimation. All the parameter estimates have the expected sign and are significant at the 5 or 10 percent level. A more detailed estimation of the custom rate function may improve results, but this estimate provides a basis for discussing the factors that influence rates.

Moreover, this rate function can be used to estimate a custom hauling rate for different shipment characteristices. For example, a ten-mile shipment during harvest would incur an estimated rate per bushel of approximately 9.6 cents if other variables are place at their sample means. The same shipment during non-harvest produces an estimated rate of 7.9 cents per bushel. Similarly, an 18-mile shipment results in an estimated rate of 10.7 cents during harvest and nine cents during non-harvest.

N.D. Farm Truck Fleet

Costs and characteristics of N.D. producer deliveries are tied closely to their delivery equipment decisions. The inventory of trucks provided by survey respondents establishes a base for understanding the typical use, ownership and delivery costs for farm trucks. This information will be used to estimate delivery costs for alternative truck types and to make assessments regarding the future of the N.D. farm truck fleet.

Truck Use

Wheat producers were asked to distribute annual truck miles among three categories of use: hauling their own grain, providing custom hauling services, and other uses (feed, seed...) On average, producers attributed 75 percent of their annual miles to hauling their own grain, 17 percent to other activities such as hauling feed or seed, and 8 percent to custom

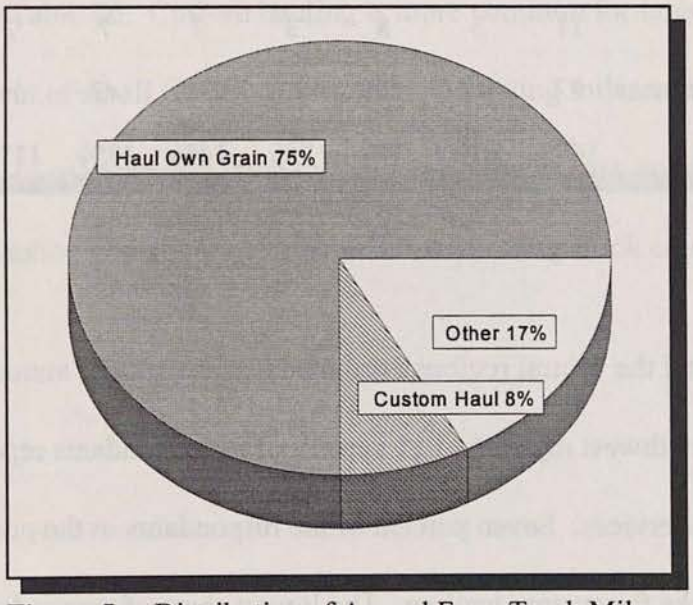

Figure 5. Distribution of Annual Farm Truck Miles Among Alternative Activities

hauling grain. Thus, producers reported 92 percent of annual truck miles were attributed to personal use and 8 percent to custom hauling activities. Individually, the share of truck miles attributed to custom hauling varied, as only 9 percent of the survey respondants reported custom hauling activities. Although this share of respondents is relatively small, it is a 80 percent increase compared to 1980 when only 5 percent of the respondants reported being engaged in custom hauling activities.

Based on survey responses the east central region (C.R.D. 6) has the largest share of producers who provide custom hauling service, as 17 percent of the respondants attributed a portion of annual truck miles to custom hauling. Fourteen percent of the respondants from

Table 15. Share of Respondants Engaged in Custom Hauling Activities, by Location

	Region									
	NW	**NC**	**NE**	**WC**	**C**	**EC**	**SW**	**SC**	**SE**	**All**
No	66	46	101	39	43	35	59	17	48	458
Yes	11	3	8	3	7	7	7	1	3	46
Total # of Responses	*77*	*49*	*109*	*42*	*50*	*42*	*66*	*18*	*51*	*504*
% Yes	**14%**	**6%**	**7%**	**7%**	**14%**	**17%**	**11%**	**6%**	**6%**	**9%**

the northwest and the central regions attributed a share of their annual truck miles to custom hauling. The southwest region had 11 percent of its respondants report that they provided custom hauling services. Seven percent of the respondants in the northeast and westcentral regions use trucks for custom hauling. The lowest share of respondants engaged in custom

hauling activities were in the northcental, southcentral, and southeast, with each region reporting 6 percent of the respondants attributing a portion of annual truck miles to custom hauling activities.

Table 16. Share of Respondants Engaged in Custom Hauling Activities, by Farm Size

	Small Farms (<800 acres)	Medium Farms (801 to 1999 acres)	Large Farms (2000+ acres)
No	119	235	136
Yes	9	25	21
Total	*128*	*260*	*157*
% Yes	**7%**	**10%**	**13%**

Farm size appears to be positively related to the propensity of producers to custom haul, as illustrated in Table 16. Custom hauling is more common for large farms relative to small, as only 7 percent of small farms reported custom hauling miles compared to 10 and 13 percent, respectively, of medium and large farms. Larger farms may consider custom hauling a means of deiversification and source of income for supporting truck equipment investments.

Truck Ownership

Characterizing truck ownership and identifying changes since 1980 is an important element of understanding future requirements of N.D. wheat producers. Truck categories considered in the survey were single axle, tandem axle, tri-axle, conventional semi, and cabover semi trucks. For the 632 survey respondants who listed trucks, the farm truck fleet totalled 1,382 trucks. A majority of the fleet was single axle, with these trucks accounting for 57 percent of the trucks listed. Tandem axles were the second most common, as 455, or 33 percent, of the trucks were attributed to this category. Tri-axle and semi-trucks were third among the five truck categories, with each accounting for 4 percent of the fleet. The remaining 33 trucks were in the cabover category. Due to limited use of tri-axle and cabover semi-trucks, the discussion of farm truck costs developed in this report considers only the single-axle, tandem-axle and conventional semi-truck categories.

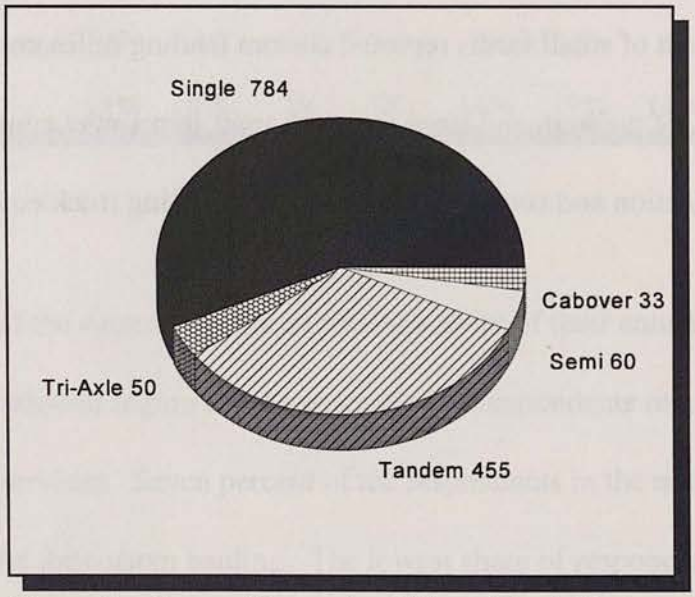

Figure 6. Survey Respondents' Farm Truck Fleet

Among regions, the northeast region of North Dakota accounted for the largest share of trucks listed in the survey. The 305 trucks listed by northeast survey respondents accounted for 27 percent of the total. The northwest region of North Dakota was second accounting for 15 percent of the farm truck survey fleet. The central, east central and southwest regions each accounted for 10 percent of the farm truck numbers. The northcentral and west central regions housed 9 and 7 percent of the responses respectively. The south central region of the state accounted for the smallest share among regions with 3 percent of the truck inventory.

Table 17. Distribution and Density of Respondants' Farm Truck Fleet, by Region

	- Region -									
	NW	**NC**	**NE**	**WC**	**C**	**EC**	**SW**	**SC**	**SE**	**All**
# Responses	*78*	*54*	*112*	*93*	*52*	*44*	*69*	*20*	*53*	*575*
Single Axle	114	78	157	67	67	47	92	27	76	725
	67%	73%	51%	77%	61%	47%	68%	75%	65%	62%
Tandem	49	28	130	15	36	46	40	6	38	388
	29%	26%	43%	17%	33%	46%	29%	17%	32%	33%
Semi	7	1	18	5	7	8	4	3	3	56
	4%	1%	6%	6%	6%	8%	3%	8%	3%	5%
Total	170	107	305	87	110	101	136	36	117	1,169
Density:										
Trucks per Farm	**2.2**	**2.0**	**2.7**	**0.9**	**2.1**	**2.3**	**2.0**	**1.8**	**2.2**	**2.0**
Acres per Truck	**765**	**762**	**678**	**673**	**757**	**709**	**766**	**854**	**588**	**714**

Density of farm trucks, measured in trucks per farm and bushels per truck for each region, provide information regarding the availablity of resources. Density of trucks, when measured in trucks per farm ranged from 0.9 in the west central region to 2.7 in the northeast region. Acres per truck ranged from 588 in the southeast region to 854 in the southcentral region, with an average of 714 acres per farm truck reported by survey respondents. These density measures provide information regarding the availablity of farm-to-market resources, illustrating that some regions have more resources invested/available for marketing their crops.

Truck Costs

This section of the study contains cost estimates for three categories of farm trucks. They are single axle trucks, twinscrew tandem trucks, and conventional semi tractors with hopper bottom trailers. Average annual mileage for these trucks was 2,500, 4,000, and 6,000 miles, respectively, based on 1995 survey responses. In addition to estimating costs for typical use, costs for all three types of trucks were estimated using a constant mileage of 2,000 miles per year. The following discussion of farm truck costs includes two categories, fixed and variable costs. The cost components considered in these categories are defined and estimates based on survey responses, are presented below.

Fixed Costs

In the long run all truck costs are variable. However, at the beginning of each period, the farmer must decide whether to commence or continue trucking operations for the period, and at what scale to operate. Once the decision is made to pursue operations at a certain scale for the period, several types of costs are realized regardless of the number of shipments made or the number of miles traveled. These fixed costs include vehicle depreciation, return on investment, license fees, insurance, and housing costs.

Typically, these costs are placed on a per mile basis by dividing total annual fixed costs by average annual miles of travel for a particular truck configuration. To the extent that these costs do not vary with miles of travel, allocations on a per mile basis are arbitrary.

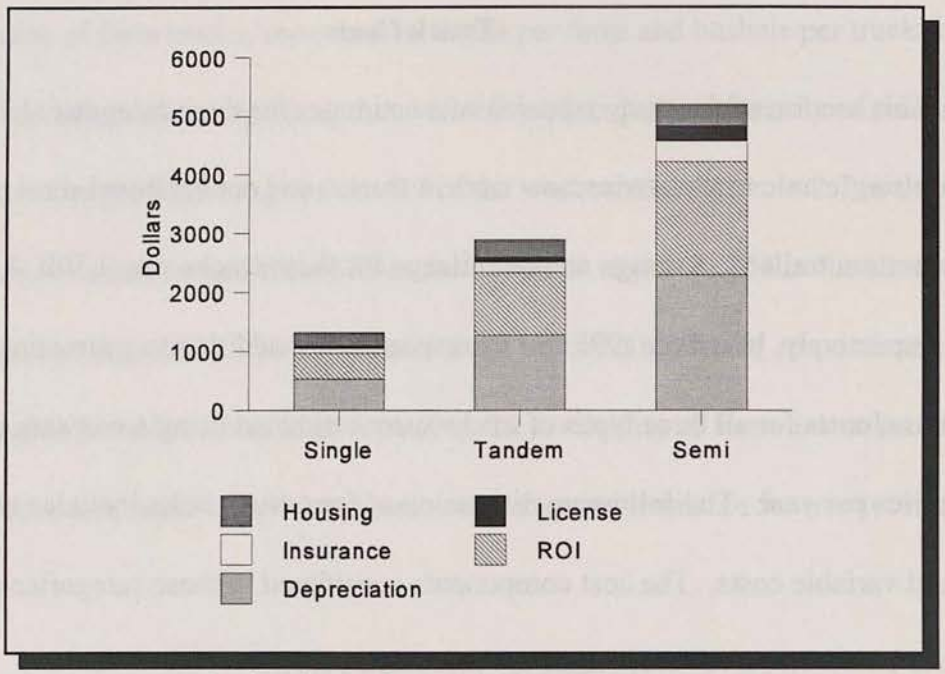

Figure 7. Total Fixed Cost for Each Truck Type, 1995

However, many of these costs are not completely fixed in the short run. For example, vehicle depreciation and insurance both increase to a certain extent with mile of travel. More detailed explanations for estimation of the fixed cost components are included in the following sections.

Table 18. Total Fixed Cost per Year for Each Truck Type, 1995

	Single Axle	Tandem Axle	Semi Tractor & Trailer
Depreciation:	$530.00	$1,275.00	$2,300.00
Return on Investment:	$445.00	$1,060.00	$1,920.00
Insurance:	$75.00	$175.00	$350.00
License Fees:	$47.00	$84.00	$265.00
Housing:	$222.00	$296.00	$444.00
Total Fixed Cost:	**$1,319.00**	**$2,890.00**	**$5,279.00**

Depreciation

Depreciation is the devaluation of a capital investment over its useful life. Straight line depreciation was used to calculate value of a farm truck over its life. Using a 10-year life and 25 percent salvage value, depreciation was calculated by subtracting the salvage value from the purchase price then dividing that value by the 10-year useful life. Farm truck are typically purchased as used equipment. Thus, farm truck costs were based on used equipment prices rather than new equipment prices for a more accurate/realistic cost estimate.

Depreciation = (Purchase Price - Salvage Value) / Useful Life

Single, twinscrew tandem axle, and conventional semi tractor and hopper bottom trailer truck prices averaged $7,100, $17,000, and $30,700, respectively. These prices were estimated by averaging two years of prices paid for farm trucks sold at area auctions and area equipment dealers (Auction Price Guide 1993, 1994). Depreciation was estimated to be $530, $1,275, and $2,300 per year for the single axle, tandem axle, and semi tractor and trailer, respectively.

Return on Investment

Return on investment (ROI) are costs that result from interest paid on debt capital or from the opportunity cost of the equity in the equipment. Opportunity cost represents the interest that could have been earned on that capital if it had been invested in its best alternative.

Return on investment is calculated by subtracting the salvage value from the purchase price and dividing it by two to get the average investment over the life of the truck. This value is then added to the salvage value and multiplied by the interest rate.

$$ROI = ((Purchase\ Price - Salvage\ Value)/2 + Salvage\ Value) \times Interest\ Rate$$

Surveying local banks around the state, an average interest rate of 10 percent for 1994 was indicated for agricultural machinery loans. Thus, the resulting ROI values were $445, $1,060, and $1,920, respectively, for single axle, tandem axle, and semi tractor and trailer combinations.

Insurance Costs

Personal interviews with insurance agents were used to obtain insurance cost estimates for the alternative truck types. Insurance costs averaged $75, $175, $350 for single axle, tandem axle, and semi tractor and trailer combinations, respectively. Insurance agents indicated the semi tractor and trailer insurance rates often increase if the truck is used for custom hauling or for hauls beyond a 100-mile radius of the farm.

License Fees

License fees required by the North Dakota Department of Motor Vehicle in 1994 were $47, $84, and $265, respectively, for single axle, tandem axle, and semi tractor and trailer trucks.

Housing Costs

Housing costs for farm trucks were estimated by using the amount of storage space each truck requires and the per unit value of the storage facility. Personal interviews of farmers and building manufacturers indicated an $8 per square foot cost of buildings. Depreciating a building with a 25 percent salvage value over a 25-year life and using a building cost of $8 per ft^2, a $0.24 per ft^2 per year cost to farm trucks was calculated. Storage space requirements of 300 ft^2, 400 ft^2, and 600 ft^2 were calculated for the trucks types. Building Depreciation Cost for single axle, tandem axle, and semi tractor trucks was $72, $96, and $144 respectively.

Building Costs = Building Depreciation + ROI for Building

- ***Building Depreciation = (Purchase Price - Salvage Value) / Useful Life***
- ***ROI = ((Building Price - Salvage Value)/2 + Salvage Value) x Interest Rate***

Return on investment also is part of storage cost. These costs were $150, $200, and $300, respectively, for single axle, tandem axle, and semi tractors trucks. Total housing costs of $222, $296, and $444, respectively, were calculated for single axle, tandem axle, and semi truck costs.

Table 19. Housing Cost and Space Required for Each Truck Type, 1995

Truck Type	Space Required (Ft^2)	Total Housing Cost
Single Axle:	300	$222.00
Tandem Axle: assumed	400	$296.00
Semi Tractor & Trailer:	600	$444.00

Variable Costs

Variable costs are those which vary with the mileage driven and number of hauls made per year. For example, if the truck is never driven, variable costs equal zero, while fixed costs are still incurred. Tire cost, fuel, maintenance and repair, and driver's labor are each components of the variable cost categories. Mileage used for each truck type is equal

Table 20. Total Variable Cost for Each Truck, 1995

	Single Axle	**Tandem Axle**	**Semi Tractor & Trailer**
Tire Cost:	$0.042	$0.041	$0.056
Fuel Cost:	$0.177	$0.221	$0.206
Maintenance:	$0.210	$0.160	$0.250
Labor: $7.50 / hr	$0.240	$0.265	$0.340
Total Variable Cost:	$0.669	$0.687	$0.852

to average annual use reported by survey respondents. Mileages were 2,000, 4,000, and 6,000, respectively, for single axle, tandem, and semi tractor and trailer trucks.

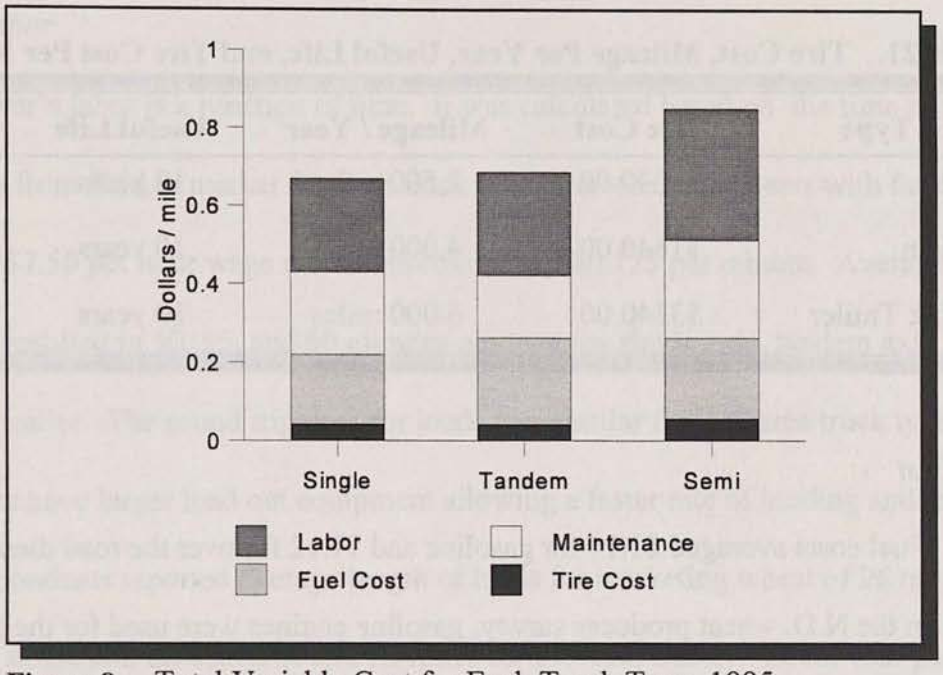

Figure 8. Total Variable Cost for Each Truck Type, 1995

Tire Cost

Personal interviews were used to estimate tire costs. A survey of truck dealers, farmers, and tire suppliers indicated that farm truck tires do not use their entire mileage rating due to travel on poor roads and fields. Weather checking and aging of tires, were sited as the primary wear factors. Thus, the tire cost was distributed evenly over its 10-year life.

Tire Cost / mile = (Tire Cost) / (Mileage / Year) / Useful Life

Tire costs were calculated to be $.042, $.041, and $.056 per mile respectively for single axle, tandem axle, and semi truck types.

Table 21. Tire Cost, Mileage Per Year, Useful Life, and Tire Cost Per Mile, 1995

Truck Type	Tire Cost	Mileage / Year	Useful Life	Cost per Mile
Single	$1040.00	2,500 miles	10 years	$.042 per mile
Tandem	$1640.00	4,000 miles	10 years	$.041 per mile
Semi & Trailer	$3340.00	6,000 miles	10 years	$.056 per mile

Fuel Cost

Fuel costs averaged $1.14 for gasoline and $1.12 for over the road diesel in 1994. Based on the N.D. wheat producer survey, gasoline engines were used for the single, and tandem axle trucks, while diesel engines were used for the semi tractor. Survey respondents reported averaging 6.44, 4.16, and 5.43 miles per gallon while operating single, tandem, and semi tractor trucks. These fuel costs equate to $.177, $.221, and $.206 per mile, respectively, for single, tandem, and semi tractor trucks.

Maintenance and Repair

Personal interviews with farmers were used to estimate annual repair and maintenance costs for the alternative farm truck categories because these costs vary substantially from year to year. Engine overhauls, tuneups, lubrication, and miscellaneous repairs are the primary components of maintenance and repair costs. Based on the interviews, these costs were calculated to be $0.21, $0.16, and $0.25 per mile for single, tandem, and semi tractor trucks.

Driver's Labor

Driver's labor is a function of time. It was calculated based on the time required for a round trip from field to market for each truck type. Personal interviews with farmers indicated a $7.50 per hour wage rate or approximately $0.125 per minute. Average length of round trips resulted in 50, 55, and 60 minutes per load for single axle, tandem axle, and semi tractor and trailer. The round trip time for loads was similar for the three truck types because larger trucks have larger load out equipment allowing a faster rate of loading and unloading. Survey respondents reported average length of hauls for marketing wheat of 26 miles round trip for the single and tandem axle and 22 miles for the semi tractor. Labor cost-per-mile is estimated by dividing average round trip labor cost (round trip minutes x $.125) by average round trip mileage.

Labor Cost / Mile = Avg. Round Trip Minutes x $.125 / Avg. Round Trip Miles

This resulted in $0.24, $0.265, and $0.34 per mile respectively for single, tandem, and semi tractor trucks.

Table 22. Total Cost per Mile for Each Truck Type, 1995

	Single Axle	Tandem Axle	Semi Tractor & Trailer
Avg Annual Miles: (miles)	2,500	4,000	6,000
Fixed Cost:	$0.53	$0.72	$0.88
Variable Cost:	$0.67	$0.69	$0.85
Total Cost:	**$1.20**	**$1.41**	**$1.73**
Truck Capacity: (bushels)	316	570	890
Total Cost per Mile:	**$1.20**	**$1.41**	**$1.73**
Total Cost per Bu. Mile:	**$0.0076**	**$0.0049**	**$0.0039**

Cost Comparison for Farm Truck Types

The following paragraphs provide a comparison of single axle, tandem axle, and semi tractor farm truck costs. Costs are shown on both a per mile and per bushel-mile basis. Because the producer's objective is to move a given amount of grain at the lowest cost, per bushel mile comparisons are the most useful. Costs per mile are estimated as those incurred for empty or loaded miles as follows:

Cost per Mile = ((Tot Variable Cost x Avg Ann Miles) + Tot. Fixed Cost) / Avg Ann Miles

Costs per bushel-mile are estimated as the costs of hauling one bushel for one mile. To estimate costs per bushel-mile, the costs per loaded truck-mile must be estimated first. Costs per loaded truck mile are estimated as:

Cost per Loaded Mile = Cost per Mile / 1 - Proportion of Miles Empty

This attributes empty mileage costs to the loaded portion of the shipment. Costs per bushel-mile are estimated as:

Cost per Bushel-Mile = Cost per Loaded Mile / Payload Capacity (bu.)

Single Axle

Single axle trucks had a fixed cost of $1,319 and a variable cost of $.669 per mile. The N.D. wheat producer survey indicated an average annual mileage of 2,500 miles and a 316 bushel payload capacity. The resulting cost per mile estimate is $1.20, and the resulting cost per bushel-mile is $.0076.

As an example of how to use these per bushel-mile costs, consider a trip to a local elevator that is located 13 miles from the farm. The cost per bushel-mile is multiplied by the number of bushels in the load and then multiplied by the number of loaded miles, equal to 13 miles in this example. If the truck holds 316 bushels, the resulting total shipment cost is $31.22.

Twinscrew Tandem Axle

Tandem axle trucks had a higher fixed cost than single axle due mostly to higher depreciation and return on investment costs. Fixed costs for tandem axle trucks were $2,890. Variable costs were only 2.7 percent higher than for single axle trucks. These two were very similar in per mile variable costs because the trucks are so similar. However, tandem trucks have another axle, and can carry a larger payload.

Tandem axle trucks averaged 4,000 miles annually, as indicated by the N.D. wheat producer marketing survey. The survey also showed an average capacity of 570 bushels. Tandem axle trucks had a total cost of $1.41 per-mile. This is $.21 per mile higher than the cost for single axle trucks. However, when placed on a per-bushel cost the cost of $.0049 is much lower for tandem axle trucks. This can be attributed to a higher loading capacity for tandem axle trucks. A 26-mile round trip would cost $36.66 per load or $.064 per bushel for the tandem axle as compared to $.099 per bushel for the single axle truck.

Semi Tractor and Hopper Bottom Trailer

The semi tractor and trailer had a fixed cost of $5,279 and a variable cost of $.852 per mile. Both fixed and variable costs were higher than the single, and tandem axle trucks. The N.D. wheat producer marketing survey indicated semi tractors average 6,000 miles annually. The survey also showed an average payload capacity of 890 bushels of wheat. Total cost per mile was calculated to be $1.73 per mile, or $.32 more per mile than for tandem axle trucks. However, because of the higher payload capacity, the per bushel mile cost was $.0039. By comparison single and tandem axle per bushel costs were $.0076 and $.0049 respectively.

Using a 26-mile round trip, it would cost a farmer $44.98 per load or $.051 per bushel to move wheat to the market place. This compares favorably to the $.099 and $.064 per bushel-mile for single and tandem trucks.

Comparison of Truck Costs at Constant Mileages

Two constants were used to compare the three truck types: 2,000 and 6,000 miles, respectively. Using 2,000 annual miles for all truck types, per mile costs were $1.33, $2.13, and $3.49, respectively, for single, tandem, and semi trucks. $.0084, $.0075, and $.0078 per bushel-mile were calculated using their respective payload capacities. For example, a 26-mile round trip would cost $.109, $.098, and $.101 per bushel, respectively, for single, tandem, and semi truck types. At low annual miles single axle trucks can be relatively cost efficient because of a much lower depreciation and capital investment cost. Single axle truck's largest expense over the other truck types is labor.

Using the 6,000 annual miles showed per mile costs of $.88, $1.17, and $1.73, respectively, for single, tandem, and semi trucks. These costs equated to per bushel-mile costs of $.0056, $.0041, $.0039, respectively, for single, tandem, and semi truck types. For example, the same 26-mile round trip would now have a per bushel cost of $.073, $.053, $.051, respectively, for single, tandem, and semi truck types. This shows that as the annual mileage increases the larger trucks become more cost effective. It should be noted that maintenance costs for single axle trucks may increase at a faster rate than tandem axle and semi trucks as annual miles are increased because the single axle trucks are older, on average. Thus, cost estimate for the single axle truck with 6,000 annual miles may be understated.

Table 23. Cost per Mile and Cost per Bushel-Mile for each Truck Type with Constant Annual Mileages, 1995

	2,000 Annual Miles		6,000 Annual Miles	
Truck Type	**Cost / Mile**	**Cost / Bu Mile**	**Cost / Mile**	**Cost / Bu Mile**
Single Axle	$1.31	$.0083	$.88	$.0056
Tandem Axle	$2.10	$.0075	$1.16	$.0041
Semi Tractor & Trailer	$3.45	$.0078	$1.50	$.0034

Conclusion

N.D. producers market about five million bushels of grain and oilseeds through N.D. elevators annually. As the agricultural industry adapts to advancements in technology and a globalized market it is important to understand the marketing decisions of producers, as they are the initial link in the grain marketing chain. Thus, the objective of this study was to profile the farmgate to market segment of N.D. wheat marketing industry, including:

- Factors that may influence the marketing decisions of N.D. wheat producers,
- General criteria used in the grain marketing decision,
- The current farm truck fleet, and
- Farm truck costs.

The data used to address these objectives was collected in a 1995 survey of N.D. wheat producers.

For survey respondents, farms typically included 1,300 acres of owned and rented land and housed storage for 35,005 bushels of grain. Producers seeded 46 percent of their available acres to wheat.

In marketing their wheat, producers depended heavily on the local elevator system, delivering 94 and 93 percent of their H.R.S. and durum wheat to local elevators, respectively. Based on the producers' rating of factors that influence the wheat marketing decision, pricing, grading and testing equipment, distance to market, and roads are the primary criteria for market selection. Other factors such as offering additional services at the elevator, membership in a cooperative elevator, and location of the elevator near other business are also considered in the grain marketing decision, but were viewed as relatively less important.

Producers typically checked board prices at two elevators and often a third before making a delivery decision. In many cases, these elevators included the elevator that is in closest proximity to the producer. About 53 percent of the respondents delivered to their closest elevator in 1995. This is 24 percentage points fewer than in 1980, when 67 percent of the survey respondents delivered to their closest elevator.

Although the closest elevator remains an important market for many producers, they traveled farther to deliver grain to their closest elevator in 1995 than they did 15 years ago. With the rationalization of both the farm and elevator industries, the distance to the closest elevator has increased 17 percent over the past 15 years. Distance averaged 9.6 miles for survey respondents in 1995 compared to 8.2 miles in 1980.

Distance to the nearest elevator is an indicator of elevator density and proximity of producers to a market, but for the purposes of characterizing grain deliveries and estimating truck costs, more important measures of producer hauling are the miles and roads traveled to make deliveries to the preferred elevator.

Survey respondents reported hauling grain an average of 13.3 miles to their preferred elevator. This distance represents a 21 percent increase in length of haul to the Preferred Elevator compared to 1980. For an average haul to the Preferred Elevator, 35 percent of the distance of the haul was attributed to gravel road surfaces. When a producer chose to deliver to the best alternative market, miles increased 55 percent, on average, with a larger share of the additional miles attributed to paved road surfaces.

Costs and characteristics of N.D. producer deliveries are tied closely to their delivery equipment decisions. A breakdown of the fixed and variable cost components of truck

ownership were calculated for single axle, tandem axle and conventional semi truck. These cost estimates may be valuable for producers who are considering truck investments and custom hauling options for their farm-to-market hauls.

References

North Dakota Agricultural Statistics, Various Years. North Dakota Agricultural Statistics Service. Fargo.

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Appendix A: Distribution of Farm to Nearest Elevator Distances, 1980 and 1995

Table Segment I: Distance from Farm to Nearest Elevator in 1980

Miles to nearest elevator	- Region -									All
	NW	NC	NE	WC	C	EC	SW	SC	SE	
1-2	7.5%	12.9%	9.5%	4.8%	15.7%	21.5%	5.9%	8.4%	14.8%	11.8%
3-5	27.1%	29.0%	34.5%	12.4%	25.9%	43.0%	14.7%	15.7%	28.7%	26.8%
6-10	40.2%	37.6%	43.1%	22.9%	42.6%	30.9%	26.5%	31.3%	38.3%	34.9%
11-15	23.4%	14.0%	11.2%	24.8%	14.8%	4.7%	18.6%	20.5%	15.7%	15.7%
16-25	1.9%	4.3%	1.7%	31.4%	0.9%	0.0%	29.4%	21.7%	1.7%	9.4%
over 25	0.0%	2.2%	0.0%	3.8%	0.0%	0.0%	4.9%	2.4%	0.9%	1.4%
Responses	107	93	116	105	108	149	102	83	115	978

Table Segment II: Distance from Farm to Nearest Elevator in 1995

Miles to nearest elevator	- Region -									All
	NW	NC	NE	WC	C	EC	SW	SC	SE	
1-2	2.7%	6.3%	10.4%	2.6%	5.6%	18.0%	3.2%	8.7%	8.1%	7.4%
3-5	22.7%	28.6%	38.3%	18.4%	20.4%	36.0%	17.5%	21.7%	32.3%	27.8%
6-10	37.3%	44.4%	37.4%	34.2%	38.9%	32.0%	31.7%	30.4%	35.5%	36.5%
11-15	22.7%	14.3%	13.0%	23.7%	20.4%	8.0%	23.8%	21.7%	17.7%	17.7%
16-25	13.3%	4.8%	0.9%	18.4%	14.8%	4.0%	22.2%	8.7%	4.8%	9.2%
over 25	1.3%	1.6%	0.0%	2.6%	0.0%	2.0%	1.6%	8.7%	1.6%	1.5%
Responses	75	63	115	38	54	50	63	23	62	543

Table Segment III: Change in Farm to Nearest Elevator Distances, 1980 to 1995

Miles to nearest elevator	- Region -									All
	NW	NC	NE	WC	C	EC	SW	SC	SE	
1-2	(64)%	(51)%	10%	(45)%	(65)%	(16)%	(46)%	3%	(45)%	(37)%
3-5	(16)%	(2)%	11%	49%	(21)%	(16)%	19%	39%	12%	4%
6-10	(7)%	18%	(13)%	50%	(9)%	4%	20%	(3)%	(7)%	5%
11-15	(3)%	2%	16%	(4)%	38%	70%	28%	6%	13%	12%
16-25	613%	11%	(50)%	(41)%	1500%	r.t.	(24)%	(60)%	178%	(2)%
over 25	r.t.	(26)%	0%	(31)%	0%	r.t.	(68)%	261%	85%	3%

r.t.: Refer to Table Segments I & II

Appendix B. Distance & Road Surfaces Traveled to Deliver Wheat to First and Second-Choice Elevators, 1995

Miles to elevator:	- Region -									
	NW	NC	NE	WC	C	EC	SW	SC	SE	All
1st Gravel	5.1	5.5	3.7	5.8	3.7	4.1	6.3	4.9	4.2	4.7
1st Paved	8.4	6.0	7.7	10.5	10.8	5.9	10.8	10.2	7.6	8.6
1st Total	13.5	11.5	11.4	16.3	14.5	10.0	17.1	15.1	11.8	13.3
2nd Gravel	8.1	7.3	3.9	6.2	5.4	4.9	6.7	7.4	7.2	6.2
2nd Paved	13.6	13.7	13.2	19.2	15.1	10.1	15.3	20.6	15.7	14.5
2nd Total	21.7	21.0	17.1	25.4	20.5	14.9	22.0	28.0	22.9	20.6

Appendix C. N.D. Wheat Producer Survey, 1995

General Information about your farming operation

Q-1 What county is your farm primarily located in? _____

Q-2 How many acres of cropland do you farm, including owned and rented acres? _____ acres

Q-3 How many bushels of on-farm storage do you have? _____ bushels

Q-4 What percent of your wheat do you haul to market during harvest? _____ %

Q-5 What did your 1994 wheat production and truck marketing activities include?

	Acres Harvested	Hauled to Market in Your Truck	Hauled to Market in Custom Truck	If Custom Hauled is it part of Custom Combining	
HRS Wheat	_____	_____ %	_____ %	Yes	No
Durum	_____	_____ %	_____ %	Yes	No

Q-6 What Share of your HRS and Durum Wheat do you Sell through various markets?

Market:	HRS Wheat	Durum
1. Local Elevators	_____ %	_____ %
2. Terminal Markets (ie. Minneapolis)	_____ %	_____ %
3. North Dakota Processors	_____ %	_____ %
4. Domestic Processors (outside ND)	_____ %	_____ %
5. Other _____	_____ %	_____ %
TOTAL	100 %	100 %

The Grain Marketing Decision

Q-7 How important are these Factors in Your Wheat Marketing Decisions?

	not important				very important
1. Elevator Board Price	1	2	3	4	5
2. Distance to the Elevator	1	2	3	4	5
3. Condition of Roads to Elevator	1	2	3	4	5
4. It is a Farmers Co-op you Patronize	1	2	3	4	5
5. Quality of Service you Receive	1	2	3	4	5
6. Located in your Local Community	1	2	3	4	5
7. Additional Services Offered at the Elevator	1	2	3	4	5
8. Graining Practices & Testing Eqpt	1	2	3	4	5
9. The Elevator is Located near other Businesses you Patronize	1	2	3	4	5

Q-8 Please Rate the following factors that May Affect your Wheat Marketing Decisions:

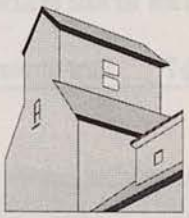
	not adequate				very adequate
1. Local Road Conditions	1	2	3	4	5
2. Competition among Local Elevators	1	2	3	4	5
3. Availability of Custom Hauling Services During Harvest	1	2	3	4	5
4. Availability of Custom Hauling Services During Non-Harvest	1	2	3	4	5
5. Availability of Market Information	1	2	3	4	5

Q-9 How many miles is it to your closest elevator? _____ miles

Q-10 How many elevators' board prices do you check before you make your grain delivery?

1. one
2. two
3. three
4. four or more

Q-11 Please list the name and location of your 1st & 2nd Choices for Wheat Deliveries:



1st Choice _____

2nd Choice _____

Q-12 Distance traveled One-Way, on paved & gravel road surfaces, to your 1st & 2nd Choice Elevators for the most frequently traveled route:

	1st Choice Elevator	2nd Choice Elevator
gravel miles	miles	miles
paved miles	miles	miles

Q-13 What Percent of the Wheat you sold in 1994 did you Delivery to these Elevators?

	1st Choice Elevator	2nd Choice Elevator
% of the HRS Wheat you sell annually	%	%
% of the Durum you sell annually	%	%

Q-14 Were you unable to make a delivery to your 1st Choice during 1994 because it was full? YES NO

Q-15 How many miles would you haul your wheat past your 1st Choice Elevator for an additional:

2 cents per bushel _____ miles

5 cents per bushel _____ miles

10 cents per bushel _____ miles

Q-16 How do you Rate your 1st Choice Elevator?

	very unsatisfactory				very satisfactory
1. Management	1	2	3	4	5
2. Overall Service You Receive	1	2	3	4	5
3. Grading Practices	1	2	3	4	5
4. Pricing Options (Basis, Delayed...)	1	2	3	4	5
5. Time Required for Unloading	1	2	3	4	5
6. Storage Availability	1	2	3	4	5
7. Hours Open for Grain Delivery	1	2	3	4	5
8. Offer additional Services (ie. fertilizer, seed cleaning)	1	2	3	4	5

Trucking Practices in the Grain Marketing Process

Q-17 Number of Trucks you Own & Lease for Grain Marketing:

	# Owned	# Leased	Longest One-Way Mileage Traveled with Truck Type
1. Single Axle			miles
2. Tandem Axle			miles
3. Tri-Axle			miles
4. Conventional Semi Tractors			miles
5. Cabover Semi Tractors			miles

Q-19 If you lease trucking equipment please list the type of truck and the terms: (ie. tandem at $.20/mile ...)

Q-18 What Percent of your Total Annual Truck Mileage is Used to:

1. Haul your own grain _____ %
2. Custom haul grain _____ %
3. Other (feed/seed..) _____ %

TOTAL 100 %

Q-20 Please complete the following table for your Primary Grain Truck(s), it is important for estimating Annual Operating Cost Information for the study.

	1st Grain Truck	2nd Grain Truck
1. Type (single axle, tandem..)		
2. Model Year		
3. Year Purchased		
4. Purchase Price	$	$
5. Average Annual Hours for		
6. Average Annual Miles	miles	miles
7. Average Miles Per Gallon	mpg	mpg
8. Avg Number of Loads Hauled	loads	loads
9. Avg Load (bu. of wheat)	bushels	bushels

Q-21 If you Hired Trucks to Haul your Wheat during 1994, Please Provide the Following Information so the Impact of Custom Trucking Activities on Wheat Marketing can be Evaluated?

Commodity (circle)	Month in 1994	Rate	One-Way Distance	Approx. Bushels per Load	# of Loads
HRS Durum		¢/bu	mi	bu	
HRS Durum		¢/bu	mi	bu	
HRS Durum		¢/bu	mi	bu	

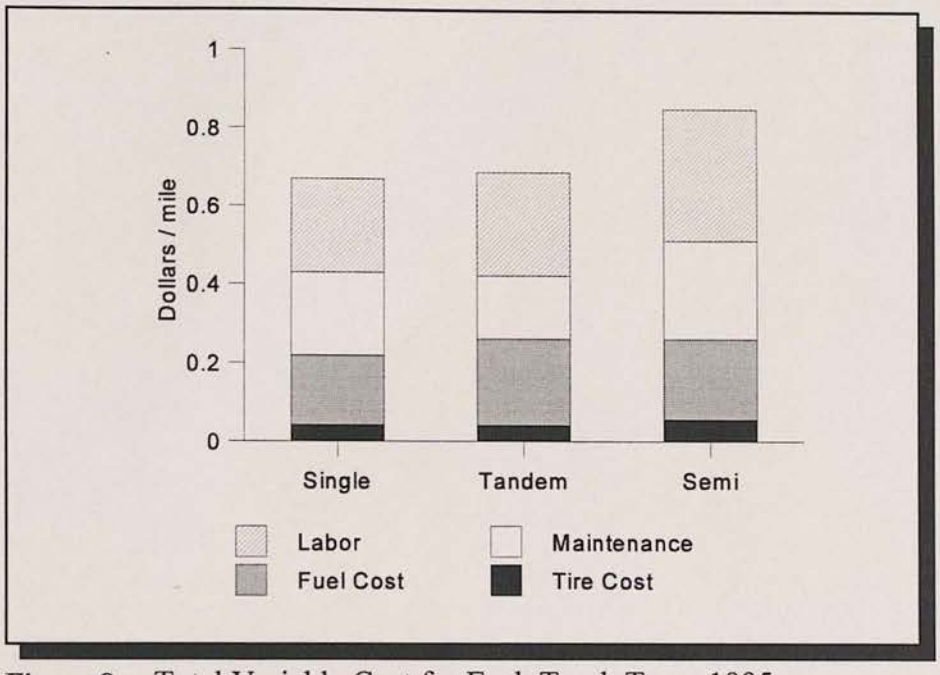


Figure 8. Total Variable Cost for Each Truck Type, 1995

Tire Cost

Personal interviews were used to estimate tire costs. A survey of truck dealers, farmers, and tire suppliers indicated that farm truck tires do not use their entire mileage rating due to travel on poor roads and fields. Weather checking and aging of tires, were sited as the primary wear factors. Thus, the tire cost was distributed evenly over its 10-year life.

Tire Cost / mile = (Tire Cost) / (Mileage / Year) / Useful Life

Tire costs were calculated to be $.042, $.041, and $.056 per mile respectively for single axle, tandem axle, and semi truck types.