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

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ABSTRACT

Transport of commodities in rural areas is an important issue and an area where research is needed. As trends for rural road funding decrease, the need for improvements and maintenance of rural roads used for rural freight transportation increase. Although rural roads are in need of improvements, uncertainties exist about what type of improvements road users think are most important and whether or not they would pay more for bettering services to these roads.

The objective of this report is to develop a profile of rural road users' opinions of rural road services. More specifically, what are rural agricultural producers willing to pay for local road service improvements and what financing methods would they be most agreeable to? Local government decision makers have limited budgets for roads, and thus are faced with difficult allocation decisions. Data about what producers think is important in rural road services can help determine options for these roads and assist in forming conclusions beneficial to rural road users. This data will be helpful in local government budget decision making and appropriation decisions, state DOT planning, and economic development strategies.

Survey data for this research was collected in a case study analysis. The survey included questions about producers' perceptions of roads used to haul commodities to market. Although the participants of this survey were restricted to producers from the state of North Dakota, results are applicable to other rural states. To define a specific farm to market route, surveys were mailed to producers who haul or have hauled product to two facilities in Enderlin, North Dakota: the Plains, Grain, and Agronomy grain elevator shuttle facility and the ADM Northern Sun oilseed processing plant. The survey questions were divided into three sections including farm operation description, rural road usage, and rural road services perceptions.

The two rural road service issues that appear predominant from response analysis are rural road surface quality 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. Load limits stand out as especially important to producers. When asked about willingness to pay for improving various road services, the greatest number of participants indicates they would pay for improvements that would increase load limits (36 percent).

Gravel road surfaces are an area producers would like to see money used for in rural road improvements. Other areas where producers indicate they would like to see money spent for improvements include paved road surfaces and signs & 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 innovative financing methods.

INTRODUCTION

States that rely heavily on agriculture depend on rural roads for agricultural-related transport. Agricultural states 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-axel and semi-trailer trucks are often used by farmers to

haul their crops. 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% 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. Further, given the current transportation funding climate, it would be unfeasible 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 improvements. Trends such as federal funding decreases 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 also make this an important research topic. Today many producers are bypassing small elevators and transporting 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 due to 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 agriculture-based. Included is an assessment of the monetary amount the public is willing to pay for various improvements and maintenance of gravel roads. Producers are asked what they perceive their time is worth and if they are willing to drive further for access to better roads. Participants answer questions about non-traditional financing methods that are becoming more common out of necessity.

Because roads are a public good, user willingness-to-pay 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 due to improved road surface, and improving roadway traffic control devices (signs). The disaggregate investigation into WTP for rural road services provides valuable insight into rural freight transport.

BACKGROUND AND NEED FOR THIS RESEARCH

Current research is available on innovative financing methods for rural roads. There has also been work completed summarizing road user perceptions regarding road conditions and associated needs. There is literature on the importance of transportation planning and the difficulties of road funding. However, there is a lack of data on perceptions of road services for

those roads used in freight transportation.

Research is needed to draw accurate conclusions for specific road services that road users view in need of improvements. People actually making use of roads have an insider's perspective on exactly what will make freight transportation better and more efficient. Knowing exactly if and how these users are willing to contribute to these improvements has the potential to aid in funding opportunity changes and advancements. The need for this detailed information is clear. Much time and money is spent debating the issue of how and where to distribute funds that are available for road services. The data gathered in this project will allow decision makers to look at real needs and use them to allocate resources in a more precise and timely manner.

There are different groups and levels of transportation decision makers and road users. One major road user group in 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. The current research aids making this goal possible.

METHODOLOGY

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, North Dakota market. The case study includes two major grain facilities. The facilities are Enderlin 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 2-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. Willingness-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).

Administering the Survey

It was decided that the survey should be mailed out to producers in the farming off-season to capture the greatest number of responses. Two survey mailings were sent out. The surveys were

mailed in January and March of 2004. The first mailing was sent to approximately 1900 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 1900 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.

RESULTS

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.

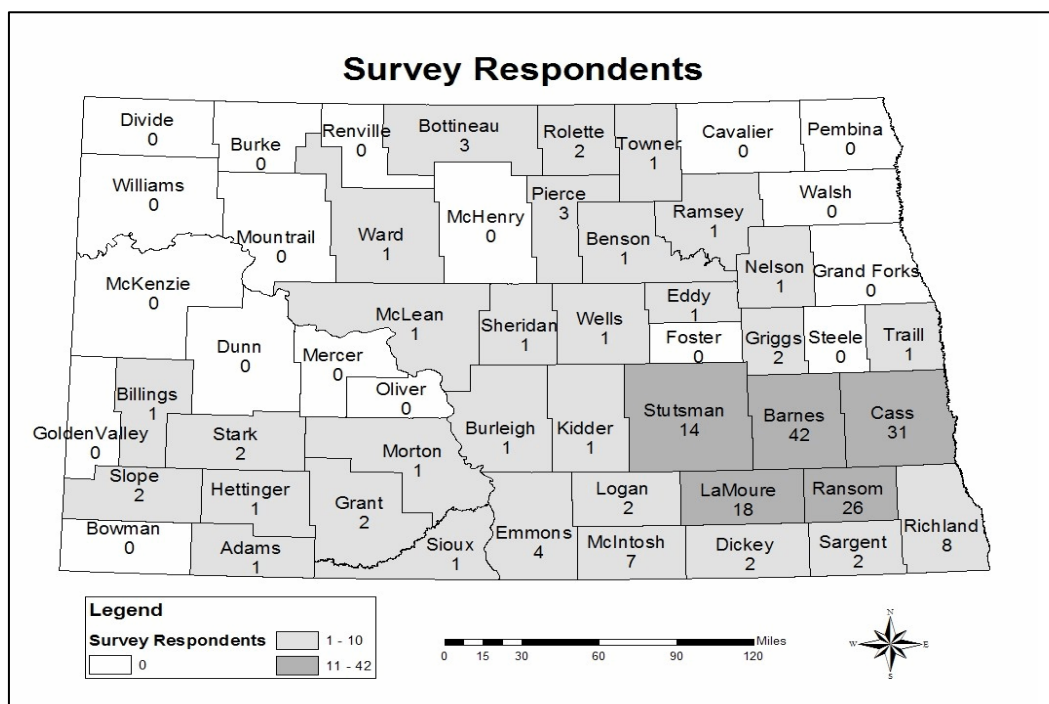


Figure 1. Survey Responses by County

Producers answering the survey have farmed a range of 2 to 66 years with the average being 28 years. The average farm size is 2807 acres with a range of 160 to 11,000 acres. Figure 2 illustrates respondent farm size. The average distance of survey respondents' farm locations to Enderlin is 76 miles. The furthest respondent is 350 miles from Enderlin, while the closest farms 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.

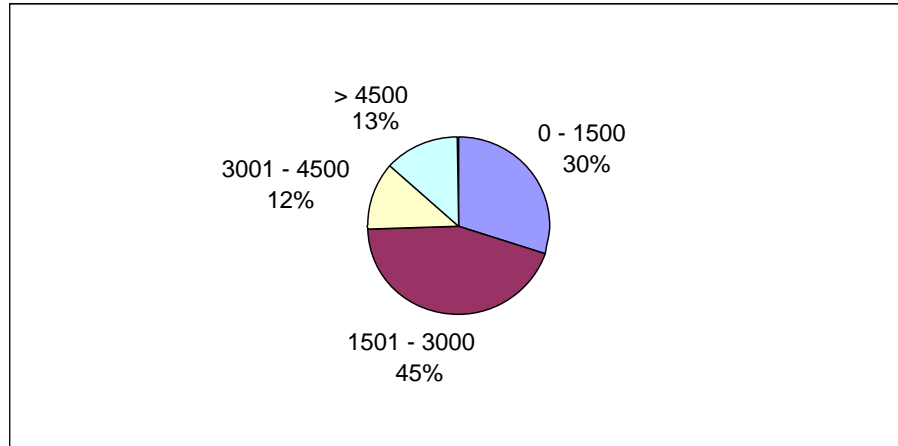


Figure 2. Respondents' Farm Size, in Acres

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.

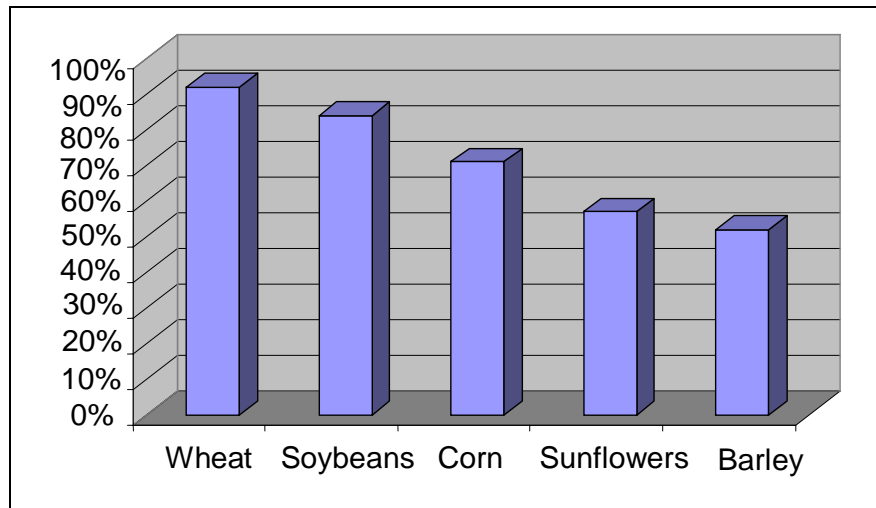


Figure 3. Percent of Respondents That Hauled Specified Commodities via Rural Roads, 2003

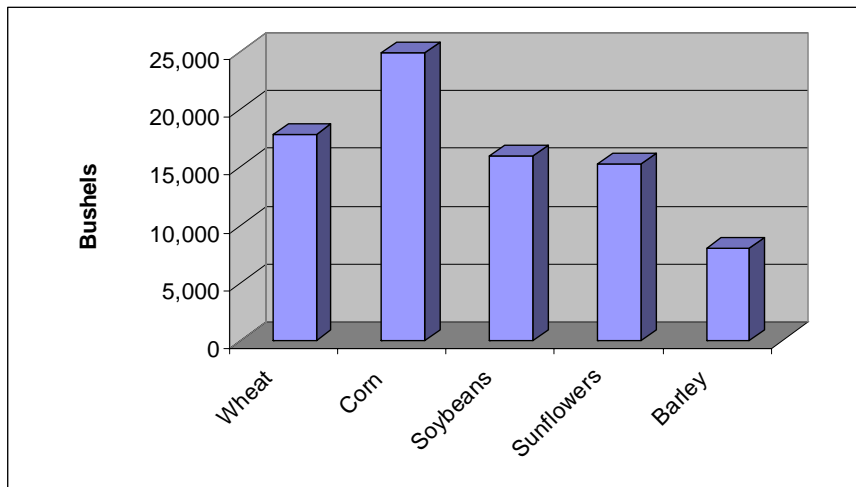


Figure 4. Average Number of Bushels Hauled to Enderlin by Commodity, 2003.

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 (miles)	14.6	17.1	27.3	131.8	29.1
Average percent of trip that is gravel road surface	38.4	39.7	30.8	13.0	22.3
Weighted average percent of trip that is gravel road surface	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

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 from the 193 surveys for these two questions are illustrated in Figure 5.

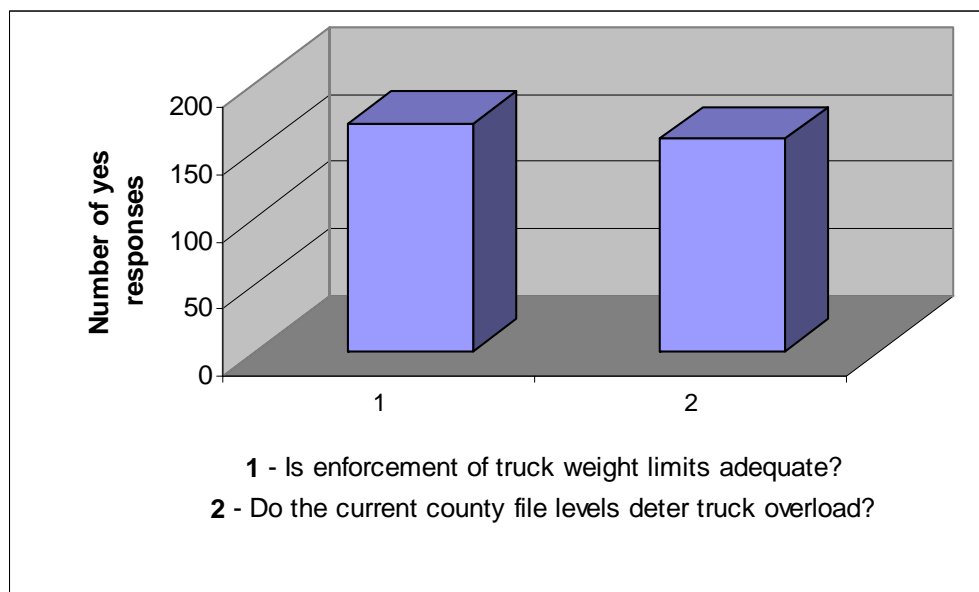


Figure 5. Respondent Agreement with Weight Enforcement Adequacy and Fine Deterrence of Truck Overload

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 yeses 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 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. When weighted by bushels yes responses for this question decrease slightly, accounting for 46 percent.

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 than 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, no” questions are shown in Figure 6 below.

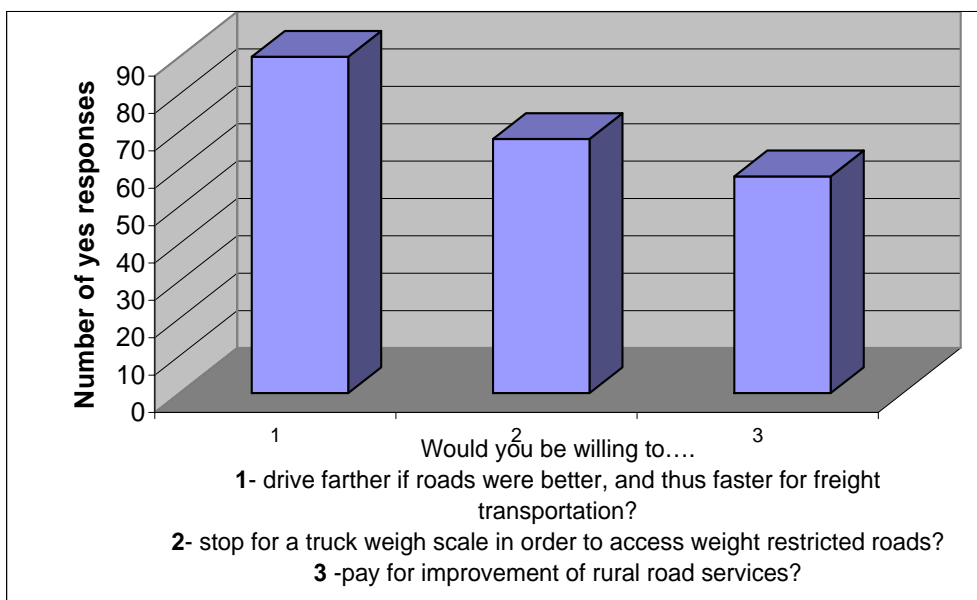


Figure 6. Willingness to Drive Further, Stop for a Truck Weigh Scale, and Pay for Improvements

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 respondents that fit into various dollar categories (weighted by total bushels hauled to Enderlin). Seventy percent indicated they would not be willing to pay anything for such technology.

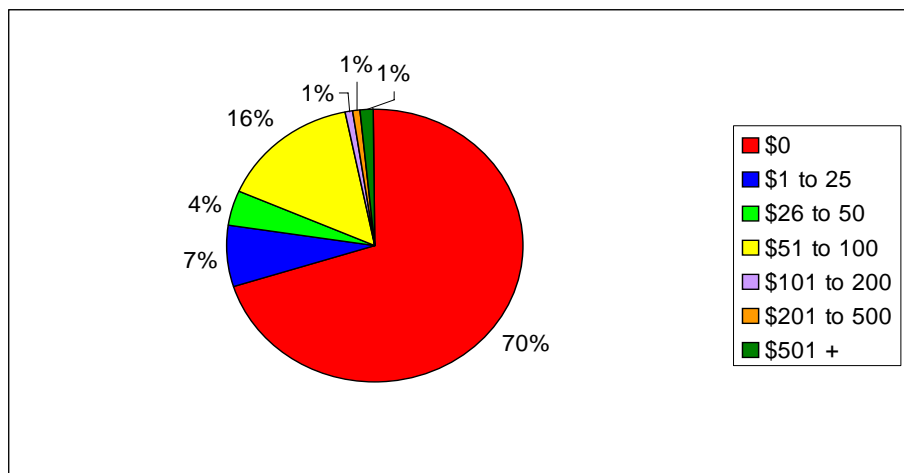


Figure 7. Percent of Respondents in various Willingness-to-Pay Categories for Vehicle-Based Weight Indicators

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 a value in this range. 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, but 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 below in Table 3.

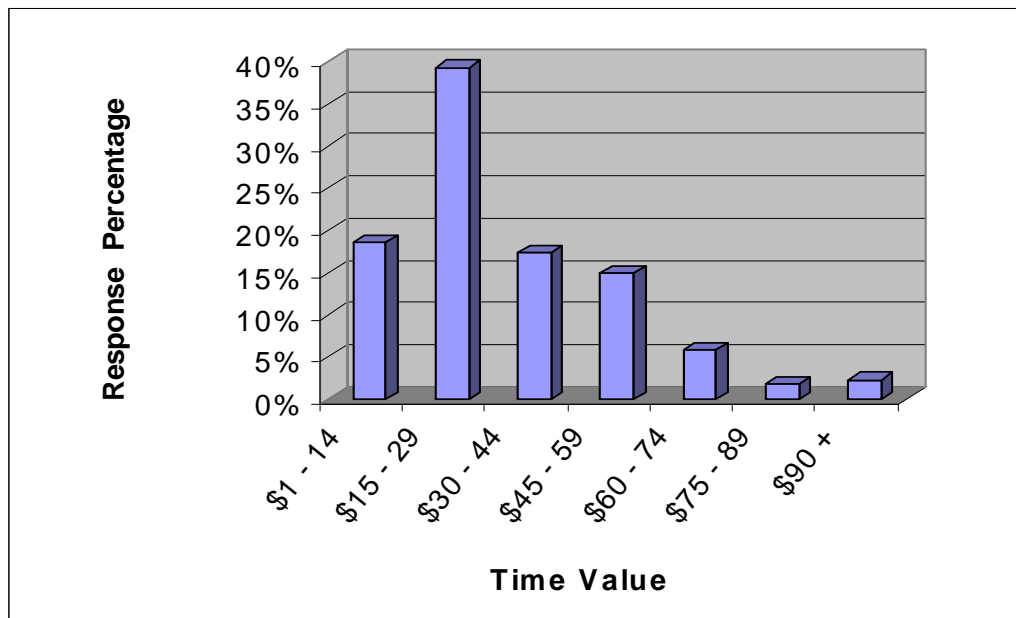


Figure 8. Responses for Values Placed on Time Spent Operating a Truck

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 % 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 below shows response averages by mile categories.

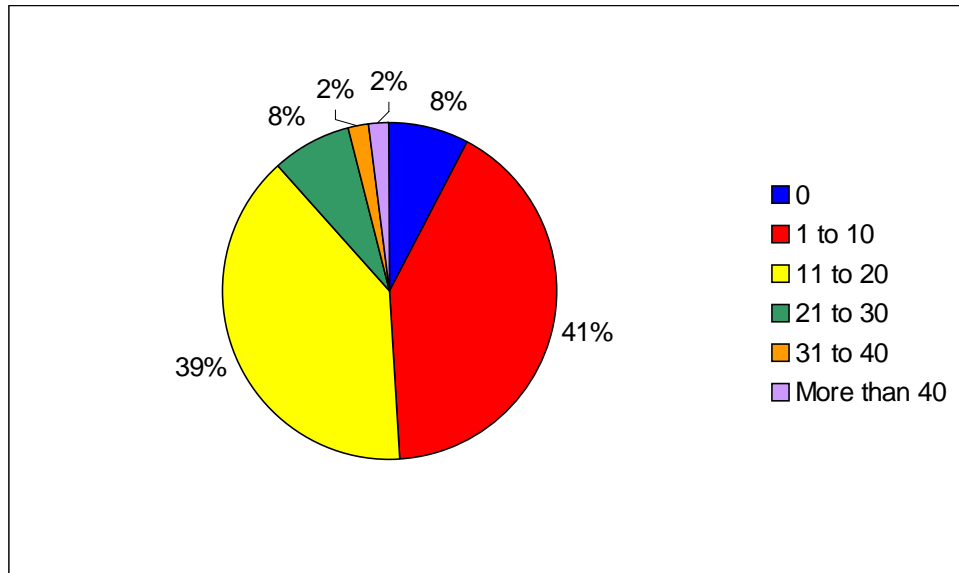


Figure 9. Additional Miles Producers Would Travel to Increase Load Limits from 20,000 to 40,000 lbs

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, then 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.

Table 4. Summary of Willingness-to-pay 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

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 1/3 of respondents). In addition, twenty-eight 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 eleven 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 \$1248 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 5. Averages and Range (\$) for Willingness-to-Pay 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 \$1.00 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 \$1.00 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 \$1.00 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.

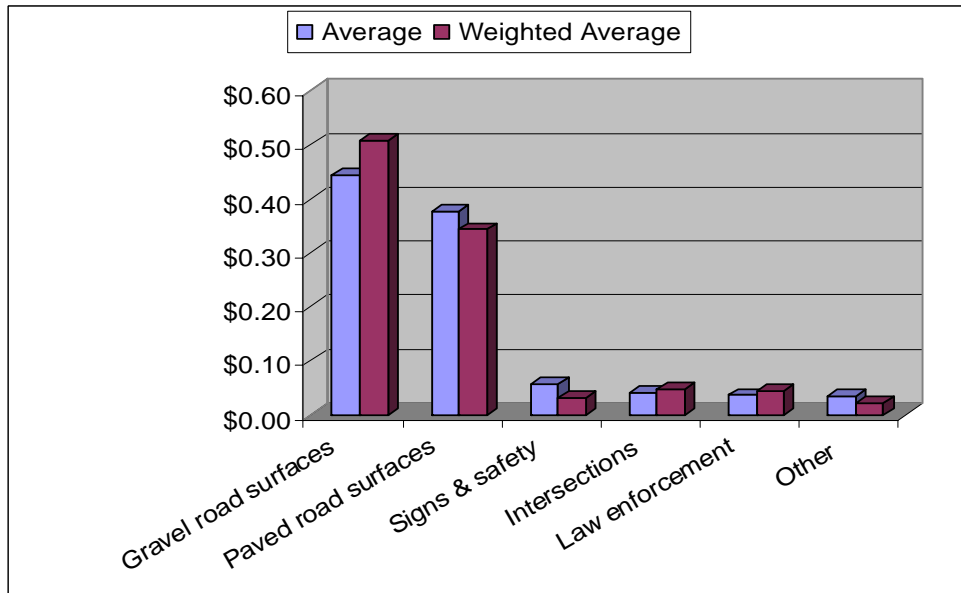


Figure 10. Dollar Amount for Various Rural Road Services, Average and *Weighted Average

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

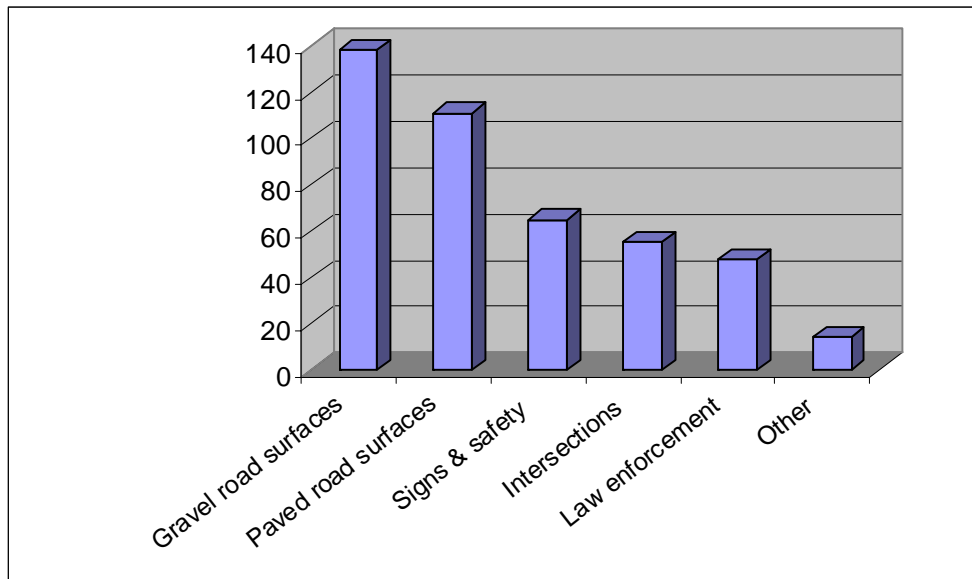


Figure 11. Number of Respondents Indicating They Would Spend Money for Each Rural Road Service

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. Definitions for the innovative financing methods included in this question are listed below.

- 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

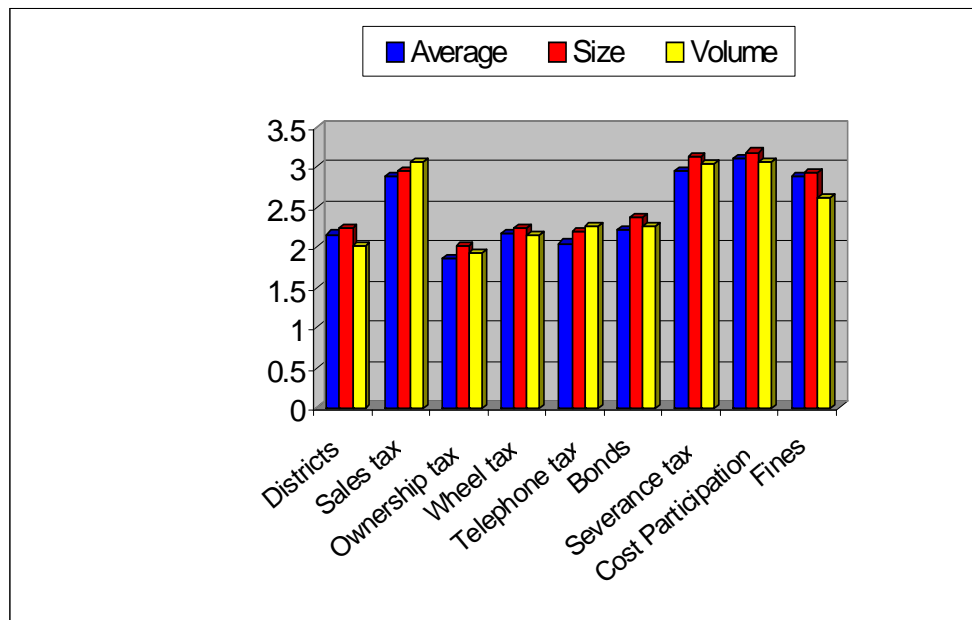


Figure 12. Averages and *Weighted Averages for Innovative Financing Method Responses
 *Weighted by farm size and total volume of grain moved to Enderlin from survey

Table 6. Innovative Financing Methods 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

SUMMARY AND CONCLUSIONS

Rural roads are important to agricultural 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 cooperation with two agricultural entities located in the Enderlin, North Dakota area, a survey was mailed out to 1900 producers. The statewide survey drew a 10 percent response rate with 193 completed surveys

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.

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 reference 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 is 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.

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