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16. Abstract

Over the past two decades, changes in transportation demand of agriculture and rural industry have interacted with the deregulation of the transportation sector. This has resulted in the abandonment both of the regulation of truck rates and competition, and of many rural rail links that were deemed inefficient. Agricultural industrialization and the move towards applying market principles to guide production decisions have had a profound impact on rural transportation infrastructure. Together with strategic rail decisions to terminate inefficient services, these changes have resulted in larger and heavier truck hauling agricultural products over longer distances on pavements and bridges that were not constructed to withstand these loads. Clearly there is a need to better understand the strategic challenges and issues as well as the critical role that transportation plays in promoting competitive agriculture and a vibrant rural economy. The objectives of this project were to (a) explore the rural agriculture/industry-transportation relationship, (b) provide information on major rural stakeholder, industry, and trucking views, (c) highlight the factors that result in greater demands on rural roads from the perspective of the Texas Department of Transportation, (d) present a methodology to prioritize rural transportation needs in transportation planning decisions, and (e) list a number of policy options to address rural transportation concerns.

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TRANSPORTATION CHALLENGES AND ISSUES FACING RURAL TEXAS: A METHODOLOGY TO PRIORITIZE RURAL TRANSPORTATION NEEDS

By

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Research Report SWUTC/07/473700-00068-1

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ABSTRACT

Over the past two decades, changes in transportation demand of agriculture and rural industry have interacted with the deregulation of the transportation sector. This has resulted in the abandonment both of the regulation of truck rates and competition, and of many rural rail links that were deemed inefficient. Agricultural industrialization and the move towards applying market principles to guide production decisions have had a profound impact on rural transportation infrastructure. Together with strategic rail decisions to terminate inefficient services, these changes have resulted in larger and heavier truck hauling agricultural products over longer distances on pavements and bridges that were not constructed to withstand these loads. Clearly there is a need to better understand the strategic challenges and issues as well as the critical role that transportation plays in promoting competitive agriculture and a vibrant rural economy. The objectives of this project were to (a) explore the rural agriculture/industry-transportation relationship, (b) provide information on major rural stakeholder, industry, and trucking views, (c) highlight the factors that result in greater demands on rural roads from the perspective of the Texas Department of Transportation, (d) present a methodology to prioritize rural transportation needs in transportation planning decisions, and (e) list a number of policy options to address rural transportation concerns.

EXECUTIVE SUMMARY

The provision of highways in the United States over the past seventy years can be viewed as a series of phases comprising the provision of all weather rural roads and state arterials, the interstate system, metropolitan freeways and more recently toll roads. This aggregates to form a substantial asset base which is widely regarded as currently under-funded. Texas has a substantial rural network which requires continuous maintenance and rehabilitation if it is to be kept in acceptable condition. This study addresses the strategic challenges and issues that highway transportation now faces in its role promoting a competitive agricultural sector and a vibrant rural economy.

The study objectives were to:

a) explore the rural agriculture/industry transportation relationship,
b) provide major rural stakeholder, industry, and trucking views,
c) highlight factors that place greater demands on rural roads from the perspective of the Texas Department of Transportation (TxDOT),
d) offer a methodology to prioritize rural transportation needs and finally,
e) list policy options that address rural transportation concerns.

The current rural network goes back to the work of paving the roads to rural communities and centers of economic activity in the 1930's. The weight limit on Texas highways, even as late as 1958, was 58,200 pounds and this was the design standard used for much of the rural transportation system now maintained by the various TxDOT Districts. In the 50 year period since these roads were first paved, the rural rail system changed dramatically and over 45 percent of the 1960 rail track was abandoned by the mid 1990's. Rural commodities - especially grains - that previously used the lower volume rail lines were transferred to trucks which placed heavier loads on the rural highway network. And the drive to economies of scale in most rural activities - grain elevators, stockyards, timber, minerals, oil-field equipment and industrialized farming equipment – all added heavier axle loads on the highway system. From the highway planning perspective, there are grave concerns that this will lead to a substantial deterioration in the condition of the rural network. There is still time to address these concerns since, despite the increased average annual daily truck-traffic volumes on rural Texas' highways, the 2003 PMIS data revealed that the overall condition of the farm-to-market (FM) system in Texas is generally good. Statewide, approximately 84 percent of the FM network was rated good to very good in terms of the distress score and 87 percent was rated good to very good in terms of the overall conditions score. In general, it can be seen that TxDOT District staff are maintaining the State's FM roadbed section miles effectively, even though certain Districts are more impacted by larger and heavier trucks traversing certain parts of the state network.

However, behind these ratings lie concerns about future maintenance and upgrading of the network in the wake of increased truck traffic and inadequate state highway funding. As users of rural infrastructure on a daily basis, rural truckers expressed a number of transportation concerns throughout rural communities. These include the width of rural roads, inadequate shoulders, the need for better maintenance and rehabilitation, and concerns about the impact of increased truck traffic on selected rural highways and specific towns.

TxDOT district staff indicated that priority is often given to high-volume projects when prioritizing maintenance and rehabilitation needs. Prioritization is thus likely to become even more important in the future as the disparity between available funding and rural needs

increase. Techniques to prioritize projects are introduced in the study and include a multi-attribute criteria framework as a possible alternative to current prioritization methods. But even improved prioritization does not alleviate the central problem with the rural system - the scale of the funding needs required to maintain and rehabilitate the extensive FM system in Texas. The state gas tax has not been raised since 1992 and the 2007 legislative session again failed to remedy the situation. In addition, innovative policy options developed by the TxDOT Commission have also been largely put on hold so the short fall between the funding needs for improving the arterial system and the rural system together with metropolitan needs are placing a burden that can not be adequately met from conventional funding. The report offers a number of options available to TxDOT to supplement limited budgets and address rural capacity needs. The authors believe that the Texas highway system, as currently structured and funded, is probably too large and its needs too great for the predict stream of revenues from traditional sources. A series of recommendations are made in the report and include:

a) Reducing the TxDOT rural network. The rural network should be carefully re-evaluated and possibly re-classified to focus scarce maintenance and rehabilitation funding on to the most heavily trafficked and crucially economic links of the current system. Some states, like North Dakota, have begun to re-classify their system using a hierarchy which allows direct funding into the higher ranked categories where funds are scarce. Alternatively this could be done in a more direct way by simply removing highways segments from the current system.

b) Improving rural traffic use data. Greater information needs to be collected on disaggregated demand and use of rural highways. This type of demand analysis should generate different types of data to sharpen and improve state planning, particularly where additional funding is concerned. This would allow economically efficient decisions to be made on a variety of highway segments, ranging from major corridors passing through the rural region carrying much of the regional trade to individual economic generators within the District. Highway links to the specific rural generators associated with employment and wealth generation deserve targeted support.

c) Recognizing changes in freight movements. Key state logistical supply chains should be designated and incorporated into preferential highway planning. The study recognizes that freight users develop routes based on the needs of their shippers and the commodities being moved. The designation of supply chains for key commodities should therefore assist statewide planning and the targeting of funds on those sections of highway passing through rural areas. Moreover, it will link those generators to different parts of the state and ensure that supply chains are not simply seen as portions of the interstate system, but as critical to the efficient movement of goods from origin and destination be it within a district, state region and even national highway network.

ACKNOWLEDGEMENTS

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1. Background

In 1936 Texas initiated a system of farm-to-market and ranch-to-market roads in an effort to provide Texas farmers and ranchers with access to a high-quality system of roads and bridges to move their products from farms and ranches to markets in cities. Although initiated in 1936, the system expanded only after the 1949 Texas Legislature dedicated $15 million annually from the Omnibus Clearance Fund for the construction of roads that did not have sufficient traffic to justify their construction and maintenance (Texas State Historical Association, Undated). This resulted in the creation of a large rural network linked by arterials acting as intercity connectors between the larger Texas cities. Although Texas's rural road system facilitated the low-cost movement of agricultural products to markets and enhanced the competitiveness of Texas farmers, it is important to recognize at the outset that traffic volumes did not motivate Texas's farm-to-market and ranch-to-market network.

The rural road network was largely established through improvements to then existing unpaved roads linking rural settlements - much of it in the form of moving from unpaved to all-weather designs. Today the farm-to-market and ranch-to-market roads are representing more than half of the centerline miles — 40,784 miles — of the state maintained system. Some of these roads have seen a dramatic increase in the volume of truck traffic as a result of agricultural industrialization, the increases in the physical sizes of agricultural equipment, House Bill 2060 that allows 84,000 lb vehicles (gross vehicle weight) to traverse roads posted for 58,240 lbs (gross vehicle weight), and the abandonment of approximately 2,400 miles of rail track in Texas. A central problem associated with this growth in truck volumes is that while the arterial systems (particularly the interstate elements) have been designed to carry increases in volumes and heavier axle loads, much of the rural system has not. Both on-and off-systems contain posted highways and posted bridges, which reflect the 58,200 lb load limit that is in line with the traffic characteristics of the 1940s and 1950s.

In addition, rural economies have also been impacted by demographic changes, which are characterized as a broad transfer of population from rural areas to a relatively small number of metropolitan areas. Information from the state demographer indicates that since 1990, around 100 counties have experienced a significant population loss and that this rate of loss has accelerated since 2000. Furthermore, the demographic data suggest that the Texas population will continue to grow over the next 20 years, will be diverse, younger, and metropolitan based (Murdock, 2005) – thereby further weakening the traditional role of rural counties in the state. Rural Texas thus faces a number of socio-demographic challenges:

- The rural young migrating to urban areas and the urban elderly migrating to rural areas resulting in an aging population. In 2000, more than 15 percent of the people in rural Texas were older than 65 years, compared to nine percent in urban areas.

- Texas's rural population is comparatively poorer than its urban counterparts. The rural population has substantially lower per capita incomes compared to the urban population: $20,887 versus $24,383 in 2000.

- Rural Texans generally have fewer years of education than urban Texans do. In 2000 13.6 percent of the population in rural Texas had a college degree, compared to 25.1 percent in urban counties.

- Rural Texans, in general, have less access to health services. The Office of Rural Community Affairs (2002) reported that 24 rural counties had no primary care physician, 64 rural counties had no hospital, 13 had no pharmacist, and 40 had no dentist.

- Finally, available housing is a major issue in rural Texas (Office of Rural Community Affairs, 2002).

Against this background, this report (a) describes the changing transportation demands of rural agriculture that have resulted in an increased reliance on trucking, (b) reports the findings of a mail survey of rural stakeholders, industry and trucking companies, (c) discuses the factors that impact the rural network from the perspective of the Texas Department of Transportation (TxDOT), (d) discusses the existing farm-to-market (FM) road system in Texas, (e) suggest a methodology to prioritize the funding needs of the FM system before, (f) concluding with a list of policy options that can be considered by TxDOT to address the FM system needs.

2. Rural Agricultural Transportation Relationship

2.1 Introduction

Data from the Bureau of Economic Analysis revealed that employment/economic opportunities in rural Texas are largely tied to four sectors: government, service, farming, and mining. "Government and Government Services" was the primary revenue-earning sector for 79 rural counties in 2000. That was followed by the service sector (45 counties), farming (30), and finally mining (22 counties). These four sectors were the major revenue earners in 176 of the 196 rural counties in Texas, representing almost 90 percent of the rural counties in Texas. Also, it was found that employment/economic opportunities in rural communities are largely area-specific, tied to a community's natural resources or comparative advantage. For example, farming is the primary revenue generator in Northern Texas and mining is one of the primary revenue earners in Western Texas.

Texas was divided into four geographic regions: Northern Texas, Southern Texas, Eastern Texas, and Western Texas (see Figure 1 for a map of the four regions). These four regions formed the basis for surveying rural stakeholders, industry, and trucking companies, and for interviewing TxDOT district offices.

Figure 1*: Geographic Regions*

In the subsequent reporting of the survey results (Chapter 3) and the factors that are impacting rural Texas (Chapter 4), the reader is referred to Figure 1 for geographical perspective. This chapter of the report discusses agricultural production by Texas region and highlights the sector's increased reliance on trucking.

2.2 Rural Agriculture in Texas

Texas is in many aspects an agricultural state:

- Texas has 227,000 farms — twice as many as any other state,
- farm land is Texas's principle land use — farm acreage comprises 78 percent of the total land area in Texas,
- Texas produce approximately seven percent of the total U.S. agricultural income ($13.8 billion in 2000),
- farming and farm-related jobs provide employment to about 15 percent of all Texans (Office of Rural Community Affairs, 2002),
- farming is the major income generator in 50 out of Texas's 196 rural counties, being one of the top three revenue generators in the county in 2000 (Bureau of Economic Analysis, 2000).

In Texas agriculture is the second largest industry, producing 16 percent of the state's gross product and contributing $80 billion to the Texas economy (Office of Rural Community Affairs, 2002). Historically, rail served the key transportation needs of rural agriculture. In recent years, however, changes in rural agriculture and in the transportation sector resulted in an increased use of rural trucking (as is evident from the survey results presented in Chapter 3). Initiatives that impact rural output thus potentially impact the demand for rural trucking.

Having said that, agricultural production is mostly concentrated in northern and eastern Texas. Approximately 70 percent of all agricultural output is produced in northern and eastern Texas. Southern Texas produces approximately 20 percent of the agricultural output, with western Texas contributing only about 7 percent of the estimated agricultural production of the state (personal communication with Carl Anderson, 2003). Figure 2 displays the value of agricultural production by region in 2002.

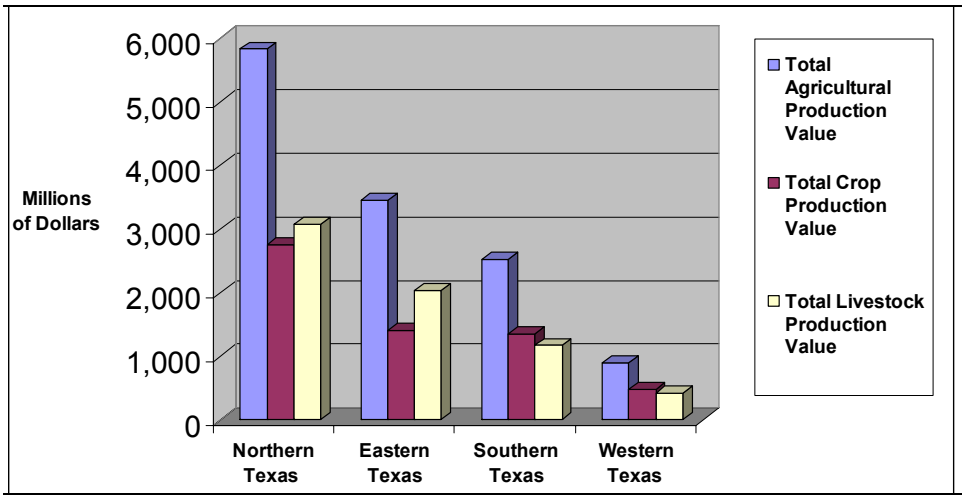


Figure 2: ***Estimated Value of Agricultural Production by Texas Region, 2002***

2.3 Northern Texas

In terms of the value of agricultural production, Northern Texas is a large producer of beef, specifically fed cattle (40 percent), cotton (18 percent), feed crops (14 percent), and food grains (5 percent). All fed cattle in northern Texas are transported by truck. Calves bred in other regions in Texas are transported by truck to feedlots in the Panhandle. Between 80 and 85 percent of the animals are bred outside the region. Summer stock (accounts for 40 percent of all stock) is purchased from March to May and then either transported to winter pasture or to area feedlots. Winter stock is purchased between September and October, comes off pasture in March/May, and is shipped to area feedlots (personal communication with Amosson, June 2003). Once fed and ready for the market, the animals are transported by truck to nearby slaughter houses and packing plants. From there, the prepared meat is transported by refrigerated trucks to points of demand in the state, out-of-state, and to ports for export (personal communication with Stephen Fuller, June 2003).

Cotton is the second most important commodity produced in the region in terms of the value of agricultural production. Most of the cotton from this region is produced in the South Plains close to Lubbock. Approximately 30 percent of the cotton produced in this region is destined for U.S. mills (personal communication with Smith, June 2003). The transportation of the cotton from field to gin, and then from gin to manufacture facility, is seasonal. Cotton is harvested in late summer, and the transporting of cotton to the gin occurs in the months of October, November, and December by truck. Typically, four acres of irrigated land can produce 10 bales of cotton (approximately 10 tons including both the lint and seed), which is hauled predominantly by a single truck within 20 to 30 miles to a gin. From the gin to the warehouse, the cotton bales are again moved by truck over relatively short distances. Approximately 40 percent of the cotton produced in Texas is destined for Mexico. Most of these shipments are moved by truck. Rail is not considered to be convenient, partly because of chronic rail car shortages during the harvesting season. However, cotton shipments with out-of-state destinations, for example to California, are moved by rail (personal communication with Carl Anderson, June 2003). Since northern Texas has experienced the greatest rail abandonment in the state, most suppliers of cotton do not have the option of using rail anymore.

The largely cultivated and irrigated Texas Panhandle facilitates the growing of corn, wheat, and grain sorghum for use as feed for the cattle raised in the Panhandle. According to Stephen Fuller (personal communication, June 2003), crop agriculture is best served by trucking during assembly, which requires a good arterial transportation network to move the crops to county elevators within approximately 100 miles of the production location. From September to December the crops harvested in the area satisfy the feed demand of area feed lots, but in general more cattle are fed in northern Texas than grain produced. Grain is thus transported by long-distance shuttle trains from out-of-state origins, such as Nebraska, eastern Kansas, and western Iowa into the region (personal communication with Stephen Fuller, June 2003). Trucks are used to distribute the grain to the feedlots over relatively short distances — approximately 100 miles.

Wheat produced in the region is normally trucked to county elevators from which point shipments are moved in unit trains over longer distances to destinations such as California (personal communication with Stephen Fuller, June 2003). Grain flow data show large quantities of rail-transported grain are received in Texas for export via Texas Gulf of Mexico ports — Houston and Corpus Christi — and overland border crossings into Mexico, as well as for consumption by Texas livestock, poultry, and diary populations. Overall, however, the role of rail in the transportation of grain is diminishing (personal communication with Carl Anderson, June 2003).

2.4 Eastern Texas

In terms of the value of agricultural production, timber (26 percent), poultry (25 percent), and the beef industry (19 percent) are important to the eastern Texas economy. In 1999 the Texas forest sector contributed $12.9 billion to the state's economy in industry outputs (Office of Rural Community Affairs, 2002). Timber production is cyclical. When most of the foliage has been cleared, the area will be left unattended until the newly planted seeds regrow (personal communication with Carl Anderson, June 2003). Most of the timber in eastern Texas is transported by truck.

Eastern Texas also has a large number of industrialized farms producing cattle (cow and calf operations), hogs, and poultry. Grain is railed into the region from Illinois to feed the poultry. Broiler farmers in this region normally contract with a central processing plant, such as the "Pilgrim's Pride" company, to cut up and process the chicken. Pilgrim's Pride is located near Beaumont and is becoming the leading supplier of broilers in Texas. From these processing plants, the chicken legs and backs are exported to Mexico and Russia. Texas is the third largest broiler producing state in the U.S. (personal communication with Stephen Fuller, June 2003).

2.5 Southern Texas

While beef and poultry are relatively significant commodities produced in southern Texas, the region is better known for its production of fruits and vegetables. This is largely because this is the only region in the state where fruits and vegetables are produced. The transportation of fruits and vegetables requires an extensive transportation system. Citrus, onions, melons, and other vegetables are shipped from southern Texas mainly by truck. The citrus transported out of state is sold in urban markets in California and the Midwest. Southern Texas vegetables are sold in major U.S. urban markets (via retail grocery companies and food service companies). Most of this produce is transported long distances to out-of-state destinations by truck, because of its perishable nature (personal communication with Robinson, June 2003).

2.6 Western Texas

Western Texas is a relatively minor contributor of agricultural produce in terms of the estimated value of agricultural production in Texas. Beef accounts for 17 percent, cotton for 23 percent, vegetables for 26 percent, and milk for 12 percent of the value of agricultural production in the region. Most of the beef production involves cow and calf operations with the purpose of raising one calf per cow a year. These calves are eventually transported to northern Texas to be fed. During the winter months and in times of drought, when hay produced in the area is inadequate, there is a need to move hay into the area (in some instances from out of state) (personal communication with Stephen Fuller, June 2003). Cow and calf operations are usually moved in pickup trucks and gooseneck trailers (personal communication with Carl Anderson, June 2003). The demands on the infrastructure in terms of agricultural truck shipments are thus perceived to be relatively modest in this region (personal communication with Stephen Fuller, June 2003).

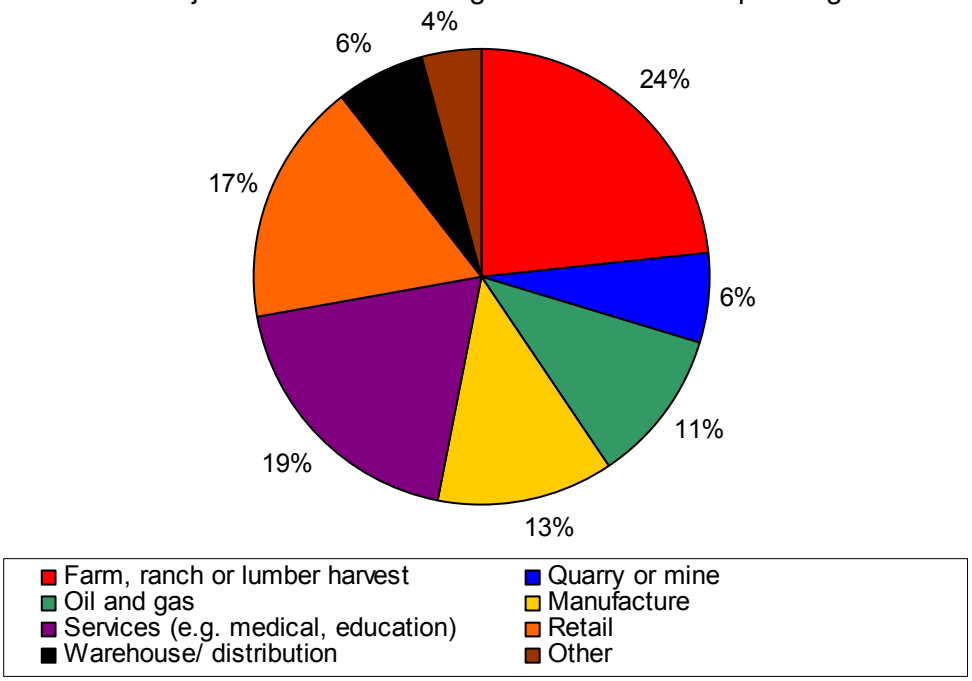
3. Rural Stakeholders, Industry, and Trucking Perspective

3.1 Introduction

During this research, surveys were undertaken of rural stakeholders, industry, and trucking companies, to identify major rural truck traffic generators, to collect data on commodities transported, trip patterns, and to determine whether rural transportation is regarded a concern in rural communities. This Chapter of the report summarizes the major findings of these surveys.

3.2 Rural Stakeholder Perspectives

The rural stakeholder survey was sent to 56 rural Chambers of Commerce. Of these 14 rural Chambers of Commerce (25 percent) completed and returned the survey. Rural stakeholders were asked to identify the major sectors that generate income/economic activity in their county. As can be seen from Figure 3.1, farming, ranching or lumber harvesting (24 percent), services, for example medical and education (19 percent), and retail (17 percent) were identified as the three major income/economic generators in the responding counties.



Other includes tourism and a power plant.
Number of responses = 47

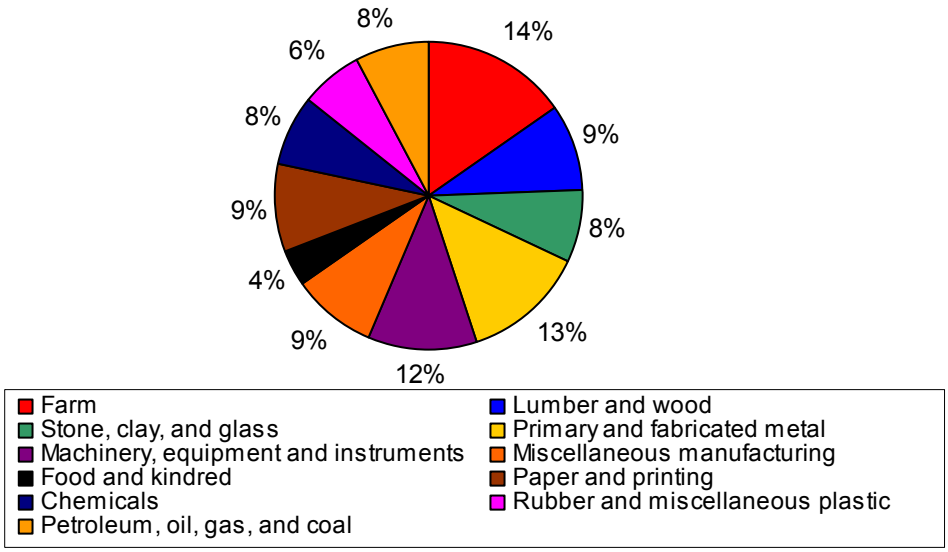
Figure 3.1: ***Major Income/Economic Generators***

Rural stakeholders were also asked whether rural transportation is a major issue or concern in their community. More than 90 percent of the respondents indicated that rural transportation is a major issue or concern. A myriad transportation concerns were expressed, ranging from the county having inadequate infrastructure to support for shipping by rail to the general condition and deterioration of county roads.

3.3 Rural Shipper Perspectives

Fifty-two rural shippers from 42 rural counties completed and returned the rural shipper questionnaire. The majority of the respondents were small shippers with 47 percent having a workforce of five or less, including the owner. Only six percent of the respondents employed more than 50 people. The largest rural shipper that participated in the survey employed 250 people.

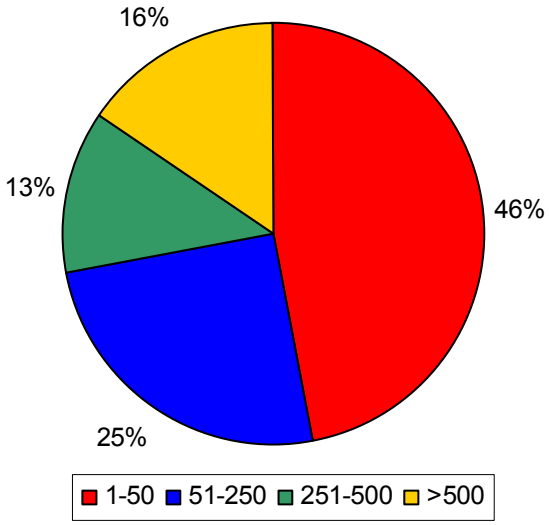
The respondents were asked to indicate the major commodities that were delivered to the shipper in a representative year. These are illustrated in Figure 3.2. As can be seen from this figure, rural agriculture and industry receives a variety of products in a representative year.



Number of Reponses = 78

Figure 3.2: ***Incoming Commodities***

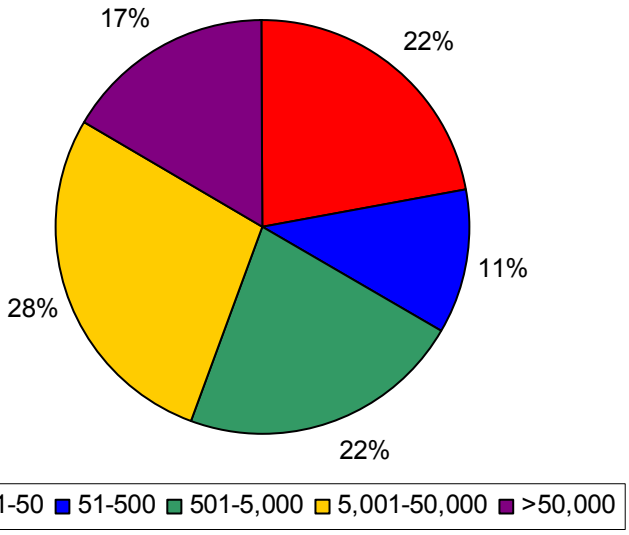
The respondents were asked to indicate how many loads (or tonnage) are received in a representative year. Almost half of the respondents (46 percent) that answered this question in terms of loads received indicated that they receive typically less than one load per week. Another 25 percent of the respondents receive approximately 51 to 250 loads per year. Only 16 percent of the respondents (five) received more than 500 loads per year – thus more than two loads per week day (see Figure 3.3).



Number of Respondents = 32

Figure 3.3: ***Number of Loads Delivered/Year***

In terms of tonnage, the responses varied considerably (See Figure 3.4). On the one extreme, 22 percent of the respondents received less than 50 tons per year, while on the other 17 percent of the respondents received more than 50,000 tons per year.

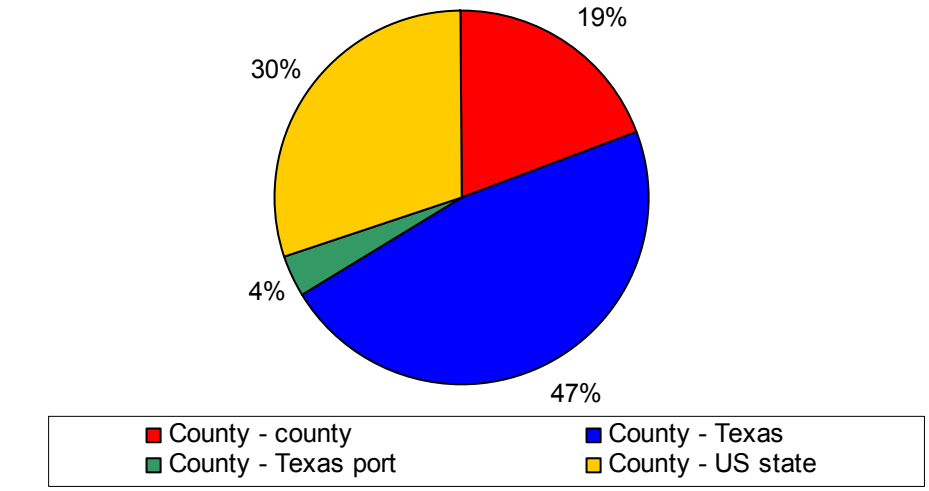


Number of Respondents = 18

Figure 3.4: ***Tonnage Delivered/Year***

The major origin-destination pairs for the incoming shipments reported by the respondents are illustrated in Figure 3.5. As can be seen, 19 percent of the shipments involve an intra-county movement, 47 percent involves a movement between the county the shipper resides in and another county in Texas (not considering a Texas port), and 30 percent involves a movement between the county the shipper resides in and another U.S. state. Only 4 percent

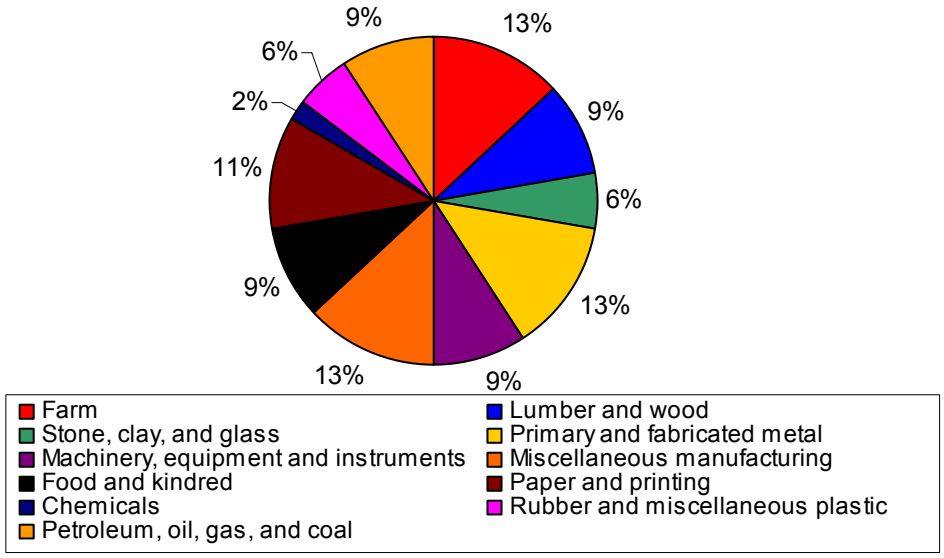
of the shipments involve a movement between the county the shipper resides in and a Texas port.



Number of Responses = 32

Figure 3.5: ***Incoming Shipments: Major Origin-Destination Pairs***

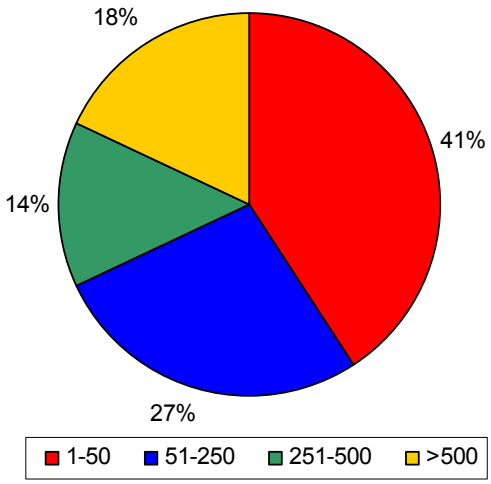
The respondents were also asked to indicate the major commodities that were shipped in a representative year (see Figure 3.6). As is the case with the incoming shipments, rural businesses ship a variety of commodities. The three major commodities reported were farm products, primary and fabricated metal products, and miscellaneous manufacturing products, together representing almost 40 percent of the responses.



Number of Responses = 54

Figure 3.6: ***Outgoing Commodities***

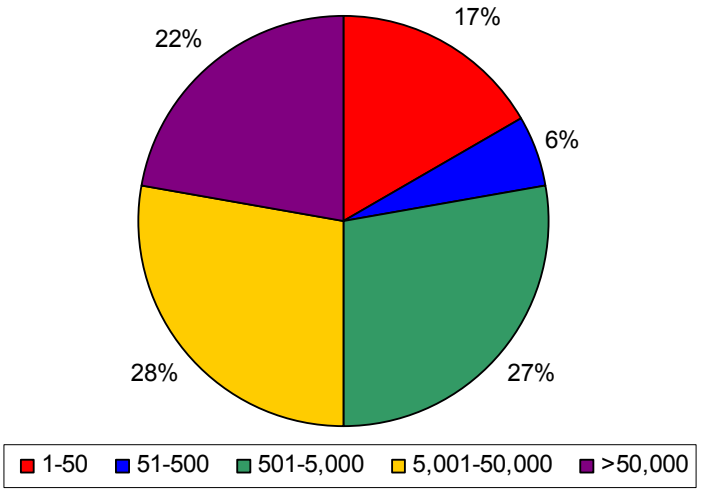
The respondents were also asked for outgoing shipments to indicate how many loads (or tonnage) were shipped in a representative year. As can be seen from Figure 3.7, 41 percent of the respondents that answered this question in terms of the number of loads shipped, indicated that they typically ship less than one load per week. Another 27 percent of the respondents ship approximately 51 to 250 loads per year. Only 18 percent (four) of the respondents ship more than 500 loads per year – thus about two loads per week day.



Number of Respondents = 22

Figure 3.7: ***Number of Loads Shipped/Year***

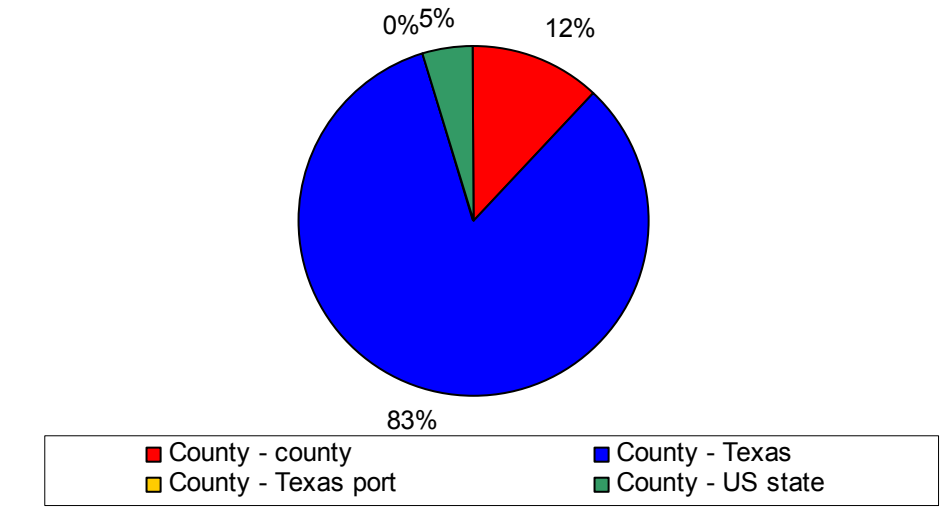
In terms of tonnage, the responses varied considerably (See Figure 3.8). On the one extreme, 17 percent of the respondents that answered this question in terms of tonnage, shipped less than 50 tons per year. On the other hand, 22 percent of the respondents shipped more than 50,000 tons per year.



Number of Respondents = 18

Figure 3.8: ***Tonnage Shipped/Year***

Finally, the survey data collected revealed that rural shippers have come to rely on trucks for both incoming shipments and the shipment of their commodities. Ninety four percent of the rural respondents indicated that 100 percent of their outgoing shipments (tonnage or loads) are moved by truck. Only three respondents indicated that less than 100 percent of their shipments are shipped by truck. These respondents use rail to deliver 10, 15, and 50 percent of their outgoing shipments, respectively. The major origin-destination pairs for the outgoing shipments reported by the respondents are illustrated in Figure 3.9. As can be seen, 12 percent of the shipments involve an intra-county movement, 83 percent involves a movement between the county the shipper resides in and another county in Texas (not considering a Texas port), and 5 percent involves a movement between the county the shipper resides in and another U.S. state.

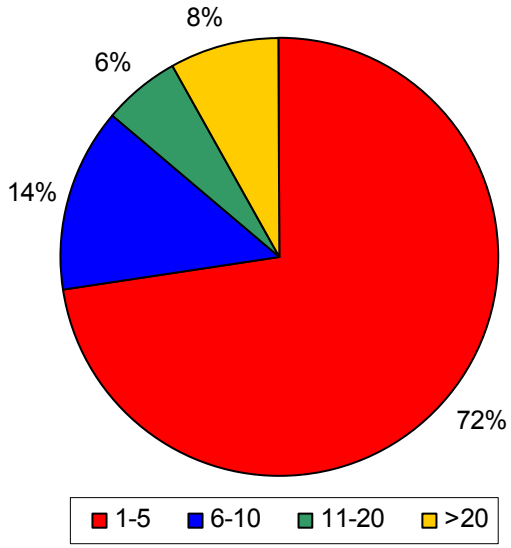


Number of Responses = 22

Figure 3.9: ***Outgoing Shipments: Major Origin-Destination Pairs***

3.4 Rural Trucking Perspectives

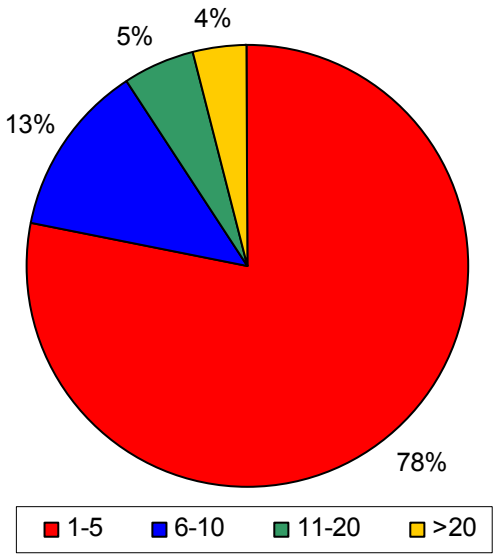
Hundred and fifty-two valid trucking responses were received. The respondents were asked to record the size of their operation by indicating the number of single unit trucks, number of truck tractors, number of trailers, or the number of drivers employed. As is evident from Figure 3.10, 72 percent of the respondents owned between one and five single unit trucks. Only eight percent of the respondents owned more than 20 single unit trucks, with the largest trucking company owning 190 single unit trucks.



Number of Respondents = 87

Figure 3.10: ***Number of Single Unit Trucks***

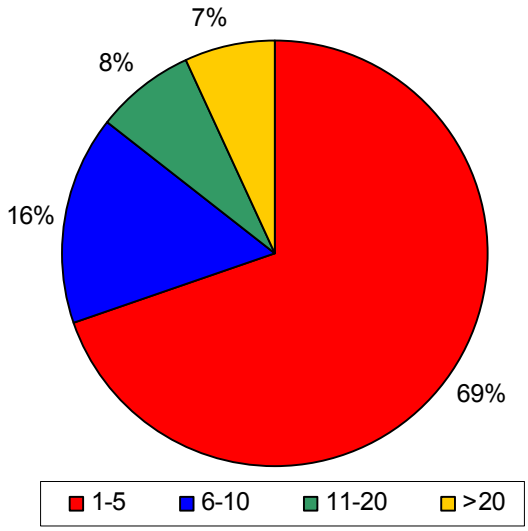
More than 90 percent of the rural trucking companies that responded owned 10 or less truck tractors. Only four percent (five respondents) owned more than 20 truck tractors. The largest owner operated 50 truck tractors (see Figure 3.11).



Number of Respondents = 132

Figure 3.11: ***Number of Truck Tractors***

Also, almost 85 percent of the respondents owned 10 or less trailers. Only seven percent (nine respondents) owned more than 20 trailers and the largest owner had 100 trailers (see Figure 3.12).



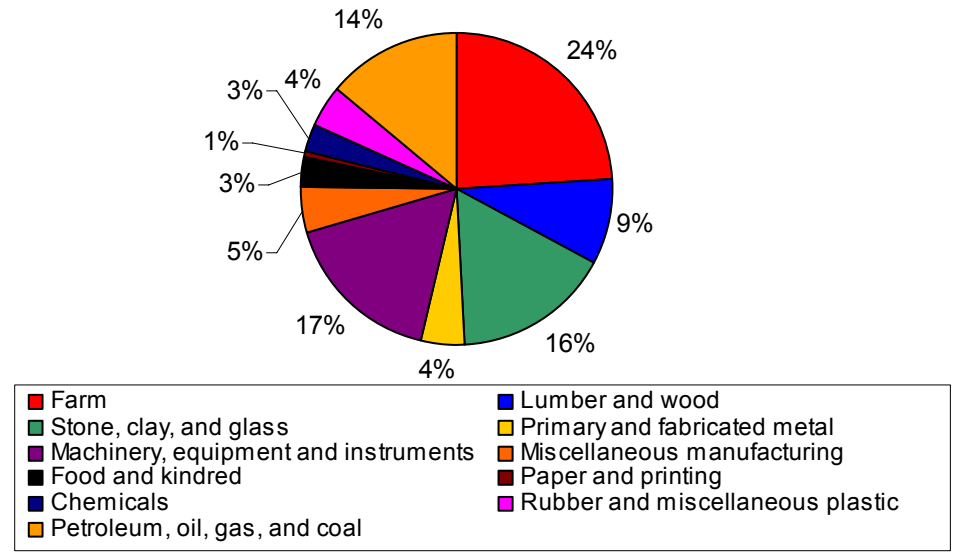
Number of Respondents = 132

Figure 3.12: ***Number of Trailers***

Seventy two percent of the respondents employed five or less drivers, including four cases where the owner also drives the trucks. Less than 20 percent of the respondents employed more than 10 drivers. Most of the respondents to the trucking questionnaire were thus smaller sized companies.

Rural trucking respondents were asked to list the three major commodities transported in a representative year, as well as the tonnage or number of loads transported. The responses are illustrated in Figure 3.13.

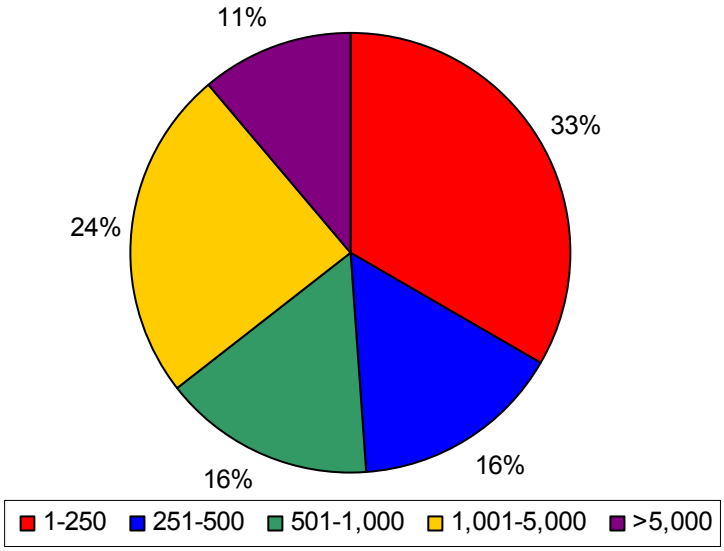
As can be seen from Figure 3.13, the three major commodities reported were farm products (24 percent), machinery, equipment, and instruments (17 percent), and stone, clay, and glass products (16 percent). In addition, miscellaneous manufacturing (14 percent) was reported to be a major commodity transported by rural trucking. These four commodity groups represented more than 70 percent of the total responses.



Number of Reponses = 323

Figure 3.13: ***Major Commodities Transported***

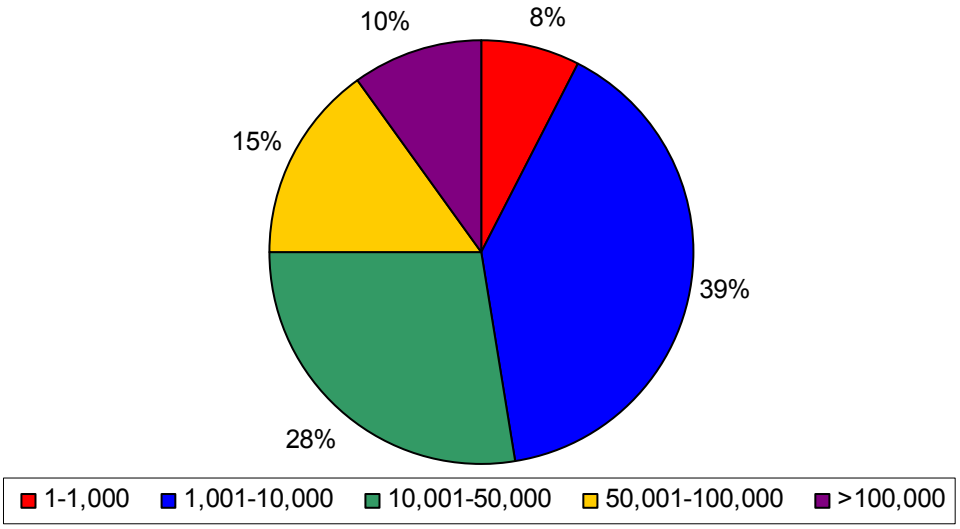
The rural trucking respondents were asked to indicate how many loads (or tonnage) these commodities represent in a typical year. In terms of the respondents who reported the number of loads transported in a representative year, one-third indicated that they move on average less than five loads per week. Another third moves between 251 and 1,000 loads per year – thus five to 20 loads per week. Eleven percent of the respondents indicated that they move more than 5,000 loads per year. The maximum value reported was 50,000 loads per year (see Figure 3.14).



Number of Respondents = 45

Figure 3:14: ***Number of Loads Moved/ Year***

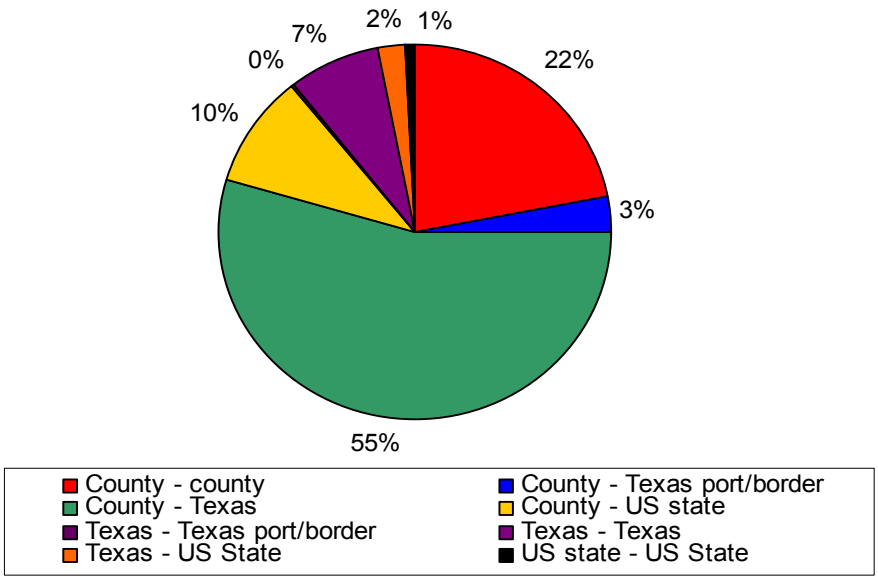
In terms of the respondents who answered the question in terms of tonnage transported, it was found that 8 percent of the respondents moved less than 1,000 tons per year – less than 20 tons per week. Most of the rural carriers (40 percent), however, move between 1,001 tons and 10,000 tons per year. In addition, 25 percent move more than 50,000 tons per year. The maximum value recorded by a trucking company was 1.3 million tons per year (see Figure 3.15).



Number of Respondents = 40

Figure 3.15: ***Tonnage Moved/Year***

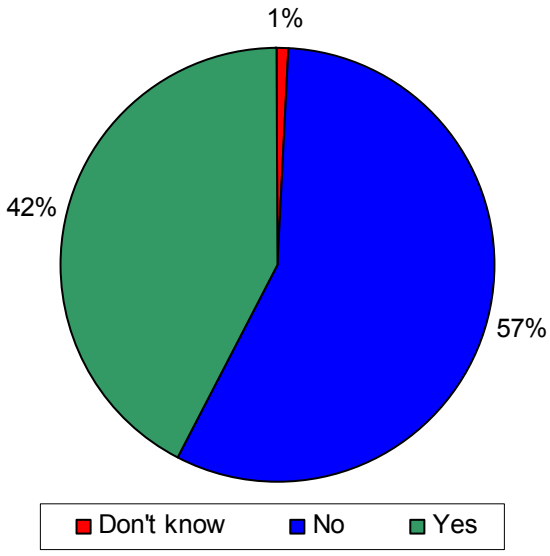
The majority of the trips reported by rural trucking companies for the three major commodities transported are between the county the company resides in and another county in Texas (55 percent of the trips). Twenty two percent of the trips are intra-county, 10 percent are between the county the business resides in and another U.S. state, and finally seven percent are between two counties in Texas that differ from the county in which the trucking company resides in (see Figure 3.16).



Number of Responses = 228

Figure 3.16: ***Major Origin/Destinations Pairs***

Finally, respondents were asked if rural transportation – both road and rail – present a major concern or issue in the rural counties served by the truck respondent. As can be seen from Figure 3.17, 57 percent of the respondents said that rural transportation does not present a major concern or issue in rural counties served. On the other side, forty two percent of the respondents indicated that transportation represents a major concern. Some of the concerns raised in the space allowed on the questionnaire are summarized in the Text box.



Number of Responses = 132

Figure 3.17: ***Rural Road/Rail Transportation Concerns***

Transportation Concerns in Rural Counties:
Comments Received from Rural Trucking Respondents

"… The county roads are not paved, nor do they have good caliche on them. Most are only one lane wide and the bridges are weak, and in deplorable shape. The roads in Karnes county are in deplorable shape. Farm-to-market road 792 is so narrow that 2 semi trucks can't pass each other without one of trucks dropping off the pavement. The posted speed limit is 70 mph, which is far too fast for the condition of the road."

"Almost without exception, where feed lots and dairies have come into our vicinity, the local roads are much to narrow to accommodate the increased truck traffic, which makes them unsafe. As trucks have to pull off the shoulder when meeting other trucks, the edges of the paving stay in a deteriorating condition, and dangerous potholes are created in wet weather... along the edges of the paving. These farm-to-market roads were not meant to carry the large volume of truck traffic that they now have. The narrow FM roads are not adequate or safe, due to greatly increased truck traffic on them."

"Roads are a major issue. Distances to markets are long. Few residents are scattered over large area. All of Real County has 2,500 residents. People live from transporting heavy commodities, such as livestock, cedar posts, cedar logs, building materials, food supplies, cedar wood oil, and cedar fiber!"

"The rural towns in own area are not set up to handle the longer loads and rigs today at intersections. The highways are fine."

"Rail transportation is much more cost effective and saves our rural road from deterioration and truck traffic."

"Our only complaint is that there tend to be no shoulders on these roads and the signs are often placed too closely to the roadway rather than further back on the right of way …"

"It is a major concern to us as we use the roads every day. Quality of all roads in our area is on the decline. The only improvements we see are seal coating with large rocks to break our windshields. FM roads would be rated at very poor to downright dangerous-rough and rutted. US 60 is mostly adequate with one stretch (from 3 miles east of Glazier to Glazier being dangerous with such deep ruts that hydroplaning in wet weather is a reality and moving in and out of the ruts is dangerous)"

"Most of the roads in my area are lower quality now, than I have ever seen them. The rural roads in my area are in need of repair."

"For the development of our area and business, we must have an excellent road system. Hwy 359 runs through our trade area and needs to be a divided highway for NAFTA. Our FM road system floods often- we need drainage to clean ditches. Please help us!"

"We use a lot of county and rural roads and most of them are not in very good shape. This causes a lot of wear and tear on our trucks and trailers."

"They are redoing Hwy 96. But the part we have to drive on has potholes. Bumps. Very poor condition. No one seems to care. Will not patch holes or fix bumps? Please come see. Just take a ride up or down Hwy 96. Then you will know why I am so damn mad."

3.5 Concluding Remarks

Although it is obvious that the survey results are biased towards smaller truck traffic generators and trucking companies, the results do provide useful insights into what constitutes the major rural truck traffic generators, commodities transported, trip patterns, and rural rail and road transportation concerns. As the users of rural infrastructure on a daily basis, rural truckers expressed a number of transportation concerns in rural communities. These points to concerns about the width of rural roads, inadequate shoulders, a need for better maintenance and rehabilitation – especially with regards to county and FM roads -, and concerns about the impact of increased truck traffic on rural roads and towns.

4. Texas Department of Transportation Perspective

4.1 Introduction

This chapter covers the impact of trucks on the rural network in Texas from the TxDOT district perspective. The majority of the District interviews were conducted by making a personal trip to the District offices where face-to-face interviews allowed for a detailed discussion of the factors that impact Texas's rural road system. The rest of the interviews were conducted through personal interviews either with district staff away from the district or by telephone. The TxDOT districts surveyed in each geographic area are given in Table 4.1. Researchers contacted the District Engineer or District Senior Planner and, where possible, set up a meeting with both the senior planner and any other TxDOT personnel the senior planner deemed pertinent to the discussion. The objective of this chapter is to highlight the factors pertaining to rural agriculture and industry that have resulted in increased rural truck volumes in Texas as perceived by those TxDOT districts interviewed.

Table 4.1 TxDOT Districts Surveyed

Region	TxDOT District
North	Abilene Amarillo Childress Lubbock Wichita Falls
East	Tyler Atlanta Paris Beaumont
South	San Antonio Laredo
West	El Paso Odessa

4.2 Distribution Centers

The location of large distribution centers is an issue now faced by the majority of districts as a consequence of changes in the way goods are distributed prior to sale. Led by large retailers, such as Wal-Mart, products are funneled through large load centers or distribution points prior to final sale. Retailing has been "super-sized" since the mid 1980s with distribution centers exceeding 250,000 square feet in area now being used to channel products into the retail stores. Goods are "cross-docked" - a process that entails rapidly unloading a semi-trailer at one side of the building, stacking, sorting and setting up a scheduled delivery to a specific store from the products in the center of the facility for loading the semi-trailer from a bay on the other side of the facility. The turnover of full and empty trailers creates a large number of daily trips which in turn causes accelerated deterioration of pavements, and creates new traffic signal and safety issues associated with the increased truck volumes. The number of distribution centers in rural areas is increasing rapidly. Since these centers hold the potential of increased

employment opportunities and an increased tax base for the rural counties, they exhibit substantial negotiating power and often demand certain road improvements to a site under consideration. This places district staff in a difficult position because, while they should support the efforts of local Chambers of Commerce and those promoting new economic activity, funding these unforeseen needs can be problematic. In the past, TxDOT district staff had to transfer scarce district funds to improve links to such sites, which are substantial truck traffic generators in these counties.

4.3 Agricultural Equipment and Goods

Transportation planners in rural districts face several problems caused by the new, larger, agricultural equipment now being introduced in Texas. Often the width of this new agricultural equipment results in stress on the edge of pavement surfaces and causes damage. In addition, turning movements create a variety of edge stresses and pavement loads that causes damage which needs to be corrected quickly before further, more significant, damage occurs. Farm implements can also cut the surface.

Agricultural goods moved along the FM roads can also create loads in excess of the pavement design loads. As an example, receivers of agricultural goods are sometimes willing to accept up to 100,000 lbs of product even though truck weight limits are 80,000 lbs, unless the trucker has a 2060 permit which raises the figure to 84,000 lbs. Shippers see the overloads as a means of increasing their profit by decreasing the number of trips to the receiver. During the harvest season, there simply are not enough license and weight personnel to police all the roads and sometimes enforcement is weak because of the misguided view that the local economy may be hurt if weight limits are strictly enforced. These types of overloads allegedly create significant damage to the FM pavements.

Also, by legislation, instruments of husbandry are exempt from certain weight restrictions. Oversized loadings from harvester equipment and other agricultural implements thus overstress the FM pavements. As an example, anhydrous ammonia used in farming can be delivered by a truck well within the legal weight limits of the truck, but when loaded onto farm equipment which operates near or on a pavement edge pavement failures result that district programs have to fund and remedy. These oversized loads are also detrimental to bridges in rural areas.

Finally, statistics compiled by Gleaton and Anderson (2003) show that farmers are starting to lease or jointly own large and expensive pieces of farm equipment, or else outsource these services to custom operators. Given this trend and the fact that the size of this farming equipment has been increasing (from 2-row tractors in the 1940s to 18-to-24-row tractors, currently), the potential impact on rural road infrastructure is a concern in northern Texas (personal communication with Carl Anderson, June 2003). Heavy farm equipment operating on the edge of the roads can cause significant damage to the edges of rural pavements. Oversized harvesting equipment and other implements increase the load on rural pavements, especially the FM road system, reducing the life of these pavements.

4.4 New Industrialized Agriculture

Since the 1950s U.S. agriculture has started to apply industrial principles to agricultural production, but it has only been during the past 20 years, when farmers were able to control diseases in large animal production operations, that industrialization started to dramatically

change the sector. Increased agricultural industrialization in rural Texas is evident from the following:

- Approximately three percent of farm operations (7,000 farms) have sales in excess of $250,000. These farm operations account for 30 percent of the farm land in Texas.
- In 1997 8.6 percent of Texas farms accounted for 86.7 percent of total farm sales in Texas (Gleaton and Anderson, 2003).

These statistics highlight the fact that agricultural industrialization resulted in farm consolidations in Texas. In addition, industrialization required the move away from diversified (multi-product) farms to specialized (single-product) farms. This has resulted in fewer but larger farms and the need to move products between specialized operations.

4.5 Rail Initiatives

The Staggers Act of 1980 resulted in the deregulation of the railroad industry, which allowed greater railroad pricing flexibility, expedited abandonment procedures, and accelerated railroad mergers. Railroads were thus allowed to abandon unprofitable rural rail links. The state of Texas lost approximately 2,400 miles of rail track between 1981 and 1998 (Texas Department of Transportation, 2003). Given the miles of abandoned rail lines in northern Texas, the potential for large Class I railroads to serve rural agricultural shippers have been substantially reduced.

On the other hand, the Staggers Act brought about railroad investments in plants and equipment that were innovative and more productive. In the late 1990s the industry invested in high-strength rail corridors, new locomotives, and more productive cars, and adopted a business philosophy that promoted unit and shuttle trains — loaded rapidly at major terminals and moved efficiently between points in the system — in an effort to reduce their costs. For example, the large Class I railroads have moved to the hub or “load center” approach to transport grain. Load centers act like the hub of a wheel, with the spokes being the links to smaller grain silos that once may have been served by rail. Such silos – with a capacity under 1 million bushels - can only generate single numbers of carloads whereas the load centers generate 100 car unit trains, substantially reducing costs to the shipper. The 2001 Texas Grain Transportation Study (Fuller, et al, 2001) drew attention to the impact of grain load centering, which when linked to unit train operations can reduce shipping costs by as much as 50 percent per mile/bushel. Larger agricultural shippers thus stand to benefit. But for those not on a rail network (or unable to put together high carload numbers to link with unit train schedules), rail service has become a major issue (Prozzi, Harrison, and Prozzi, 2003). It also should be noted that Texas rural highways are critical for grain haulage – in part due to the concentration of rail operations at load centers – and that the average truck trip for grain was over 200 miles, much higher than in other grain states like Kansas. Finally, Brennan (1998) speculates that Class I railroads will experience capacity limitations on many of their segments in the following decade. Already the use of rail by the agricultural sector in Texas is limited due to a shortage of rail equipment during the harvest season. Capacity constraints can thus have significant implications for larger agricultural users in the form of higher rates, poorer service, or both. This will result in an even larger number of bulk commodities being moved on rural roads (Brennan, 1998).

4.6 Other Factors/Concerns

4.6.1 Trucks Taking Alternative, Less Appropriate Routes

Trucks regularly divert onto Farm-to-Market (FM) and even county roads as an alternative to highways designed to carry truck traffic. The reasons include winter weather, delays, and avoiding specific weigh station locations when they are open. In some areas, farmers stated that they can tell the days when a weigh station is open by the increase in truck traffic on the FM roads. As the rural network continues to age, this may become a serious problem as pavement sections and bridges are posted for axle and gross loads.

4.6.2 Tire Issues

A significant problem is the use of Super singles" - radial tires that have a cross section less than that of the dual tires and which are designed to replace dual rear tires on both trucks and semi-trailers. "Super singles" reduce fuel consumption – perhaps by as much as 3 percent – but they increase pavement stress, which would be particularly noticeable on lower designed rural sections of the network. "super singles" have been fitted on agricultural semi-trailers, which could result in increased maintenance costs on key agricultural corridors in the future.

4.6.3 Entrance/Exit Lanes and Speed Differences

Two-lane roads in rural districts routinely experience a mix of truck traffic, agricultural equipment, tourists towing large campers (often with vehicles that are underpowered for towing), and passenger cars. This mixture of vehicle types can present a problem as drivers become frustrated when trying to pass slower vehicles and drive more aggressively. Differential speed limits between automobiles and trucks also present a problem in some rural areas. The daytime speed limit for automobiles, for example, in some cases is 75 mph and the daytime speed limit for trucks is 70 mph. The acceleration or deceleration of large trucks as they exit or enter cattle feed lots present another rural transportation challenge in some districts. In some instances, trucks queuing to turn can significantly back traffic on the traffic lanes. The "super two" concept incorporates turning lanes into centers of production/consumption to permit trucks to gain safe entry and exit speeds.

4.7 Concluding Remarks

Rural Texas is undergoing both social and economic changes. In one respect, this is merely the culmination of many years of change, particularly in agricultural practices which have led to larger production units and a greater reliance on capital intensive, rather than labor intensive, practices so lowering employment needs. Linked to this is the reduction in rail penetration of rural markets—manifested in the abandonment of low-demand rural rail links—and the greater role of the more flexible and competitive trucking market. The consequences of the move to trucks are now well known to every TxDOT district planner and maintenance staff. Table 4.2 provides a detailed breakdown of the rural concerns listed by the TxDOT districts interviewed.

Trucks are currently dominating the movement of agricultural shipments in Texas — particularly if these shipments have both an origin and destination in the state. By legislative

mandate, higher axle loads are permissible for certain commodities, of which agricultural produce is an example. It is thus unsurprising that the movement of agricultural goods and equipment was ranked first in terms of rural concerns by 10 TxDOT districts interviewed. Texas, like other agricultural producing states, will continue to evolve its agricultural production patterns which means the industry will always be near the top of any list of rural transportation concerns.

Table 4.2 Rural Transportation Issues for Districts Surveyed

Issue	Abilene	Amarillo	Childress	El Paso	Lubbock	Wichita Falls	Tyler	Atlanta	Paris	San Antonio	Laredo	Odessa	Beaumont
Distribution Centers		•		•	•	•	•			•	•	•	•
Agricultural Equipment and Goods	•	•	•	•	•	•	•	•	•				•
New Industrialized Agriculture			•	•	•	•							
Rail Initiatives	•			•						•	•		•
Other Factors													
Truck taking alternative, less appropriate routes		•	•		•	•	•	•	•			•	
Tire Issues	•	•	•		•	•	•		•			•	•
Entrance/Exit Lanes and Speed Differences		•	•	•	•	•				•			•

The next ranked issue contains one of the most interesting, and for TxDOT worrying, developments - namely the growth of “big box” distribution centers. The element of concern is created because TxDOT is often excluded from the process of negotiation until towards the end of the deal making, and this results in district planning staff having to struggle to fit the increased truck numbers, pavement condition and geometry needs, together with safety and signaling issues, into a planning process already inadequately funded. Finally, there are a series of issues related to rail initiatives, trucking operations, tires, and speed differentials

To conclude, this chapter highlighted a number of factors that have resulted in increased rural truck volumes in Texas. The next chapter provides an overview of the pavement condition in rural Texas, documents how rural infrastructure needs are prioritized and funded, and suggest a methodology to help TxDOT prioritize future rural infrastructure needs.

5. Prioritization to Address Rural Road Issues

5.1 Introduction

The Texas state-maintained rural road network consists of FM roads, state highways, U.S. Highways, and interstate highways. Funding for projects falls into one of four categories of treatments: preventative maintenance, light rehabilitation, medium rehabilitation, and heavy rehabilitation. In each funding category formulas considering a number of factors are used to determine a district's needs. Maintenance and rehabilitation funding allocations among TxDOT districts are thus made centrally and are based on formulas[1] that consider such variables as regional rainfall, pavement condition scores (failures and ride quality), number of lane miles, average daily traffic, daily truck vehicle miles, and a myriad others. After funding allocations for maintenance projects are made from the state to each individual district, each district decides on what projects will be undertaken.

The FM system thus competes with the demands of the rest of the system as Districts are responsible for balancing rural and metropolitan needs and for balancing maintenance funding by highway type (personal communication with Richard Kirby, July 2003). Since TxDOT districts with large rural counties are often in the unenviable position of having to prioritize needs based on the competing demands of the rural and urban road systems, concerns have been expressed that rural interests are often overlooked to satisfy the demands of the urban areas. This is partly attributable to the fact that urban roads are usually more heavily traveled – thus benefiting more people - than roads in rural communities. Budgetary constraints have thus made it difficult for most of the 25 TxDOT districts to maintain and modernize rural infrastructure and to balance the needs among rural and urban counties. This chapter provides an overview of the pavement condition scores of the rural FM system, assess available funding for the FM road system, documents how TxDOT districts prioritize rural infrastructure needs, and proposes a methodology to help TxDOT staff to rank and prioritize rural infrastructure needs.

5.2 Texas Farm-To-Market Roads: Pavement Conditions

In 1983 TxDOT initiated the Pavement Surface Distress Data Collection (PSDDC) program to record the condition of the state-maintained road network (Turnbull, Dresser, and Higgins, 1999). As part of this effort, TxDOT collects pavement condition data each fiscal year (September 1 through August 31) to update its Pavement Management Information System (PMIS) database. The PSDDC program is conducted on a county-by-county basis. TxDOT measures ride quality[2] and rates pavement distress[3] on all state-maintained roads to assist districts in identifying deficient highway segments (needs) and developing cost-effective design procedures. The overall condition scores are calculated as a function of the distress score and the ride utility value.[4]

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1 For example, almost fifty individual needs-based formulas exist for the allocation of the available ***routine maintenance*** funding among the twenty five districts.

2 The ride score reflects the perceived ride quality of the road by a user.

3 Pavement distress scores reflect the condition of the roads.

4 The ride utility value is a function of the ride quality lost, which is calculated considering both the traffic speed and the traffic volume. In other words, the overall condition score for a given section will be lower given higher traffic speed and volumes compared to low traffic speeds and volume sections, all else being constant.

The 2003 PMIS data were analyzed by highway type. The 2003 PMIS data revealed that the condition of the rural FM system was rated well. Statewide, approximately 84 percent of the system was rated good to very good in terms of the distress score and 87 percent was rated good to very good in terms of the overall condition score. In terms of the ride score, about 44 percent of the FM rural roadbed section-miles were rated fair to very poor.

In addition, the PMIS data by highway type were also analyzed for each TxDOT district. The analysis found that nine Texas districts had more than 10 percent of their rural farm-to-market roadbed section miles rated poor or very poor in 2003. Of these nine districts, five were in eastern Texas, two were in northern Texas, and two were in southern Texas. This finding was consistent with the contention expressed by many rural stakeholders interviewed that increased agricultural industrialization and the use of larger and heavier trucks to move agricultural produce in northern Texas and the impact of timber harvesting in eastern Texas is causing undue stress on rural roadways in these areas. Although PMIS data represent a surface measurement—not subsurface measurement—distress scores in Category D (poor) and F (very poor) are most likely an indication of structural problems (personal communication with Bryan Stampley, 2003). Lubbock, Yoakum, Tyler, and Lufkin Districts had the most rural FM roadbed section-miles rated poor or very poor in 2003 at 431 (14.7 %), 292 (16.3 %), 253 (17.5 %), and 228.7 (13.4 %) miles, respectively.

5.3 Available Funding for the Farm-to-Market Road System

Pavement condition scores are used to determine funding needs by highway type. Funding needs are estimated based on predefined criteria for four categories of treatments: preventive maintenance, light rehabilitation, medium rehabilitation, and heavy rehabilitation. In 2002, TxDOT estimated that approximately $1.9 billion will be needed to maintain and repair the road system excluding funding required for right-of-way, bridge repair, capacity, safety, traffic control, or other roadside improvement costs (Texas Department of Transportation, 2001/2002). Of this, it is estimated that approximately 35 percent ($651 million) is needed for the FM system. More importantly, of the total preventative maintenance and light rehabilitation needs calculated, the FM road system accounts for 47 percent ($168 million), and 66 percent ($189 million) of the preventative and light rehabilitation needs, respectively.

The total state highway fund disbursements for maintenance in fiscal year 2002 were $988.7 million (Texas Department of Transportation, 2002). The FM road system is entirely funded by state resources. Previously, two funding categories existed to fund the expansion and rehabilitation of Texas FM roads: *Category 8A: Rehabilitation of Texas Farm to Market Roads,* and *8B: Texas Farm to Market Roads System Expansion*. Funds from these categories were restricted and could only be spent outside urbanized areas with populations of 50,000 or more, considered rural areas (Texas Department of Transportation, 2002). As of January 2004, TxDOT has streamlined its number of funding categories from 34 to 12 with the result that no separate funding categories currently exist to maintain and update the FM roads. As indicated earlier, the districts are now responsible for balancing rural and metropolitan needs for funding and for balancing maintenance funding by highway type given the funding allocated to each district (personal communication with Richard Kirby, July 2003). Given the estimated needs and available funding, TxDOT will be faced with increasingly difficult decisions about prioritization – a situation similar to what Class I railroads experienced in the 1980s.

5.4 Prioritizing District Needs

The research team interviewed a number of representatives from seven districts (i.e., Tyler, Odessa, Laredo, Yoakum, Lubbock, Pharr, and Bryan) to determine how rural needs (maintenance and rehabilitation) are prioritized and who decides the priorities. These districts were selected to gain insights into the different approaches and factors adopted to prioritize maintenance and rehabilitation needs.

Table 5.1 summarizes which factors are considered in determining priorities, as well as who sets the priorities. As can be seen from Table 5.1, maintenance priorities are usually set by the maintenance supervisors or by the district staff (in some instances in consultation with the area engineers or maintenance supervisors). In the cases where maintenance prioritizing is delegated, it was reported that the maintenance supervisors regularly drive the roads under their jurisdiction and thus have a solid knowledge of the condition of the roads and which sections are in need of maintenance. In the cases where district staff prioritize maintenance, it is clear from Table 5.1 that the districts use different factors to prioritize maintenance, although pavement condition scores are — as would be expected — a factor considered by all districts.

Rehabilitation priorities are mostly determined by district staff. As can be seen from Table 5.1, each district has its own selection criteria that are used to prioritize projects. The criteria used vary substantially, but most districts consider traffic volumes in their allocation of rehabilitation funding. Only Laredo District considers the economic benefits associated with the proposed project. These methods of priority determination have been tailored by each district to the specific circumstances of the district. Most districts interviewed thus felt that their adopted prioritization approach is working well.

Table 5.1 Responsibility and Factors Considered in Setting Maintenance and Rehabilitation Priorities

District	Maintenance Priorities		Rehabilitation Priorities	
	Responsibility	**Factors**	**Responsibility**	**Factors**
Bryan	Maintenance supervisors	• Maintenance supervisor knowledge of road conditions • Public complaints	District staff	• District evaluation • Cost • Average daily traffic • Political concerns
Laredo		Pavement condition	Area engineers	• Cost-effectiveness • Safety • Project economic benefits • Ranking of area engineer
Lubbock	Maintenance supervisors	Maintenance supervisor's knowledge of road conditions	Area engineers	District funds all first priorities, then second priorities and so on until budget is exhausted.
Odessa	Area engineers in consultation with maintenance supervisors	Maintenance supervisor's knowledge of road conditions	District in consultation with area engineers	• Pavement condition (rutting, cracking, failures, etc.) • Average daily traffic • Average daily truck traffic • Past maintenance expenditures
Pharr	District staff in consultation with area engineers	• Pavement condition (rutting, cracking, fatigue) • Facility type (volume, speed)		• Average daily traffic • Safety index
Tyler	District staff in consultation with maintenance supervisors	• Pavement condition • Expenditures incurred	District staff	• District evaluation • Cost • Traffic volumes • Past expenditures • Visual inspection data from area engineers
Yoakum	District staff	• Lane-miles • Cost of materials • Pavement condition	District staff	• PMIS scores • Traffic volumes

5.5 Proposed Additional Criteria for Prioritizing Rural Needs

The fact that available funding does not cover all the identified district needs requires districts to prioritize their needs. As indicated before, each district has its own prioritization procedure that varies from less formal assessments to some form of ranking considering different criteria. If this disparity between available funding and rural needs increases, as anticipated, effective prioritization will become more important in the future. The objective of this section is to propose a number of additional parameters and criteria in a "multi-attribute criteria methodology" framework that can be considered by TxDOT to prioritize significant maintenance and rehabilitation projects.

The first step is to identify the important parameters and criteria (impacts) associated with the identified rural projects. A number of parameters and criteria that TxDOT might want to draw from are summarized in Table 5.2. This list is by no means exhaustive and in some cases a number of criteria are presented for the same parameter. The TxDOT districts can use this as a basis to expand the factors currently considered, if so desired.

Multi-attribute criteria analysis is founded in benefit costs analysis (BCA), but unlike BCA that requires the quantification of all impacts (benefits and costs), multi-attribute criteria analysis does not require the expression of all impacts in monetary terms. This type of analysis allows the analyst to rank identified impacts in a structured framework.

It is suggested that TxDOT produce a scoring method after agreeing on the parameters and criteria. For example, TxDOT staff can be asked to rank the parameters and criteria on a scale of 1 to 5, where 1 represents a very high cost or low benefit and 5 represents a very low cost or high benefit**.**

At the same time, not all the parameters might be of equal importance. When parameters of differing importance are combined into a single decision-making tool, a weight should be assigned to each of the parameters to prevent less important parameters from driving the decision.

Table 5.2 Multi-Attribute Criteria Example

Parameter/Criteria	Projects								
	P1	P2	P3	P4	P5	P6	P7	P8	P9
Project Cost (Weight = 15)									
$									
$/vehicle mile									
$/mile									
Pavement Condition (Weight = 15)									
PMIS scores (distress, ride score, overall condition)									
Demand (Weight = 15)									
Average daily traffic									
Vehicle-miles traveled									
Average daily truck traffic									
Truck-miles traveled									
Past Agency Maintenance Expenses (Weight = 5)									
$									
$/vehicle mile									
$/mile									
Connectivity (Weight = 15)									
Access to rural farms and industry									
Links between towns and cities									
Link for travel across the state									
Access to parks, wildlife and recreational opportunities									
Alternative roads available									
Safety (Weight = 15)									
Number of incidents									
Number of injuries									
Number of fatalities									
Economic Benefits (Weight = 10)									
Number of farms or rural shippers served									
Potential to attract new business and jobs									
Social Benefits (Weight = 10)									
Serving poor or minority community									
Number of schools									
Number of clinics									
Number of religious centers									

6. Policy Considerations for Addressing Farm-to-Market Road Needs

The Texas highway system, as currently structured and financed, is too large and its needs too great when evaluated over a 20 year planning cycle. Of concern to most TxDOT districts interviewed was the widening gap between available funding and the needs of the rural road system. Since more emphasis is typically placed on addressing the needs of the higher volume facilities, i.e., interstate, U.S., and state highways, and urban areas, some districts have expressed concern about maintaining the FM system. In addition, districts find it challenging to address unforeseen needs. Given that there is little political interest to raise gasoline taxation further (at least at the moment) and given inadequate state budgets in the near future this section highlights a number of policy options that can be considered to fund unmet and unforeseen maintenance needs in rural areas.

6.1 Return of Gas Tax Revenues

A number of Texas legislators[5] and many Texas representatives in Congress have worked together to change the current percentage that Texas receives as its rate of return of gas tax revenues in an attempt to increase the highway funds available to the state. Historically, for every dollar Texas has contributed to the Highway Trust Fund, it has received less than a dollar back. For example, since the inception of ISTEA in 1991, Texas has received approximately 77 cents in highway program funds for each dollar contributed. Under TEA-21, Texas received approximately 88 cents in highway program funds for each dollar contributed. The Texas delegation in the U.S. House and Senate has thus been advocating that all states should receive at least a 95 percent rate of return (Senate Research Center, n.d.). This would increase the funding available to Texas for maintaining and rehabilitating its extensive road system, including hypothetically its rural FM system.

6.2 Super 2 Highways

Texas' FM roads were built to provide access to rural areas of the state. With increased rural traffic, there has been a growing demand to increase the capacity of some of these roads. A number of rural trucking companies surveyed were concerned about the width of rural roads and inadequate shoulders, especially with regards to county and FM roads. Super 2 Highways are seen as a possible solution to increase the capacity of many rural roads. Super 2 Highways are two-lane roadways with improved operating features, such as:

- added passing lanes - Super 2 Highways feature an additional lane for passing in one or both directions of travel to facilitate easier passing. TTI concluded that passing lane length and spacing between passing lane segments are integral to improving traffic conditions on these highways. The difficulty for transportation planners is determining the proper lane length, because too short of a lane leads to an uneven dispersal of platoons while lanes that are too long are inefficient (Wooldridge et al., nd). Economic, safety, and traffic volume factors are some of the primary variables used for determining optimal lane length and spacing.

[5] Lloyd Doggett (DEM-TX), Chet Edwards (DEM-TX), Tom Delay (REP-TX), Lamar Smith (REP-TX), Ron Paul (REP-TX), Kevin Brady (REP-TX), John Culberson (REP-TX).

- increased lane and shoulder width - Safety is the overriding factor that is used to determine proper lane and shoulder width. Wider shoulders and lanes give motorists more time to recover from driver error and therefore tend to reduce the number of roadway accidents.

- improved signing and marking - TTI recommended a number of roadway signing and pavement marking improvements to enhance the safety and efficiency of Super 2 Highways in Texas, including: (a) advance signing of passing lanes – approximately two miles before the passing lane - to make drivers aware of upcoming passing opportunities; (b) a sign near the end of each passing lane to inform motorists about the distance to the next passing lane, (c) a dashed white line to separate the passing lane from the right lane in the transition area extending from near the highway centerline to the beginning of the white dashed line; and (d) standard taper rates, as defined in the TEXAS MUTCD, to add and drop lanes for the passing lane section (Wooldridge et al, nd).

6.3 Toll Roads in Rural Texas

Toll equity and Regional Mobility Authorities – allowed for by Senate Bill 342 and the Constitutional Amendment – are voter-approved financial tools that have the objective to leverage limited state transportation funds. A possible solution for modernizing and rebuilding existing infrastructure in rural areas is thus to fund the projects through investments that can be recouped from tolls charged to users. Future initiatives can take the form of more toll road choices, but to a large extent toll solutions are the purview of metropolitan, not rural communities where potentially high traffic volumes and thus revenues can ensure the financial feasibility of the road. Another and possibly more appropriate option for rural areas might be using pass-through tolls to finance individual projects. In using pass-through tolls, a local government or private partner provides the funding for transportation improvements on the state maintained system. The entities are reimbursed later by the state through a fee based on the number of vehicles using the highway. In effect, the toll typically paid by the motorist is paid for or “passed through” to the state.

6.4 Restructuring the Rural Road Network

One aspect of interest is the justification for maintaining a large rural FM network when the communities are shrinking in terms of population and transportation demand. Given the inability of fuel revenues to meet current highway needs, should large rural networks be maintained? The financial short-fall, of course, is not unique to Texas – almost all U.S states are facing the same problem. It is therefore interesting; therefore, to note that in North Dakota, the state DOT has developed a highway designation related to use that parallels the traditional state and farm to market terms known to all state planners. This new designation allows planners to “substantially reduce” investment in lower tier highway segments if funding is not forthcoming for the entire system. In one sense, this could be done in a more direct way by simply removing certain highways from the state system. The subject is clearly a sensitive one, based on social as well as economic factors but nonetheless deserves scrutiny in the light of diminishing highway revenues.

6.5 Rural Rail Transportation Districts

One of the key objectives of the formation of Rural Rail Transportation Districts (RRTDs) in 1981 by the Texas Legislature was to preserve abandoned Class I rail lines as a viable

transportation option for small farmers in rural Texas. At the same time, increased use of rural rail is often seen as a potential solution for diverting truck traffic away from the rural FM network, thus preserving the system. The program, however, had variable results, working well in some instances but not in others (see Table 6.1). NETEX and Centex Rural Rail Districts are considered the most successful in terms of the RRTD program. Centex, for example, was servicing 65 shippers and annual traffic levels exceeded 20,000 carloads in 2001 (Roop et al., 2001). Centex's success has been predicated on its commodity diversification.

Table 6.1 Status of Texas Rural Rail Transportation Districts (August 31, 2001)

Rural Rail Transportation District	Number of Counties	Formed	Primary Motivation	Current Board Status	Status of Line	Ownership	Outside Funding Sources
Burnet County	1	2000	Abandonment	Inactive	Operational	None	N/A
Calhoun County	1	1999	Economic Development	Inactive	N/A	None	N/A
Centex	5	Early 1990s	Abandonment	Active	Operational	Right-of-Way	Texas Department of Agriculture (to operator)
Deep East Texas	12	1993/94	Abandonment	Inactive	SP Line Abandoned	None	N/A
Ellis County	1	1998	Economic Development	Active	Progressing as Planned	Right-of-Way & Structures	Public-Private Partnership
Fannin	1	1999	Abandonment	Active	Impending Abandonment	None	N/A
Gulf Coast	2	1993/94	Abandonment	Inactive	Inactive line; Purchased by TM	None	N/A
Gulf Link	2	1998	Economic Development	Inactive	N/A	None	N/A
Matagorda County	1	2001	Economic Development	Active	N/A	None	N/A
North Central	2	1995	Abandonment	Inactive	Operational	None	N/A
North Texas	2	1995/96	Abandonment	Active	Abandoned	Purchased 7-mile segment	Texas Parks & Wildlife Department (for trails)
Northeast Texas	4	1994	Abandonment	Active	Operational	Right-of-Way & Structures	Texas Legislature & U.S. Department of Agriculture
Northwest Texas	7	1993	Abandonment	Inactive	Abandoned	None	N/A
Nueces County	1	2001	Economic Development	Active	N/A	None	N/A
South Orient	11	1991	Abandonment	Inactive	Operational	TxDOT	Texas Legislature
South Texas	3	Early 1990s	Abandonment	Inactive	Abandoned	Right-of-Way	N/A

(Source: Roop et al., 2001)

However, for rural rail to be operationally effective and offer rail services to rural entities it has significant hurdles to overcome in Texas. For one, transporting goods by truck are often less expensive and more efficient than rural rail. Also, financing for rural rail remains problematic because the only funding source that is available to RRTDs, other than receiving donations of cash and property, has been the districts' authority to issue revenue bonds. In essence, rail districts are expected to charge rents sufficient to maintain their properties and pay off their revenue bonds. To date, no RRTDs have issued any revenue bonds, although two RRTDs have been successful in securing specific legislative "riders" that granted them funds from state general revenue through TxDOT. Attracting clients is thus essential for the rural rail district to stay active.

Also, the distribution and transportation demands of traditional rail clients, such as the agricultural industry, have changed significantly. Innovations in information technology now allow daily tracking of customer demand, which ultimately shapes farmers' production strategies (Branscomb, 1994). Large retailers now demand specific and consistent product characteristics, assured supplies, and timely delivery, which favor the trucking industry. Similarly, identity preservation typically works against transporting goods by rail. Identify preservation, which can take on many forms, usually carries with it the need for smaller shipment sizes, careful handling to prevent damage to fragile cargo, and reduced transit times, all of which tend to favor trucking.

On the other side, Mexico remains an important market for Texas-produced commodities, and the efficient transportation of agricultural products to Mexico is critical for Texas farmers to ensure competitiveness in the market. The South Orient and Centex RRTDS have been successful in transporting agricultural exports to Mexico. The South Orient Railway (SORR) - owned by TxDOT with operations leased to the Texas Pacifico Railroad (TXPF) - operates between San Angelo Junction and Presidio (a total of around 385 miles) and permits goods to move (rather slowly at the moment) between Presidio and Dallas/Fort Worth. Funds are being sought to improve the track first to 25 mph, and then to 40 mph which would offer a competitive transportation alternative to the highways currently used by shippers. This may thus be an area where rural rail can fulfill a growing need.

The viability of the RRTD program, which has allowed some districts to expand into multidistrict regions and to add new infrastructure that connect to existing and active railroads within Texas, thus remains tenuous. While it was an innovative idea in transportation, questions persist about whether districts have the ability to meet the changing expectations of rural shippers and thereby alleviating the burden on rural roads.

6.6 Private Road Associations

Private Road Associations provide an example of how public funding can be supplemented to fund unmet maintenance needs. In Sweden, Private Road Associations (PRAs) manage two-thirds of the Swedish road network at less than half of the cost of maintaining government-provided roads. The system has proved remarkably effective because the users of the roads are responsible for the financial and physical consequences of any delayed intervention in treating emerging problems. The members of the PRA (property owners along the road) own individual shares in the road. The individual shares are a proxy for the maintenance and other road costs they have to incur, which is based on the size of their property and the traffic they generate. Financial responsibility for the construction, upgrading, operation, and maintenance of private roads thus rests with the PRA members (Ivarsson and Calvo, 2003).

The Swedish government subsidizes private roads that are, among other considerations, open to the public. The PRA sizes vary quite dramatically. Most PRAs own or manage a few kilometers, but some have 70 kilometers of road and include up to 3,500 properties (Ivarsson and Calvo, 2003).

For numerous reasons, the Swedish government supports this program:

- encourage living and settling in remote and sparsely populated areas,
- promote trade and industrial development in areas where the cost of providing roads might be high,
- provide access to areas of public recreation and leisure,
- secure the public capital investment in roads, and
- ensure general traffic safety and environmental interests (Ivarsson and Calvo, 2003).

Although most of the private roads are low-volume roads, RMAs provide an example of how public funding can be supplemented to fund unmet maintenance needs. Private roads support the notion that those directly benefiting from and consuming rural pavements (i.e., large truck-traffic generators) can be asked to contribute to the strengthening, rehabilitation, and maintenance of rural roads.

6.7 Outsourcing

Outsourcing aims to use resources more efficiently and capture economies of scale. In the National Cooperative Highway Research Program's (NCHRP) Synthesis 313 (2003) it was reported that many state DOTs have started to outsource traditionally undertaken activities (i.e., administration, construction, design, maintenance, operations, planning, and right-of-way) in an effort to improve efficiency and reduce costs.

Two important aspects of outsourcing is the selection of the provider and determining the effectiveness of outsourcing. Different DOTs measure effectiveness differently. Some of the measures include:

- cost-effectiveness — the cost of outsourced services relative to in-house services, calculated using the "current cost" or lifecycle cost approach;
- schedule constraints — resulting from staffing shortages;
- product delivery — because the state agency is not in a position to perform the task;
- legal requirement — in South Carolina, for example, legislation mandated increased privatization of maintenance operations; and
- legislative or executive intent — for example, the Florida governor required a reduction of 25 percent in DOT staff over a 3 year period, necessitating the outsourcing of some activities (NCHRP, 2003).

Overall satisfaction with outsourcing was reported to vary, although satisfaction with administration, maintenance, and operations ranked higher than the other activities (i.e. construction, design, planning, and right-of-way). TxDOT already uses contractors to undertake some of the maintenance, rehabilitation, and reconstruction projects. The agency could consider outsourcing all maintenance, for example, in an effort to achieve economies of scale and reduce costs. On the other hand, TxDOT is a significant employer in many of the rural

areas, so that a move to 100 percent outsourcing could have substantial social and economic impacts on communities that are already struggling to keep and attract new jobs. What is often overlooked is that the TxDOT district system carries with it many advantages as far as rural communities are concerned ranging from professional employment opportunities through to distinct knowledge of the local highway needs which give rise to dynamic and efficient decision-making, particularly related to emergency maintenance. Moreover, since it is not clear as to exactly what the reductions in costs would be the question seems to be not so much as to who should do the work but how it should be financed.

7. Conclusions and Recommendations

Over the past two decades, the changing transportation demands of agriculture and rural industry, and the strategic rail decisions that resulted in the abandonment of many rural rail links, have had severe impacts on rural road infrastructure. Many TxDOT districts have seen an increase in the volume of truck traffic on sections of the rural FM system as a result of agricultural industrialization, resulting in fewer but larger farms and the trend toward moving products between specialized operations, increases in the physical sizes of agricultural equipment, and the abandonment of approximately 2,400 miles of rail track in Texas, following the Staggers Act. Many TxDOT districts have thus seen an increase in the truck numbers and axle loads on certain portions of their network and have found disequilibrium between rural demand and highway supply – often necessitating increased maintenance. A central problem associated with the growth of trucks in the state is that while the arterial systems (particularly the interstate) have been designed to carry increases in volumes and heavier axle loads, much of the rural system has not. These posted highways and posted bridges reflect the 58,200-lb load limit that was in existence when these roads were originally designed by the Texas Highway Department in the 1940s and 1950s.

However, despite evidence of increased average annual daily truck-traffic volumes in rural Texas, the 2003 PMIS data revealed that the overall condition of the FM system was rated well. Statewide, approximately 84 percent of the FM network was rated good to very good in terms of the distress score and 87 percent was rated good to very good in terms of the overall condition score. In general it was thus found that TxDOT district staff is maintaining the state's FM roadbed section-miles very well, although certain districts are more impacted by larger and heavier trucks traversing certain of their FM roadways.

But looming behind the ratings are concerns about maintaining and upgrading the extensive network in the wake of increased truck traffic and inadequate funding. As the users of rural infrastructure on a daily basis, rural truckers expressed a number of transportation concerns in rural communities. These point to concerns about the width of rural roads, inadequate shoulders, a need for better maintenance and rehabilitation – especially with regards to county and FM roads -, and concerns about the impact of increased truck traffic on rural roads and towns.

TxDOT districts indicated that priority is often given to high volume projects when prioritizing maintenance and rehabilitation needs. With urban and rural areas competing for the funding allocated to TxDOT districts, districts find it increasingly challenging to balance urban and rural needs. Prioritizing is thus likely to become even more important in the future as the disparity between available funding and rural needs increase. Techniques to prioritize projects, such as the multi-attribute criteria framework, proposed in this report are a possible alternative to current prioritization methods. But even improved prioritization methods do not alleviate the root problem – the lack of funding to maintain and rehabilitate all of the state's extensive FM road system. The state gas tax has not been raised since 1993 and the 2005 legislative session failed to remedy this situation. This means that innovative policy options need to be considered to address the funding shortfall between available revenues and the needs of the FM road system. This report offered a number of options available to TxDOT to supplement limited budgets and to address rural road capacity concerns

To conclude, the Texas highway system, as it is currently structured, is probably too large and its needs too great for the predicted stream of revenues from traditional sources. Given that there is little political interest to raise gasoline taxation further (at least at the moment) and given inadequate state budgets in the near future the following are a list of recommendations for TxDOT to consider:

- Should TxDOT abandon part of its rural network? The rural network should be carefully evaluated and reclassified to target the maintenance and rehabilitation funding of the system. Some states, for example North Dakota, have begun to reclassify their systems using a hierarchy which allows them to direct the funding only into higher need categories where funds are scarce. Alternatively, this could be done in a more direct way by simply removing certain highways from the state system.

- Much greater information needs to be collected on the demand for (use of) rural highways. This type of demand analysis will generate different types of data that will sharpen state planning, particularly where additional funding is concerned. For example, one of the critical aspects that require dedicated maintenance and rehabilitation activities are the major highway corridors passing through the rural regions carrying much of the regional trade. Secondly, the links to the specific rural generators associated with employment and wealth generation need similar support.

- Designate key state supply chains. This study recognizes that users develop their highway routes based on the needs of their shippers and the commodities that are being moved. The designation of supply chains for key commodities should therefore assist statewide planning and the targeting of funding on those sections of highways passing through rural areas. Moreover, it will link into those generators within different parts of the state and ensure that the supply chains are not simply portions of the interstate but cover the movement of goods from origin to destination within a district network.

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