Investment in Rural Roads: Willingness-to-Pay for Improved Gravel Road Service in Freight Transportation

Tamara VanWechel
Kimberly Vachal

Upper Great Plains Transportation Institute
North Dakota State University
Fargo, North Dakota

December 2004

Disclaimer

The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the information presented herein. This document is disseminated under the sponsorship of the Department of Transportation, University Transportation Centers Program, in the interest of information exchange. The U.S. government assumes no liability for the contents or use thereof.

EXECUTIVE SUMMARY

North Dakota, as well as other Great Plains states, relies heavily on agriculture for economic viability. Transport of commodities from farm to market is an important issue and one where research is needed. As funding for rural roads is decreasing, the need for improvements and maintenance of rural roads used for agricultural freight transportation is increasing. Producers are using bigger, heavier trucks to move products to market which could have negative impacts on rural road conditions. Although it is obvious that these rural roads are in need of improvements, it is unknown exactly what rural road services producers think are most important and if producers would pay more for bettering these services. In addition, it is not known what methods farmers believe would be best for financing such improvements.

The objective of this report is to ascertain information on user willingness-to-pay for improving service on gravel roads and user perceptions of funding for improving freight transportation services, such as road surface, safety and maintenance in rural areas. Ultimately this information will contribute to efficient resource management by local, county government and the North Dakota Department of Transportation.

Data were collected using a survey to ask producers about their perceptions of roads used to haul commodities to market. To define a specific farm-to-market route, surveys were mailed to producers who haul or have hauled product to two facilities in Enderlin, N.D. – the Plains Grain and Agronomy shuttle facility and the ADM Northern Sun facility. The survey questions were divided into three sections: farm operation description, use of rural roads and rural road services.

The statewide survey of agricultural producers resulted in a 10 percent response rate with 193 completed surveys. When asked if they would be willing to pay for improvements to rural roads if it meant higher vehicle weight limits, 34 percent of respondents said yes. Thirty percent said yes to the willingness-to-pay question regarding improvements to rural roads that would lead to shorter driving distances to market. When asked about willingness-to-pay for pavement of gravel roads, 20 percent said yes. For improvement to rural road signing, 12 percent said they would be willing to pay more. The highest average willingness-to-pay (WTP) value is $724 annually for pavement of rural roads.

The information gained through the WTP survey done for this project offers insight for a current information void in freight transportation. Although transportation on rural roads is an important issue, there is little research describing the value of these roads to farmers or whether farmers are willing to pay for these roads to be paved. This data will be helpful in local government budget decision making, state DOT planning and economic development strategies.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

States that rely heavily on agriculture depend on rural roads for agricultural-related transport. Agricultural states like North Dakota are often home to grain processors and terminals that are vital to nearby rural economies. Thus, grain flow to these processors is an important issue. Roads surrounding the processing facility are more susceptible to damage from frequent use by heavy equipment and therefore need to be optimally maintained. As farm size has increased, so has the size of trucks used for agricultural purposes. Tandem-axle and semi-trailer trucks are often used by farmers to haul their crops. About 88 percent of North Dakota's 66,648 miles of roads are rural (controlled by local government divisions other than federal or state) (Regional Transportation Online Center). Many rural roads used to transport grain to processing facilities are gravel. Gravel roads offer less than ideal operating conditions for various reasons. They are often narrow, uneven, bumpy and create low visibility due to dust build-up. Paved roads are convenient, not only for agricultural transportation purposes, but for general travel. However, more than 50 percent of the roads in the United States (1.6 million miles) (Selim & Skorseth 2000) are unpaved.

These rural roads require routine maintenance, yet some receive little service. Given the current transportation funding climate, it would be infeasible to publicly fund the paving of even the more frequently used gravel roads. Officials in charge of local and county rural roads and bridges face a dilemma in financing maintenance and improvement. Trends such as decreases in federal funding for rural roads and bridges, fuel efficient cars, diminishing numbers of rural residents, and fuel tax exemptions play a part in the limited existing financial assistance for rural roads (Bitzan et al., 1992). Because of this, innovative financing methods are becoming more important for rural road upkeep.

Changes in grain procurement logistics makes this an important research topic. Today many producers bypass small elevators and transport grain longer distances by truck to terminal elevators and local processors. As producer marketing decisions shift traffic from rail to road, rural roads are deteriorating more quickly because of higher traffic flow. Freight transportation on rural roads is a critical issue, yet little research has been conducted regarding user perceptions of transportation service value and funding alternatives.

This study focuses on ascertaining information about user willingness-to-pay (WTP) and perceptions of funding for improving gravel roads which support freight transportation service in rural areas. The research considers safety, road type, and maintenance valuation for rural roads. The results will be especially beneficial to rural states that are agriculturally based. Included is an assessment of the monetary amount the public is willing to pay for improvement and maintenance of gravel roads. Producers are asked what they perceive their time is worth and if they are willing to drive further if the roads were better. Non-traditional financing methods are becoming more common out of necessity. Participants answered questions about some of these methods and use of such financing strategies for rural road financing.

As roads are a public good, user WTP is not easily quantified. This research uses a producer survey to obtain the aforementioned data. A survey of rural road users (specifically agricultural producer-suppliers)

was used to estimate WTP for alternative transportation services such as road surface type (i.e., paving), improving rural highway/rail intersections, increasing allowable vehicle weight, increasing vehicle operating speeds because of improved road surface and improving roadway traffic control devices (signs). The disaggregate investigation into WTP for rural road services will provide valuable insight for future research into rural freight transport.

The remaining portion of this report is divided into four sections. The literature review section describes MPC projects related to this project. It also touches on innovative financing for roads, willingness-to-pay, public opinions of roads, and load restrictions and speed limits for trucks. The methodology section reviews the process involved in creating a survey instrument and the survey itself. The results section summarizes survey responses. Finally, the summary concludes the report with an overview, emphasizing main themes from survey responses.

2. REVIEW OF LITERATURE

This section of the report covers literature related to the project. First, other Mountain-Plains Consortium reports that are related or were helpful in the development of the project are described. This is followed by a comprehensive overview of literature that corresponds to WTP and freight transportation.

2.1 Related MPC Research Projects

MPC Report No. 97-74 "Innovative Financing Methods for Local Roads in the Midwest an Mountain-Plains States." Hough, Smadi and Bitzan. 1997.

This willingness-to-pay study focuses on upgrading, improving, and maintaining rural roads to optimize benefits to users. MPC Report 97-74 describes various methods that could be used to obtain additional funding for such road activities. The study cites fuel taxes, property taxes, vehicle registration fees, and mill levies as most common road financing methods used by local governments. This was concluded from a survey conducted in Minnesota, Montana, North Dakota, South Dakota, Utah, and Wyoming. The survey asked for methods used to finance road maintenance and construction as well as what percent each method covered. Nine methods were indicated in survey results and the study concluded that four of these methods would be potentially useful to local governments because of the contributions they make to counties that use them. These four methods are rural improvement districts, sales tax, special ownership tax, and wheel tax. The other five methods identified were telephone tax, bonds, severance tax, cost participation, and fines. Fourteen cost-reducing strategies were also described. The results from this study are helpful in addressing WTP for freight transportation and options related to maintenance and improvement of rural roads.

MPC Report No. 03-140 "An Assessment of Regional Road User Needs in Three Rural States". Hough, Hegland and Bahe. 2003.

This report summarizes perceptions of road users and decision makers in North Dakota, South Dakota, and Montana. A questionnaire was sent out to decision makers and road user groups in each of the three states. A federal policy mandating that active and effective plans involve public participation in road decisions makes this data significant. The Inter-modal Surface Transportation Efficience Act (ISTEA of 1991) and the Transportation Efficiency Act (TEA-21 of 1998) mandate states to get public participation in state planning. This hasn't been implemented to full potential in a number of states. Much of the public participation is centered in urban areas so the rural population is left out. Conclusions indicate that the greatest difference in perceptions of roads was between road user and decision maker groups in North Dakota. The report was helpful in creating a specific survey for grain flow transporters.

MPC Report No. 99-102 "Guidelines for Consolidating Township Roads: A Case Study Showing Benefit/Cost Analysis for Closing Township Roads in North Dakota." Hough and Ova. 1999.

This study describes the importance of transportation planning and the funding difficulties, especially in rural areas. Hough and Ova used a North Dakota case study including a survey to obtain data as the research method for guiding road network reduction. Using an in-depth case study of Clifton Township in Cass County, three road network reduction alternatives were calculated. The increases in user costs for each alternative were compared to the decrease in maintenance costs. The three scenarios reduced the miles of township road by16, 25, and 24 miles. Conclusions found that annual net benefits for these scenarios were $3,681, $1,656, and $5,490 respectively. It is also stated that closures of some township roads could lead to a decrease in marginal benefits and considerable user costs.

MPC Report No. 92-13 "Rural Road Financing Strategies: Two New Models Applied to North Dakota Counties." Bitzan, Tolliver and Zink. 1992.

Bitzan et al. developed a model for county road expenditures. When applied to North Dakota county road services, it was determined that factors in addition to costs are significant in determining county road expenditures. Significant economies of size were found for county road services of North Dakota, which indicates there may be benefits in consolidating county road services. Also presented was a model for finding an optimal mix of county road services. When using this model in North Dakota county applications, changes to road services could be identified to optimize the mix of rural roads. Such changes include converting gravel to paved or converting paved to gravel.

2.2 Innovative Road Financing

Three financing programs are identified as attractive to Indiana state transportation agencies by Drike and Sinha (2003). Their study evaluates innovative financing methods available from the federal government. The purpose of these tools is to capitalize on existing federal funds. These include Grant Anticipation Revenue Vehicle bonds, the State Infrastructure Bank, and the Transportation Infrastructure Financing and Innovation Act. Each finance project strategically uses federal assistance to improve state and local roads. No new sources of revenue are evaluated. Instead, the focus is to make better use of existing federal funds, which can be used with other finances to complete projects in a more timely manner. The methods evaluated in this study entail borrowing money from non-traditional lending entities.

The most common road financing methods used by local governments are property and fuel taxes, mill levies, and vehicle registration (Hough et al., 1997). Local governments are continually in need of road funding and therefore have been looking outside traditional sources for funding. In an eight-state survey inquiring about road financing methods, Hough et al. identified nine innovative financing methods. Of the nine methods identified, four were considered significant by percent of budget and were described in detail. These include rural improvement districts, special ownership tax, wheel tax, and sales tax. The other five

methods that were found to be used in generating funds for roads were telephone tax, severance tax, bonds, fines, and cost participation.

2.3 Willingness-to-Pay

Willingness-to-pay is defined as "the amount an individual is willing to pay to acquire some good or service. This may be elicited from stated or revealed preference approaches" (EEA Glossary). As indicated by this definition, willingness-to-pay can be measured through revealed preference or stated preference methods. Revealed and stated preference are defined as follows by the University of California at Berkeley Economics Laboratory. Revealed preference data is either observed or reported actual behavior. Stated preference data is observed or expressed in response to hypothetical scenarios (Econ. Lab., 2002). Danielis and Rotaris indicate that stated preference techniques have been introduced into the transport field. Both passenger transport demand and freight transport demand analyses have been using stated preference methods in the last two decades (Danielis and Rotaris, 1999).

A commonly used form of stated preference that is used for willingness-to-pay studies is contingent valuation. This method is used when a traditional competitive market does not exist for the matter at hand. It provides a way to obtain value estimates and is often used in studies of environmental goods. Common topics for studies that use contingent valuation are flood risk levels and watershed improvements. One definition for contingent valuation is "the use of questionnaires about valuation to estimate the willingness of respondents to pay for public projects or programs" (economics.about.com).

Brownstone et al. used revealed preference to measure drivers' WTP for a reduction in travel time (2002). This study answered the question, "What are people willing to pay for a reduction in morning travel time when congestion is high?" This study uses revealed preference from a congestion pricing project in San Diego along the I-15. Most revealed preference (RP) "value of time" estimates are based upon mode choice models for the trade-off between transit and auto travel. Although the Brownstone study focuses on a metropolitan road environment opposed to a rural road environment, the methodology for measuring WTP is consistent with this study.

The congestion pricing project consisted of two phases. In the first phase, drivers purchased monthly unlimited passes for the express lanes. The second phase consists of using a FasTrak fee which is debited per trip using an automatic transponder. The FasTrack user accounts are charged automatically through the transponders if they choose to use the express lane. The fee is posted on road signs and can change as often as every 6 minutes, adjusting to traffic conditions. The data came from two panel surveys of commuters using the stretch of road specified in the study with the designated express lanes. Traffic flow data was also used in calculating the results. The authors conclude that $30 per hour is the median WTP for regular morning drivers. The authors conclude that $30 per hour is the median WTP for regular morning drivers to reduce driving time by one hour. It was also found that the use of FasTrak is correlated to time savings and price. As time savings increased, use of FasTrak increased. On the other hand, as price increased, use of FasTrak decreased.

When drivers use roads in need of repair, extra vehicle operating costs are incurred. These costs vary by state. The national average extra vehicle operating cost per person per year is $222. This cost is $148 in Minnesota, $152 in Montana, $107 in North Dakota, and $325 in South Dakota. These costs are based on travel on roads categorized as poor, mediocre, and fair condition and are calculated using the Highway Development and Management Model (HDM). The HDM report is based on studies that measure factors on vehicle operating costs. Drivers who travel on roads that need improvement or repair pay an additional $222 annually in vehicle operating costs (Extra Vehicle 2001).

2.4 Public Opinions of Roads

A federal government report found the public supports the use of more durable paving materials for road resurfacing (Keever et al., 2001). The report includes results from several surveys conducted nationwide by the Bureau of Transportation Statistics and the Federal Highway Administration. When motorists were asked about improvements to transportation for traffic delays, the top choice was more durable paving materials. More than 60 percent of drivers surveyed indicated this as a top choice. When asked about targeting resources for highway improvements, the top choices were traffic flow, safety, and pavement conditions.

Hough et al. (2003) state that there are different groups and levels of transportation decision makers and road users. One major road user group in North Dakota and other rural states is agricultural producers. As mentioned by Hough et al. (2003), organizations deciding on rural road needs and the people using the roads may have different perceptions. It is important that the perceptions of these groups match.

Hough et al. found that when rating road elements of paved roads, North Dakota decision makers rated road width, ditch steepness, and road shoulder significantly better then road users. In the same study, it was found that North Dakota decision makers answered "yes" more often than road users when asked the following questions: are there adequate signs along the road to warn of hazards? Do elements affect the road speed drivers could travel? And do conditions of the roads cause additional wear and tear on vehicles? On maintenance issues, the study found that decision makers believed snow, road, and bridge maintenance were better than did road users in general. When asked about road improvement funding, North Dakota decision makers favored using a fuel tax. North Dakota road users favored using sales tax. Other alternative funding answers given in the survey results included federal tax, income tax, bulk oil, and luxury tax.

2.5 Load Restrictions and Speed Limits

It is a common misconception: slower speed limits will lead to less road damage. Sometimes local governments reduce truck speeds to avoid load limits, which would reduce payloads. However, research has shown that slower vehicles actually cause more damage. As vehicle speed decreases, pavement deflection increases, thus leading to an increase in pavement damage. Another way to explain this phenomenon is that when a truck slows its speed, the load is applied to the road for a longer time creating more damage (Minnesota Department of Transportation, 2002).

Huft, a South Dakota DOT engineer, provides an example. When a vehicle reduces speed from 50 mph to 25 mph, pavement deflection increases by 40 percent while pavement damage increases by 250 percent (Huft). This example illustrates the fact that when deflection of pavement doubles, damage to payment more than doubles. Huft states that certain models indicate when deflection doubles, pavement damage increases tenfold. Because of this, load limits remain the most effective way to maintain roads. In addition, roads need to be built correctly initially to support heavy truck loads. By implementing good spring load restrictions, a low volume asphalt road's lift can be increased by 10 percent. This would lead to a $10,000 savings per year (Minnesota Department of Transportation, 2002). This information regarding load restrictions and speed limits was important in determining questions for the WTP survey.

3. METHODOLOGY

This section describes the survey instrument used to collect the data for this project. Included is an explanation of how the survey questions were designed and how the survey was administered.

3.1 Constructing the Survey

To make the survey questions as realistic as possible, the questions are based on a specific freight transport network in a case study for farm-to-market deliveries for the Enderlin, N.D., market. The case study includes two major grain facilities. The facilities are Plains Grain & Agronomy elevator and the ADM Northern Sun facility. All participants are customers of one or both facilities and thus haul commodities to these destinations on a regular basis during the farming season.

Questions used in the survey instrument are based on recommendations from a panel of professionals including managers from Plains Grain & Agronomy and ADM Northern Sun facilities, a Ransom county commissioner, and a DOT engineer. The final survey includes sections to describe individual farming operations, use of rural roads, and opinions of rural road services. All questions asked in the survey pertain to movement of commodities for the 2003 marketing year.

The two-page booklet survey consisted of 23 questions, some of which were made up of multiple parts. One section included a table for respondents to complete that provided a profile of crops hauled to Enderlin in the 2003 marketing year. Rural road services questions were yes or no answers, fill in the blank, or multiple choice. Willigness-to-pay questions were either yes or no questions or multiple-part yes or no questions followed by a fill-in-the-dollar amount. A Likert scale question about road financing methods was also included where answers ranged from 1 (not willing) to 5 (very willing). The complete survey instrument is included at the end of the report in Appendix A.

3.2 Administering the Survey

The survey was mailed to producers in the farming off-season, January and March of 2004, to capture the greatest number of responses. Two survey mailings were sent out. The first mailing was sent to approximately 1,900 producers in North Dakota. The second mailing was narrowed to a 50 mile radius of Enderlin. This mailing went out to 789 of the original 1,900 producers. Ten surveys were returned because of undeliverable mailing addresses. Six surveys were returned indicating that the individual was either retired or no longer farming, for a total of 773 total surveys. For the two mailings, a total of 193 producers filled out and mailed the survey back for a 10 percent response rate.

4. RESULTS

The following section describes the data collected from the survey. Questions regarding participants' farm operation, use of rural roads, and rural road services are described along with corresponding responses.

4.1 Producer Profile

Responses for the survey include 35 North Dakota counties. The highest number of responses from a single county is 42 from Barnes county. Other counties with high response rates are Cass and Ransom. Enderlin is located partially in Ransom County and partially in Cass County. Figure 1 shows the number of responses from each county.

Producers answering the survey have farmed a range of 2 to 66 years with the average being 28 years. The average farm size is 2,807 acres with a range of 160 to 11,000 acres. Figure 2 illustrates respondents' farm sizes. The average distance of survey respondents' farm locations to Enderlin is 76 miles. The furthest respondent is 350 miles from Enderlin, while the closest farm is two miles away. Most farmers haul their own crops to market, as responses specify only an average of 18 percent of respondents (and only 14 percent when weighted by total bushels hauled to Enderlin from survey) use custom truckers to haul crops.

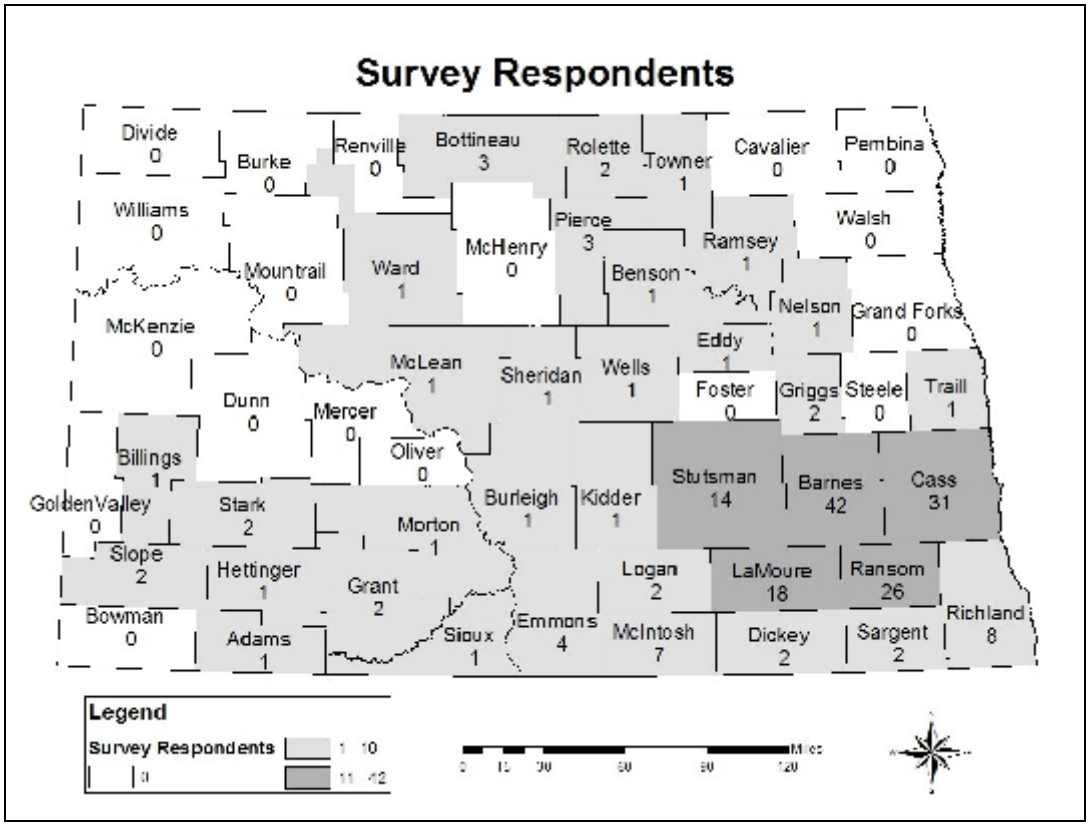

Figure 1. Survey responses by county

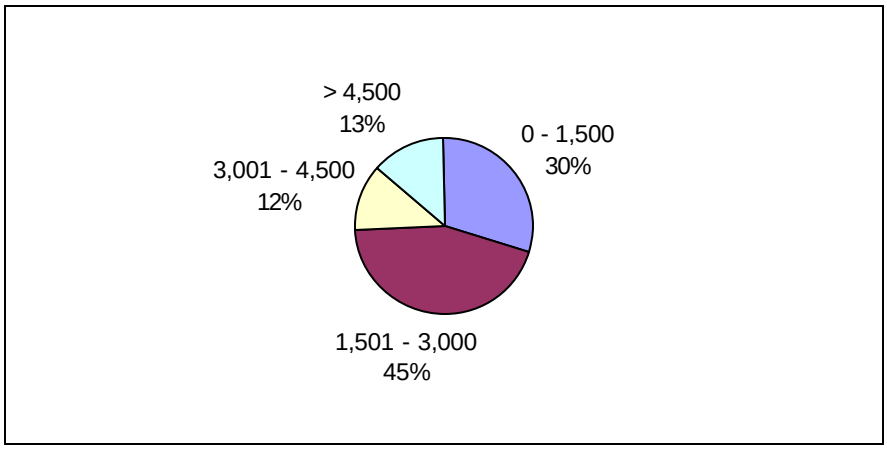

Figure 2. Respondents' farm size, in acres

4.2 Rural Road Use

The second portion of the survey inquired about producers' use of rural roads. When asked about crops transported on rural roads, 92 percent indicate they transport wheat. Eighty-four percent of respondents transport soybeans; 71 percent move corn; 57 percent move sunflowers; and 52 percent move barley. These numbers are illustrated in Figure 3. Of the producers who reported hauling products to Enderlin in 2003, the largest average number of bushels hauled for the year is 24,864 for corn. The averages for other commodities are displayed in Figure 4. Table 1 is a compilation of characteristics for crops hauled to Enderlin in 2003.

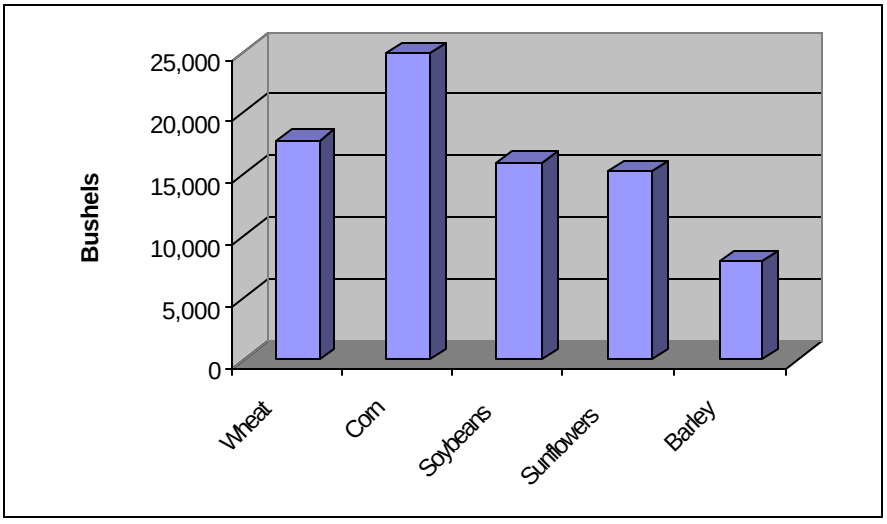

Figure 3. Average number of bushels hauled to Enderlin by commodity, 2003

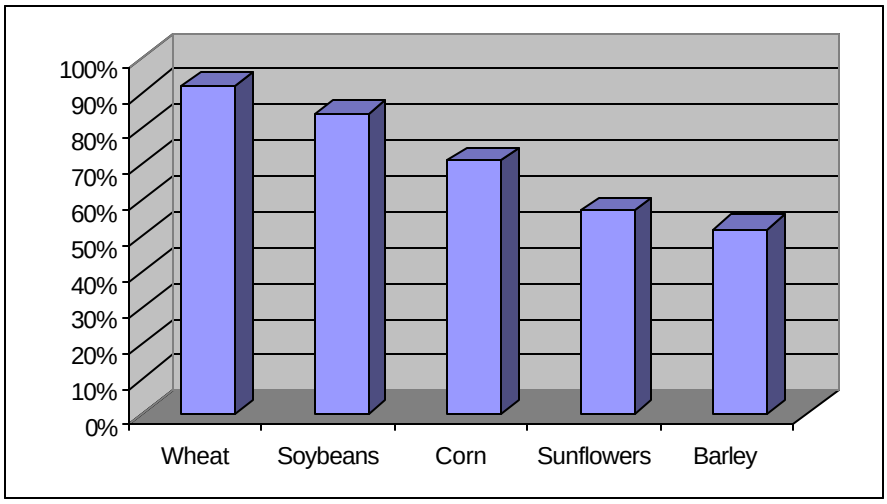

Figure 4. Percent of respondents that hauled specified commodities via rural roads, 2003

Table 1. Shipping Characteristics for Commodities Hauled to Enderlin

	Wheat	Corn	Soybeans	Sunflowers	Barley
Average trip distance (miles)	16.9	17.1	33.4	125.3	24.4
Weighted average trip distance	14.6	17.1	27.3	131.8	29.1
Average percent of trip that is	38.4	39.7	30.8	13.0	22.3
Weighted average percent of trip	51.4	48.8	34.5	10.7	24.5
Average one-way trip time (minutes)	36.1	35.9	58.6	149.2	27.5
Weighted average one-way trip time (minutes)	37.2	35.1	55.6	179.5	35.2
Average bushels hauled per trip	697.3	815.8	796.0	1357.1	809.9
Weighted average bushels hauled per trip	687.9	862.3	803.2	1447.8	912.0
Truck type most often used	Semi	Semi	Semi	Semi	Semi

* Weighted averages are weighted by bushels hauled to Enderlin for each commodity

4.3 User Perspectives on Rural Road Services

In the last section of the survey, producers answered questions regarding rural road services. When asked about current county fine levels, 86 percent of respondents agreed they do deter truck overload, accounting for 89 percent of total bushels hauled to Enderlin by survey respondents. In addition, 90 percent agreed that current enforcement of truck weight limits is adequate, which accounts for 98 percent of total volume hauled to Enderlin by survey respondents. Yes responses out of the 193 surveys for these two questions are illustrated in Figure 5.

Figure 5. Weight enforcement adequacy and fine deterrence of truck overload

It is important to understand how producers, a major road-user group, feel about rural roads. Data about whether and how much they are willing to invest in improvements to these roads is useful information for state decision makers. Thirty-seven percent of producers indicated they would be willing to stop for a truck weigh scale if it allowed them to access weight restricted roads. However, the yes responses only account for 20 percent of bushels moved to Enderlin by producers who filled out the survey. When asked if they would be willing to pay for improvement of rural road services, 32 percent said yes while the remaining 68 percent said no. The same percentages apply to the corresponding volumes accounting for the yes and no answers. In response to the question, "Would you be willing to drive farther if the roads were better, and thus faster for freight transportation?" yes and no responses were equal and the yes responses account for 46 percent of the commodities moved to Enderlin according by survey respondents.

Results from these questions suggest an important trend for producers. Although only 32 percent of respondents (and bushels) indicate they would actually be willing to pay some monetary value for improvements to rural roads, 50 percent (46 percent of bushels) would be willing to drive further for faster freight transportation. In other words, half of the producers would be willing to pay more by spending more on fuel for their trucks to use better roads, but only one-third would pay the government more for improved roads. The survey asks producers if they would be willing to pay more money for the government to improve services on roads used for freight transportation. From the responses, this option is less attractive then spending more money to fuel trucks for a longer haul on better roads. One explanation may be the extra cost for a longer truck haul is completely controlled by and visible to producers. On the other hand, when paying more money to the government for improved roads (increased taxes, for example) the benefits are more difficult to monitor. Yes responses for these yes and no questions are shown in Figure 6.

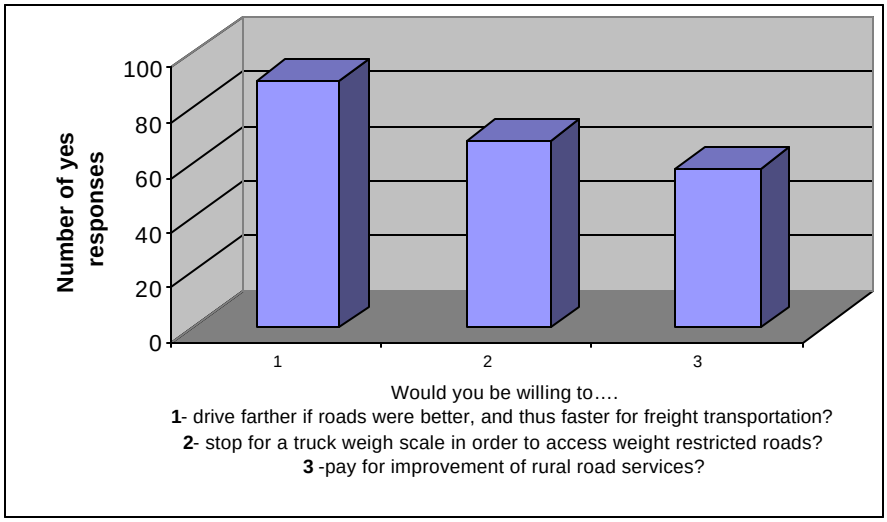

Figure 6. Weight enforcement adequacy and fine deterrence of truck overload

The survey included a question asking participants how much they would be willing to pay for vehicle-based weight indicators that would allow them to bypass weight scales to access weight-restricted roads. This question was open-ended, allowing participants to fill in a dollar amount. The average dollar amount per vehicle that respondents indicated they would pay for vehicle-based weight indicators is $41.51. The average dollar amount weighted by total bushels hauled to Enderlin from the survey is $37.37. Answers to this question ranged from $0 to $1,000. Figure 7 shows percent of total bushels hauled to Enderlin that correspond to willingness-to-pay categories for the vehicle-based weight indicator question.

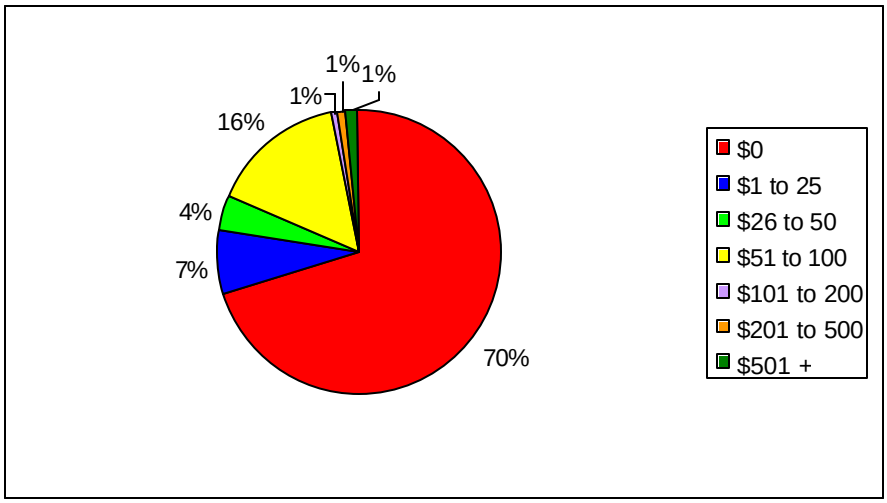

Figure 7. Percent of total bushels assigned to willingness-to-pay categories for vehicle-based weight indicators

Table 2 contains results from the survey question asking producers to indicate reasons for taking alternative routes while hauling commodities to Enderlin. The most popular answer for taking alternative routes is to use a paved road. Other popular answers are to use a shorter, more direct route and to avoid broken-up road surfaces.

Table 2. Reasons for Taking Alternative Routes to Enderlin

Reason	Frequency	Percent	Percent of total volume
To use a road with higher speed limits	30	15.7	17.1
To avoid traffic	42	22.0	23.9
To avoid broken up road surfaces	49	25.7	35.9
To avoid a narrow road	28	14.7	22.8
To use paved roads	73	38.2	41.7
To take a shorter, more direct route	58	30.4	35.1
To avoid bridges	7	3.7	11.1
To avoid roads with dust and rideability problems	25	13.1	15.9

Producers assigned a dollar value to the time they spend operating a truck. The most popular answer was a value between $15 and $29 per hour, with 39 percent of respondents assigning this value. Figure 8 illustrates the percentage of respondents indicating each value spread for time spent operating a truck. This does vary slightly when looking at the total volume of bushels hauled to Enderlin for each category. The value of trucking time stays around $15-$44 per hour. Percentages of respondents and percentages of total volume for each dollar category are included in Table 3.

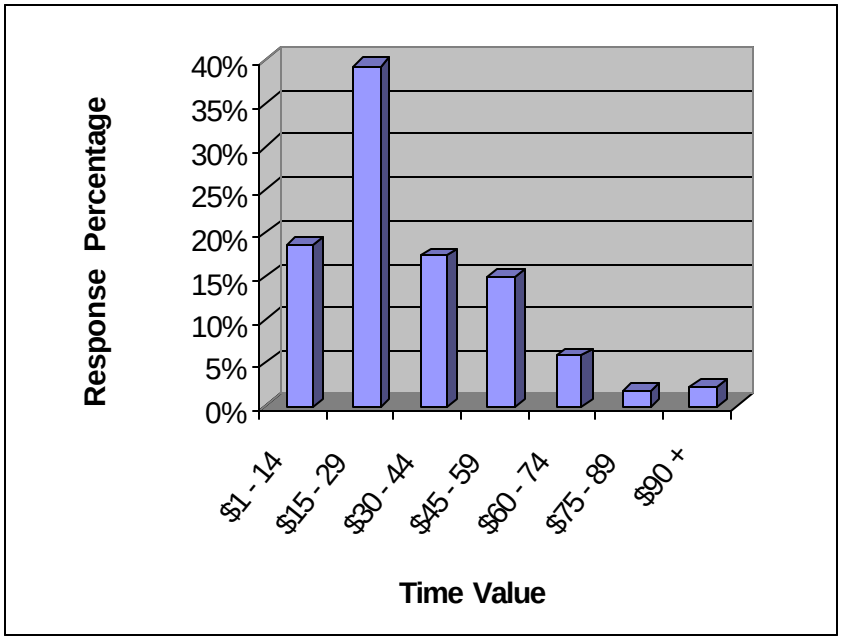

Figure 8. Frequency of responses for values placed on time spent operating a truck

Table 3. Percent Reporting Each Value Range ($/hour) for Time Spent Driving Truck

	Percent of respondents	Percent of total volume
$1-14	18.5	23.9
$15-29	39.3	32.9
$30-44	17.3	16.9
$45-59	15.0	21.0
$60-74	5.8	1.8
$75-89	1.7	2.7
$90 +	2.3	.8

The survey included questions regarding choices between travel distances and truck load limits. Given two alternatives, 82 percent of respondents picked traveling 22 miles with a 46,000 pound load limit (describing 84 percent of total bushels to Enderlin) over traveling 15 miles with a 36,000 pound load limit. This suggests load limit is more important to producers than distance. In other words, the results indicated producers want to fill their truck as full as possible when hauling commodities to market and are willing to drive farther in order to increase the truck's load. When asked "how many additional miles would you travel to use a route with a 40,000 pound load limit, versus using the shortest route of 10 miles with a 20,000 pound load limit," the average response was 14 miles. Figure 9 shows response averages by mile categories.

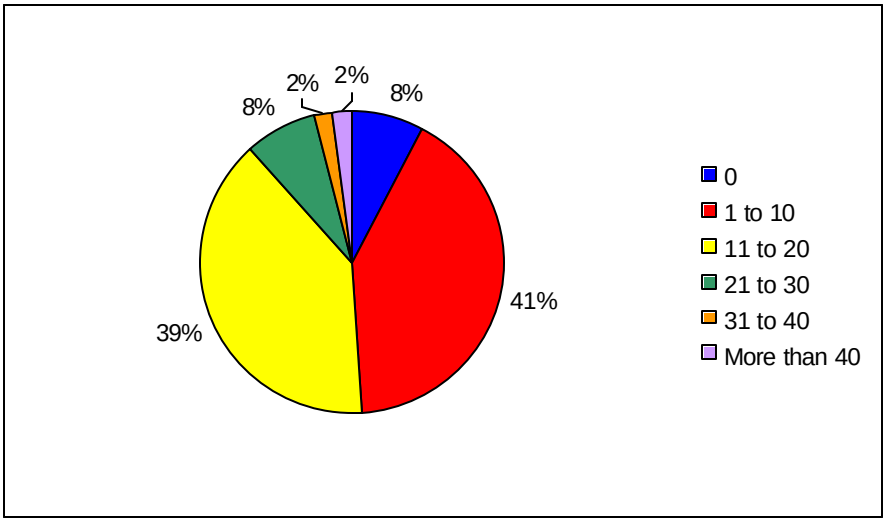

Figure 9. Additional miles producers would travel to increase load limits from 20,000 to 40,000 lbs.

The survey also included four specific willingness-to-pay questions regarding improvements to rural roads they use for farm-related transportation. The respondents were first asked whether or not they would be willing to pay more for improvements to a specific rural road service. If the respondent answered yes, they were asked to indicate a dollar amount per year they would pay for that service. Table 4 summarizes percent of respondents who answered yes as well as percent of total volume moved to Enderlin accounted for by these yes responses.

The highest WTP value is for converting gravel to paved roads, while the most people said they are willing to pay for investments to increase load limits (almost a third of respondents). In addition, 28 percent said they would be willing to pay for road improvements which lead to a decrease in distance traveled from farm to market. From the answers to these WTP questions, it can be concluded that farmers are not very concerned about signing on rural roads as only 11 percent would be willing to pay for improvements in this area. Table 5 shows weighted averages for willingness- to-pay amounts for the same questions. This table has average value responses weighted by number of years producers have farmed, farm size, distance of farm location to Enderlin, and total volume of grain hauled to Enderlin, according to survey responses.

The variable having the most effect on the values is farm size. When weighted by farm size, the average WTP value increases from $724 to $1,248 for the question regarding WTP for paving gravel roads. The average changes from $385 to $507 for the question asking WTP for improvement of rural roads that would lead to shorter trip distances. Again, the average increases from a value of $414 to $478 when asked about WTP for improvements of roads that would lead to greater vehicle weight limits. For the question about WTP for improved signing on rural roads, the mean value decreases from $96 to $89 when weighted by farm size.

Table 4. Summary of WTP for Improvements for Rural Road Services

Question	% Yes	% Bushels accounted for
Would you be willing to pay more for the pavement of gravel roads that you use for farm-related transportation?	19.2	18.2
Would you be willing to pay more for improved signing on rural roads that you use for farm-related transportation?	10.9	12.4
Would you be willing to pay more for improved road surfaces of rural roads that you use for farm-related transportation if it meant driving shorter distances to market?	28.0	30.9
Would you be willing to pay more for improved gravel road surfaces if it meant an increase in allowable vehicle weight limits on roads that you use for farm-related transportation?	31.6	35.1

Table 5. Averages and Range ($) for WTP Questions

Question - Would you be willing to pay more for...	Average	By Farm Size	By Years Farmed	By Miles	By Volume	Range
...the pavement of gravel roads that you use for farm-related transportation?	$724	$1,248	$815	$732	$346	$50-5,000
...improved signing on rural roads that you use for farm-related transportation?	$96	$89	$66	$75	$67	$5-500
...improved road surfaces of rural roads that you use for farm-related transportation if it meant driving shorter distances to market?	$385	$507	$413	$344	$353	$5-1,000
...improved gravel road surfaces if it meant an increase in allowable vehicle weight limits on roads that you use for farm-related transportation?	$414	$478	$431	$341	$391	$2-1,000

Another question instructed survey participants to assign $1 to rural road service improvements. They could spend it all on one item, or divide it up among items. The most common service respondents indicated they would use the $1 for was gravel road surfaces, allocating an average dollar amount of 51 cents when weighted by volume. The remaining services were assigned an average value as follows; intersections (5 cents), law enforcement (4 cents), paved road surfaces (34 cents), signs and safety (3 cents), and other (2 cents) (Figure 10). Answers specified for the "other" category include regrading, maintenance, increase load limits, truck inspections, snow removal, and bridges. Figure 11 shows overall number of respondents who said they would spend some portion of the $1 on specific rural road service improvements. The most popular categories for spending money for rural road improvements are gravel road surfaces and paved road surfaces.

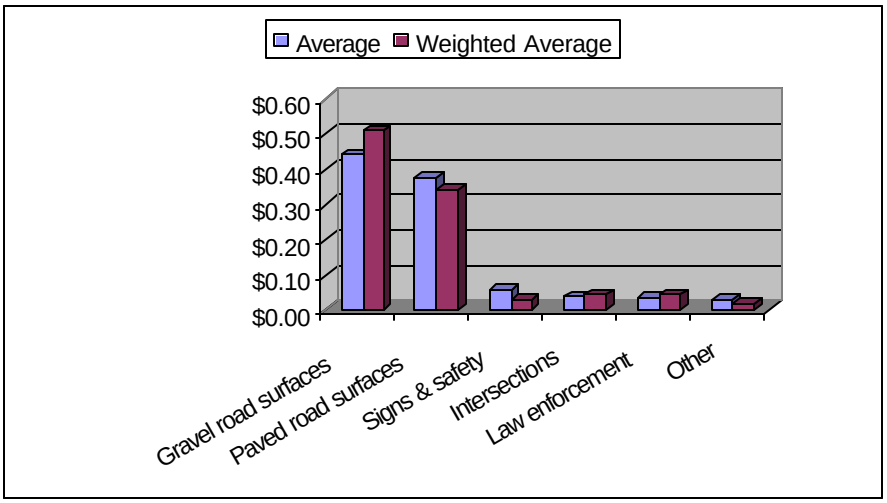

Figure 10. Dollar amount for various rural road services, average and *weighted average

*Weighted by total volume of grain moved to Enderlin from survey

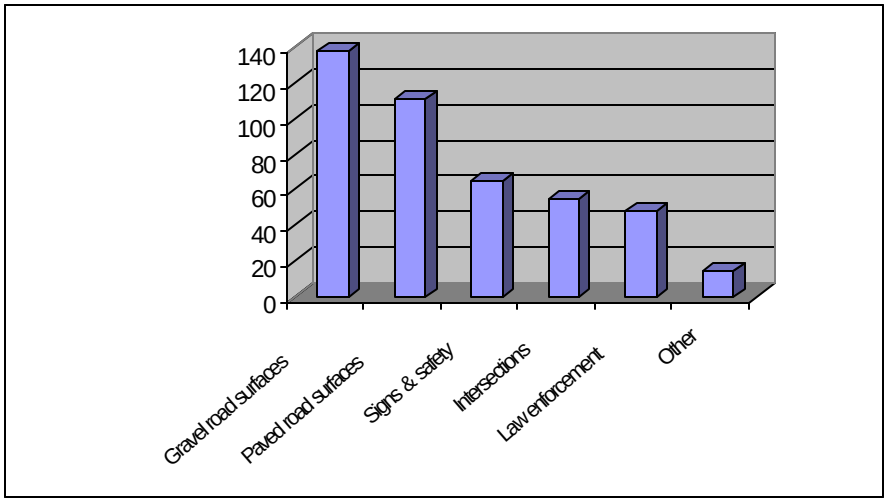

Figure 11. Number of respondents indicating they would spend money for each rural road service

The final portion of the survey was comprised of a Likert scale question instructing producers to assign a value of 1 (not willing to agree to use for road improvements) to 5 (very willing to agree to use for road improvements) to nine innovative road financing methods. The financing methods listed in the survey came from the MPC Report "Innovative Financing Methods for Local Roads in the Midwest and Mountain-Plains States" by Hough et al. (1997). The most popular innovative financing method was cost participation with a mean value of 3.11. Other preferred methods are severance tax, fines, and sales tax. When weighted by farm size or volume of bushels hauled to Enderlin, the results do vary slightly. Cost participation still has the highest average value, followed by severance tax, fines, and sales tax, as illustrated in Figure 12. Table 6 summarizes the responses to this survey question.

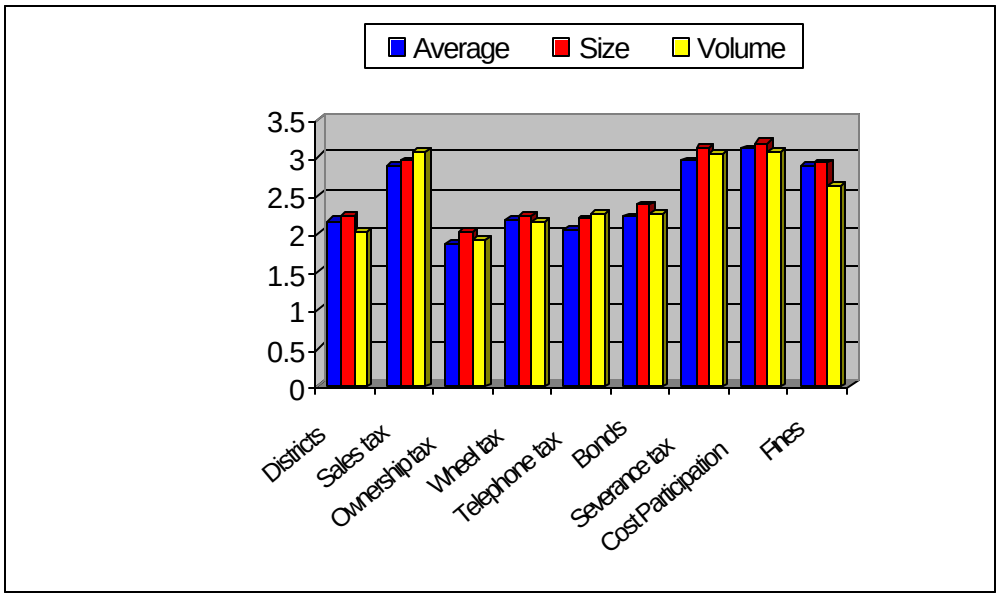

Figure 12. Averages and *weighted averages for innovative financing method responses

*Weighted by farm size and total volume of grain moved to Enderlin from survey

Table 6. Innovative Financing Methods[1] for Improvement of Rural Road Services

Innovative financing methods	Mean	1	2	3	4	5
		---------- Frequency of response ----------				
Rural improvement districts	2.16	75	33	37	24	6
Sales tax	2.88	45	25	43	36	29
Special ownership tax	1.87	84	40	41	6	3
Wheel tax	2.17	77	31	35	27	6
Telephone tax	2.05	87	28	34	19	8
Bonds	2.22	70	38	41	19	10
Severance tax	2.94	44	23	40	38	31
Cost participation	3.11	30	24	48	44	30
Fines	2.89	52	21	39	25	40

[1]Innovative financing method definitions:

Rural improvement districts - A fee for rural developments and subdivisions which are created through a petition process.
Sales tax - Use of county sales tax for road funding.
Special ownership tax - A fee for owners of specific items such as mobile homes.
Wheel tax - A county charge on each tire of a vehicle collected when vehicle licenses are purchased.
Telephone tax - City owned phone company contributes a percentage of its tax collection to roads.
Bonds - A written promise to pay a specified sum of money at a date(s) in the future along with interest at a specific rate.
Severance tax - Based mineral extraction to compensate for extra wear and tear on roads.
Cost participation - Adopting projects where other agencies assist with the work and costs.
Fines - Use money from overland fines for county road improvements.

5. SUMMARY AND CONCLUSIONS

Approximately eighty-eight percent of North Dakota's 66,648 miles of road are rural (controlled by government divisions other than federal or state) (Regional Transportation Online Center). These roads are important to the state's producers as they are the primary mode for hauling agricultural commodities from farm to market. Although some of these roads are in need of improvement, using them is necessary for some farm-to-market routes. Local government decision makers have only a limited budget for roads and thus are faced with difficult decisions. Data about what producers think is important in rural road services can help determine options for these roads and assist in making road improvements most beneficial to rural road users. In addition, information regarding whether or not producers are willing-to-pay for rural road improvements could prove helpful when processing appropriation decisions.

The objective for this project was to assess and develop a profile of producers' opinions of rural road services in North Dakota. In cooperation with two agricultural entities located in the Enderlin, N.D., area, a survey was mailed out to 1,900 producers. The statewide survey drew a 10 percent response rate with 193 completed surveys.

Survey participants live in 35 North Dakota counties. The distance from farm to Enderlin ranges from two miles to 350 miles. The average number of years farmed by these producers is 28 with an average farm size of 2,807 acres. The furthest average trip distance for hauling various commodities to Enderlin is 125 miles for sunflowers. From the 193 responses, results indicate that wheat is the most common commodity hauled to Enderlin with 92 percent of respondents indicating they do so. Of the producers indicating they haul each commodity, corn is the commodity with the highest average number of bushels hauled. On average, 24,864 bushels of corn were hauled to Enderlin in 2003 by producers indicating they haul corn.

The two rural road service issues that appear predominant from response analysis are rural road surface and vehicle weight limits. These services show up frequently in survey responses. Producers are concerned about, want improvements to, and are willing to pay for these services.

Thirty-nine percent of the producers who filled out the survey stated a personal value for time spent operating a truck between $15 and $29 per hour, which accounts for 33 percent of total bushels of grain and oilseeds hauled to Enderlin. Other popular values were $15-$29 and $45-$59, which account for 24 and 21 percent of bushels hauled, respectively.

An average range of 11 to 32 percent of respondents said they would be willing to pay more for various improvements to rural roads used for farm-related transportation. Load limits stand out as important to the producers as the greatest number of participants are willing to pay for improvements that increase them (36 percent). This number describes 35 percent of the crops hauled to Enderlin. When weighted by total volume of bushels hauled to Enderlin, the average amount participants are willing to pay for improvements to roads that lead to load limits was greatest at $391 a year.

The most common category producers were willing to pay in rural road improvements is gravel road surfaces. Other popular answers for improvements include paved road surfaces as well as signs and safety. Survey respondents also say they are most willing to use cost participation, fines, or sales tax to finance rural road improvements when questioned about a variety of innovative financing methods.

The information gained through the WTP survey done for this project offers insight for a current information void in freight transportation. Although transportation on rural roads is an important issue, there is little research describing the value of these roads to farmers, or whether farmers are willing to pay for these roads to be paved. This data will be helpful in local government budget decision making, state DOT planning, and economic development strategies.

When local governments allocate funds for rural roads, this concrete data could be referenced for prioritization purposes. Information that identifies areas in which freight transporters would like to see improvements could potentially make these decisions easier as well as credible. By basing allocation decisions on perceptions of rural road users, hopefully the greatest benefits can be achieved from use of road funds. The same principles apply at the state DOT levels. In a rural state such as North Dakota where agriculture plays a vital role in the economy, road planning decisions impact producers who are using roads for freight transportation. As the DOT strives to make the road system safe for users, these survey results refer to areas that actual road users feel there is room for safety or efficiency improvements. While there are many facets to economic developments, improvements to the production and distribution of goods are an important part. Again, the results of this report will be available for economic development plans that ultimately aid in the growth of the economy where agriculture plays a vital role. By using the data provided by producers, there is potential for freight transportation efficiency improvements through various levels of rural road resource allocation strategies.

6. REFERENCES

Brownstone, David, Arindam Ghosh, Tahomas Golob, Camilla Kazimi, and Dirk Van Amesfort. "Drivers' Willingness-to-Pay to Reduce Travel Time: Evidence from the San Diego I-15 Congestion Pricing Project." May 2002.

Danielis, Romeo and Lucia Rotaris. "Analyzing Freight Transport Demand Using Stated Preference Data: A Survey and a Research Project for the Friuli-Venezia Giulia Region." http://www.univ.trieste.it/~nirdses/dises/faculty/wp68.pdf . Accessed Jan. 5, 2004.

Drike, Kristine and Kumares C. Sinha. "An Evaluation of Innovative Highway Financing Techniques for Indiana." *Transportation Quarterly*. Vol. 57, No. 1. Winter 2003 (59-76).

EEA Glossary. http://glossary.eea.eu.int/EEAGlossary/W/willingness_to_pay/ . Accessed June 13, 2003.

http://economics.about.com/library/glossary/bldef-contingent-valuation.htm . Accessed December 8, 2003.

"Extra Vehicle Operating Costs: What Motorists Pay to Drive on Roads in Need of Repair." The Road Information Program. Washington, DC. April 2002.

Hough, Jill, Gary Hegland, and Crystal Bahe. "An Assessment of Regional Road User Needs in Three Rural States." MPC Report No. 03-140, Mountain-Plains Consortium, North Dakota State University, Fargo, ND. April 2003.

Hough, Jill and Kiel Ova. "Guidelines for Consolidating Township Roads: A Case Study Showing Benefit/Cost Analysis for Closing Township Roads in North Dakota." MPC Report No. 99-102, Mountain-Plains Consortium, North Dakota State University, Fargo, ND. May 1999.

Hough, Jill, Ayman Smadi, and John Bitzan. "Innovative Financing Methods for Local Roads in the Midwest and Mountain-Plains States." MPC Report No. 97-74, Mountain-Plains Consortium, North Dakota State University, Fargo, ND. July 1997.

Huft, David. "Spring Speed Restrictions - Do They Work?" South Dakota Transportation Technology Transfer Center. Special Alert, Volume 2. 1992.

Kjartan Saelensminde. "Stated Choice Valuation of Urban Traffic Air Pollution and Noise." Transportation Research Part D. Vol. 4, Issue 1. January 1999 (13-27).

Keever, David B., Karen E. Weiss, and Rebecca C. Quarles. "Moving Ahead: The American Public Speaks on Roadways and Transportation in Communities." February 2001. At http://www.fhwa.dot.gov/reports/movingahead.pdf .

Lamberton, Charles E. "Alternative Road Networks for a South Dakota Township." Economics Research Report 92-5, Department of Economics, South Dakota State University. June 1992.

Minnesota Department of Transportation. "Spring Load Restrictions Technical Fact Sheet." h http://www.mnroad.dot.state.mn.us/research/thawindex/TFS_SLR.asp . Accessed March 21, 2002.

O'Fallon, Carolyn, Charles Sullivan, and David Hensher. "Understanding Underlying Constraints Affecting Decision-Making by Morning Car Commuters." Institute of Transport Studies, The University of Sydney, Australia. August 2002. At http://www.its.usyd.edu.au/publications/working_papers/wp2002/ITS-WP-02-13.pdf .

Regional Transportation Online Center. National Association of Development Organizations. http://www.nado.org/rtoc/library/nd.html . Accessed May 19, 2003.

Skorseth, Ken and Ali Selim. "Gravel Roads: Maintenance and Design Manual." South Dakota Local Transportation Assistance Program. November 2000. At http://www.epa.gov/owow/nps/gravelman.pdf .

7. APPENDIX — SURVEY

Investment in Rural Roads

Willingness-to-Pay for Improved Gravel Road Services in Freight Transportation

Upper Great Plains Transportation Institute
North Dakota State University
2004

We appreciate your help in completing this survey.

Please return your completed questionnaire by March 24, 2004

INDIVIDUAL RESPONSES ARE CONFIDENTIAL!

Data will be Aggregated for Survey Results

Note: This survey includes all grain movements to Northern Sun and/or Plains, Grain, & Agronomy, LLC

Please Describe your Operation:

1. Primary farm location: County:_____

   Township:_____

2. Number of years you have been farming:_____years

3. Size of farming operation:_____acres

4. Miles from your farm to Enderlin? _____ miles

5.

6. What percentage of your product is hauled to market by custom truckers? _____%

Please Describe your use of rural roads:

7. What crops do you transport via rural gravel roads? (circle all that apply)

a. Wheat
b. Corn
c. Soybeans
d. Sunflowers
e. Barley
f. Other (please specify)_____

8. For crops hauled to **Enderlin** in the 2003 marketing year, please provide a profile:

	Wheat	Corn	Soybeans	Sunflowers	Barley
Total bushels (cwt.) hauled to Enderlin?	bu.	bu.	bu.	cwt.	bu.
Average trip distance (miles)					
Percent of trip distance that is gravel road surface?	%	%	%	%	%
Average trip time? (minutes)					
Truck most often used? a. Single Axle b. Tandem Axle c. Semi Truck d. _____	a b c d	a b c d	a b c d	a b c d	a b c d
Average bushels (cwt.) hauled per trip	bu.	bu.	bu.	cwt.	bu.

Rural Road Services

9. Do the current county fine levels deter truck overload? a. Yes b. No

10. Is enforcement of truck weight limits adequate? a. Yes b. No

11. Would you be willing to stop for a truck weigh scale if it allowed you access to weight restricted roads?
a. Yes b. No

12. How much would you be willing to pay for vehicle-based weight indicators that allowed you to bypass weight scales to access weight restricted roads? $_____ per vehicle

13. If you take an alternate route to the Northern Sun or Plains, Grain, & Agronomy facilities, what is (are) the reason(s)? Please circle all that apply.
a. To use a road with higher speed limits
b. To avoid traffic
c. To avoid broken up surfaces
d. To avoid a narrow road
e. To use paved roads
f. To take a shorter, more direct route
g. To avoid bridges
h. To avoid roads with dust and rideability

14. How valuable is your time spent operating your truck? (Please describe on a per hour basis)
a. Under $15 per hour
b. $15-$29 per hour
c. $30-$44 per hour
d. $45-$59 per hour
e. $60-$74 per hour
f. $75-$89 per hour
g. $90 or more per hour

15. Would you be willing to pay for improvement of rural road services?
a. Yes b. No

16. Would you be willing to drive farther if the roads were better, and thus faster for freight transportation purposes?
a. Yes b. No

17. Assume you were allowed gravel road route alternatives under different load limits. Would you choose to (please circle one):
a. travel 22 miles with a 46,000 lb load limit
b. travel 15 miles with a 36,000 lb load limit

18. Assume you have gravel road route alternatives under different load limits. The shortest route is 10 miles and has a 20,000 lb load limit. How many additional miles would you travel to use a route with a 40,000 lb load limit?
_____ miles

19. Would you be willing to pay more for the pavement of gravel roads that you use for farm-related transportation?
a. Yes, I would be willing to pay $_____ more annually for the pavement of gravel roads.
b. No

20. Would you be willing to pay more for improved signing on rural roads that you use for farm-related transportation?
a. Yes, I would be willing to pay $_____ more annually for improved signing on rural roads.
b. No

21. Would you be willing to pay more for improved road surface of rural roads that you use for farm-related transportation if it meant driving shorter distances to market ?
a. Yes, I would be willing to pay $_____ more annually for improved road surfaces if it meant driving shorter distances.
b. No

22. Would you be willing to pay more for improved gravel road surfaces if it meant an increase in allowable vehicle weight limits on roads that you use for farm-related transportation?
a. Yes, I would be willing to pay $_____ more annually for improved gravel road surfaces if it meant higher vehicle weight limits.
b. No

23. If you had $1.00 to spend on rural road service improvements, how would you use it? Please assign each item the amount you would spend so the total adds up to $1.00.

a. Gravel Road Surfaces _____
b. Intersections _____
c. Law Enforcement _____
d. Paved Road Surfaces _____
e. Signs & Safety _____
f. Other (specify)_____ _____

24. Listed in the following table are nine innovative road financing methods. Please rate how you feel regarding willingness to pay using these methods.

		Not willing to agree to use for road				Very willing to agree to use for road improvements
a	Rural improvement districts -a fee for rural developments and subdivisions which are created through a petition process	1	2	3	4	5
b	Sales tax -use of county sales tax for road funding	1	2	3	4	5
c	Special ownership tax -a fee for owners of specific items such as mobile homes	1	2	3	4	5
d	Wheel tax -a county charge on each tire of a vehicle collected when vehicle licenses are purchased	1	2	3	4	5
e	Telephone tax -city owned phone company contributes a percentage of its tax collection to roads	1	2	3	4	5
f	Bonds -a written promise to pay a specified sum of money at a date(s) in the future along with interest at a specific rate	1	2	3	4	5
g	Severance tax -based mineral extraction to compensate for extra wear and tear on roads	1	2	3	4	5
h	Cost participation -adopting projects where other agencies assist with the work and costs	1	2	3	4	5
l	Fines -use money from overload fines for county road improvements	1	2	3	4	5

We welcome any additional comments regarding willingness-to-pay for rural road improvements:

Thank You!

For questions contact Tamara VanWechel tamara.vanwechel@ndsu.nodak.edu
P:(701)231-6427• North Dakota State University