

TEXAS GRAIN TRANSPORTATION STUDY

by

Stephen Fuller, Tun-Hsiang Yu, Dennis Collier, Jerry Jamieson, and Rob Harrison

CENTER FOR TRANSPORTATION RESEARCH
The University of Texas at Austin

and the

DEPARTMENT OF AGRICULTURAL ECONOMICS
Texas A&M University

A Report to the 77th Texas Legislature

January 2001

ACKNOWLEDGMENTS

Individuals making important contributions to this study include Steve Roop of the Texas Transportation Institute, Ben Boerner of the Texas Grain and Feed Dealers Association, Matt Brockman at the Texas Department of Agriculture, Mike Jones of the Texas Railroad Commission, Curtis Morgan, formerly with the Texas Department of Transportation, and Wayne Dennis, Jim Randall, and Paul Douglas, all with the Texas Department of Transportation. Kellie Spurgeon, an intern from the University of South Florida, ably administered the development of the survey design and its pilot test. Steven Bobb of Burlington Northern Santa Fe and Bill Eilbracht of Union Pacific, together with Craig Rockey of the Association of American Railroads, provided information on Class 1 railroads. Allen Haley offered further information on railroad operations, while John Helsley guided us on rural rail transportation district issues. Finally, Otto Sonefeld, with the American Association of State Highway and Transportation Officials (AASHTO), provided information on shortline and regional railroads. In addition, a special thanks is extended to Texas grain handling industry personnel for their willingness to provide information so this study might be carried out. Finally, sincere appreciation is expressed to Connie Smotek and Patricia Hord for manuscript preparation, and to Ray Donley for editing this document.

EXECUTIVE SUMMARY

This study reports on various aspects of grain transportation in Texas. Attention is given to Texas grain production and consumption trends, and to the geographic location of grain production and consumption. Data on interstate and intrastate grain flow patterns and mode use are identified, as are perceptions of Texas grain handlers regarding the quality of service offered by railroads and motor carriers. (Please note: The discussion of trends in Texas grain production and consumption that are included in this report is based on historic information. No analyses were performed to determine why these trends occurred or whether they are likely to occur in the future.)

Texas farmers produce in excess of 500 million bushels — 14 million tons — of corn, grain sorghum, wheat, and rice. Corn production makes up about 43 percent of total production, while grain sorghum, wheat, and rice comprise about 29, 21, and 7 percent, respectively, of production. The High Plains, North and South Central, and Lower Valley regions produce about 51, 28, and 5 percent, respectively, of Texas' total grain output. Grain consumption by the livestock, poultry, and dairy populations in Texas is estimated to annually exceed 415 million bushels, which is greater than Texas' feed grain (corn, grain sorghum) production (and which consequently accounts for the need to import from out-of-state origins). The largest grain-consuming populations are in the High Plains, North Central, and East Texas regions.

Grain flow data show large quantities of rail-transported grain are received in Texas for export via Texas Gulf ports and overland border crossings into Mexico, and for consumption by Texas livestock, poultry, and dairy populations. In 1998, an estimated 286 million bushels of rail-transported corn were received in Texas from mostly Corn Belt origins; about 30 percent was destined for the grain-deficit High Plains, 17 percent for the grain-deficit North Central and East

Texas regions, and 53 percent for other Texas grain-importing regions, Texas-Mexico border crossing sites, and Texas Gulf ports. Approximately 355 million bushels of rail-transported wheat were received at Texas locations in 1998. This grain was primarily destined for Texas Gulf ports (about 80 percent) and North Central Texas, a region that includes terminal elevators that tranship wheat prior to its final shipment to Texas Gulf ports and regional flourmills. Texas sites received an estimated 104 million bushels of rail-transported grain sorghum in 1998, with most destined to Texas Gulf ports, Texas-Mexico border crossing sites, and Texas poultry-producing regions. Thus, in 1998, Texas sites received about 745 million bushels of rail-transported wheat, corn, and grain sorghum.

A survey of Texas grain handlers shows that motor carriers are the primary transporter of Texas-produced grain, with railroads playing important roles for selected grains on particular routes.

In the High Plains, a leading feed grain producing and consuming region, most feed grain is marketed to regional livestock populations; all such feed grain is truck transported. However, High Plains wheat production is dependent on motor carriers and railroads. Motor carriers assemble important quantities of wheat from country elevators to region terminal elevators, while railroads are central for transport of wheat from country elevators and terminal elevators to Texas Gulf ports and Arizona/California markets. A similar dependency on truck and rail modes is shown in Texas' other wheat producing regions (Low Plains and North Central regions). Corn production in the eastern half of Texas is primarily destined for livestock, poultry, and dairy consumption (where truck haulage dominates) and, to a lesser extent, for Texas Gulf ports and Mexico (where motor carriers and railroads play important roles). Grain sorghum production in the eastern half of Texas is largely destined for Texas Gulf ports, Texas feeders and processors, and Mexico. Sorghum shipments to Texas feeders and processors are primarily truck transported, while trucks and railroads are important for movements to Gulf ports and Mexico. All rough rice shipments to Texas mills and Gulf ports are carried by truck, while shipments to Mexico are primarily transported by railroads. In summary, the truck mode is central to the marketing of Texas-produced grain; however, rail is very important for selected grains on particular corridors.

The Texas elevator and feed mill surveys indicated that one-fifth of the respondents were without rail service because of rail line abandonment, while one-third of the rice driers were located on abandoned rail lines. Further, one-third of the country elevator operators observed that their truck shipments of grain had increased in the past 5 years by nearly 60 percent, while about 60 percent of the elevator operators indicated that their rail shipments had decreased by about 38 percent. Thus, there is an increased use of trucks in the marketing of Texas grain production.

Texas grain handlers believe their motor carrier service is satisfactory; by contrast, most registered some dissatisfaction with rail service. The greatest concern centers on grain handlers' difficulty in obtaining railroad service and on the promptness of railroads in providing service. About half of the country elevator operators indicated that inadequate rail service had at times required them to lower their grain bid to farmers by an average of \$0.14/bushel. Country elevators and feed mills indicated the most dissatisfaction with railroads, while terminal elevators were more nearly satisfied with the service offered by railroads.

The following observations regarding grain transportation in Texas seem most important:

1. Large quantities of rail-transported grain are received in Texas from out-of-state origins for consumption by its livestock, poultry, and dairy populations and for export via Gulf ports and Texas-Mexico border crossing sites — hence, the importance of this transportation and imported grain supplies to Texas agribusiness.
2. Trends in Texas feed grain production suggest a continued dependence on out-of-state grain supplies.
3. Because Mexico is an increasingly important market for Texas-produced grain, efficient transportation systems are critical for Texas' competitiveness in this market.
4. Motor carriers are (a) central to transportation of Texas feed grain production (corn, grain sorghum), since most is consumed in state; (b) the primary transporter of Texas rice production; and (c) important for Texas wheat production. But because principal markets are at extended distances, there is a dependence on railroads to access these long-haul markets.
5. Texas rural highways are critical for the marketing of Texas grain production.
6. Texas grain handlers believe service offered by motor carriers is satisfactory, while many are dissatisfied with service offered by Class 1 railroads.
7. Class 1 railroad companies in Texas are striving to improve grain service schedules (with varying success); however, trucks have the competitive advantage on trips less than 250 miles in length. On those routes where trains remain competitive, larger grain shippers are able to take advantage of the lower rates offered on unit and shuttle train operations, while smaller shippers can take up guaranteed delivery programs (like BNSF's certificates of transportation).

Recommendations

1. The State should support efforts to enhance multi-modal transportation planning in Texas, particularly those activities related to rail operations. Such support is needed in order to address not only the problems that are now facing rail providers of all sizes, but also the impacts that these problems are having on the agricultural sector, which is dependent on efficient transportation.
2. Truck volumes on rural highways moving grain within the distribution chain will continue to grow, probably significantly. This growth will have an adverse impact on the condition of rural highways and bridges. The problem should be addressed by enhancing activities in three areas: first, within state transportation planning; second, in the funding needs for the rural highway and bridge system; and, third, in the construction (and connectivity) of the Texas Trunk System.
3. Agricultural and transportation planners need more extensive and timely data on grain flows in order to focus on those areas of the state most in need of transportation investment and service improvement. A database should be designed so as to address the agricultural flows associated with grain, cotton, and livestock, in order to provide a comprehensive approach to rural transportation needs in Texas. This study was not designed to address this need and further work should therefore be undertaken to determine the type of database, how data would be collected, and which agency should manage and administer it.

TABLE OF CONTENTS

Executive Summary	iii
Glossary of Terms	xi
I. Introduction	1
II. Texas Grain Production and Associated Trends.....	1
Corn.....	1
Grain Sorghum	1
Wheat	2
Rice.....	2
Summary of Texas Grain Production and Associated Trends	2
III. Texas Grain Consumption Populations and Associated Trends	2
Fed Cattle	3
Hogs	3
Broilers	3
Dairy.....	3
Summary of Texas Grain Consumption Populations and Associated Trends	4
IV. Texas' Grain Flow Patterns	4
Historic Texas Grain Flow Patterns	4
Rail-Transported Grain Flow Patterns Involving Texas	5
Corn.....	6
Grain Sorghum	6
Wheat	7
Rice.....	8
Texas Grain Flow Patterns Based on 2000 Survey	9
Corn.....	9
Grain Sorghum	10
Wheat	10
Rice.....	11
V. Trends in Transport Mode Use Based on 2000 Survey.....	11
VI. Perceived Performance of Truck and Rail Modes Based on 2000 Survey	12
VII. Summary of Grain Transportation in Texas.....	13
VIII. Railroads and Motor Carrier Grain Transportation in Texas	16
Introduction	16
Class 1 Railroad Responses to Survey Service Issues	18
Burlington Northern Santa Fe (BNSF).....	18
Union Pacific (UP)	20

Shortline Rail Service.....	21
Trucking	22
IX. Emerging Trends in Transportation	23
Grain Is a Globally Traded Commodity.....	23
Rail Service	24
Future Rail Issues	24
Continual Growth in Grain Trucking	25
Grain Transportation Database.....	25
Rural Rail Transportation Districts	26
X. Observations and Recommendations	26
Observations.....	26
Recommendations	27
References	73
Appendix A — Rail-Transported Grain Flows Involving Texas.....	75
Appendix B — Railroad Rate Equations	83
Appendix C — Survey Instrument and Responses to Survey.....	87
Appendix D — Trucking Survey Results	93

LIST OF TABLES

Table 1.	Estimated Railroad Shipments of Corn from Various States to Texas BEA Regions, 1998	29
Table 2.	Estimated Intrastate Railroad Shipments of Texas Corn, 1998.....	30
Table 3.	Estimated Railroad Shipments of Grain Sorghum from Various States to Texas BEA Regions, 1998.....	31
Table 4.	Estimated Intrastate Railroad Shipments of Texas Sorghum, 1998	31
Table 5.	Estimated Railroad Shipments of Wheat from Various States to Texas BEA Regions, 1998	32
Table 6.	Estimated Intrastate Railroad Shipments of Texas Wheat, 1998	33
Table 7.	Estimated Railroad Shipments of Rough Rice from Various States to Texas BEA Regions, 1998.....	34
Table 8.	Estimated Intrastate Railroad Shipments of Texas Rough Rice, 1998.....	34
Table 9.	Estimated Percent of Corn Shipments to Various Markets by Country Elevators and Percent Shipped by Truck and Rail	35
Table 10.	Estimated Percent of Corn Receipts/Shipments by Terminal Elevators from/to Various Markets and Percent Received/Shipped by Truck and Rail.....	36
Table 11.	Estimated Percent of Corn Receipts from Various States by Texas Feed Mills and Percent Received by Truck and Rail	37
Table 12.	Estimated Percent of Grain Sorghum Shipments to Various Markets by Country Elevators and Percent Shipped by Truck and Rail	38
Table 13.	Estimated Percent of Grain Sorghum Receipts/Shipments by Terminal Elevators from/to Various Markets and Percent Received/Shipped by Truck and Rail.....	39
Table 14.	Estimated Receipts of Grain Sorghum from Various States by Texas Feed Mills and Percent Received by Truck and Rail	40
Table 15.	Estimated Percent of Wheat Shipments to Various Markets by Country Elevators and Percent Shipped by Truck and Rail	41
Table 16.	Estimated Percent of Wheat Receipts/Shipments by Terminal Elevators from/to Various Markets and Percent Received/Shipped by Truck and Rail.....	42
Table 17.	Estimated Percent of Rough Rice Shipments to Various Markets by Rice Driers and Percent Shipped by Truck and Rail	43
Table 18.	Country Elevators' Response to Questions Regarding Changes in Truck Shipments.....	44
Table 19.	Country Elevators' Response to Questions Regarding Changes in Railroad Shipments.....	45
Table 20.	Feed Mills' Response to Questions Regarding Changes in Truck Grain Receipts	46
Table 21.	Feed Mills' Response to Questions Regarding Changes in Railroad Grain Receipts	47
Table 22.	Rice Driers' Response to Questions Regarding Changes in Truck Shipments.	48
Table 23.	Rice Driers' Response to Questions Regarding Changes in Railroad Shipments.	49
Table 24.	Perceptions of Motor Carrier Performance by Country Elevator Operators Based on Performance Scale where 1 = Poor and 5 = Excellent.....	50

Table 25.	Perceptions of Motor Carrier Performance by Feed Mill Operators Based on Performance Scale where 1 = Poor and 5 = Excellent	51
Table 26.	Perceptions of Motor Carrier Performance by Terminal Operators Based on Performance Scale where 1 = Poor and 5 = Excellent	52
Table 27.	Perceptions of Motor Carrier Performance by Export Elevator Operators and Rice Drier Operators Based on Performance Scale where 1 = Poor and 5 = Excellent	53
Table 28.	Average Perceptions of Railroad Performance by Country Elevator Operators Based on Performance Scale where 1 = Poor and 5 = Excellent.....	54
Table 29.	Perceptions of Railroad Performance by Feed Mill Operators Based on Performance Scale where 1 = Poor and 5 = Excellent	55
Table 30.	Perceptions of Railroad Performance by Export Elevator Operators and Rice Drier Operators Based on Performance Scale where 1 = Poor and 5 = Excellent.....	56
Table 31.	Perceptions of Railroad Performance by Terminal Elevators Based on Performance Scale where 1 = Poor and 5 = Excellent	57
Table 32.	Country Elevators' Response to Questions Regarding Effect of Railroad Service on Farm Bid Price.....	58
Table 33.	Feed Mills' Response to Questions Regarding Effect of Railroad Service on Grain Bid Price	58
Table 34.	Terminal Elevators' Response to Questions Regarding Effect of Railroad Service on Bid Price	59
Table 35.	Rice Driers' Response to Questions Regarding Effect of Railroad Service on Rough Rice Price or Profit.....	59
Table 36.	Trends Identified in Recent Rail Research	60
Table 37.	The Shrinking U.S. Railroad Networks in Various Agricultural States	61
Table 38.	Long-Term Implications for U.S. Agriculture.....	62
Table 39.	BEAs Referenced in This Report	63

LIST OF FIGURES

Figure 1.	Texas Regions.....	64
Figure 2a.	Production and Location of Texas Corn, 1980-2000.....	65
Figure 2b.	Production and Location of Texas Sorghum, 1980-2000.....	65
Figure 2c.	Production and Location of Texas Wheat, 1980-2000	66
Figure 2d.	Production and Location of Texas Rice, 1980-2000	66
Figure 3a.	Marketings and Location of Texas Fed Cattle, 1980-1998.	67
Figure 3b.	Marketings and Location of Texas Hog Production, 1980-1999	67
Figure 3c.	Production and Location of Broilers in Texas, 1980-1999.....	68
Figure 3d.	Quantity and Location of Milk Cows in Texas, 1980-1999	68
Figure 4a.	Texas Grain Facilities Involved in Trade of Corn, Grain Sorghum, and Wheat with Principal Interfacility Grain Flows.....	69
Figure 4b.	Texas Rice Facilities with Principal Interfacility Flows.....	69
Figure 5.	Bureau of Economic Analysis (BEA) Areas.	70
Figure 6.	U.S. Grain and Oilseed Modal Shares, 1978-98.....	70
Figure 7.	Class 1 Railroad Performance, 1964-99	71
Figure 8.	Railroad Share of U.S. Corn, Soybean, and Wheat Shipments, 1978-98.....	71
Figure 9.	Types of Shipment Patterns from Country Elevators to Houston, Texas.....	72

GLOSSARY OF TERMS

Abandonment: Elimination of a segment from the rail network. Abandonments must be approved by the Surface Transportation Board.

BEA: Bureau of Economic Analysis. The Bureau of Economic Analysis (BEA) is an agency of the Department of Commerce. Along with the Census Bureau and STAT-USA, the BEA is part of the Department's Economics and Statistics Administration. The mission of the BEA is to produce and disseminate accurate, timely, relevant, and cost-effective economic accounts statistics that provide government, businesses, households, and individuals with a comprehensive, up-to-date picture of economic activity. The BEA's national, regional, and international economic accounts present basic information on such key issues as U.S. economic growth, regional economic development, and the nation's position in the world economy. To facilitate regional economic analyses, the BEA has identified 172 geographic economic areas throughout the U.S.

Bushel: A dry volume measure of varying weight for grain, fruit, etc., equal to 4 pecks or 8 gallons (2150.42 cubic inches). A bushel of grain sorghum weighs 56 pounds (though bushels of other produce may weigh more or less). In terms of freight movements, 900 bushels of grain represent a truckload, while 3,200 to 3,600 bushels represent a railcar load.

Carrier: A person or company engaged in the transportation of passengers or property by land or water as a common, contract, or private carrier, or by civil aircraft.

Class 1 freight railroad: Defined by the Interstate Commerce Commission each year based on annual operating revenue of \$259 million or more (1998 figure). There are three Class 1 railroads currently (2001) operating in Texas: Burlington Northern Santa Fe, Union Pacific, and Kansas City Southern.

Common carrier: A person or company providing service to anyone seeking a transportation movement, publication of rates, provision of the service on schedule, service to designated points or to a designated area, and service of a given class of movement and commodity.

Contract carrier: A carrier, whatever mode, that provides service according to contractual agreement. The contract specifies charges to be applied, the character of the service, and the time of performance. There are no specified rates under regulation, but the charges applied must be made public.

COTs: Certificates of Transportation — A prepayment program offered by Burlington Northern Santa Fe (BNSF) that allows grain producers to prepay for future service at a locked-in rate set by the market through a bid system. Through a time-specific car guarantee (e.g., the purchaser of the COT will pledge to use at least twenty-five cars), shippers and receivers are better able to plan their logistics and thereby reduce demurrage, interest, and late shipment penalties. BNSF can also improve its efficiency through enhanced corridor management of power and equipment.

Country elevator: A rural warehouse and the initial part of the grain marketing system that evolved in the latter half of the 19th century across grain-producing regions of the United States and Canada. These warehouses, nostalgically recalled as "prairie skyscrapers,"

serve as assembly points for the receiving, weighing, storing, and transferring of farmer-produced grain.

Export elevators: Facilities that transship truck-, rail-, and barge-carried grain from inland sites to bulk carriers for maritime transport.

Feed mills: Facilities that process grain for livestock, dairy, and poultry consumption.

Flourmills: Facilities that process wheat to produce flour for human consumption.

Intermodal: The use of two or more modes to complete the movement of a shipment of freight or a passenger trip from origin to destination.

Interstate shipment: Traffic that originates in one state and terminates in another.

Intrastate shipment: Traffic that originates and terminates in the same state.

Linehaul railroad: A railroad principally involved in the movement of freight from one town or city to another.

Load center: A centralized location where grain can be stored and loaded rapidly onto rail cars. Such centers create advantages of scale and allow unit and shuttle trains to operate at maximum efficiency.

Rice driers: Facilities that dry newly harvested rice (green rice) so that it may be stored.

Rice mills: Facilities that process rough rice for human consumption.

Rough rice: Newly harvested rice that has been dried.

Rural Rail Districts: Rural Rail Transportation Districts are a special government entity authorized under the rail district law passed in 1981 (Article 6550c of Texas Revised Civil Statutes). Among other characteristics, these districts can be established by one or more counties; have eminent domain power; can construct new rail lines or acquire and rehabilitate existing rail lines; can be used to develop rail-served industrial parks, intermodal facilities, and transloading facilities; can issue revenue bonds to finance acquisitions and construction; must charge rents that are sufficient to maintain their properties and pay off their bonds; and cannot levy or collect ad valorem taxes. There are currently (2001) eleven rail districts established in Texas.

Short-line railroad: A railroad company whose operational scope is less than 100 miles.

Shuttle train: A heavy unit train, with 125-ton cars and the latest locomotive, operating on schedules that require fast turnaround. Shuttle trains are most efficient when routed through load centers.

STB: Surface Transportation Board — the federal body charged with enforcing acts of Congress affecting interstate rail traffic.

SWAPs: A Burlington Northern Santa Fe (BNSF) program whereby the company leases a privately owned rail car at market rates and brings it into its system, treating it as a controlled car. BNSF commits to a fixed turnaround for the period of the lease and the customer commits to loading it. Like COTs, SWAPs can be traded on the secondary market.

Terminal elevator: A large elevator (warehouse) facility with the capacity to transfer grain to rail cars, barges, or ships for transport to domestic or foreign markets. Terminal elevators receive much of their grain receipts from smaller country elevators.

Texas Trunk System: A highway system consisting of 10,500 miles that is part of an annually reviewed, 10-year plan for the Texas Department of Transportation to program highway projects. The primary goal of the Trunk System is to more efficiently move people by upgrading highways on the system from two-lanes to divided highways. This highway system, first approved in 1990, includes and complements the Interstate Highway System.

286,000 lb rail: The maximum gross weight of rail cars on rail (about 125 tons). This is *not* the weight of the rail.

Unit trains: An entire, uninterrupted locomotive-and-car set usually comprising over 100 grain cars.

Waybill: The document relating to a specific freight shipment. The document typically shows the forwarding and receiving stations, the name of the consignor and consignee, the car initials and number, the routing, the description and weight of the commodity, instructions for special services, the rate, total charges, advances and waybill reference for previous services, and the amount prepaid.

TEXAS GRAIN TRANSPORTATION STUDY

I. Introduction

This study reports on various aspects of grain transportation in Texas. Sections II and III identify the geographic location of grain production and grain consumption populations in Texas and the associated trends in Texas grain production and consumption populations over time. Identifying the geographic location of Texas grain production and consumption broadly defines the need or demand for transportation service. The fourth section (Section IV) reports on Texas' geographic grain flow patterns and the dependence of Texas grain producers and consumers on various transportation modes. Section V reports on trends regarding the use of rail and truck modes in grain transportation in Texas, while Section VI focuses on the perceived quality of transportation service provided to Texas grain handlers. Section VII summarizes the grain transportation situation in Texas. A discussion of Texas motor carrier and railroad firms engaging in grain transportation is included in Section VIII. Section IX identifies possible areas for legislative action by the State of Texas, while Section X summarizes the observations and recommendations of this study.

II. Texas Grain Production and Associated Trends

The purpose of this section is to offer background regarding Texas grain production and the location of that production. Grain transportation demands and flow patterns are determined by the geographic distribution of grain production and consumption — hence, the importance of this background to understanding grain transportation in Texas. In this study, we focus on Texas corn, sorghum, wheat, and rice. During the latter 1990s, the farm value of these Texas grains was about \$1.49 billion. Corn, sorghum, wheat, and rice represented about 97 percent of the total value of all grain production in Texas during the latter 1990s (Texas Agricultural Statistics Service).

Corn

Texas corn production expanded by over 60 percent during the 1990s, increasing from an average of 136 million bushels in 1988-1990 to 219 million bushels in 1998-2000. Figure 1* identifies Texas regions included in the following discussion; Figure 2a shows Texas corn production over 1980-2000, along with a dot map of planted corn acreage. As shown in the map, corn production is concentrated in the High Plains (62 percent), North and South Central Texas (25 percent), and Upper Coast (7 percent) (Figure 2a). Corn production in the High Plains is irrigated and comparatively constant relative to other regions (where a substantial portion of production is dry land).

Grain Sorghum

Texas grain sorghum production trended downward during the 1980s but exhibited no obvious production trend during the 1990s. Statewide production during the period 1998-2000 averaged 148 million bushels, an amount similar to estimated production in 1988-1990. Texas grain

* Figures and tables begin on page 29.

sorghum production tends to be geographically dispersed relative to corn production. Leading production regions include the High Plains (31 percent), North and South Central Texas (36 percent), Lower Valley (13 percent), and Upper Coast (11 percent) (Figure 2b). About half of the High Plains' sorghum production is irrigated, while comparatively modest portions are irrigated in remaining Texas regions (except in the Lower Valley, where one-third of the production is irrigated [see Figure 1]).

Wheat

Texas wheat production exhibited no trend during the 1990s after declining about one-third during the 1980s. Statewide wheat production averaged about 108 million bushels in 1988-2000. Leading production regions include the High Plains (52 percent), Low Plains (20 percent), and the North Texas (21 percent) regions (Figure 2c). About half of the High Plains wheat production is irrigated, with modest shares of production irrigated in remaining Texas regions.

Rice

Texas rice production in 1998-2000 averaged 15.9 million hundredweight (cwt). Recent production levels are about 80 percent of Texas rice production levels attained during the early 1990s and about 60 percent of Texas rice production levels attained in the early 1980s (Figure 2d). Texas rice production is concentrated in the Upper Coast (76 percent) and South Central (17 percent) production regions.

Summary of Texas Grain Production and Associated Trends

In summary, corn production in Texas during recent years has comprised about 43 percent of total grain production, while sorghum, wheat, and rice represented about 29, 21, and 7 percent, respectively. Only corn production in Texas has trended upward over the past decade; production of the remaining grains has trended downward or was without direction during the past decade. Corn, sorghum, and wheat production in Texas tends to be concentrated in several regions. They include the High Plains, North and South Central Texas, and Lower Valley, with about 51, 28, and 5 percent, respectively, of total grain production. During the latter 1990s, the High Plains dominated grain production, producing during this time about two-thirds of Texas' corn output, about half of its wheat production, and nearly one-third of the state's grain sorghum production. Rice production is concentrated in the Upper Coast, where about three-fourths of Texas production is grown.

III. Texas Grain Consumption Populations and Associated Trends

This section describes the major grain-consuming populations in Texas and their changes over time. Texas is the leading producer of fed cattle in the United States; the state also ranks sixth in broiler production and milk cow numbers, seventh in egg production, and seventeenth in hog and pig numbers. In addition, Texas leads the nation in beef cow, sheep, and lamb populations.

Fed Cattle

Fed-cattle production in Texas increased by about 19 percent during the 1980s and, similarly, by about 19 percent during the decade of the 1990s (Figure 3a). In 1998 and 1999, Texas feedlots marketed about 6.1 million head of fed cattle. Nearly 90 percent of Texas fed-cattle production is located in the High Plains (Figure 3a). Precise estimates of grain consumption are difficult, given that grain prices, fed-cattle prices, and other factors influence grain consumption. A survey of feedlots and nutritionists undertaken during the mid-1990s estimated that cattle fed in the Texas High Plains consumed about 2,800 lb (50 bu) of grain/head, while West and South Texas fed-cattle grain consumption was estimated at 2,150 lb (38.4 bu) and 1,870 lb (33.4 bu), respectively. Based on these consumption parameters and on 1998/1999 fed-cattle marketings, annual grain consumption is estimated to be about 295 million bushels. Beef cows, stockers, and feeders in Texas are estimated to annually consume about 7 million bushels of grain. Corn and grain sorghum are the principal grains used to fatten cattle, though during selected periods wheat may be included in the animal's ration.

Hogs

Texas hog marketings in 1999 reached a 25-year high of 1.32 million head (Figure 3b). Estimated grain consumption by market and breeding hogs in Texas was estimated to be about 19 million bushels in 1999. Based on December 1, 1999, hog inventory numbers, about 75 percent of Texas' hogs are located in the Texas High Plains. In addition, East and South Central Texas are estimated to include about 10 and 5 percent, respectively, of the Texas hog population. Hogs are fed rations that include corn and grain sorghum.

Broilers

Texas broiler production has increased each year since 1984, when production was 200.5 million birds. In 1999, Texas broiler production was estimated to be 507.9 million birds, a 153 percent increase relative to 1984 production (Figure 3c). East and South Central Texas annually make up about 85 and 15 percent, respectively, of Texas broiler production. Texas broilers are estimated to have consumed over 50 million bushels of grain in 1999. In 1999, Texas layers are estimated to have consumed about 13.5 million bushels of grain in the production of 4.3 billion eggs. Texas egg production is located in South Central (40 percent), East (32 percent), Upper Coast (15 percent), and North Central (8 percent) regions. Corn and grain sorghum are the principal grains fed to Texas poultry.

Dairy

Texas milk cow populations have declined since reaching a high of 400,000 head in 1996 (Figure 3d). In 1999, there were an estimated 340,000 head of milk cows in Texas. Milk cows and replacement heifers are estimated to have consumed about 30 million bushels of grain in 1999. Milk cows are concentrated in North Central Texas, which has about 56 percent of Texas' total milk cow population. East Texas included about 38 percent of the Texas milk cow population in 1999. Dairy cows and replacement heifers are fed rations that include corn, grain sorghum, other grains, and grain milling by-products.

Summary of Texas Grain Consumption Populations and Associated Trends

In summary, Texas includes important grain-consuming populations that annually consume in excess of 415 million bushels of grain. Rations of the consuming populations include significant quantities of corn and grain sorghum. The most important consuming populations are located in the High Plains and East Texas regions, which include comparatively large numbers of fed cattle, poultry, milk cows, and hogs. Other Texas areas with substantial grain-consuming populations include the North and South Central regions (Figure 1).

IV. Texas' Grain Flow Patterns

This section identifies not only important intra- and interstate grain transportation corridors, but also rail and motor carrier use on these corridors. A review of previous grain flow studies, commodity flow studies, and databases revealed only modest information on current grain flow patterns and utilized transportation modes. Because current commodity flow studies typically aggregate numerous commodities and often focus on one mode, it is difficult to identify grain movements and modal splits (Ghareib, Lamkin, and Burke; USDOT). Consequently, the perspective on Texas grain flow patterns and utilized transport modes was obtained by reviewing studies carried out in the 1970s, by analyzing the Master Railroad Waybill file for 1997/98, and by examining results of a survey distributed to Texas grain handlers in summer 2000.

Figure 4a identifies grain-handling firms in Texas and the anticipated grain flows among these firms. The schematic is generally applicable to feed grains (corn, sorghum) and wheat. Feed grains are primarily destined for livestock/dairy/poultry consumption and export, while most wheat moves to flourmills for ultimate human consumption and export (Figure 4a). Figure 4b provides a perspective on Texas rice handling firms. Most Texas rice is transported from farm to nearby driers for reduction of moisture content; after drying, the rice kernel, because it still includes its hull, is referred to as *rough rice*. Rough rice may be directly exported (to port elevator or to the Mexico border) or it may be transported to a mill for processing. The milled rice is exported or moved into domestic consumption channels (Figure 4b).

Historic Texas Grain Flow Patterns

A Texas grain flow study on corn, sorghum, and wheat was conducted in the mid-1970s, when these crops' respective production levels were about 26, 200, and 60 percent of current levels and when major grain-consumption populations were about 60 percent of current levels. The corn flow study showed that about two-thirds of Texas elevators' corn was shipped to Texas feed yards; thus, livestock feeding operations were the principal market for Texas corn production during the mid-1970s. In addition, about 13, 12, and 8 percent of Texas elevators' corn shipments were to other inland Texas elevators, Texas export elevators, and Texas feed mills, respectively (Fuller and Knudsen 1977). The survey showed that over 95 percent of the corn transported from Texas elevators to Texas feed yards was transported by truck, with most of this trade located in the High Plains. On average, about two-thirds of the corn transported between Texas elevators was carried by truck, with the remainder transported by rail. In addition, the 1974 study showed that over 95 percent of Texas elevators' corn shipments to Texas export elevators were

transported by railroads, with most of the corn exports originating in the High Plains. About 85 percent of Texas elevators' corn shipments to Texas feed mills were carried by railroads.

The mid-1970s' Texas grain sorghum flow study showed that nearly half of Texas elevators' sorghum shipments were to Texas export elevators; however, the portion destined for the export market differed by Texas region, as did the modal split (Fuller and Knudsen 1977). For example, about 20 percent of the High Plains' sorghum moved to export, with about 97 percent transported by railroads. By contrast, in the Texas Coastal regions and South Texas, about 85 percent of all sorghum was exported via Texas ports, with over 90 percent transported to port by truck. About half of the High Plains' sorghum was destined for Texas feedlots and about 98 percent was truck transported. In other Texas regions, feed yards received 3 to 70 percent of elevators' sorghum shipments; about 97 percent of these flows were truck transported. On a statewide basis, about 9 and 4 percent of Texas elevators' sorghum shipments were to other Texas elevators and feed mills, respectively, and about two-thirds of these flows were transported by rail.

Based on a mid-1970s' wheat flow study, nearly 75 percent of Texas grain elevators' wheat shipments were to Texas export elevators; thus, during this period the export market was the principal destination for Texas wheat production (Fuller, Paggi, and Engler 1977). In the Texas Plains, over 90 percent of the wheat shipped to Texas ports was transported by rail. The second most important destination for Texas elevator wheat shipments was other elevators, which received an estimated 22 percent of the shipments. About half of the wheat shipments to other Texas elevators were rail transported, while 95 percent of shipments to out-of-state elevators were carried by rail. During the 1970s, railroads in the south plains (Kansas, Oklahoma, Texas) featured a transit-rate structure. This rate structure, which allowed grain shippers to transship grain at selected inland terminal sites without a rate penalty, accounts for the substantial wheat shipments from Texas elevators to other elevators during this period.

Rail-Transported Grain Flow Patterns Involving Texas

To identify current, railroad-transported grain flows involving Texas grain handling firms, data were obtained from the Master Railroad Waybill file for corn, grain sorghum, wheat, and rice for 1997 and 1998. These data were used to identify major Texas intrastate and interstate grain flows and the transportation characteristics associated with these rail-transported flows. To assure grain-firm confidentiality, only grain flows between comparatively large geographic regions (BEA) were identified. Figure 5 is a U.S. map showing associated BEA regions.

In 1997 and 1998, BEAs in Texas were estimated to have received 15.7 million tons (545.9 million bushels) and 21.7 million tons (749.3 million bushels), respectively, of rail-transported grain (corn, grain sorghum, wheat, and rice). For these respective years, an estimated 2.2 (75.9 million bushels) and 2.5 million tons (86.3 million bushels) of these receipts involved an intra-Texas movement. On average, wheat comprised about half of all rail-transported, intrastate grain receipts in Texas, while corn, sorghum, and rice made up about 34, 14, and 2 percent, respectively, of total receipts. Grain shipments from Texas to out-of-state destinations were comparatively small. In 1997 and 1998, about 0.9 million tons (31.5 million bushels) of grain were shipped by rail from Texas to out-of state destinations; in both years, wheat represented about 75 percent of these shipments.

Corn

Table 1 identifies rail-transported corn flows from identified states to BEA regions in Texas in 1998. In 1998, BEA regions in Texas received over 8 million tons (286.27 million bushels) of corn. This corn originated in twelve different states (including Texas) and was destined to thirteen Texas BEA regions. The principal originating states included Nebraska (44 percent), Iowa (13 percent), Kansas (11 percent), Illinois (9 percent), Texas (9 percent), and Missouri (8 percent). The primary destinations for these shipments were the High Plains (29 percent) (BEAs 137 and 138); BEA 134, which surrounds San Antonio (22 percent); BEA 131, which includes the Upper Coast (21 percent); and BEA 127, which includes East and North Texas (17 percent). As noted above, the High Plains includes large grain-consuming populations (fed cattle and hogs), as does East and North Texas (broilers, dairy cows, laying hens, and hogs), with such populations accounting for the importance of these regions as destinations for corn receipts. BEA 131 (Upper Coast) includes a significant poultry population and is the location of export terminals at Houston and Galveston. In 1998, North Texas ports exported about 0.65 million tons (23.2 million bushels) of corn, which, in part, was probably delivered by rail. BEA 134 includes important poultry populations (Gonzales County) and also includes Laredo, the principal gateway for overland corn exports to Mexico. A review of the 1997 Waybill data showed a similar geographical distribution of Texas corn receipts/shipments; however, involved flows were about two-thirds of those in 1998.

In 1998, railroads transported about 0.72 million tons (25.61 million bushels) of corn from Texas origins to Texas destinations (intrastate) (Table 2). The principal intrastate corn movements involved shipments from BEA 131 to BEA 138 (0.32 million tons), from BEA 132 to BEA 134 (0.18 million tons), and from BEA 127 to BEA 138 (0.14 million tons). BEA 138 (High Plains) received about two-thirds of all rail-transported corn receipts, while BEA 134 was the destination for about 28 percent of receipts. BEAs 131 and 132 shipped approximately 45 and 24 percent, respectively, of all intrastate corn shipments.

Tables A1, A2, A3, A4, and A5 (Appendix A) provide more detailed rail transportation information about major corn movements. In 1998, railroads shipped an estimated 0.94 million tons (33.5 million bushels) of corn from central Nebraska (BEA 120) to the Texas High Plains (BEA 138) (Table A1). This amount was the largest interregional corn flow involving a Texas region in 1998. Approximately two-thirds (65 percent) of this movement involved 52–103 cars per shipment: the average rail rate for these shipments was \$19.73/ton (\$0.55/bu). An estimated 3, 27, and 5 percent of shipments involved 6–25, 26–51, and >103 cars, respectively. The average rate for all shipments was \$19.69/ton. Tables A2, A3, A4, and A5 show similar information for additional corn shipments to Texas destinations.

Grain Sorghum

In 1998, an estimated 2.89 million tons (103.54 million bushels) of rail-transported grain sorghum were received at Texas BEAs from five states, including Texas (Table 3). The principal sorghum-originating states were Kansas (80 percent), Texas (12 percent), and Nebraska (6 percent). About one-third (33 percent) of the shipments were to BEA 134, a region having an important poultry population (Gonzales County) and a major border crossing into Mexico (Laredo). BEAs 131 and

87 received an estimated 27 and 10 percent of sorghum receipts, respectively. These two regions include ports at Houston/Galveston/Beaumont (North Texas ports) and poultry populations. BEA 132, which surrounds the Corpus Christi port, received in 1998 an estimated 0.21 million tons of rail-transported sorghum. The USDA estimates 1998 sorghum exports from North and South Texas ports to be 1.20 and 0.31 million tons, respectively, about 36 percent of the total U.S. sorghum exports. Significant quantities of sorghum were also received in North and East Texas (BEA 127), the location of important poultry, dairy cow, and hog populations. In 1998, Texas shipped small quantities of grain sorghum (0.02 million tons/0.61 million bushels) to out-of-state destinations. The geographic flow patterns for sorghum in 1997 were similar to those in 1998; however, flows were about 85 percent of those in 1998.

Table 4 shows that railroads transported an estimated 0.33 million tons (11.95 million bushels) of grain sorghum among Texas sites (intrastate) in 1998. Most of these shipments (72 percent) were from BEA 132 (Corpus Christi area) to BEA 134, which includes Laredo, an important crossing point into Mexico.

Tables A6, A7, A8, and A9 include additional rail transportation information on major interstate/intrastate grain sorghum flows involving Texas. In 1998, railroads shipped an estimated 0.53 million tons (18.9 million bushels) of sorghum from central and west Kansas (BEA 122) to Texas BEA 131, the location of the Houston/Galveston ports and a poultry population (Table A12). Approximately 70 percent of this rail-transported flow involved 52–103 cars per shipment. The average rate for these shipments was \$14.49/ton (\$0.41/bushel). An estimated 16 percent of this flow involved >103 cars per shipment that moved at an average rate of \$11.73/ton (\$0.33/bushel). Remaining tables detail rail shipments from Kansas (BEA 122) to Texas BEA 134 and from Texas BEA 132 to Texas BEA 134.

Wheat

Table 5 shows rail-transported wheat flows from various states (including Texas) to Texas BEA regions in 1998. An estimated 10.65 million tons (355.23 million bushels) of wheat were received in Texas BEAs from thirteen states (including Texas). Over 90 percent of all wheat receipts originated in Kansas (55 percent), Oklahoma (17 percent), Texas (15 percent) and Colorado (5 percent). In 1998, the leading BEA destinations in Texas were BEAs 131 (70 percent), 127 (11 percent), 87 (7 percent), and 132 (6 percent). BEA 131 received an estimated 7.39 million tons (246.55 million bushels) or nearly 70 percent of Texas' wheat receipts. The fact that BEAs 131 and 87 include the Houston/Galveston/Beaumont ports as well as a flourmill accounts for the large shipments to these destinations. In 1998, the USDA estimated north Texas ports (Houston/Galveston/Beaumont) exported 7.62 million tons (254.27 million bushels). Another important destination BEA 132 includes is the Corpus Christi port. The USDA estimates that South Texas ports (Corpus Christi/Brownsville) exported 0.99 million tons (33.11 million bushels) of wheat in 1998 and that North and South Texas ports exported 8.62 million tons (287.38 million bushels), about 29 percent of total U.S. wheat exports. BEA 127 includes Ft. Worth, a major transshipment center (inland terminals) for Texas, Kansas, and Oklahoma wheat (accounting for its importance as a destination for wheat shipments to Texas). In addition, BEA 127 includes several flourmills. BEA 134 includes two flourmills and Laredo, which is a major rail-crossing location for grain exports to Mexico and, hence, a major wheat destination (Table 5).

In 1997, geographical wheat distribution patterns were similar to those in 1998, however, flows were about 75 percent of 1998 flows.

An estimated 0.78 million tons (25.92 million bushels) of interstate wheat shipments originated in Texas during 1998. Approximately 97 percent of the out-of-state shipments originated in the Texas Plains (BEAs 137 and 138) and about 90 and 7 percent of these shipments were destined to California and Arizona, respectively.

In 1998, rail-transported intrastate movements of wheat in Texas were estimated to be 1.63 million tons (54.28 million bushels) (Table 6). About two-thirds (65 percent) of Texas' wheat shipments originated in BEA 127, a major transshipment location (Ft. Worth) and Texas wheat production area. BEA 138 in the Texas Plains originated 24 percent of Texas' intrastate wheat shipments. Remaining originating regions (BEAs 128, 129, 130, 134, and 137) originated 3 percent or less of all intrastate, rail-transported wheat movements. In 1998, BEAs 131 and 87 (North Texas ports) were the destinations for over three-fourths (76 percent) of Texas' intrastate wheat movements, while BEAs 132 and 127 received an estimated 9 and 8 percent, respectively, of total wheat receipts.

Tables A10, A11, A12, A13, A14, and A15 provide additional information on railroad-carried wheat movements involving Texas. In 1998, the largest inter-BEA wheat flow (3.56 million tons/118.56 million bushels) involved shipments from central and west Kansas (BEA 122) to BEA 131 (North Texas ports) (Table A10). Approximately 50 percent of this flow involved 52–103 cars per shipment at an average rate of \$17.01/ton (\$0.51/bushel), while 36 percent of the total movement involved >103 cars per shipment at an average rate of \$15.38/ton (\$0.46/bushel). The remaining tables relate similar information for shipments from central Oklahoma (BEA 125) and Texas High Plains (BEA 138) to BEA 131 (North Texas ports).

Rice

Texas BEAs received about 0.31 million tons of rough rice from five states (including Texas) in 1998 (Table 7). Arkansas originated nearly half (48 percent) of these shipments, with remaining receipts from Louisiana (22 percent), Missouri (13 percent), Texas (12 percent), and California (5 percent). Virtually all shipments (96 percent) were to BEA 134, which includes Laredo, the leading border crossing into Mexico. It is presumed that nearly all rough rice shipments to BEA 134 were destined for export to Mexico. The 1998 Waybill shows Texas' rough rice shipments originated in BEA 131, the major rice producing region in Texas, and were shipped to BEA 134, the principal border crossing point for exports to Mexico (Table 8).

Tables A16 and A17 provide detailed information on rail-transported rough rice shipments from Arkansas (BEA 90) and Louisiana (BEA 89) to Texas BEA 134. Nearly 80 percent of the rough rice shipments from Louisiana BEA 89 to Texas BEA 134 involved 6–25 cars per shipment. The average rate on these rough rice shipments was \$20.65/ton. Remaining flow involved <5 cars per shipment. By contrast, nearly three-fourths (73 percent) of the rice shipments from Arkansas BEA 90 to Texas BEA 134 involved <5 cars per shipment; the average rate on this move was \$23.74/ton.

Appendix B contains an econometric analysis of factors affecting railroad rates in Texas. The analysis employs data from the Master Railroad Waybill file.

Texas Grain Flow Patterns Based on 2000 Survey

Additional information on Texas grain flow patterns, utilized truck and railroad modes, and perceived performance of carriers by Texas grain handlers was obtained via a survey sent to Texas country elevators, terminal elevators, export elevators, feed mills, flourmills, rice driers, and rice mills. This section reports on the responses received from country elevators, terminal elevators, feed mills, and rice driers regarding grain flow patterns and utilized transportation modes. Responses from export elevators, flourmills, and rice mills are not included (it was deemed that their populations and usable returns were so small that published results could inadvertently reveal proprietary information). Appendix C contains the country elevator survey instrument and the response rate of sampled populations. Surveys sent to other Texas grain handlers were similar to that supplied to country elevators.

Corn

Table 9 includes information on Texas country elevators' corn shipments to various markets and utilized transport modes, while Tables 10 and 11 relate corn receipts/shipments of Texas terminal elevators and feed mills, respectively. Country elevators are central to the marketing of Texas grain production, given that these firms receive the majority of off-farm grain sales. Survey results showed Texas feeders to be the principal destination for country elevators' corn shipments, and trucks to be the primary carrier. In the leading production regions — High Plains (62 percent), North Texas and South Texas (25 percent), and Upper Coast (7 percent) — an estimated 96, 52, 43, and 70 percent of respective corn shipments were made to Texas feeders, with virtually all shipped by truck (Table 9). Texas processors, Texas terminals, and Mexico were identified as significant markets for country elevators in North and South Central Texas. In all cases, trucks transported from 67 to 100 percent of all corn flows. Interestingly, Mexico is a significant destination for country elevator corn shipments in five of the seven Texas regions. Responses from Texas terminal elevators (Table 10) and feed mills (Table 11) reinforced the Master Railroad Waybill file data, which showed large quantities of rail-transported corn shipments from Corn Belt origins to the High Plains, North Central, and East Texas regions. Texas terminals in the east and west half of Texas (Table 10) and feed mills in the eastern half of Texas (Table 11) showed that from 77 to 98 percent of corn receipts were from out-of-state locations, with railroads being the principal transporter of these flows.

In summary, motor carriers and railroads are important suppliers of transportation service to Texas corn producers and consumers. Much of Texas' corn production appears to be transported to regional markets (Texas feeders and processors) by truck, while imports from Corn Belt origins are mostly transported by railroads. Corn supplies from Corn Belt origins supply the grain consumption needs of Texas' cattle, poultry, and dairy industries.

Grain Sorghum

Respondents to the country elevator survey in the High Plains (31 percent production share) indicate that about 80 percent of their sorghum shipments went to Texas feeders and that all such shipments were transported by truck (Table 12). Similarly, country elevators in the Low Plains, Edwards Plateau, North Central, and Upper Coast regions of Texas shipped important quantities of sorghum by truck to Texas feeders. Texas Gulf ports and Mexico were important destination markets for country elevators in the eastern half of Texas. In the North and South Central regions (36 percent), nearly one-fourth of country elevators' sorghum shipments went to Texas Gulf ports, while an estimated 47 percent of Upper Coast (11 percent) shipments went to Texas Gulf ports. South Central elevators indicate that about 58 percent of sorghum shipments went to Mexico, while the Lower Valley (13 percent) elevators estimate that about 96 percent of sorghum shipments went to Mexico. In general, trucks were the primary transporters of sorghum to Gulf ports and Mexico, though the actual modal split varies by region. In North Central Texas, the truck and rail modes transport similar quantities to Gulf ports, while rail was estimated to transport 100 percent of the region's sorghum exports to Mexico. In the South Central, Upper Coast, and Lower Valley regions, from 85 to 100 percent of all sorghum shipments to Gulf ports and Mexico were estimated to be truck transported (Table 12). Terminal elevators in the east and west half of Texas received most sorghum from Texas origins by truck (Tables 13). About two-thirds of Texas terminal's sorghum shipments went to Texas feeders and processors; virtually all were truck transported. Remaining shipments were to Arizona/California, Kansas/Oklahoma, Mexico, and other locations where a variety of truck and rail modes were used. Reporting feed mills in the east and west half of Texas received over 90 percent of their sorghum receipts from Texas origins and from 90 to 100 percent was truck transported (Table 14).

In summary, grain sorghum production in the western half of Texas is largely dependent on motor carriage for transportation to Texas feeders and processors, a significant outlet for this area's production. Gulf ports and Mexico are important markets for regions in the eastern one-half of Texas, and in most regions motor carriers are the primary transport mode; however, in selected supply regions, railroads play important roles in serving these markets. The survey showed that comparatively small quantities of sorghum were received from out-of-state sources by truck and rail modes.

Wheat

Country elevators in the High Plains (52 percent production share), Low Plains (20 percent), and North Central Texas (21 percent) shipped most wheat to Texas Gulf ports and Texas terminal elevators; however, in the High Plains, Arizona/California was an important destination (Table 15). High Plains wheat production was highly dependent on railroad transport, with virtually all shipments to Texas Gulf ports (21 percent of shipments) and Arizona/California destinations (31 percent of shipments) carried by this mode. In the Low Plains, an estimated 13 and 85 percent of the respective wheat shipments were to Texas Gulf ports and Texas terminals, whereas in the North Central region, 43 percent were destined for Gulf ports and 34 percent to Texas terminal elevators. Railroads in the Low Plains and North Central region transport about 57 percent of country elevators' wheat shipments to Gulf ports; in all three major producing regions, from 83 to 100 percent of the shipments to Texas terminal elevators were truck transported. Terminal

elevators in the eastern half of Texas indicate that about half of their wheat receipts originate in Texas, with other known supplies coming from Oklahoma (25 percent) and Kansas (8 percent) (Table 16). From 67 to 100 percent of these flows were transported by truck. Terminal elevators in East Texas shipped about 90 percent of their wheat shipment to Gulf ports and 10 percent to flourmills. All shipments to Gulf ports were rail carried, while all shipments to flourmills were transported by truck. Terminal elevators in the western portion of Texas indicate that 85 percent of their wheat receipts came from Texas origins, with remaining wheat originating in Oklahoma (3 percent) and Kansas (9 percent); from 95 to 100 percent of these receipts were truck transported (Table 16). An estimated 30 and 62 percent of this area's terminal elevator wheat shipments were to Texas Gulf ports and Arizona/California destinations, respectively, and from 76 to 96 percent of these flows were carried by railroads (Table 16).

In summary, Texas wheat production tends to be more highly dependent on rail transportation than does other Texas grain production; however, trucks are important at various stages of the marketing process. In the High Plains, country elevators ship about half of their wheat shipments to Gulf ports and Arizona/California destinations, with all shipments going by rail. Similarly, terminal elevators in this region ship most wheat to these destinations, with 75 to 96 percent being rail transported. Country elevators in other major producing regions (Low Plains and North Central) shipped important quantities to Gulf ports; about 57 percent of these flows went by rail. Terminal elevators in the eastern half of Texas made 90 percent of their wheat shipments to Gulf ports; all shipments were transported by railroads. Country elevators in the three major wheat-producing regions shipped important quantities of wheat to terminal elevators (27 to 85 percent) and most (> 83 percent) were truck transported. Thus, Texas wheat is dependent on both transport modes for reaching its most important markets.

Rice

Rice production in Texas is concentrated in the Upper Coast (76 percent) and South Central (17 percent) regions. Table 17 shows that Texas rice driers shipped about 84 percent of their rough rice to Texas mills, and that all shipments were transported by truck. The second most important destination for driers' rough rice shipments was Mexico (12 percent), with an estimated 73 and 27 percent rail and truck transported, respectively. Approximately 3 percent of the rough rice shipments were destined for Texas Gulf ports; all shipments were truck transported.

In summary, rice production in Texas is highly dependent on motor carrier transportation, with over 90 percent of all rough rice shipments being carried by truck.

V. Trends in Transport Mode Use Based on 2000 Survey

To determine trends in transport mode use, the researchers asked personnel at country elevators, feed mills, and rice driers to identify whether their use of the truck/railroad modes had increased or decreased over the past 5 years and why. Tables 18 through 23 summarize the respondents' answers to these questions. Thirty-six percent of the country elevator respondents indicated that truck-transported grain shipments had increased over the past 5 years by an average of almost 60 percent, while 11 percent noted an average decrease in truck shipments of 37 percent (Table 18). Half of the respondents who had increased truck shipments cited "worse rail service" as the

reason for increased truck use, while “rail abandonment” and “change in market location” were offered by 26 and 21 percent of the respondents, respectively, as the reasons for increased truck usage. For those who had decreased their truck shipments, “worse truck service” and “better rail service” were cited by 86 and 14 percent of the respondents, respectively, as the reasons for the decreased truck use.

Country elevator personnel were also asked whether rail shipments of grain had increased or decreased over the past 5 years and the reasons for any changes (Table 19). Fourteen percent of the respondents indicated that their rail shipments had increased an average of 38 percent over the past 5 years, while 60 percent indicated an average decrease in rail shipments of 58 percent. Half of those respondents who had increased rail shipments cited “worse truck service,” while “change in market location” and “better rail service” were equally cited as the reasons for increased railroad shipments. Two-thirds of the elevator personnel indicated “worse rail service” as the reason for declining railroad shipments, while “change in market location” and “better truck service” were offered by 26 and 9 percent, respectively, for the decreased use of railroads (Table 19).

Feed mill survey results also suggest an increased use of truck and a decreased use of railroads in grain procurement, while rice drier results seem to suggest the opposite (Tables 20, 21, 22, and 23). However, for both surveys, the returns are sparse; consequently, some caution in interpretation is required.

VI. Perceived Performance of Truck and Rail Modes Based on 2000 Survey

This section reports on Texas grain handlers’ perceptions regarding the performance of serving motor carriers and railroads. The results report on responses obtained from personnel at country elevators, feed mills, terminal elevators, export elevators, and rice driers. Respondents ranked carriers on ten transport service attributes by identifying a number ranging from 1 through 5 that best reflected the perceived performance of the carrier, where 1 = poor performance and 5 = excellent performance. The ten transport service attributes, identical for trucks and railroads, are identified in Tables 24 through 33.

Table 24 relates the average performance scores offered by Texas country elevator operators for motor carrier service in eight Texas regions; statewide average scores are also provided. Average scores for each of the ten attributes in most Texas regions range between 3 and 4. A score of 3.0 suggests acceptable or average performance, since it is the central number in the scale; thus, the scores given by country elevators for truck performance indicate an above average to good performance for all identified service attributes. The highest average statewide scores were given for the service attribute “transit time,” with a score of 3.96, while the lowest scores were for “equipment quality” and “financially responsible,” with average scores of 3.48 and 3.50, respectively. Scores offered by personnel at Texas feed mills, terminal elevators, port elevators, and rice driers regarding motor carrier performance were similar to those offered by Texas country elevator personnel (Tables 25–27).

Table 28 includes average performance scores offered by Texas country elevator operators for railroad service in five Texas regions; statewide average performance scores are also provided. In general, the scores supplied by country elevators regarding railroad performance were considerably lower than those offered for motor carrier performance. Only three of the railroads' statewide performance scores were near 3.00; they include "equipment quality," with a score of 2.98, and "loss and damage claims" and "financially responsible," with scores of 3.00 and 3.22, respectively. The remaining scores for various service attributes ranged from 1.92 for "prompt pick-up and delivery," to 2.48 for "reasonable rates for service offered." The greatest dissatisfaction was associated with obtaining railroad service and with the rate or speed at which railroads provided service to the country elevators. This dissatisfaction was reflected by the comparatively low performance score associated with "prompt pick-up and delivery" (1.92), "readily available" (2.06), and "ease of arranging shipment" (2.12). Feed mills also indicated dissatisfaction with railroad performance, with statewide performance scores ranging from 1.83 to 2.67 for the various service attributes (Table 29). Export elevator operators report somewhat better railroad performance, with their scores ranging from 2.00 to 3.5 (Table 30). Interestingly, terminal elevator and rice drier operations give railroads comparatively high performance scores. Terminal elevator operators gave railroads a performance score of 3.00 or more on six of the ten service attributes, while remaining attribute scores ranged from 2.55 to 2.89 (Table 31). Rice driers indicated railroad performance scores ranging from 3.0 to 4.0 for all service attributes (Table 30).

Additional perspective on railroad performance was gained by asking grain handlers whether inadequate rail service had unfavorably affected their grain prices or earnings. Fifty-seven percent of the country elevator operators indicated that their farmer bid price was lowered an average of \$0.14/bushel about 45 percent of the time because of inadequate rail service (Table 32). About one-fourth of the feed mills and one-third of the terminal elevators also indicated that inadequate railroad service had unfavorably affected their prices/earnings (Tables 33, 34, and 35).

In summary, Texas grain handlers report motor carrier performance to be above average to good, while important segments of the Texas grain industry suggest comparatively poor railroad performance. Country elevators, a critical link in the Texas grain marketing system, give railroads below-average performance scores for seven of the ten service attributes. The greatest concern centers on country elevators' inability or difficulty in accessing railroad service and on the promptness of the railroads in providing service.

VII. Summary of Grain Transportation in Texas

The purpose of the previous sections was to provide information regarding Texas grain production and its geographic location, Texas grain production/consumption trends, the dependence of Texas grain production/consumption industries on railroad and truck transportation, and the quality of transportation service provided to Texas grain handlers by trucks and railroads.

This study focuses on Texas corn, grain sorghum, wheat, and rice production, given that these four grains comprise about 97 percent of the total value of all grain production in Texas. Annually, Texas farmers produce in excess of 500 million bushels — or 14 million tons — of

these four grains. Corn production in recent years has represented about 43 percent of the total production of these four grains, while grain sorghum, wheat, and rice have represented about 29, 21, and 7 percent, respectively, of production. Corn and grain sorghum are feed grains that are largely consumed by livestock/poultry/dairy populations, while wheat and rice are food grains that are primarily destined for human consumption. Grain consumption by the livestock/poultry/dairy populations in Texas is estimated to annually exceed 415 million bushels; consequently, there is a need for Texas to import feed grains for these grain-consuming populations.

Corn production in Texas has expanded by over 60 percent during the decade of the 1990s, while the production of the remaining grains has been comparatively constant or has trended downward. By contrast, the Texas fed-cattle population increased by about 19 percent during the decade of the 1990s, after displaying an equivalent percentage increase during the 1980s. Further, since the mid-1980s, broiler production in Texas has increased by about 153 percent. Fed-cattle production is responsible for about 72 percent of grain consumption by Texas livestock/poultry/dairy populations, while an estimated 12 percent is consumed by broilers.

Grain production in Texas is largely confined to the High Plains, Rolling Plains, North Central, South Central, Upper Coast, and Lower Valley regions. The High Plains dominates with respect to grain production: It produces nearly two-thirds of Texas' corn output, about half of its wheat production, and about one-third of its sorghum production. The High Plains, North and South Central Texas, and the Lower Valley produce about 51, 28, and 5 percent, respectively, of total grain production in Texas. Rice production is concentrated in the Upper Coast region. The High Plains, with about 90 percent of Texas' fed-cattle production, is a leading grain-consuming region. East Texas, North Central, and, to a lesser extent, South Central are also important grain-consuming regions, with important poultry, milk cow, and hog populations.

Obtained information on grain flows and utilized transportation modes indicates large quantities of truck and rail-transported grain enter Texas from out-of-state origins. Much of this grain is corn, which is transported by railroads from Corn Belt origins to grain-deficit regions in the Texas High Plains, North Texas, and East Texas. For example, in 1998, an estimated 286 million bushels of rail-transported corn were received in Texas from various sources, while an estimated 30 percent was destined for the grain-deficit High Plains and 17 percent was destined for the grain-deficit North and East Texas regions. In addition, large quantities of rail-transported corn were shipped to U.S.-Mexico border regions for export to Mexico and to regions having Texas port facilities. Further, in 1998, an estimated 355 million bushels of rail-transported wheat were received in Texas, with about 77 percent destined for Texas port regions and 11 percent destined for North Texas, a region that includes numerous terminal elevators that tranship wheat prior to its final shipment to region flourmills and to Texas Gulf ports. Also, in 1998, an estimated 104 million bushels of rail-transported grain sorghum were received at Texas destinations. Much of this grain was destined for export via Gulf ports and via overland means to Mexico, with smaller quantities received in Texas poultry production regions. In summary, Texas destinations in 1998 received about 745 million bushels of rail-transported wheat, corn, and grain sorghum.

A survey of Texas grain handlers offered useful insight into markets for Texas-produced grain, utilized transportation modes, trends in mode use by Texas grain handlers, and quality of service

offered by trucks and railroads. Results show truck to be an extremely important transporter of Texas-produced grain, with railroads playing important roles for selected grains on particular corridors. In the High Plains, a leading Texas grain producing region, most corn and grain sorghum production is marketed to Texas feeders; all shipments are truck transported. By contrast, High Plains wheat production is dependent on both truck and rail modes. Truck is central for the assembly of wheat from country elevators to terminal elevators, while rail is central for the movement of wheat from country elevators and terminals to Texas Gulf ports and to Arizona/California. A similar dependency on truck and rail modes for wheat transportation was shown in the Low Plains and North Central regions, the other primary wheat-producing regions in Texas. Corn production in the eastern half of Texas is largely destined for Texas feeders and processors (where truck haulage dominates) and, to a lesser extent, Gulf ports and Mexico (where the rail and truck modes play important roles). Grain sorghum production in the eastern half of Texas is largely destined for Texas Gulf ports, Texas feeders and processors, and Mexico. Shipments to Texas feeders and processors are largely truck transported, while trucks and railroads are used on remaining shipments. In general, truck dominates if the grain sorghum shipping region is comparatively close to Gulf ports or Mexico, while rail and truck modes share shipments if the shipping region is more remote. Virtually all rough rice production in Texas is truck transported to its various markets — except for exports to Mexico, which are mostly transported by rail. In summary, the truck mode is central to the marketing of Texas grain; however, rail is critical for transportation of selected grains on various routes.

Respondents to the Texas country elevator and feed mill surveys indicated that about one-fifth was without rail service because of rail line abandonment, while one-third of the rice driers indicated that their rail line had been abandoned. Further, over 33 percent of the country elevator operators observed that their use of trucks had increased over the past 5 years by an average of 60 percent, while 60 percent of the country elevator respondents noted that their use of railroads had decreased an average of 38 percent. A minority of country elevator operators (11 percent) noted a reduced use of trucks and an increased use of railroad (14 percent). These findings suggest that Texas highways are increasingly used in the marketing of Texas grain, and that a few country elevators may be upgrading their facilities to accommodate large, multi-car grain shipments (hence, the increased use of rail transportation by a few selected elevators).

Survey results show Texas grain handlers believe their motor carrier service is above average (satisfactory) to good. By contrast, most Texas grain handlers indicate some dissatisfaction with the railroads and the service they offer. Country elevators give railroads a below-average performance score for seven of ten service attributes. The greatest concern centers on grain handlers' inability or difficulty in obtaining railroad service and on the promptness of the railroad in providing service. About half of the country elevator respondents indicated that inadequate rail service had at times required them to lower their grain bid price to farmers an average of \$0.14/bushel. Country elevators and feed mills indicated most dissatisfaction with railroads, while terminal elevators and other larger shippers were more satisfied with the quality of railroad service being offered.

VIII. Railroads and Motor Carrier Grain Transportation in Texas

This section examines the services provided by both railroads and the motor carrier industry in the movement of Texas grains. The first part, based on a literature review of U.S. railroad services, discusses the changing nature of the industry following deregulation, the business approach developed by the industry, pricing policies, issues related to branch lines and abandonment, and current problems facing U.S. railroad companies. After conducting the literature review, the researchers contacted personnel at Burlington Northern Santa Fe (BNSF) and Union Pacific (UP) — the two primary Class 1 railroads in Texas — and asked them to comment on the service rankings reported in Section VI. Their comments are reported in the form of a case study subsection. Further information on shortline operation and rural rail districts was accessed through personal interviews with specialists in both areas. And in order to evaluate the expanding role of trucking in the movement of Texas grain, a survey of grain motor carriers was undertaken to gather information not only on grain haulage by truck, but also on emerging issues. Their responses are detailed in Appendix D. Section VIII closes with some general comments concerning both modes and their role in the movement of Texas grains.

Introduction

Historically, rail and barge provided the key transportation needs in the development of the U.S. grain industry, with networks of state rail lines and elevators reflecting the various regional market conditions facing the grain industry. In the last century, as trucking took an increasing portion of the railroad's business (particularly following the commencement of the Interstate Highway System in the 1950s), railroads became increasingly uncompetitive and, as a consequence, saw their market share drop, as shown in Figure 6. The evolution of the U.S. railroad industry in the last three decades of the twentieth century can be marked by three stages: (1) the movement toward deregulation; (2) the immediate consequences of deregulation, which included abandonment and the growth of intermodal movements; and (3) a period of large railroad mergers in the 1990s (Larson and Spraggins 2000). During this three-decade period, the importance of rail as a grain carrier increasingly diminished, as shown in Figure 7 (for corn and wheat).

The Staggers Act of 1980, which deregulated the U.S. railroads, is of particular interest in understanding the current rail issues related to the transportation of grain. The bankruptcy of the Penn Central Railroad in 1970 underscored the myriad problems facing U.S. railroads and prompted federal and state policymakers to address the historical regulations and conditions imposed on railroads through the formation of the Interstate Commerce Commission (ICC) in 1887. The Interstate Commerce Act of the same year, which was in fact the basis for the formation of the ICC, prohibited price discrimination in the railroad industry and required that rail rates be just and reasonable to all customers, irrespective of size. The act required that railroads publish their rates and that they allow access to all shippers that needed to use railroads in the movement of their cargos. It further required that railroads petition the ICC whenever they needed to change the current rate structure. In addition, the ICC made the abandonment of railroad networks difficult, time consuming, and costly. Finally, contracts were prohibited, a move that effectively prevented the development of individual price-service contracts to specific shippers.

The price control and inflexibility in adjustment, some have argued, constrained the innovation that would have lowered costs and kept the railroads more competitive (Gellman 1971).

Regulatory reform began with the Regional Rail Reorganization Act of 1973, passed primarily to restructure the northeastern network following the collapse of the Penn Central Railroad. This 1973 act was followed by the Railroad Revitalization and Regulatory Reform Act of 1976, which relaxed regulation of railroad rates, mergers, and abandonment. However, the key piece of legislation in railroad deregulation is the Staggers Rail Act of 1980. This act allowed greater pricing freedom, expedited abandonment procedures, and accelerated mergers, giving railroads flexibility in their configuration of their networks. And, crucially, the act permitted railroads to enter into confidential contracts with shippers, thereby enabling railroads to make investments in plant and equipment that were both innovative and more productive.

In the 1980s, U.S. railroads began to merge, to reduce their rail network, and to develop new business activities, particularly those associated with intermodal transport. By 1999, the major U.S. railroads had substantially upgraded their track and equipment, had increased their labor productivity, and had taken advantage of technological innovation to lower costs, as shown in Figure 7. Although still heavily capitalized, the sector offered a return on shareholders' equity in the range of 8 to 10 percent (Martland 1999). However, in the latter half of the 1990s the rail industry encountered serious problems as a result of the large mergers, especially that between the Union Pacific and the Southern Pacific, and the division of Conrail between CSX and Norfolk Southern. In the case of the UP-SP merger, services virtually ceased over critical sections of the U.S. network, including the agricultural markets in Texas. And the costs of some mergers — like that involving Conrail — now seem high when compared with the current valuation of the remaining railroads. It also seems that the merger activities distracted the staff running the railroads and, as a consequence, perhaps contributed to the poor service offered to many shippers, including those moving grain.

The industry currently faces some substantial strategic problems. The major opportunities for productivity improvement peaked in the late 1990s, a time when the railroad industry invested in high-strength rail corridors, intermodal terminals, new locomotives, and more productive cars. Although there are still cost efficiencies that can be squeezed out of the system, it is likely that prices will begin to rise in the future. Thus, the strategic challenges confronting the railroad industry include possible congestion over the key corridors established as a result of network rationalization, and associated future infrastructure needs, which include further extension of heavier rail and the replacement of a number of rail bridges to carry the heavier trains (see Table 36). Increasing trucking productivity is currently not as sensitive to railroads as it was in the 1980s; and the issue of heavier, and therefore more productive, vehicles seems to be frozen in current federal legislation. Nevertheless, trucking continues to take away rail market share, particularly in those areas where service is poor. Martland suggests that it will be difficult to maintain the recent rate of productivity improvement in the new century, given that the pricing pressures unleashed by deregulation will only grow stronger. The concern with financial problems, particularly flat or falling prices (see Figure 8), is one that was reflected by railroad industry personnel during our interviews with them.

How do these issues affect the grain industry in general and Texas in particular? First, they provide a context for understanding the rail service issues facing the industry and perhaps offer some ways to improve the service. Second, the potential for the rail industry to serve Texas shippers has been substantially reduced through rail line abandonment. Table 37 shows the loss of rail networks since 1965 in various agricultural states, including Texas. Most numbers are taken from a USDA publication, though other sources actually suggest higher rates of loss, perhaps reflecting the difficulties in defining the term “loss.” In any event, railroads cannot serve the customers they once did in Texas and this will not change in the near future. This loss of market coverage translates to reductions in rail usage, as reported in Figure 8, which clearly shows the growth of trucks at the expense of rail in the grain industry and in all the seed industries. This pattern has particularly hurt smaller and mid-sized elevator operators in Texas. Figure 9 shows the various main market shipment patterns for grains in Texas. It indicates the growth of unit train moves since 1990 and the importance of trucking to unit train terminals or load sectors, both for country elevators and farmers. And the differential pricing of grain shipments, together with the poorer service offered to single car or small carload volumes, perhaps underlies many of the complaints made by the Texas shippers (reported in Section VI).

The rest of this section comprises three parts. The first part reports material gathered from interviews with staff at Burlington Northern (BNSF), Union Pacific (UP), and the American Association of Railroads (AAR); the second part provides some information on shortlines, while the final section summarizes some of the key issues as they relate to the grain industry.

Class 1 Railroad Responses to Survey Service Issues

Burlington Northern Santa Fe (BNSF)

Mr. Stevan Bobb, Group Vice President of Agricultural Products for Burlington Northern Santa Fe (BNSF), provided the information reported in this section. Mr. Bobb stated that BNSF had taken a number of important steps to increase the capacity of its agricultural service. He defined capacity not in terms of the number of cars in the fleet, but in terms of their ability to move grain through any specific time period. BNSF had around 35,000 grain cars in 1998 and had taken great strides to improve turnaround per calendar month of operation. As an example, traditional carloads are turned around approximately 1.3 times per month, whereas the shuttle cars are turned around 4 times a month. In this way the railroad was able to substantially increase both its capacity and its service while having fewer cars on the rail system. Current grain car fleet size at BNSF is around 27,500 cars; however, volume carrying capacity levels are currently greater than 1998 levels.

Burlington Northern Santa Fe had also taken steps to improve its carload availability for routine (nonshuttle) shipments. This improvement entailed developing shipment plans and making substantial investments within the company to make carload availability known to its customers. Yet the issue and definition of availability had changed substantially over the last 20 years, and certainly BNSF did not provide the kind of car availability required by all its customers, irrespective of size. Shippers that were unable to plan or that did not follow relatively straightforward logistical plans were unlikely to benefit from the investments that BNSF had made in its attempts to improve its service to the grain shipment industry.

In response, Bobb countered that complaints to BNSF about lack of car availability were unwarranted, given that certificates of transportation (COTs) and SWAP certificates were available to shippers who would then be in a position to pre-order transportation as part of their business practices. Modern rail transportation favored those shippers that were able to develop the transportation side of their business in the same way that they developed their grain marketing, so that each matched the other. To summarize, BNSF could not accept the issue of car availability as a reasonable criticism of its rail operations; it felt that shippers in this competitive global industry should be able to accept delivery of equipment within a 15-day period.

In terms of price, BNSF had invested about \$10 billion since 1996, much of it related to locomotives (\$2.1 billion) and new cars (\$2.3 billion). The ability to structure more efficient means of rail transportation for grain (like shuttle systems) enabled it to offer real reductions in prices, while allowing the railroad to strengthen profitability. Rail, unlike such other competing modes as trucks and barges, must pay for the entire infrastructure. Bobb stated that BNSF had made all the reductions that were possible with current technologies. He suggested that the next round of policy decisions would focus on the abandonment of low-volume, high-maintenance rural networks, and on a rise in prices to reflect additional costs that they had incurred. He strongly suggested that there was very little room for further cost cutting at BNSF and that the industry would see a series of price rises in the coming year.

Because BNSF had invested in 5,500 new, heavier grain cars that are more productive than traditional unit train cars, it was able to offer shippers better rates. Bobb asked for specific instances of recent poor service, indicating that, overall in the grain industry, BNSF shipments were at about 90 percent of the estimated time of arrival set in the schedules, and that over 95 percent of all rail grain is carried at public tariff rates.

Grain is now a global market facing severe competition from regions in other parts of the world. Bobb indicated that, in order to remain competitive, there would be a move to greater consolidation in the grain industry, including the development of load centers or shuttle centers along the main corridors now equipped with 286,000 lb rail (the maximum gross weight of rail cars on rail, not the weight of the rail). The smaller terminal elevators would use trucks to ship to final delivery points within an approximately 350 to 500 mile radius. He also suggested that smaller terminal elevators would use trucking to take grain to the shuttle stations that would then load the shuttle grain trains to move product over much longer routes. He stated that shortlines are capable of providing better service to the smaller terminal elevators. However, shortline efficiency for many companies was, he said, predicated on their ability to operate over a network where maintenance and other services were not being undertaken at the optimal rate. The shortlines now face the challenge of refurbishing locomotives, repairing cars, and maintaining and upgrading track — all at a time when revenues are not likely to cover all such capital needs. He suggested that an investment tax credit for shortline railroads, either at the state level or at the federal level, might be appropriate.

For less-than-full-train-load operations, groups of cars can wait up to 3 to 5 days at origin while a matching process is undertaken at BNSF. This process groups cargo going to similar markets so that the cargo can be carried efficiently across the network. In the case of BNSF, this process is

performed through a grain desk maintained 24 hours a day, 7 days a week. BNSF believes this process is unique in the railroad industry (details are available on the company Web site). The aim of the grain desk is to provide an on-time service of plus or minus 24 hours, though such a service level might attract higher rates.

BNSF has no negative strategies with respect to the formation of rural rail districts, though no Class 1 railroad would want to pay any taxes related to rural rail districts. Although rural rail districts have the opportunity to gather rail products for ultimate consolidation on Class 1 railroads, trucking can undertake this process of gathering more cheaply than rail. On an unrelated matter, Bobb stated that some research undertaken by the Upper Great Plains Transportation Institute hinted that rural depopulation is a leading indicator of rail abandonment. In other words, he rejected the traditional argument that the abandonment of rail lines causes rural depopulation and felt that in many areas of Texas, rural depopulation occurred *before* rail abandonment.

Agriculture is now a globally competitive market and BNSF was designing its rail products to fit this concept. As an independent, private entity, operating without subsidies, it has had to reach a reasonable level of return on capital and, having attained to that level, was committed to doing whatever was necessary to sustain it. Resource allocation favors highways because of the inherent cross-subsidization that occurs in most state networks. The provision of highways funded through the gasoline tax placed into a highway trust fund results in substantial annual improvements to the highway infrastructure. This has to be matched against the problems of providing suitable capital reinvestment on the part of the railroads. At a time when TxDOT is undertaking single interchange projects costing in excess of \$100 million, BNSF is delaying the construction of a repair and maintenance facility at Alliance and is cutting back on its intermodal investment, one of its growth areas.

Union Pacific (UP)

Bill Eilbracht, General Director of Logistics, provided information on Union Pacific (UP) grain operations. With regard to shipment sizes, UP has a rate structure in place to handle smaller unit grain movements. These rates are not as low as the unit train rates based on the operating efficiencies of the latter system. When competing with trucks, the company finds it difficult to be competitive on movements that are less than 250 miles, based on the current rail cost structure. While UP is constantly looking at shortline opportunities, it is impossible to generalize about such opportunities — each must be evaluated on a case-by-case basis. UP is sensitive to complaints about grain service levels from some shippers and has made an effort over the past 2 years to improve overall transportation service for grain. For example, the company now has a cross-functional quality team that meets weekly to address those issues that have potential for improving the level of service for grain shippers.

With respect to rural rail districts, UP has recently completed a sale to the Northeast Texas Rural Rail District. Although the line is not commercially viable for a stand-alone shortline operation at this time, the RRTD's investment will preserve the railroad for possible future use. The concept of rural rail districts allows state governments to preserve those lines it sees fit to retain without asking private operators to lose money trying to continue service on lines that cannot justify

investment and operation. Providing adequate equipment for grain transportation is a real challenge, and has in the past resulted in equipment underutilization. As an example, for 28 of the past 36 months, around 6,000 grain cars have been idle, representing a potential revenue stream of some \$1.8 million per month. UP feels that it is inefficient to have this level of underutilization in its grain equipment. With regard to rail abandonment, the base cause is insufficient traffic volume to justify continued operations. Although track-upgrading programs are valuable to shortlines, the key to slowing the abandonment process is to increase traffic volumes at rates that will justify continued operation. Owing to the nature of the agricultural economy, UP has found very few shippers willing to guarantee a specific level of traffic at a rate that will provide a reasonable profit for the railroad. Finally, UP (like BNSF) has focused on improving its unit train and shuttle operations on key grain routes. UP has a monitoring system reporting changes in the actual performance of the unit train versus the schedule, producing in effect a service delivery index. This index is used as a target for improving the performance of unit trains; UP offered information that demonstrated that improvements have occurred over the last 2 years in both the speed and reliability of these operations.

Shortline Rail Service

In the United States, there are 500 shortline and regional railroads that comprise 29 percent of the network and that generate over \$3 billion in gross revenue each year (AASHTO 1999). Many of these railroads acquired infrastructure and equipment on which maintenance had been deferred. In addition to financing such maintenance, shortline railroads have had to face expanded safety requirements, faster operational schedules, and the advent of heavier rail cars (the 286,000 lb cars). It has been estimated (Zeta-Tech Assoc. 2000) that the cost to upgrade shortline and regional railroads to handle 286,000 lb cars would exceed \$6.8 billion alone. In Texas, there are some thirty shortline and regional railroads; a sample of the nine most significant (AASHTO 1999) revealed that their available funding for capital needs falls short by approximately \$73 million.

The Class 1 network in Texas has been considerably reduced over the past two decades. While some may regard future reductions as unlikely — given that the network is already lean — the interviews with railroad staff indicate that the network will continue to be evaluated on a volume and revenue basis, and that future abandonments may take place through a case-by-case analysis. Yet there appears to be a role that the state could play in preserving those lines that would otherwise be abandoned. This role involves the formation and management of rural rail districts — entities that can take ownership of the line and even enlarge its operational potential by attracting new industries and businesses into the catchment area of the rail network. Irrespective of the true impact of rail abandonment, it seems vital that the state give consideration to how it might support shortline operations in all the networks that are proposed for abandonment. If the movement of grain from the elevator systems in Texas by rail is limited to only major rail corridors, there will be a substantial increase in the volumes of trucks carrying grains to rail points. This increase will raise shipping costs, raise infrastructure costs, add to vehicle congestion, and possibly result in an increase in vehicular accidents. Allowing this to occur does not seem to be good public policy.

Trucking

As in other states, Texas trucking is extremely competitive, with many operators exhibiting low rates of return on their invested capital. For those operators having fixed agricultural contracts (i.e., no compensation for rising costs), the situation has become especially difficult in recent months as a result of higher fuel prices. Because fuel represents approximately 15 percent of the variable costs of truck operations, movements can have a substantial impact on company profitability. Apparently, in an attempt to improve air quality in Texas, consideration is being given to using new types of diesel that reduce the emissions of various gases. This fuel costs more to produce and currently appears to add a substantial cost to the overall rates at which truckers can move grain. This cost will add to the problems facing the industry, multiply the number of companies going out of business, and ultimately result in the need to have higher truck tariffs for the transportation of grain.

One of the options considered in terms of seeking higher truck productivity is to permit larger vehicles to take the grain from elevators to other sites in the state. Although these trucks are clearly more productive, they are heavier both in terms of gross load and (often) axle loads and, consequently, could potentially consume more of the highway infrastructure. In terms of specific impacts, gross loads are important for bridge performance while axle loads are related to pavement consumption. Any increase in truck size and weight regulations without a rise in taxation to cover the marginal costs would seem unfair and not good policy. Finally, many grain elevators are located on rural networks that have not been improved for many years and therefore have older and weaker pavement designs. Permitting an increase in the size and weight of current vehicles to operate over these roads could cause an increase in the damage to the system and could deplete the county and state infrastructure budgets. One way in which truckers might be assisted in the transportation of grain in rural areas is to identify and improve the routes that they need to take. Currently, there is in place a program — the Texas Trunk System (TTS) — that provides a rural arterial network of divided, four-lane design. Since grain elevators are often clustered, it may be possible to identify at the TTS planning stage the connectivity needed to allow trucks to move from these terminals to the arterial system or route for their final destination.

The trucking survey confirms recent grain transportation trends. The survey shows a median one-way trip of 150 miles and advantages over rail because of on-time delivery, greater logistical control of delivery, delivery to more locations, and a constant rate schedule. The survey respondents reported higher trucking rates versus rail, except in a few instances in which trucking held the advantage for trips of 100 miles or less. But this advantage is offset in many instances because quicker delivery turnaround creates a cost advantage. The survey also reported a median 450 miles for the longest one-way trip. Longer trips from trucks may be the result of increases in rail abandonment and of a loss of faith in rail service. The greater use of trucks has opened up new opportunities for companies looking to expand their business and has increased trucking industry competition. Thus, trucking seems to be taking advantage of the shift in destination marketing. It is cost effective on short trips, owing to cheaper rates and/or the efficiencies gained from on-time and greater control of delivery, which allows grain to be moved quickly (especially important during harvest time).

The truck survey also indicated that logistical coordination is also a source of inefficiency. Some suggestions from the survey respondents included better coordination of routing between firms to avoid route overlapping, and better coordination of load delivery between brokers and shippers. The survey also indicated a lack of coordination between trucking and rail. Only two respondents reported coordinating their grain deliveries with rail firms. Two other respondents reported problems with trying to coordinate with rail and that rail will not cooperate with trucking firms because it sees them as its competition.

Another problem plaguing the trucking industry is increased fuel costs. All respondent indicated that they have increased or were planning to increase their rates to cover the fuel cost increases. More information on the trucking survey, including responses to the questions, is provided in Appendix D.

IX. Emerging Trends in Transportation

The results of both the grain shipping service survey and the motor carrier survey have already been reported in earlier sections. Generally, rail service is not highly rated and is in fact considered inferior to that offered by motor carriers over a number of key grain routes in Texas. To assist in those developing public policy with respect to the grain shipping industry, we offer the following series of issues that are termed “emerging trends.” These trends identify several critical areas that will impact grain transportation in Texas. Where possible, we suggest an approach — or line of inquiry — that may stimulate a public policy initiative.

Grain Is a Globally Traded Commodity

World grain markets come close to meeting the four requirements of perfect competition: large numbers of producers, homogenous products, good information flows, and easy entry and exit. Left alone, competitive agricultural markets work reasonably close to the manner described by economists, particularly with respect to prices and elasticities. But for farmers, the ideal is a mixed blessing. Competition means unpredictable prices and unstable incomes as supply and demand curves shift with the weather and with patterns of world trade. In the 1970s, when market conditions favored the U.S. farm sector, farm income rose. In the 1980s, market conditions turned more difficult for much of the U.S. farm sector, one reason being competition from new sources of supply abroad. In the 1990s, this market has grown, underpinned by lowering world transport costs (in real terms) that have allowed all regionally produced grains to play a major part in the world markets. And because U.S. grain producers must now compete in a global marketplace, an understanding of logistics and a recognition of the importance of identifying future transportation needs are requirements for commercial success.

It is therefore essential in this newly emerging global grain market that shippers undertake their business with a recognition of the need to forecast their transportation requirements as accurately as possible. Those grain handlers who can clearly relate transportation needs to their marketing activities, irrespective of size, will stand the greatest chance of being able to obtain rail and truck transportation services when they most need them.

Rail Service

Because the business model adopted by the Class 1 railroads in the U.S. has favored substantial cost cutting and has focused on key commodity routes, it is little wonder that the smaller grain elevator owner has been marginalized in the process. This characteristic is not a Texas phenomenon: it is repeated in Kansas, Iowa, Nebraska, North Dakota, and in all grain-producing states. The advent of unit trains, loaded rapidly at major terminals for load centers and moved efficiently to other points in the system, is a feature of the new grain policy. Service, therefore, cannot be considered to be uniformly bad in the grain industry; moreover, movements of grain on the 286,000 lb rail network appear to be prompt, efficient, and cost effective. For those Texas grain handlers not on a rail network (or unable to put together high carload numbers to link with the unit train terminals), the issue of poor service is likely to persist. One possible solution to this problem is to urge elevator operators to structure, if possible, their business in such a way that they have a stronger understanding of logistics needs and are able to therefore purchase future car certificates of transportation (COTs) from the railroad.

Future Rail Issues

It is worth recalling the implications of current railroad policy on the U.S. agricultural sector (Prater and Klindworth 2000), given that all are pertinent to rail service in Texas. These policy implications, shown in Table 38, comprise five major issues. First, changes in domestic processing and off-farm feeding, combined with static exports and the loss of smaller grain elevators, suggest that there will be a decreasing railroad market share in grains. Second, there is an expectation of higher rates for agricultural shippers resulting from differential pricing, low rates of return, and the difficulty in getting further cost efficiencies out of the current system. Third, there is a likelihood of increased costs to access rail service. This increase may come through a variety of strategies, including requiring others to build the unit train terminals, charging higher demurrage, and requiring trucking and shortline railroads to link into the grain load centers. There is also the likelihood of higher external costs to rural highway networks that will carry the higher flows of grain trucks.

The fourth item is a reduction in shipper options. For example, there will be fewer routes, since the system will be dominated by the high-density corridors. And differential pricing will persist, drawing in grains that might have gone on other routes. There is also the elimination of co-loading rates for unit trains that hurts the smaller elevator operator, together with the closure of certain gateways. In addition, there is a tendency to respond first to shippers with competitive alternatives, rather than to captive shippers, many of whom are now the smaller grain elevator operators. Finally — the fifth issue — problems with shortline railroads indicate that there may be failures on a number of networks in the near future. Among these problems are those associated with transporting heavier carloads along the lines; also problematic are the restrictions (already mentioned) on co-loading unit trains, and the low volumes on rural networks that make it difficult to operate a rail service.

It must also be stated that the current Class 1 railroads in Texas have made significant progress in strengthening their operations, improving service over key corridors, transferring cost savings to new grain customers on larger shipments, and attempting to improve service levels by making

organizational changes. It should not be forgotten that railroads are private entities that must make an adequate return on investment and a profit for their shareholders. They are not public utilities; they cannot be expected to wait long periods until grain moves or to provide all shippers wishing to move grain at that time with the numbers of cars that are needed. One possible course of action to improve railroad service is to educate shippers on how they might best take advantage of the new services provided by the railroad industry.

Continual Growth in Grain Trucking

The trucking of grain in Texas will continue to grow in the future, serving local markets, regional feed mills, load centers for unit trains, and other consumers requiring fast, flexible service. Because many country elevators rely wholly on trucking to stay in business, any growth in their business will result in an increase in regional trucking.

There is strong evidence that trucking prices will rise, driven by an increase in vehicle operating costs. This price increase may affect the viability of those elevator businesses that cannot pass on the additional costs. Although many cost items are predicted to rise, it is the increase in fuel costs that most concerns the industry and that will most impact trucking rates. Not only has the general price of diesel risen in recent months; the new diesel types formulated to reduce emissions (and likely to be adopted in Texas) are also more expensive to produce and, as a consequence, are likely to drive up costs.

The move from rail to trucking service will impact rural highways in a number of ways. Bridges will be degraded and pavements will suffer increased consumption as a result of the passage of heavy axles. The effect will be increases in county maintenance-and-replacement budgets. It may be possible to develop some initiatives to link elevators (particularly when they are clustered) more effectively to the rural arterial system, especially as the Texas Trunk System (the rural divided four-lane system) is currently being implemented over a multi-year period (now close to 50 years, given current estimates and funding levels).

Grain Transportation Database

More state data on grain transportation flows are needed to develop a variety of strategic responses from the various agencies supporting Texas agriculture. As chronicled during the UP-SP post-merger service difficulties, the state could neither develop convincing arguments of service failures in the grain industry nor identify in a clear fashion the impacts that these service failures were having on the grain business. North Dakota's system of annual reporting that permits the development of a transportation database could be evaluated for use in Texas. Such an evaluation would require additional study, given that the registration process for grain handlers is more complex in Texas; nonetheless, it is likely that the industry would cooperate if it felt that the data were being used to improve grain transportation planning in the state. Among other things, an evaluation would need to determine which state agency would administer the program, how the program would be funded, and how other state agencies could access the information for planning and other strategic purposes.

Rural Rail Transportation Districts

The creation of rural rail transportation districts (RRTD) was based on legislation enacted in 1981 (amended in 1997), which focused on mitigating the negative impacts of rail abandonment by allowing the purchase of rail lines that were scheduled for abandonment. A rural rail transportation district can be created by a county commissioner's court and can include single or multiple county districts. Such districts are considered a governmental subdivision of the state and have nontaxing but tax-exempt authority. They also hold powers of eminent domain and are managed by a board of directors selected by the county commissioner's court. Crucially, they have the authority to issue revenue bonds and generally seek an operator to provide a rail service over the network that they purchase. The RRTD generates revenue from grants, loans, and operating agreements with these railroads.

Proponents of RRTD (John Helsley, 2000) argue that rural rail districts offer an excellent conduit for public/private partnerships to build new rail, acquire existing rail, and even facilitate the restoration of abandoned right-of-way (such as that on the Rosenberg to Victoria line). The lack of capital that Class 1 railroads currently face also suggests that others will need to address new investment in rail storage facilities, including grain. The responsibility for addressing such needs as rail storage (including grains) may ultimately fall on the shoulders of county courts, municipalities, shippers, and venture capital groups.

A recent LBJ School of Public Affairs report identified exemplary state rail freight programs in the United States. It offered the following comment:

Many states face legacies of limited involvement in rail matters. Some states have statutes prohibiting state assistance to the rail industry. They must deal in the practical realm of what is possible. Washington's Grain Train project, Virginia's and North Carolina's Rural Industrial Access Programs, and Tennessee's Transportation Equity Fund are rail freight programs limited in scope that have measurable benefits to their respective states and citizens. Their models serve as examples that it is possible to find funding to finance, operate, and implement successful rail freight projects (LBJ 1997).

Although RRTDs are not yet a program, they do represent an innovative approach to some rural rail and transportation needs. In any event, it is to be hoped that a more imaginative way of including rail freight in Texas state transportation planning is undertaken in the near future.

X. Observations and Recommendations

This section summarizes observations regarding grain transportation in Texas and closes by recommending measures that could enhance grain transportation efficiencies.

Observations

- Large quantities of grain from the Corn Belt and Central Plains are rail transported to Texas for consumption by Texas livestock, poultry, and dairy industries and for export via Texas ports. These grain supplies are critical to Texas' agriculture and agribusiness.

- Trends in Texas feed grain production suggest a continued dependence on out-of-state grain supplies for Texas livestock, poultry, and dairy industries.
- Mexico is an important grain market for U.S. and Texas-produced grains. This market is likely to become more important as a result of growth in Mexico's per capita income and with the complete implementation of NAFTA provisions. Because truck and rail modes are important for the export of grain to Mexico, efficient transportation systems are critical for Texas' competitiveness in the growing Mexican grain market.
- Trucks are central to the marketing of Texas-produced feed grains (corn, sorghum), since such grains are primarily destined for consumption by Texas livestock, poultry, and dairy industries. The exception are feed grain exports to Texas Gulf ports and Mexico, which are dependent on both truck and rail modes. Texas rice production is entirely dependent on truck transportation (except for rough rice exports to Mexico). Texas wheat production is comparatively dependent on railroad transportation for purposes of accessing export and out-of-state milling markets.
- Texas rural highways are critical for the marketing of Texas grain. Survey results suggest they have become increasingly important in recent years. Further, with the trend toward large multi-car rail shipments and shuttle trains, together with the reduced service offered to country elevators, rural roadways become more important as a transport artery for Texas grain production.
- Texas grain handlers believe the service offered by truckers is satisfactory to good. However, many Texas grain handlers are frustrated with service offered by railroads. Much of the frustration may be owing to increased railroad concentration of Class I carriers, a shrinking rail network, the push for shuttle train operations, a redefinition of the common carriage obligations, an altered car ordering system, and to other factors that have evolved during the deregulated era. Railroads are offering incentives to grain handlers to alter their operations; thus, the grain-handling industry is in a period of transition. In spite of the grain handlers' frustrations, it seems unlikely that railroad operations and practices would be altered by re-regulation.
- Class 1 railroad companies in Texas are striving to improve grain service schedules (with varying success); however, trucks have the competitive advantage on trips less than 250 miles in length. On those routes where trains remain competitive, larger grain shippers are able to take advantage of the lower rates offered on unit and shuttle train operations, while smaller shippers can take up guaranteed delivery programs (like BNSF's certificates of transportation).

Recommendations

1. The State should support efforts to enhance multi-modal transportation planning in Texas, particularly those activities related to rail operations. Such support is needed in order to address not only the problems that are now facing rail providers of all sizes, but also the impacts that these problems are having on the agricultural sector, which is dependent on efficient transportation.

2. Truck volumes on rural highways moving grain within the distribution chain will continue to grow, probably significantly. This growth will have an adverse impact on the condition of rural highways and bridges. The problem should be addressed by enhancing activities in three areas: first, within state transportation planning; second, in the funding needs for the rural highway and bridge system; and, third, in the construction (and connectivity) of the Texas Trunk System.
3. Agricultural and transportation planners need more extensive and timely data on grain flows in order to focus on those areas of the state most in need of transportation investment and service improvement. A database should be designed so as to address the agricultural flows associated with grain, cotton, and livestock, in order to provide a comprehensive approach to rural transportation needs in Texas. This study was not designed to address this need and further work should therefore be undertaken to determine the type of database, how data would be collected, and which agency should manage and administer it.

Table 1. Estimated Railroad Shipments of Corn from Various States to Texas BEA Regions, 1998.

Originating State	Texas BEA Regions (tons)													Total
	Beaumont-Port Arthur (87)	Dallas-Ft. Worth (127)	Abilene (128)	San Angelo (129)	Austin-San Marcos (130)	Houston-Galveston (131)	Corpus Christi (132)	McAllen-Edinburg (133)	San Antonio (134)	Hobbs, NM (136)	Lubbock (137)	Amarillo (138)	El Paso (157)	
Colorado	--	--	--	--	--	--	--	--	--	--	10,692	--	--	10,692
Iowa	--	262,920	--	4,848	--	80,008	32,640	42,220	532,844	21,496	24,300	31,344	--	1,032,620
Illinois	--	237,133	--	--	--	447,427	--	8,040	29,700	--	--	--	--	722,300
Kansas	6,320	361,916	7,260	41,244	--	86,292	--	46,076	212,657	7,212	50,164	86,416	3,788	909,345
Louisiana	--	--	--	--	--	--	3,492	--	--	--	--	8,712	--	12,204
Minnesota	--	--	--	--	--	116,595	44,601	20,100	41,790	--	--	21,704	--	244,790
Missouri	3,960	206,744	3,960	7,920	--	160,416	9,880	--	145,845	4,752	31,152	95,756	--	670,385
Nebraska	--	232,899	--	4,120	7,600	667,828	334,129	74,931	606,820	96,556	177,956	1,304,280	13,556	3,520,675
South Dakota	--	32,908	7,920	3,564	--	43,056	--	--	--	10,192	3,960	21,384	--	122,984
Tennessee	--	17,820	--	--	--	--	--	--	--	--	--	23,712	--	41,532
Texas	--	7,632	--	--	--	32,728	--	--	198,952	--	--	477,725	--	717,037
Wisconsin	--	--	--	--	--	12,024	--	--	--	--	--	--	--	12,024
Total	10,280	1,359,972	19,140	61,696	7,600	1,646,374	424,742	191,367	1,768,608	140,208	298,224	2,071,033	17,344	8,016,588

1 ton = 35.71 bushels

Table 2. Estimated Intrastate Railroad Shipments of Texas Corn, 1998.

Originating BEA	Destination BEA (tons)				Total
	Dallas- Ft. Worth (127)	Houston- Galveston (131)	San Antonio (134)	Amarillo (138)	
Dallas- Ft. Worth (127)	3,552	10,800	--	136,276	150,628
Austin- San Marcos (130)	--	--	--	16,856	16,856
Houston- Galveston (131)	--	--	4,040	324,593	328,633
Corpus Christi (132)	--	--	179,192	--	179,192
San Antonio (134)	B	4,848	--	--	4,848
Amarillo (138)	4,080	17,080	15,720	--	36,880
Total	7,632	32,728	198,952	477,725	717,037

1 ton = 35.71 bushels

Table 3. Estimated Railroad Shipments of Grain Sorghum from Various States to Texas BEA Regions, 1998.

Originating State	Texas BEA Regions (tons)										Total
	Beaumont-Port Arthur (87)	Dallas-Ft. Worth (127)	San Angelo (129)	Houston-Galveston (131)	Corpus Christi (132)	McAllen-Edinburg (133)	San Antonio (134)	Hobbs, NM (136)	Lubbock (137)	Amarillo (138)	El Paso (157)
Kansas	229,277	201,349	4,040	702,138	208,458	103,172	669,165	45,896	52,208	92,148	9,587
Missouri	--	21,756	--	--	--	--	20,952	--	--	--	--
Nebraska	48,160	29,560	--	64,554	--	10,000	21,540	--	--	5,880	2,319
Oklahoma	--	--	--	22,132	--	--	--	--	--	--	--
Texas	--	3,800	--	3,800	--	--	241,512	--	--	31,564	54,158
Total	277,437	256,465	4,040	792,624	208,458	113,172	953,169	45,896	52,208	129,592	66,064
1 ton = 35.71 bushels.											

Table 4. Estimated Intrastate Railroad Shipments of Texas Sorghum, 1998.

Originating BEA	Destination BEA (tons)					Total
	Dallas-Ft. Worth (127)	Houston-Galveston (131)	San Antonio (134)	Amarillo (138)	El Paso (157)	
San Angelo (129)	--	3,800	--	--	--	3,800
Houston-Galveston (131)	3,800	--	--	--	--	3,800
Corpus Christi (132)	--	--	241,512	--	--	241,512
Amarillo (138)	--	--	B	31,564	54,158	85,722
Total	3,800	3,800	241,512	31,564	54,158	334,834
1 ton = 35.71 bushels.						

Table 5. Estimated Railroad Shipments of Wheat from Various States to Texas BEA Regions, 1998.

Originating State	Texas BEA Regions (tons)								Total
	Beaumont-Port Arthur (87)	Dallas-Ft. Worth (127)	Houston-Galveston (131)	Corpus Christi (132)	San Antonio (134)	Lubbock (137)	Amarillo (138)	El Paso (157)	
Arizona	--	--	--	91,505	--	--	--	--	91,505
California	--	--	--	31,652	--	--	--	--	31,652
Colorado	55,732	32,748	451,501	41,432	--	--	--	3,190	584,603
Idaho	--	--	33,760	--	87,908	--	--	--	121,668
Kansas	601,729	773,153	3,983,382	227,056	228,742	29,908	34,716	17,280	5,895,966
Missouri	17,088	4,000	--	--	79,600	--	--	--	100,688
Montana	--	4,080	--	--	--	--	--	--	4,080
North Dakota	--	13,624	34,948	--	--	--	--	--	48,572
Nebraska	10,080	--	246,672	6,036	--	--	--	--	262,788
New Mexico	--	--	20,348	--	--	--	--	--	20,348
Oklahoma	42,664	184,120	1,438,802	94,440	96,336	--	--	2,894	1,859,256
Tennessee	--	8,400	--	--	--	--	--	--	8,400
Texas	55,220	125,964	1,187,934	136,576	71,376	30,096	--	21,291	1,628,457
Total	782,513	1,146,089	7,397,347	628,697	563,962	60,004	34,716	44,655	10,657,983

1 ton = 33.33 bushels

Table 6. Estimated Intrastate Railroad Shipments of Texas Wheat, 1998.

Originating BEA		Destination BEA (tons)						Total
		Beaumont- Port Arthur (87)	Dallas-Ft. Worth (127)	Houston- Galveston (131)	Corpus Christi (132)	San Antonio (134)	Hobbs, NM (136)	El Paso (157)
Dallas-Ft. Worth (127)		19,008	46,484	882,336	80,884	20,012	--	--
Abilene (128)		--	5,616	23,832	22,968	--	--	--
San Angelo (129)		--	11,880	29,284	--	--	--	--
Austin-San Marcos (130)		9,600	--	5,556	8,472	--	--	--
San Antonio (134)		--	--	4,440	--	--	--	--
Lubbock (137)		22,652	10,296	--	10,296	9,980	--	--
Amarillo (138)		3,960	51,688	242,486	13,956	41,384	30,096	21,291
Total		55,220	125,964	1,187,934	136,576	71,376	30,096	21,291

1 ton = 33.33 bushels.

Table 7. Estimated Railroad Shipments of Rough Rice from Various States to Texas BEA Regions, 1998.

Originating State	Texas BEA Regions (tons)			Total
	Houston-Galveston (131)	San Antonio (134)	El Paso (157)	
Arkansas	11,220	134,032	1,465	146,717
California	--	15,792	--	15,792
Louisiana	--	65,520	--	65,520
Missouri	--	39,108	687	39,795
Texas	--	38,152	--	38,152
Total	11,220	292,604	2,152	305,976

1 ton = 20 hundred weights.

Table 8. Estimated Intrastate Railroad Shipments of Texas Rough Rice, 1998.

Originating BEA	Destination BEA (tons)	Total
	San Antonio (134)	
Houston-Galveston (131)	38,152	38,152
Total	38,152	38,152

1 ton = 20 hundred weights.

Table 9. Estimated Percent of Corn Shipments to Various Markets by Country Elevators and Percent Shipped by Truck and Rail.

Region	# of responses	Texas Gulf Ports	Texas Feeders	Texas Processors	Texas Terminals	Arizona California	Oklahoma Kansas	Mexico	Other
High Plains	34	0.0	95.9	0.1	0.6	0.0	0.0	0.0	3.4
% Truck		--	100.0	100.0	100.0	--	--	--	100.0
% Rail		--	0.0	0.0	0.0	--	--	--	0.0
Edwards Plateau	4	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
% Truck		--	100.0	--	--	--	--	--	--
% Rail		--	0.0	--	--	--	--	--	--
North Central	23	6.7	52.3	27.6	1.4	2.6	0.0	9.4	0.0
% Truck		21.7	92.1	88.2	66.8	0.0	--	0.0	--
% Rail		78.3	7.9	11.8	33.2	100.0	--	100.0	--
South Central	15	1.6	42.7	17.1	15.6	0.0	0.0	14.6	8.4
% Truck		100.0	100.0	100.0	100.0	--	--	86.5	100.0
% Rail		0.0	0.0	0.0	0.0	--	--	13.5	0.0
Upper Coast	7	27.4	70.3	0.3	0.0	0.0	0.0	2.0	0.0
% Truck		87.7	100.0	100.0	--	--	--	100.0	--
% Rail		12.3	0.0	0.0	--	--	--	0.0	--
South Texas	2	0.0	50.0	0.0	0.0	0.0	0.0	50.0	0.0
% Truck		--	100.0	B	--	--	--	100.0	--
% Rail		--	0.0	--	--	--	--	0.0	--
Lower Valley	6	0.0	1.3	0.0	0.0	0.0	0.0	98.7	0.0
% Truck		--	100.0	--	--	--	--	100.0	--
% Rail		--	0.0	--	--	--	--	0.0	--

Table 10. Estimated Percent of Corn Receipts/Shipments by Terminal Elevators from/to Various Markets and Percent Received/Shipped by Truck and Rail.

Region	# of responses	Receipts			
		Texas	Oklahoma	Kansas	Other
		----- % -----			
East Texas ¹	3	23.1	0.0	0.3	76.6
% Truck		100.0	--	100.0	0.0
% Rail		0.0	--	0.0	100.0
West Texas ²	6	1.7	0.0	0.0	98.3
% Truck		100.0	--	--	0.0
% Rail		0.0	--	--	100.0

Region	# of responses	Shipments						
		Texas Gulf Ports	Texas Feeders	Texas Processor	Texas Terminal	Arizona California	Oklahoma Kansas	Other
		----- % -----						
East Texas ¹	3	0.0	100.0	0.0	0.0	0.0	0.0	0.0
% Truck		--	100.0	--	--	--	--	--
% Rail		--	0.0	--	--	--	--	--
West Texas ²	6	0.0	99.9	0.1	0.0	0.0	0.0	0.0
% Truck		B	100.0	0.0	--	--	--	--
% Rail		--	0.0	100.0	--	--	--	--

¹ Includes responses from firms in North Central, East Texas, South Central, and South Texas regions.

² Includes responses from firms in High Plains, Low Plains and Edwards Plateau.

¹ Includes responses from firms in North Central, East Texas, South Central, and South Texas regions.

² Includes responses from firms in High Plains, Low Plains and Edwards Plateau.

Table 11. Estimated Percent of Corn Receipts from Various States by Texas Feed Mills and Percent Received by Truck and Rail.

Region	# of responses	Supply Regions							
		Texas	Oklahoma	Kansas	Nebraska	Colorado	Iowa	Missouri	Other
----- % -----									
East Texas ¹	11	9.6	0.1	2.1	12.6	0.0	43.9	10.2	21.5
% Truck		100.0	100.0	2.8	0.5	--	0.0	0.0	0.0
% Rail		0.0	0.0	97.2	99.5	--	100.0	100.0	100.0
West Texas ²	7	92.8	2.2	3.2	1.1	0.7	0.0	0.0	0.0
% Truck		100.0	100.0	99.1	97.6	100.0	--	--	--
% Rail		0.0	0.0	0.9	2.4	0.0	--	--	--

¹ Includes responses from firms in North Central, East Texas, South Central, and South Texas regions.

² Includes responses from firms in High Plains, Low Plains, and Edwards Plateau.

Table 12. Estimated Percent of Grain Sorghum Shipments to Various Markets by Country Elevators and Percent Shipped by Truck and Rail.

Region	# of responses	%							
		Texas Gulf Ports	Texas Feeders	Texas Processors	Texas Terminals	Arizona California	Oklahoma Kansas	Mexico	Other
High Plains % Truck	34	0.0	79.8	2.5	2.4	11.9	0.0	3.5	0.0
% Rail		--	100.0	100.0	100.0	0.0	--	0.0	0.0
Low Plains % Truck	7	--	0.0	0.0	0.0	100.0	--	100.0	0.0
% Rail		0.0	85.1	9.1	0.0	0.0	5.7	0.0	0.0
Edwards Plateau % Truck	4	--	100.0	100.0	--	--	100.0	--	--
% Rail		--	0.0	0.0	--	--	0.0	--	--
North Central % Truck	23	4.3	78.8	0.0	0.0	0.0	0.0	1.4	15.5
% Rail		100.0	100.0	--	--	--	--	100.0	100.0
South Central % Truck	15	0.0	0.0	--	--	--	--	0.0	0.0
% Rail		21.9	50.6	13.7	2.6	2.1	0.1	8.6	0.0
Upper Coast % Truck	8	48.4	91.3	77.7	85.0	8.0	100.0	0.0	--
% Rail		51.6	8.7	22.3	15.0	92.0	0.0	100.0	--
South Texas % Truck	2	24.5	12.1	2.7	0.9	1.8	0.0	57.8	0.0
% Rail		98.4	100.0	100.0	100.0	100.0	--	84.5	--
Lower Valley % Truck	6	1.6	0.0	0.0	0.0	0.0	--	15.5	--
% Rail		47.0	43.8	2.1	7.1	0.0	0.0	0.0	0.0
South Texas % Truck	2	100.0	100.0	100.0	100.0	--	--	--	--
% Rail		0.0	0.0	0.0	0.0	--	--	--	--
Lower Valley % Truck	6	0.0	4.1	0.0	0.0	0.0	0.0	95.9	0.0
% Rail		--	100.0	B	--	--	--	100.0	--
		--	0.0	--	--	--	--	0.0	--

Table 13. Estimated Percent of Grain Sorghum Receipts/Shipments by Terminal Elevators from/to Various Markets and Percent Received/Shipped by Truck and Rail.

Region	# of responses	Receipts					Shipments							
		Texas	Oklahoma	Kansas	Other	%	Texas Gulf Ports	Texas Feeders	Texas Processors	Texas Terminals	Arizona California	Oklahoma Kansas	Mexico	Other
East Texas ¹	3	100.0	0.0	0.0	0.0									
% Truck		90.6	--	--	--		0.0	100.0	100.0	--	--	--	100.0	0.0
% Rail		9.4	--	--	--		0.0	0.0	0.0	--	--	--	0.0	100.0
West Texas ²	6	78.8	0.0	0.0	21.2									
% Truck		96.2	--	--	42.9		B	100.0	100.0	--	55.5	100.0	92.0	100.0
% Rail		3.8	-	-	57.1		--	0.0	0.0	--	44.5	0.0	8.0	

¹ Includes responses from firms in East Texas, South Central, and South Texas regions.

² Includes responses from firms in High Plains, Low Plains, and Edwards Plateau.

Table 14. Estimated Receipts of Grain Sorghum from Various States by Texas Feed Mills and Percent Received by Truck and Rail.

Region	# of responses	Supply Regions		
		Texas	Oklahoma	Kansas
		----- % -----		
East Texas ¹	11	91.2	0.4	8.4
% Truck		89.3	100.0	0.0
% Rail		10.7	0.0	100.0
West Texas ²	7	100.0		
% Truck		100.0		
% Rail		0.0		

¹ Includes responses from firms in East Texas, South Central, and South Texas regions.

² Includes responses from firms in High Plains, Low Plains and Edwards Plateau.

Table 15. Estimated Percent of Wheat Shipments to Various Markets by Country Elevators and Percent Shipped by Truck and Rail.

Region	# of responses	Texas Gulf Ports	Texas Feeders	Texas Processors	Texas Terminals	Arizona California	Oklahoma Kansas	Mexico	Other
----- % -----									
High Plains	34	20.9	2.2	13.4	27.4	31.2	2.5	2.3	0.1
% Truck		1.2	100.0	69.3	83.0	0.0	100.0	0.0	0.0
% Rail		98.8	0.0	30.7	17.0	100.0	0.0	100.0	100.0
Low Plains	7	13.3	0.5	0.5	84.7	0.0	0.9	0.0	0.0
% Truck		43.2	100.0	100.0	100.0	--	100.0	--	--
% Rail		56.8	0.0	0.0	0.0	--	0.0	--	--
Edwards Plateau	4	74.5	8.5	17.0	0.0	0.0	0.0	0.0	0.0
% Truck		60.3	100.0	100.0	--	--	--	--	--
% Rail		39.7	0.0	0.0	--	--	--	--	--
North Central	23	42.9	18.8	4.7	33.6	0.0	0.0	0.0	0.0
% Truck		43.0	100.0	100.0	98.8	B	--	--	--
% Rail		57.0	0.0	0.0	1.2	--	--	--	--
South Central	15	94.6	0.8	4.6	0.0	0.0	0.0	0.0	0.0
% Truck		98.6	100.0	100.0	--	--	--	--	--
% Rail		1.4	0.0	0.0	--	--	--	--	--

Table 16. Estimated Percent of Wheat Receipts/Shipments by Terminal Elevators from/to Various Markets and Percent Received/Shipped by Truck and Rail.

Region	# of responses	Receipts				Shipments							
		Texas	Oklahoma	Kansas	Other	Texas Gulf Ports	Texas Feeders	Texas Processors	Texas Terminals	Arizona California	Oklahoma Kansas	Mexico	Other
		----- % -----											
East Texas ¹	3	49.6	24.8	8.3	17.4								
% Truck		83.3	66.7	100.0	0.0								
% Rail		16.7	33.3	0.0	100.0								
West Texas ²	6	85.6	3.3	8.5	2.5								
% Truck		95.0	100.0	100.0	100.0								
% Rail		5.0	0.0	0.0	0.0								
----- % -----													
East Texas ¹	3	89.6	0.0	10.4	0.0								
% Truck		0.0	--	100.0	--								
% Rail		100.0	B	0.0	--								
West Texas ²	6	30.4	1.5	0.6	2.9								
% Truck		24.4	100.0	100.0	79.8								
% Rail		75.6	0.0	0.0	20.2								

¹ Includes responses from firms in East Texas, South Central, and South Texas regions.

² Includes responses from firms in High Plains, Low Plains and Edwards Plateau.

Table 17. Estimated Percent of Rough Rice Shipments to Various Markets by Rice Driers and Percent Shipped by Truck and Rail.

Region	# of responses	Shipments					
		Texas Gulf Ports	Texas Mills	Another Rice Drier	Louisiana Mills	Mexico Border	Other
----- % -----							
Texas Rice Driers	15	3.4	84.1	0.0	0.2	12.3	0.0
% Truck		100.0	100.0	--	100.0	26.8	--
% Rail		0.0	0.0	--	0.0	73.2	--

Table 18. Country Elevators' Response to Questions Regarding Changes in Truck Shipments.

How has % of annual grain shipments transported by truck changed over past five years? (108)			
Increased:	36%		
Unchanged:	53%		
Decreased:	11%		
If shipments by truck increased, what is % increase? (36)			
			59.5%
If shipments by truck decreased, what is % decrease (11)			
			36.7%
Why did your shipments by truck increase? (38)			
Better truck service:	3%		
Change in Market Location:	21%		
Rail Abandonment	26%		
Worse Rail Service:	50%		
Why did your shipments by truck decrease? (7)			
Worse truck service:	86%		
Better Rail Service:	14%		

Note: Number of respondents to each question is in parenthesis following that question.

Table 19. Country Elevators' Response to Questions Regarding Changes in Railroad Shipments.

How has % of annual grain shipments transported by railroad changed over past five years? (50)

Increased:	14%
Unchanged:	26%
Decreased:	60%

If shipments by railroad increased, what is % increase? (7)	37.7%
---	-------

If shipments by railroad decreased, what is % decrease (25)	58.0%
---	-------

Why did your shipments by rail increase? (4)

Worse truck service:	50%
Change in Market Location:	25%
Better Rail Service:	25%

Why did your shipments by rail decrease? (35)

Better truck service:	9%
Change in Market Location:	26%
Worse Rail Service:	65%

Note: Number of respondents to each question is in parenthesis following that question.

Table 20. Feed Mills' Response to Questions Regarding Changes in Truck Grain Receipts.

How has % of annual grain receipts transported by truck changed over past five years? (21)

Increased:	29%
Unchanged:	62%
Decreased:	9%

If grain receipts by truck increased, what is % increase? (6)	Average 34.2%
---	---------------

If grain receipts by truck decreased, what is % decrease (2)	Average 40.0%
--	---------------

Why did your grain receipts by truck increase? (6)

Better truck service:	17%
Worse Rail service:	66%
Other:	17%

Why did your grain receipts by truck decrease? (2)

Worse truck service:	100%
----------------------	------

Note: Number of respondents to each question is in parenthesis following that question.

Table 21. Feed Mills' Response to Questions Regarding Changes in Railroad Grain Receipts.

How has % of annual grain receipts transported by railroads changed over past five years?
(12)

Increased:	8%
Unchanged:	50%
Decreased:	42%

If grain receipts by railroad increased, what is % increase? (1) 20.0%

If grain receipts by railroad decreased, what is % decrease (5) Average 60.8%

Why did your receipts by railroad increase? (1)

Better Rail service: 100%

Why did your receipts by railroad decrease? (5)

Worse rail service: 100%

Note: Number of respondents to each question is in parenthesis following that question.

Table 22. Rice Driers' Response to Questions Regarding Changes in Truck Shipments.

How has % of annual rough rice shipments transported by truck changed over past five years?
(15)

Increased:	6.7%
Unchanged:	80.0%
Decreased:	13.3%

If shipments by truck increased, what is % increase? (1)	100%
--	------

If shipments by truck decreased, what is % decrease (2)	25%
---	-----

Why did your shipments by truck increase? (1)

Better truck service:	100%
-----------------------	------

Why did your shipments by truck decrease? (2)

Decreased Rice Production:	100%
----------------------------	------

Note: Number of respondents to each question is in parenthesis following that question.

Table 23. Rice Driers' Response to Questions Regarding Changes in Railroad Shipments.

How has % of annual rough rice shipments transported by railroad changed over past five years? (2)

Increased: 100%

Unchanged: 0%

Decreased: 0%

If shipments by railroad increased, what is % increase? (2) 35%

Why did your shipments by rail increase? (2)

Change in Market Location: 100%

Note: Number of respondents to each question is in parenthesis following that question.

Table 24. Perceptions of Motor Carrier Performance by Country Elevator Operators Based on Performance Scale where 1 = Poor and 5 = Excellent.

	High Plains	Low Plains	Edwards Plateau	North Central	South Central	Upper Coast	South Texas	Lower Valley	State Average
# of respondents	38	7	4	23	15	8	2	6	
Readily Available	3.87	3.64	2.50	3.18	3.43	3.75	3.50	3.83	3.56
Ease of Arranging Shipment	3.82	3.80	2.50	3.43	3.57	3.88	3.50	4.17	3.66
Prompt Pick-up and Delivery	3.92	3.50	3.25	3.09	3.57	3.75	3.50	3.83	3.60
Transit Time	4.13	3.70	4.00	3.76	3.79	3.88	4.00	4.50	3.96
Reasonable Rates for Service Provided	3.82	3.82	3.25	3.19	3.71	3.38	3.50	3.83	3.60
Financially Responsible	3.63	3.73	4.00	3.33	3.50	3.38	2.50	3.17	3.50
Flexible Accommodating Service	3.76	3.70	3.50	3.24	3.64	3.50	3.00	3.67	3.57
Equipment Quality	3.65	3.55	3.25	3.50	3.07	3.63	2.50	3.50	3.48
Loss and Damage Claims	3.80	3.90	3.50	3.71	3.57	4.29	4.00	3.40	3.76
Overall Quality of Service	3.84	3.70	3.00	3.52	3.50	3.88	4.00	3.50	3.66
Average	3.82	3.70	3.28	3.40	3.54	3.73	3.40	3.74	3.64

Table 25. Perceptions of Motor Carrier Performance by Feed Mill Operators Based on Performance Scale where 1 = Poor and 5 = Excellent.

	East Texas ¹	West Texas ²	State Average
# of respondents	14	8	
Readily Available	3.57	3.80	3.65
Ease of Arranging Shipment	3.79	3.60	3.72
Prompt Pick-up and Delivery	3.64	3.50	3.59
Transit Time	3.79	3.60	3.72
Reasonable Rates for Service Provided	4.00	3.60	3.85
Financially Responsible	4.08	3.80	3.98
Flexible Accommodating Service	4.15	3.50	3.91
Equipment Quality	4.00	3.60	3.85
Loss and Damage Claims	4.08	3.50	3.87
Overall Quality of Service	4.14	3.60	3.94
Average	3.92	3.61	3.81

¹ Includes responses from firms in East Texas, South Central, and South Texas regions.

² Includes responses from firms in High Plains, Low Plains and Edwards Plateau.

Table 26. Perceptions of Motor Carrier Performance by Terminal Operators Based on Performance Scale where 1 = Poor and 5 = Excellent.

	East Texas ¹	West Texas ²	State Average
# of respondents	3	6	
Readily Available	3.33	4.17	3.89
Ease of Arranging Shipment	3.67	4.00	3.89
Prompt Pick-up and Delivery	3.00	4.00	3.67
Transit Time	3.67	4.33	4.11
Reasonable Rates for Service Provided	3.33	4.00	3.78
Financially Responsible	3.00	3.67	3.56
Flexible Accommodating Service	3.00	4.17	3.78
Equipment Quality	3.00	3.83	3.55
Loss and Damage Claims	3.00	4.33	3.89
Overall Quality of Service	3.33	4.33	4.00
Average	3.23	4.08	3.80

¹ Includes responses from firms in East Texas, South Central, and South Texas regions.

² Includes responses from firms in High Plains, Low Plains and Edwards Plateau.

Table 27. Perceptions of Motor Carrier Performance by Export Elevator Operators and Rice Drier Operators Based on Performance Scale where 1 = Poor and 5 = Excellent.

	Export Elevator	Rice Drier
# of respondents	3	15
Readily Available	3.33	4.13
Ease of Arranging Shipment	3.33	4.20
Prompt Pick-up and Delivery	3.33	3.80
Transit Time	3.33	4.36
Reasonable Rates for Service Provided	3.33	3.85
Financially Responsible	3.00	4.15
Flexible Accommodating Service	3.67	4.13
Equipment Quality	3.33	3.87
Loss and Damage Claims	3.67	4.43
Overall Quality of Service	3.67	4.07
Average	3.40	4.10

**Table 28. Average Perceptions of Railroad Performance by Country Elevator Operators Based on Performance Scale where
1 = Poor and 5 = Excellent.**

	High Plains	Low Plains	North Central	South Central	Lower Valley	State Average
# of respondents	21	3	14	9	3	
Readily Available	2.43	2.00	1.86	1.78	1.33	2.06
Ease of Arranging Shipment	2.19	2.67	2.29	1.67	1.67	2.12
Prompt Pick-up and Delivery	2.15	2.33	1.86	1.67	1.00	1.92
Transit Time	2.33	3.33	2.43	2.25	1.67	2.36
Reasonable Rates for Service Provided	2.38	3.33	2.93	1.75	2.33	2.48
Financially Responsible	3.38	3.67	3.00	3.00	3.33	3.22
Flexible Accommodating Service	2.20	2.67	2.07	1.75	2.00	2.10
Equipment Quality	2.81	3.67	3.29	2.44	3.67	2.98
Loss and Damage Claims	2.65	3.67	3.25	3.13	3.33	3.00
Overall Quality of Service	2.30	2.67	2.23	2.11	2.00	2.25
Average	2.48	3.00	2.52	2.16	2.23	2.45

Table 29. Perceptions of Railroad Performance by Feed Mill Operators Based on Performance Scale where 1 = Poor and 5 = Excellent.

	East Texas ¹	West Texas ²	State Average
# of respondents	9	3	
Readily Available	2.44	1.70	2.26
Ease of Arranging Shipment	2.13	1.70	2.02
Prompt Pick-up and Delivery	2.13	1.30	1.92
Transit Time	2.33	1.30	2.07
Reasonable Rates for Service Provided	2.33	1.30	2.07
Financially Responsible	2.88	2.00	2.66
Flexible Accommodating Service	2.00	1.30	1.83
Equipment Quality	2.89	2.00	2.67
Loss and Damage Claims	2.86	2.00	2.65
Overall Quality of Service	2.56	1.70	2.35
Average	2.46	1.63	2.25

¹ Includes responses from firms in East Texas, South Central, and South Texas regions.

² Includes responses from firms in High Plains, Low Plains and Edwards Plateau.

Table 30. Perceptions of Railroad Performance by Export Elevator Operators and Rice Drier Operators Based on Performance Scale where 1 = Poor and 5 = Excellent.

	Export Elevator	Rice Drier
# of respondents	4	2
Readily Available	2.25	3.00
Ease of Arranging Shipment	2.50	3.00
Prompt Pick-up and Delivery	2.00	3.50
Transit Time	2.50	4.00
Reasonable Rates for Service Provided	2.75	3.00
Financially Responsible	3.25	4.00
Flexible Accommodating Service	2.50	4.00
Equipment Quality	3.25	3.00
Loss and Damage Claims	3.50	4.00
Overall Quality of Service	2.50	3.50
Average	2.70	3.50

Table 31. Perceptions of Railroad Performance by Terminal Elevators Based on Performance Scale where 1 = Poor and 5 = Excellent.

	East Texas ¹	West Texas ²	State Average
# of respondents	3	6	
Readily Available	2.33	3.17	2.89
Ease of Arranging Shipment	2.33	3.33	3.00
Prompt Pick-up and Delivery	2.33	2.83	2.66
Transit Time	2.00	2.83	2.55
Reasonable Rates for Service Provided	2.33	3.67	3.22
Financially Responsible	3.00	3.67	3.45
Flexible Accommodating Service	2.33	2.67	2.56
Equipment Quality	2.50	3.67	3.28
Loss and Damage Claims	2.50	3.80	3.37
Overall Quality of Service	2.33	3.33	3.00
Average	2.40	3.30	3.00

¹ Includes responses from firms in East Texas, South Central, and South Texas regions.

² Includes responses from firms in High Plains, Low Plains and Edwards Plateau.

Table 32. Country Elevators' Response to Questions Regarding Effect of Railroad Service on Farm Bid Price.

Has inadequate rail service forced you to use a shipping method that lowered your bid price to farmers? (51)

Yes: 57%
No: 43%

If your answer is yes, what portion of your annual rail shipments are affected by inadequate rail service in a representative year? (29) 45.6%

On average, what is per bushel cost of inadequate rail service for affected shipments in a representative year? (28) Average \$0.144/bushel

Note: Number of respondents to each question is in parenthesis following that question.

Table 33. Feed Mills' Response to Questions Regarding Effect of Railroad Service on Grain Bid Price.

Has inadequate rail service forced you to use a transportation method that lowered your grain bid price? (12)

Yes: 25%
No: 75%

If your answer is yes, what portion of your annual rail grain receipts are affected by inadequate rail service in a representative year? (4) Average 65%

On average, what is per bushel cost of inadequate rail service for affected receipts in a representative year? (2) Average \$0.175/bushel

Note: Number of respondents to each question is in parenthesis following that question.

Table 34. Terminal Elevators' Response to Questions Regarding Effect of Railroad Service on Bid Price.

Has inadequate rail service forced you to use a shipping method that lowered your grain bid price? (8)

Yes:	37.5%
No:	62.5%

If your answer is yes, what portion of your annual rail shipments are affected by inadequate rail service in a representative year? (3) Average 41.6%

On average, what is per bushel cost of inadequate rail service for affected shipments in a representative year? (3) Average \$0.10/bushel

Note: Number of respondents to each question is in parenthesis following that question.

Table 35. Rice Driers' Response to Questions Regarding Effect of Railroad Service on Rough Rice Price or Profit.

Has inadequate rail service forced you to use a shipping method that lowered your profits? (2)

Yes:	0%
No:	100%

Note: Number of respondents to each question is in parenthesis following that question.

Table 36. Trends Identified in Recent Rail Research

Issue	Prater & Klindworth	Larson & Spraggins	Martland
1	Increased Class 1 concentration	Longer hauls & higher densities	Diminishing opportunity for productivity gains
2	Shrinking rural rail network	Poor service	Increased pressure on pricing
3	Importance of short line and regional railroads	Movement towards changing STB	Capacity issues- lines and terminals
4	Push to trainload operations	Need for capital investment	Infrastructure needs, particularly bridges
5	Decreasing importance of common carrier obligation	Need to raise rates	Service, single cars as slow and unreliable as 1980
6	Transfer of logistical costs to shippers		Competition, prices fallen too much on certain business moves
7	Larger railcars		Open access to promote competition
8	Declining significance of agricultural traffic		Deregulation of electric utilities- pressure on reducing coal tariffs

Table 37. The Shrinking U.S. Railroad Networks in Various Agricultural States

State	Percent of Network Lost Between 1965-1998	
Iowa	49	(61)
Minnesota	40	
South Dakota	46	(69)
Missouri	33	
Montana	33	
Nebraska	33	
Kansas	30	
Illinois	30	
North Dakota	20	(37)
Texas	24	

Notes:

1. Data in parentheses from rrtrade.org
2. Texas data from personal communications with M. Jones, Texas Railroad Commission
3. All other data from Prater and Klindworth, 2000

**Table 38. Long-Term Implications for U.S. Agriculture
(Prater and Klindworth 2000)**

Issue	Remarks
Decreasing Railroad Market Share	1. Smaller shipments lost 2. Higher levels of domestic processing/off-farm feeding 3. Exports static/domestic sales doubled over last 20 years
Higher Rates for Agricultural Shippers	1. Differential pricing, raise prices where rail to rail competition is not present 2. Low rates of return not acceptable to shareholders 3. Cost savings have mostly been made 4. Short lines not covering full costs
Increased Costs to Access Rail Service	1. More trucking/short line operations to grain rail hubs 2. Higher demurrage costs 3. To gain shuttle rates, grain shippers must build new hubs 4. Higher truck damage to rural highways
Fewer Shipper Options	1. Fewer routes, not chosen by shippers 2. Differential pricing on routes 3. Elimination of co-loading rates for unit trains 4. Closure of certain gateways 5. Rail service first to shippers with viable alternatives rather than captive shippers
Problems with Shortline Railroads	1. Shift to 286,000 lb rail 2. Restrictions on co-loading unit trains 3. Low volumes on many rural networks

Table 39. BEAs Referenced in This Report

Number	Economic Area
87	Beaumont-Port Arthur, TX
89	Monroe, LA
90	Little Rock/North Little Rock, AR
118	Omaha, NE
119	Lincoln, NE
120	Grand Island, NE
122	Wichita, KS-OK
125	Oklahoma City, OK
127	Dallas-Ft. Worth, TX-AR-OK
128	Abilene, TX
129	San Angelo, TX
130	Austin-San Marcos, TX
131	Houston-Galveston, TX
132	Corpus Christi, TX
134	San Antonio, TX
137	Lubbock, TX
138	Amarillo, TX-NM
141	Denver-Boulder-Greeley, CO-KS-NE
157	El Paso, TX
160	Los Angeles-Riverside County, CA-AZ

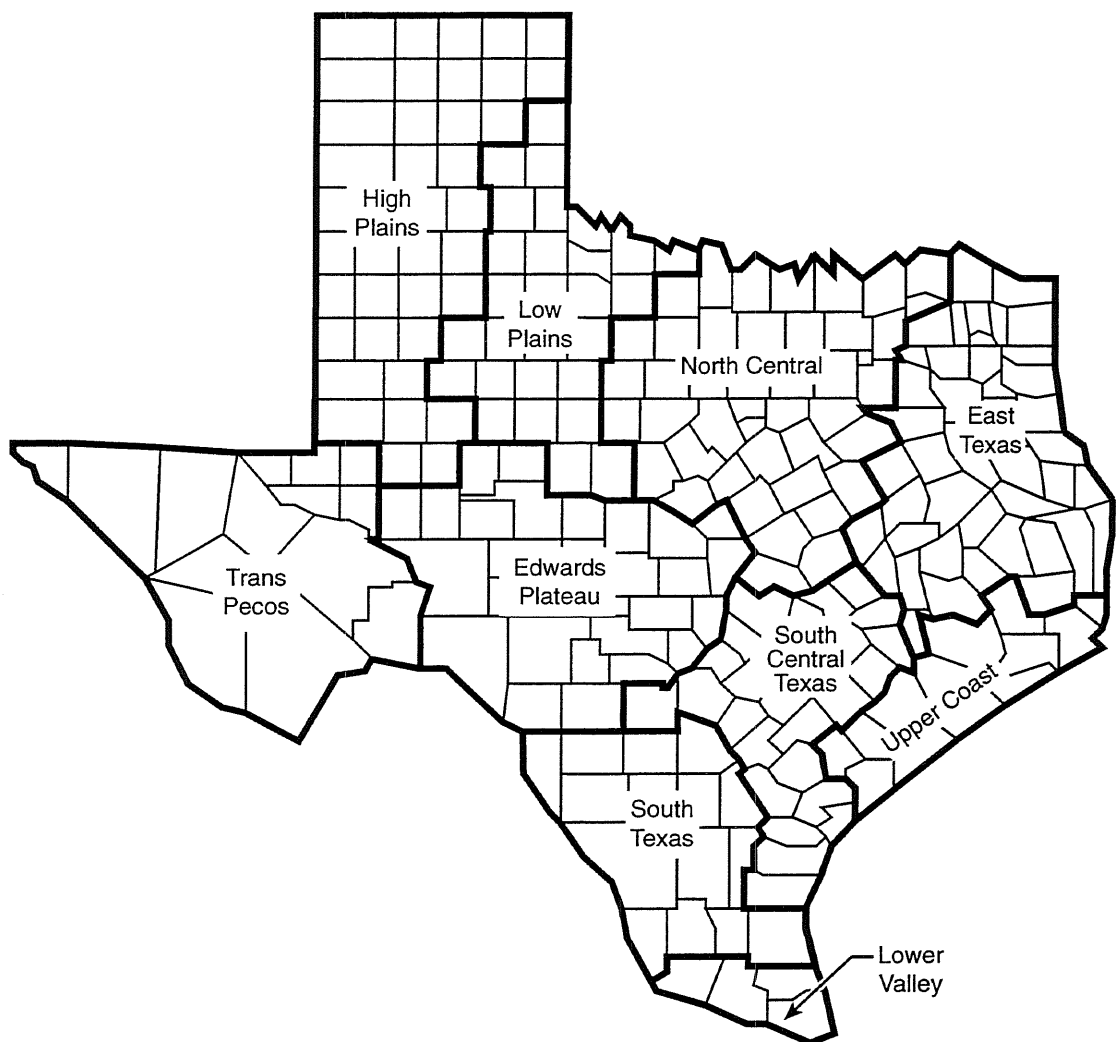
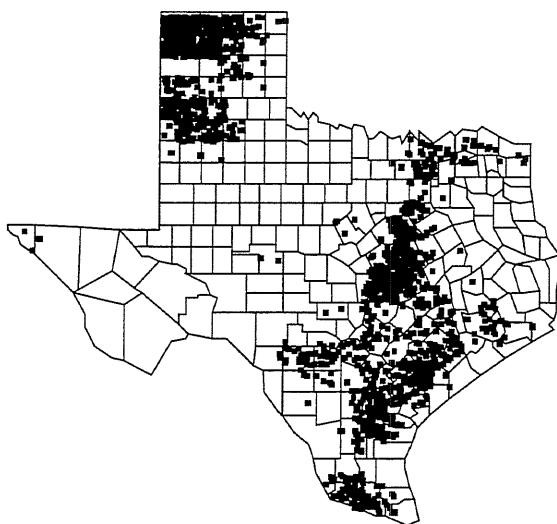
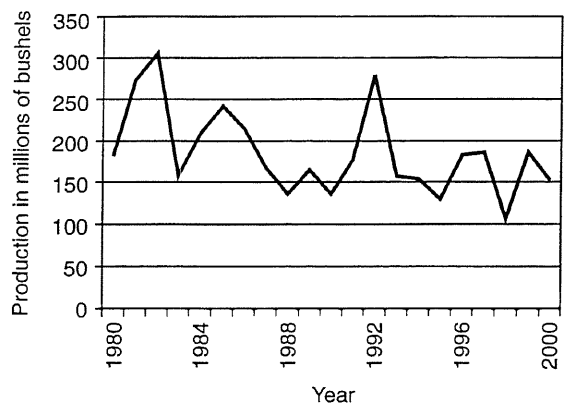
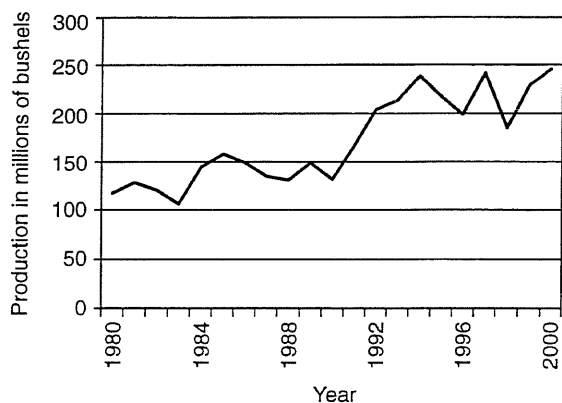


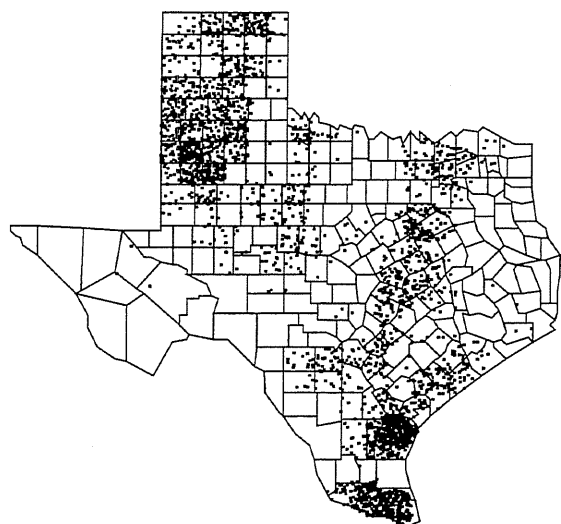
Figure 1. Texas Regions.



1 dot = 1,000 acres.
Dots indicate acreage without respect to geographic location within the county.

Source: Texas Agricultural Statistics Service,
1999 Texas Agricultural Statistics.

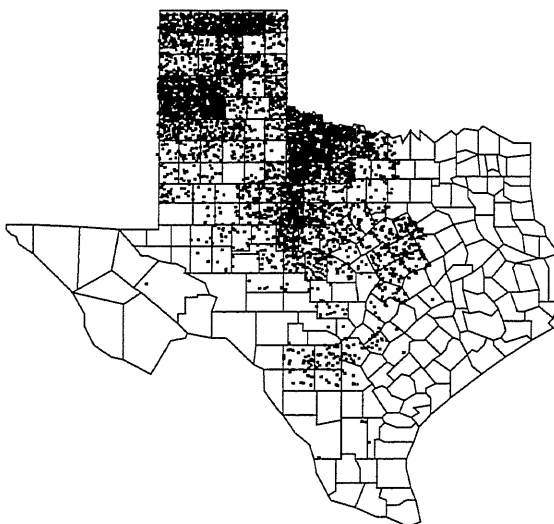
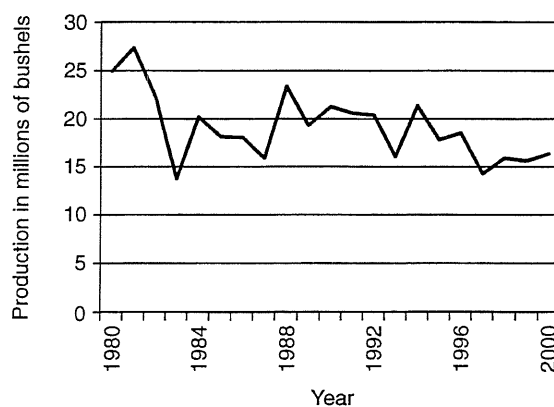
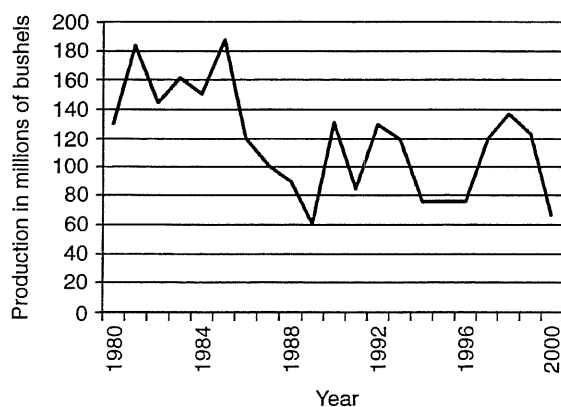
Figure 2a. Production and Location of Texas Corn, 1980-2000.



1 dot = 1,000 acres.
Dots indicate acreage without respect to geographic location within the county.

Source: Texas Agricultural Statistics Service,
1999 Texas Agricultural Statistics.

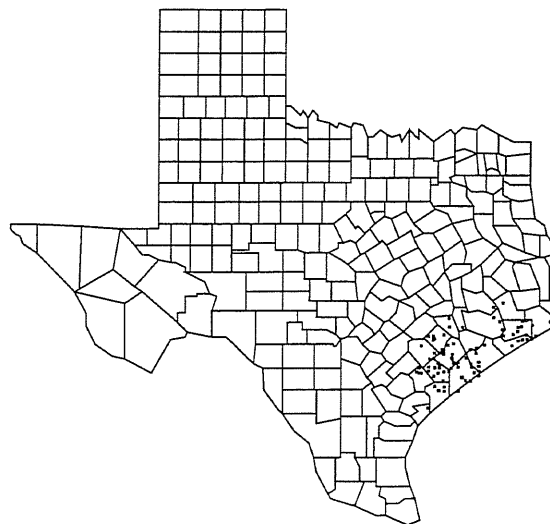
Figure 2b. Production and Location of Texas Sorghum, 1980-2000.



1 dot = 1,000 acres.
Dots indicate acreage without respect to geographic location within the county.

Source: Texas Agricultural Statistics Service,
1999 Texas Agricultural Statistics.

Figure 2c. Production and Location of Texas Wheat, 1980-2000.



1 dot = 1,000 acres.
Dots indicate acreage without respect to geographic location within the county.

Source: Texas Agricultural Statistics Service,
1999 Texas Agricultural Statistics.

Figure 2d. Production and Location of Texas Rice, 1980-2000.

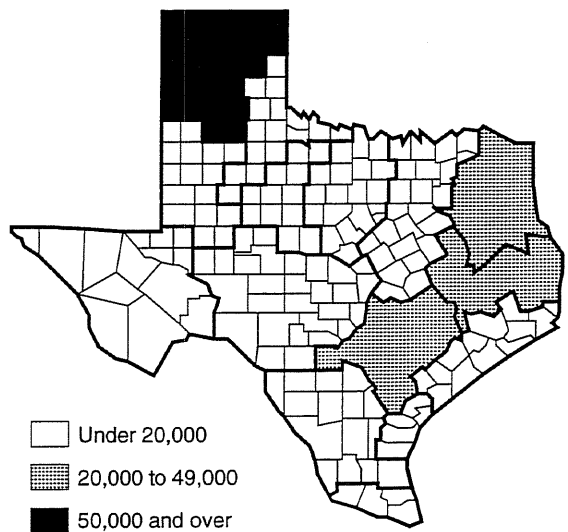
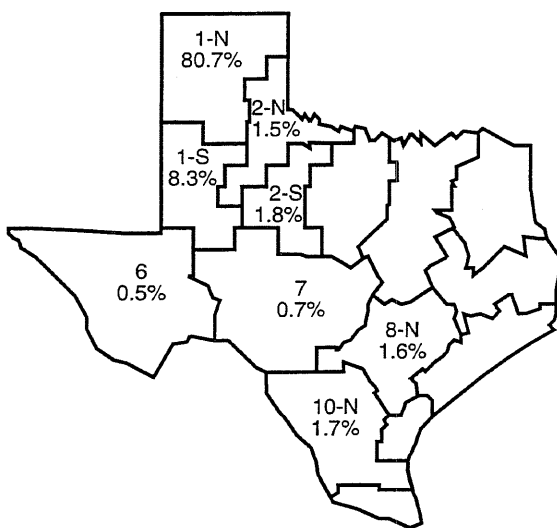
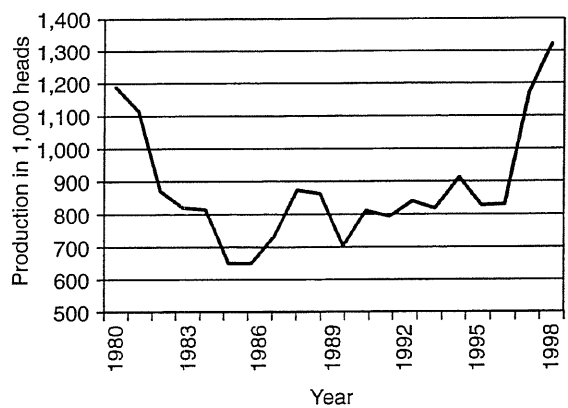
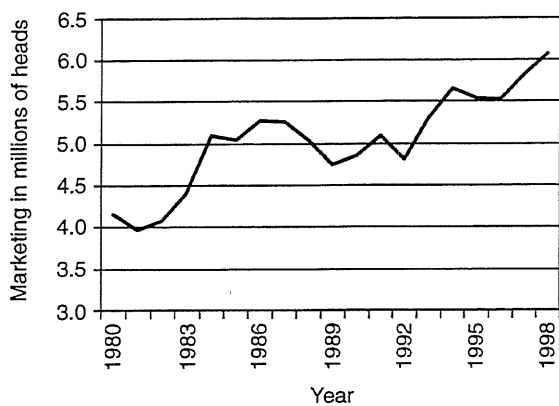
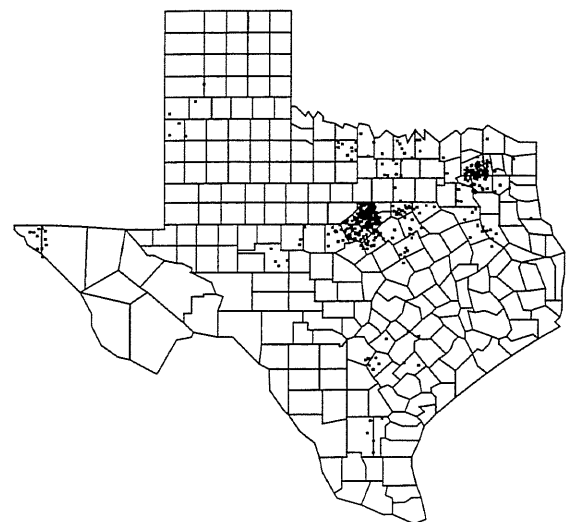
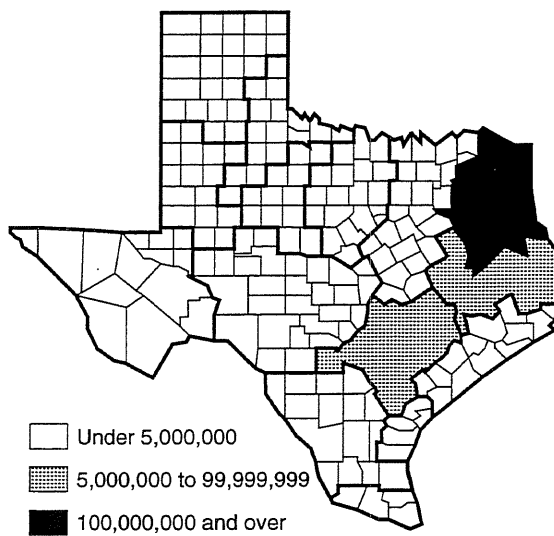
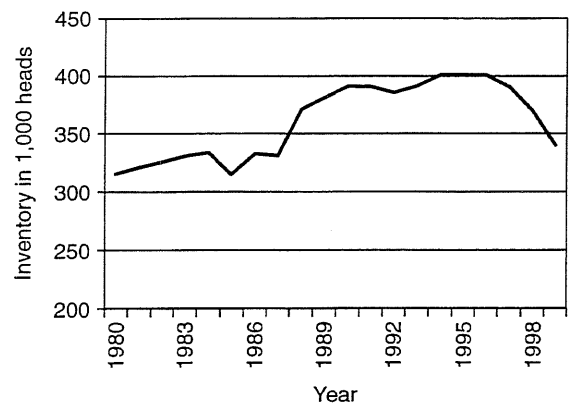
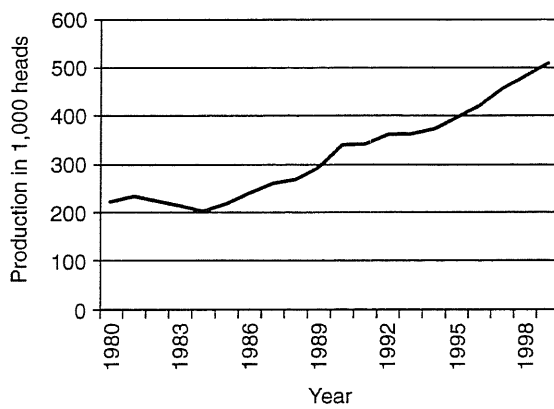


Figure 3a. Production and Location of Texas Fed Cattle, 1980-2000.

Figure 3b. Production and Location of Texas Hog Production, 1980-2000.



1 dot = 500 milk cows.

Source: Texas Agricultural Statistics Service,
1999 Texas Agricultural Statistics.

Figure 3c. Production and Location of Broilers in Texas, 1980-2000.

Figure 3d. Quantity and Location of Milk Cows in Texas, 1980-2000.

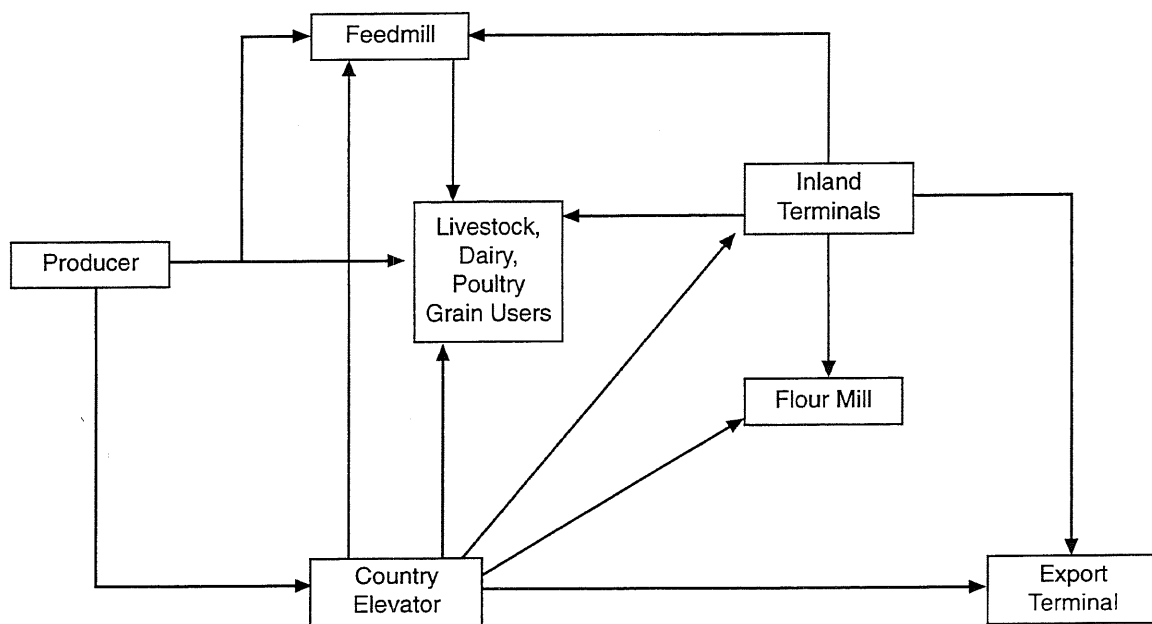


Figure 4a. Texas Grain Facilities Involved in Trade of Corn, Grain Sorghum, and Wheat with Principal Interfacility Grain Flows.

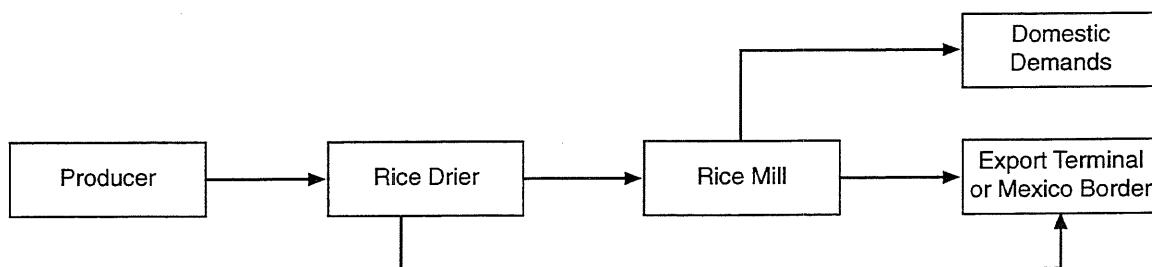


Figure 4b. Texas Rice Facilities with Principal Interfacility Flows.

BEA Economic Areas and Component Economic Area Nodes

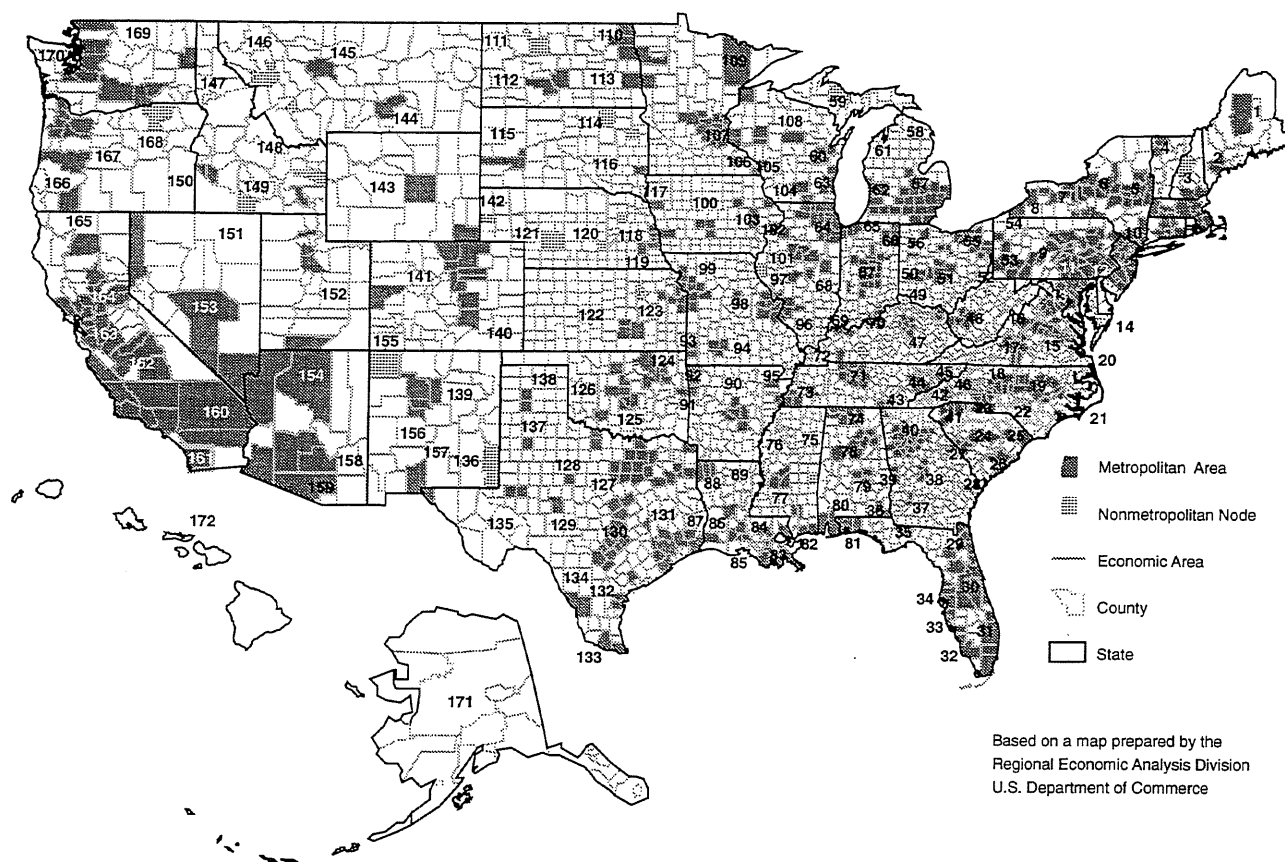


Figure 5. Bureau of Economic Analysis (BEA) Areas.

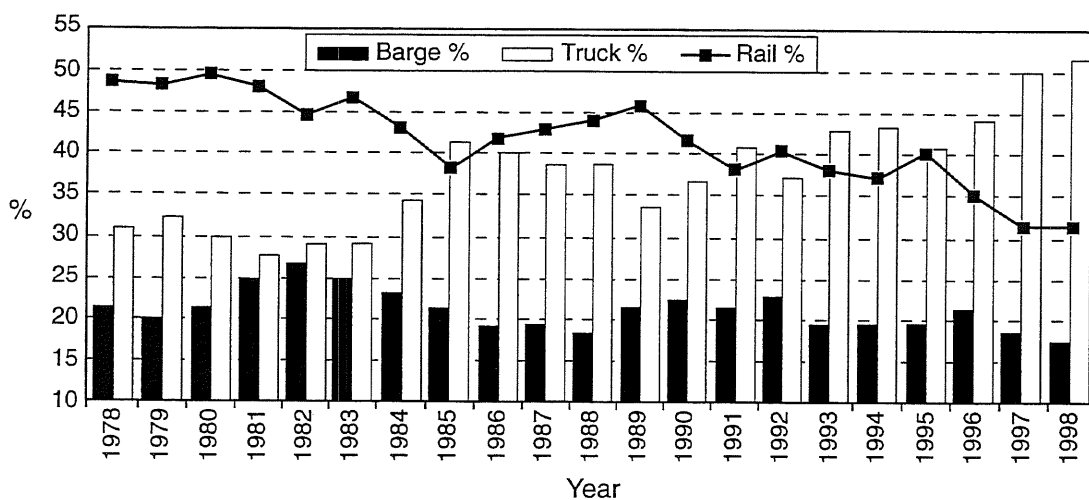


Figure 6. U.S. Grain and Oilseed Modal Shares, 1978-98 (Source: Prater and Klindworth 2000).

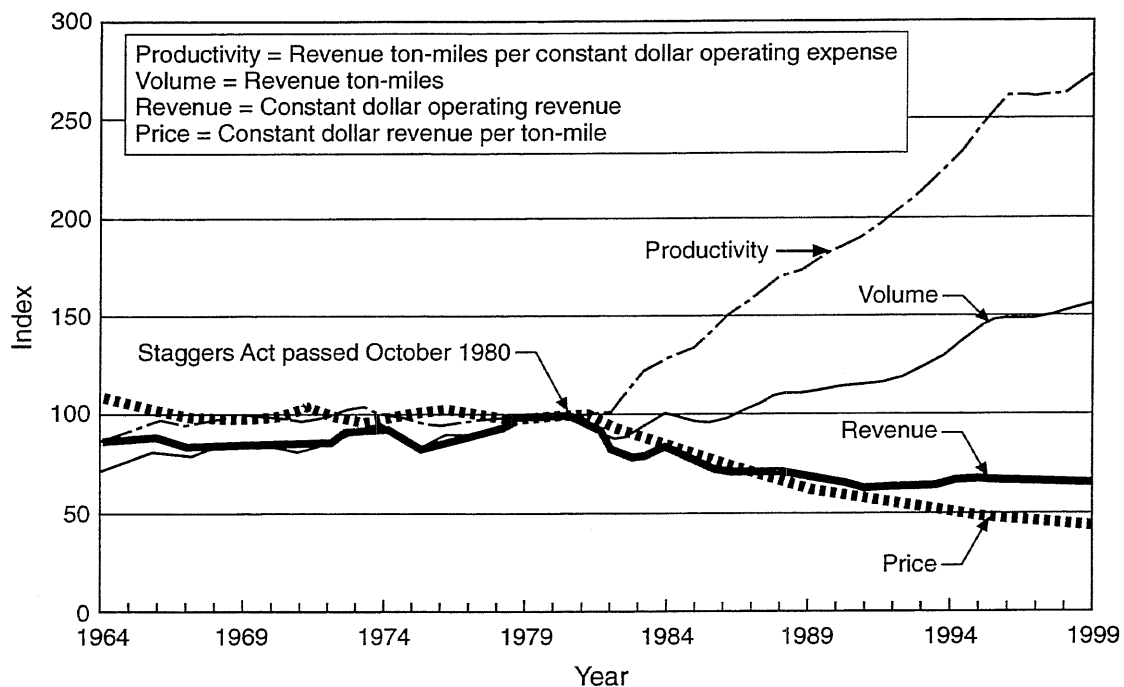


Figure 7. Class 1 Railroad Performance, 1964-99 (1981=100) (Source: AAR).

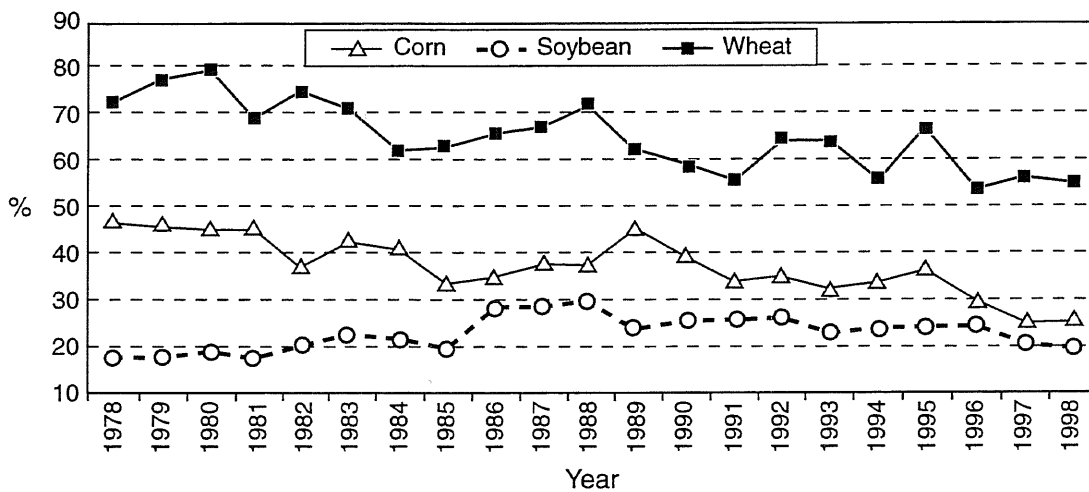


Figure 8. Railroad Share of U.S. Corn, Soybean, and Wheat Shipments, 1978-98 (Source: Prater and Klindworth 2000).

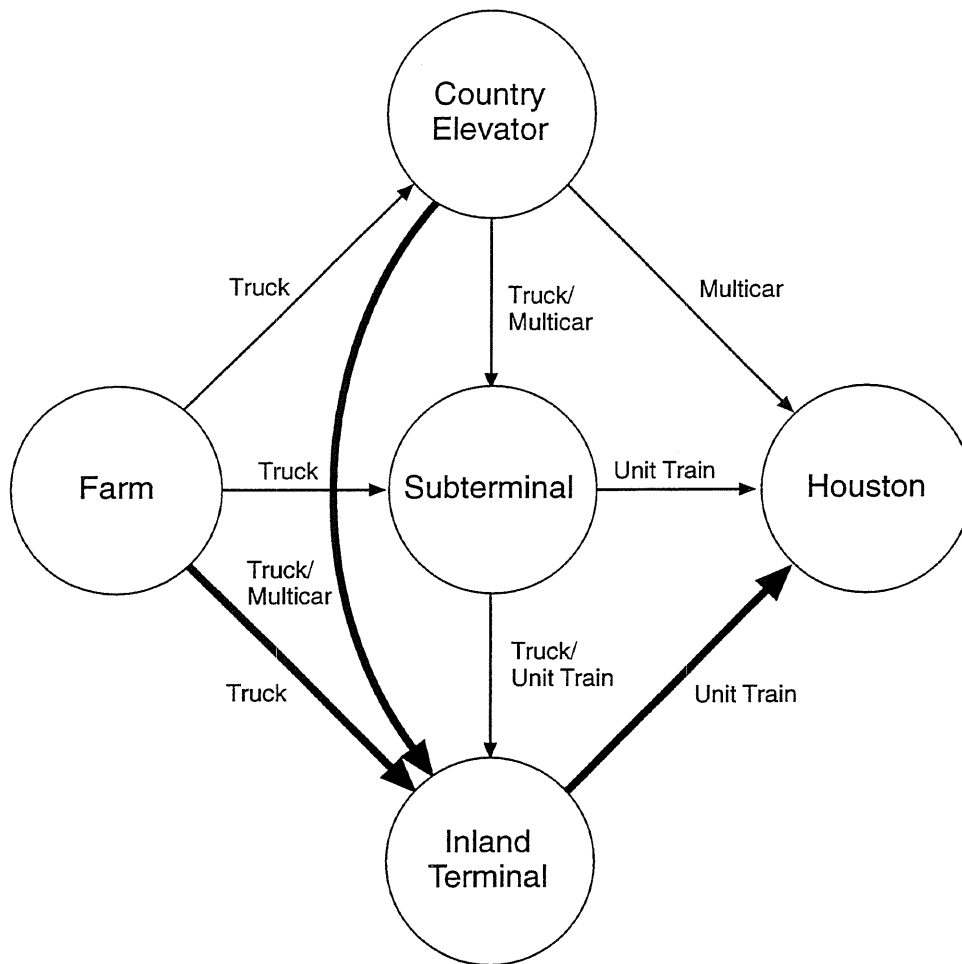


Figure 9. Types of Shipment Patterns from Country Elevators to Houston, Texas (Source: Park, J. J., et al. 1999) (Darker lines indicate growth since 1995).

REFERENCES

- American Association of State Highway and Transportation Officials, "State Programs for Light Density Rail Lines, 1976-1995." Washington, D.C., February 1997.
- American Association of State Highway and Transportation Officials. "The Ten-Year Needs of Short Line and Regional Railroads." Washington, D.C., December 1999.
- American Short Line and Regional Railroad Association (prepared by Zeta-Tech Assoc., Inc. for Am. Short Line). "An Estimation of the Investment in Track and Structures Needed to Handle 286,000 lb Rail Cars, May 2000.
- Babcock, M., M. Prater, J. Morrill, and E. R. Russell. "Competitiveness of Short Line Railroads," *Journal of the Transportation Research Forum*, Vol., 34, No. 2, (1995): 13-26.
- Boske, L. "State Rail Policies, Plans, and Programs." Policy Research Project Report 123, Lyndon B. Johnson School of Public Affairs, The University of Texas at Austin, 1997.
- Cairns, M., and J. Nash. "Regulated Access: A Flawed Approach for Canadian Rail." Paper presented at the Annual Conference of the Transportation Research Forum, Annapolis, VA, November 2000.
- Fuller, S., and B. Knudson. *Texas Feed grain Flows and Transportation Modes, 1974*. Texas Agricultural Experiment Station, B-1180, Texas A&M University, College Station, Texas, August 1977.
- Fuller, S., M. Paggi, and D. Engler. *Texas Wheat Flows and Transportation Modes, 1975*. Texas Agricultural Experiment Station, B-1179, Texas A&M University, College Station, Texas, August 1977.
- Ghareib, A., J. Lamkin, and D. Burke. *Analysis of Commodity Movements on the Texas Highway System: System Network and Regional Flows*. Texas Transportation Institute, Texas A&M University System, College Station, Texas, November 1991.
- Helsley, John. Rural District Advisors, Inc. Personal communication, December 2000.
- Larson, P. D., and H. B. Spraggins. "The American Railroad Industry: Twenty Years after Staggers," *Transportation Quarterly*, Vol. 54, No. 2 (Spring 2000), Eno Transportation Foundation, Washington, D.C.
- Martland, C. D. "Productivity and Prices in the U.S. Rail Industry: Experience from 1965 to 1995 and Prospects for the Future," *Journal of the Transportation Research Forum*, Vol. 38, No. 1, (1999): 12-25.
- Park, J. J., M. W. Babcock, and K. Lenke. "The Impact of Railroad Mergers on Grain Transportation Markets: A Kansas Case Study. *Transportation Research*, Part E 35 (1999): 269-290.

- Prater, M., and K. Klindworth. "Long-Term Trends in Railroad Service and Capacity for U.S. Agriculture." United States Department of Agriculture (USDA) Agricultural Marketing Service, November 2000.
- Texas Agricultural Statistics Service, *1998 Texas Agricultural Statistics*. Austin, Texas, 1998.
- Texas Agricultural Statistics Service, *1999 Texas Agricultural Statistics*. Austin, Texas, 1999.
- Turnbull, K., G. Dresser, and L. Higgins. "The Rural Transportation Network in Texas." Texas Transportation Institute, Texas A&M University System, College Station, Texas, August 1999.
- U.S. Department of Transportation, Bureau of Transportation Statistics, *Freight Transportation in Texas*. Washington, D.C., October 1996.
- Zeta-Tech Assoc., Inc. (prepared for the American Short Line and Regional Railroad Association). "An Estimation of the Investment in Track and Structures Needed to Handle 286,000 lb Rail Cars," May 2000.

Appendix A — Rail-Transported Grain Flows Involving Texas

Table A1. Railroad Shipments of Corn from BEA 120 (Grand Island, Nebraska) to BEA 138 (Amarillo, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
6-25	30,116	3	19.31
26-51	254,276	27	20.01
52-103	604,004	65	19.73
> 103	49,012	5	16.37
Total	937,408	100	19.69

1 ton = 35.71 bushels.

Table A2. Railroad Shipments of Corn from BEA 99 (Kansas City, Missouri) to BEA 127 (Ft. Worth, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
# 5	179,216	48	16.50
6-25	156,088	43	15.25
26-51	31,796	9	16.44
Total	367,100	100	16.13

1 ton = 35.71 bushels.

Table A3. Railroad Shipments of Corn from BEA 118 (Omaha, Nebraska) to BEA 134 (San Antonio, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
6-25	74,844	15	27.66
26-51	203,276	41	25.06
52-103	216,126	44	25.12
Total	494,246	100	25.67

1 ton = 35.71 bushels.

Table A4. Railroad Shipments of Corn from BEA 119 (Lincoln, Nebraska) to BEA 138 (Amarillo, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
26-51	10,692	8	21.31
52-103	128,556	92	19.76
Total	139,248	100	19.98

1 ton = 35.71 bushels.

Table A5. Railroad Shipments of Corn from BEA 132 (Corpus Christi, Texas) to BEA 134 (San Antonio, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
6-25	17,692	10	7.26
26-51	138,604	77	7.16
52-103	22,896	13	7.07
Total	179,192	100	7.17

1 ton = 35.71 bushels.

Table A6. Railroad Shipments of Grain Sorghum from BEA 122 (Wichita, Kansas) to BEA 131 (Houston, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
6-25	22,350	4	17.05
26-51	47,732	9	14.77
52-103	372,665	70	14.49
> 103	86,546	17	11.73
Total	529,293	100	14.39

1 ton = 35.71 bushels.

Table A7. Railroad Shipments of Grain Sorghum from BEA 122 (Wichita, Kansas) to BEA 134 (San Antonio, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
# 5	4,000	1	27.40
6-25	19,952	3	24.98
26-51	147,808	26	22.17
52-103	381,035	66	20.99
> 103	21,210	4	19.65
Total	574,005	100	21.83

1 ton = 35.71 bushels.

Table A8. Railroad Shipments of Grain Sorghum from BEA 122 (Wichita, Texas) to BEA 127 (Ft. Worth, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
# 5	8,040	5	12.04
6-25	28,368	17	14.44
26-51	10,696	7	14.44
52-103	73,032	45	14.27
> 103	42,024	26	14.88
Total	162,160	100	14.24

1 ton = 35.71 bushels.

Table A9. Railroad Shipments of Grain Sorghum from BEA 132 (Corpus Christi, Texas) to BEA 134 (San Antonio, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
# 5	35,856	15	7.82
6-25	141,456	58	7.13
26-51	64,200	27	7.09
Total	241,512	100	7.30

1 ton = 35.71 bushels.

Table A10. Railroad Shipments of Wheat from BEA 122 (Wichita, Kansas) to BEA 131 (Houston, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
# 5	19,464	1	21.61
6-25	234,404	7	21.70
26-51	256,560	7	18.74
52-103	1,783,000	50	17.01
> 103	1,263,698	35	15.38
Total	3,557,126	100	17.43

1 ton = 33.33 bushels.

Table A11. Railroad Shipments of Wheat from BEA 122 (Wichita, Kansas) to BEA 127 (Ft. Worth, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
# 5	22,472	3	15.47
6-25	171,508	23	10.75
26-51	176,240	24	12.21
52-103	366,293	50	12.65
Total	736,513	100	12.16

1 ton = 33.33 bushels.

Table A12. Railroad Shipments of Wheat from BEA 127 (Ft. Worth, Texas) to BEA 131 (Houston, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
# 5	33,716	4	15.55
6-25	136,856	16	13.54
26-51	191,164	22	14.12
52-103	203,164	23	12.25
< 103	317,436	35	9.56
Total	882,336	100	12.85

1 ton = 33.33 bushels.

Table A13. Railroad Shipments of Wheat from BEA 141 (Denver, Colorado) to BEA 131 (Houston, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
# 5	4,824	2	22.89
6-25	87,540	28	23.88
26-51	31,616	10	23.37
52-103	171,107	54	21.56
> 103	20,240	6	21.61
Total	315,327	100	22.83

1 ton = 33.33 bushels.

Table A14. Railroad Shipments of Wheat from BEA 138 (Amarillo, Texas) to BEA 131 (Houston, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
# 5	15,840	7	17.41
6-25	28,728	12	21.91
26-51	81,908	33	18.80
52-103	72,470	30	17.53
> 103	43,540	18	16.35
Total	242,486	100	18.41

1 ton = 33.33 bushels.

Table A15. Railroad Shipments of Wheat from BEA 138 (Amarillo, Texas) to BEA 160 (Los Angeles, California), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
# 5	114,968	22	24.20
6-25	232,264	44	21.55
26-51	179,108	34	21.60
Total	526,340	100	22.53

1 ton = 33.33 bushels.

Table A16. Railroad Shipments of Rough Rice from BEA 90 (Little Rock, Texas) to BEA 134 (San Antonio, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
# 5	72,516	73	23.74
6-25	26,220	27	20.73
Total	98,736	100	23.17

1 ton = 20 hundred weights.

Table A17. Railroad Shipments of Rough Rice from BEA 89 (Monroe, Louisiana) to BEA 134 (San Antonio, Texas), 1998.

Cars/Shipment	Tons	% of Total Tons	Average Freight Rate (\$/ton)
# 5	11,460	21	19.48
6-25	42,456	79	20.65
Total	53,916	100	20.23

1 ton = 20 hundred weights.

Appendix B — Railroad Rate Equations

To better understand factors that influence railroad rates, railroad rate equations were estimated for corn, wheat, grain sorghum, and rough rice (Table B1). Data for equation estimation came from the 1998 Master Waybill file and included all grain shipments that either originated from, or were destined to, a Texas location. Equations were estimated by ordinary least squares methods. In general, the results were good. About two-thirds of the annual variation in railroad rates (adjusted R-square) was explained by the selected variables. Poorest fit was associated with the estimated rough rice rate equation with an adjusted R-square of 0.59, while the best fit was associated with the estimated grain sorghum equation with an adjusted R-square of 0.76. The Durbin-Watson (D-W) test showed no serial correlation in the corn, wheat, or rough rice rate equations while the test was inconclusive regarding the grain sorghum rate equation. Signs on the continuous explanatory variables (miles of shipment, cars per shipment, and average tons per car) were as expected. Table B2 shows estimated means associated with the four continuous variables included in each equation. All remaining explanatory variables were binary variables (0, 1) and for many there were no a priori expectations regarding signs.

Results show short-line miles (Miles) to be a highly significant (0.01 level) explainer of rates (\$/ton) in the four rate equations (Table B1). In the corn equation, rates increase an average of \$0.015/ton for each mile of haul, while in the wheat, sorghum, and rice equations, rates increase \$0.013, \$0.012, and \$0.009/ton for each mile of haul. Thus, the effect of distance on rates is similar for corn, wheat, and grain sorghum shipments.

As expected, number of cars in the shipment (cars/shipment) and the average net weight for cars in the shipment (tons/car) have a negative influence on rates. Further, both variables are significant at the 0.01 level in the corn and wheat rate equations, while cars/shipment is statistically significant (0.01 level) in the sorghum equation and tons/car is similarly significant in the rough rice equation. In the corn rate equation, each additional car in the shipment lowers the rate \$0.04/ton, while the rate is lowered an average of \$0.24/ton as the average net weight per car increases by one ton. These coefficients are of a similar magnitude in those equations where this variable is statistically significant.

The effect of month (January-November) on rate was generally of little consequence except for corn, for which rates in the June-August, October, and January-February periods were lower than the base month (December) by \$1.16 to \$2.30/ton. Interestingly, corn shipments to Texas from BEAs adjacent to the Mississippi River (Miss River) and the Missouri River (Mo River) had rates that averaged \$3.59 and \$1.86/ton lower than rates for shipments from all other origins, after considering the influence of other variables included in the corn rate equation. This finding may suggest the possible influence of barge competition on rail rates. The results also suggest that the originating railroad influences the rate level. In particular, rates for corn originating on Rail Co. 1 (BNSF) and Rail Co. 2 (UPSP) trackage averaged \$2.70 and \$3.16/ton higher than rates originating on all other railroads shipping corn to Texas (Table B1). Both variables were also statistically significant and of the same sign in the wheat equation, while Rail Co. 2 was a statistically important explainer of grain sorghum rates. The Texas variable was included in the analysis to determine whether Texas intrastate rates were comparably high or low relative to other rates, after taking into consideration miles of haul, cars/shipment, tons/car, and all other

variables included in the estimated equations. Results suggest that intrastate corn and grain sorghum rates in Texas average about \$1.43 and \$2.52/ton less than other considered rates, while intrastate wheat rates averaged \$1.24/ton higher. Finally, shipments originating in Kansas, Oklahoma, and Arkansas were included as binary variables in selected equations because these states were important shippers of wheat, grain sorghum, and rough rice to Texas locations. Results show Kansas wheat shipments to Texas average about \$1.14/ton higher than all other wheat shipments, after accounting for the influence of other variables included in the equation, while Arkansas rough rice rates average about \$3.27/ton more than other rough rice shipments (Table B1).

Table B1. Estimated Corn, Wheat, Grain Sorghum, and Rough Rice Railroad Rate Equations (\$/Ton) Based on 1998 Railroad Waybill Data Involving Texas Grain Flows.

Variable	Corn	Wheat	Grain Sorghum	Rough Rice
Intercept	\$31.97*	\$35.09*	\$13.07*	\$43.57*
Miles	0.015*	0.013*	0.012*	0.009*
Cars/Shipment	-0.041*	-0.020*	-0.050*	-0.240
Tons/Car	-0.241*	-0.305*	-0.046	-0.337*
January	-2.290*	-1.074	-1.093	1.249
February	-1.719**	-0.374	-1.911**	0.055
March	0.277	-0.926	-0.882	2.501
April	-0.601	-0.836	-0.531	-2.939
May	-0.741	-0.873	-0.988	-2.659
June	-1.372**	-1.699**	1.076	-0.390
July	-2.295*	0.123	-0.497	-1.127
August	-2.205*	-1.048***	0.087	-0.846
September	-0.823	-0.880	0.646	-0.794
October	-1.159**	-1.051***	0.296	-1.274
November	-0.461	-0.513	1.198	-1.207
Mississippi River	-3.588*	--	--	--
Missouri River	-1.857*	--	--	--
Rail Company 1	2.697*	3.830*	0.522	--
Rail Company 2	3.161*	4.902*	1.945**	-0.948
Texas	-1.431**	1.240***	-2.519**	-2.00
Kansas	--	1.142**	0.944	--
Oklahoma	--	0.602	--	--
Arkansas	--	--	--	3.268**
N	653	783	224	75
Adj. R-Sq	0.64	0.66	0.76	0.59
D-W	2.06	2.14	1.81	2.38

* Significant at 0.01 level

** Significant at 0.05 level

*** Significant at 0.10 level

Table B2. Estimated Means of Continuous Variables Included in the Corn, Wheat, Grain Sorghum, and Rough Rice Railroad Rate Equations.

	Corn	Wheat	Sorghum	Rice
Rate (\$/Ton)	20.14	17.97	15.66	22.62
Miles	882.69	785.32	719.40	869.35
Cars/Shipment	28.99	46.25	38.98	3.86
Tons/Car	99.03	100.26	98.72	80.47

Table B3. Binary Variable Identification.

January - November	Binary variable (0,1) measuring influence of month (seasonality) on railroad rates.
Mississippi River	Binary variable (0,1) 1= hauls originated in BEAs adjacent to Mississippi River, 0= hauls originated in other BEAs.
Missouri River	Binary variable (0,1) 1= hauls originated in BEAs adjacent to Missouri River, 0= hauls originated in other BEAs.
Rail Company 1	Binary variable (0,1) 1= hauls originated on Burlington Northern Santa Fe Railroad, 0= hauls originated in other railroads.
Rail Company 2	Binary variable (0,1) 1= hauls originated on Union Pacific Southern Pacific Railroad, 0= hauls originated by other railroads.
Texas	Binary variable (0,1) 1= hauls originated and terminated in Texas (intrastate), 0= all other hauls.
Kansas	Binary variable (0,1) 1= hauls originated in Kansas, 0= all other hauls.
Oklahoma	Binary variable (0,1) 1= hauls originated in Oklahoma, 0= all other hauls.
Arkansas	Binary variable (0,1) 1= hauls originated in Arkansas, 0= all other hauls.

Appendix C — Survey Instrument

Confidential

Firm Name: _____

Address: _____

City: _____ County: _____ Zip Code: _____

Name of Contact Person: _____ Title: _____

Telephone: _____ FAX: _____

E-mail Address: _____

All information provided in this survey will be treated as **CONFIDENTIAL**. Please answer the following questions regarding your firm's grain handling activities at **THIS SITE**.

Your Operation

1-1. Total storage capacity in bushels: _____

1-2. Average annual bushels handled: _____



Annual Grain Receipts and Sources of Grain in a Representative Year

		% Received From:			
% by Grain		Producers	Other Elevators	Other	Total
2-1.					
Corn	_____ % 	_____ %	_____ %	_____ %	100%
Sorghum	_____ % 	_____ %	_____ %	_____ %	100%
Wheat	_____ % 	_____ %	_____ %	_____ %	100%
Other	_____ % 	_____ %	_____ %	_____ %	100%
Total	100%				

Estimate Percent of Each Grain's Annual Shipments by *Truck* and *Rail* in a Representative Year

3-1.	Truck	Rail	Other	Total
Corn	_____ %	_____ %	_____ %	100%
Sorghum	_____ %	_____ %	_____ %	100%
Wheat	_____ %	_____ %	_____ %	100%
Other	_____ %	_____ %	_____ %	100%

Estimate Percent of Each Grain's Annual Shipments To *Selected Destinations* by Truck and Rail in a Representative Year

[illegible]



Texas Truck Industry Service Quality

4-1. Please circle the number which best shows **truck** service quality you have experienced in recent years.

Service Attribute	Poor				Excellent
Readily Available	1	2	3	4	5
Ease of Arranging Shipment	1	2	3	4	5
Prompt Pick-up and Delivery	1	2	3	4	5
Transit Time	1	2	3	4	5
Reasonable Rates for Service Provided	1	2	3	4	5
Financially Responsible	1	2	3	4	5
Flexible Accommodating Service	1	2	3	4	5
Equipment Quality	1	2	3	4	5
Loss and Damage Claims	1	2	3	4	5
Overall Quality of Service	1	2	3	4	5

4-2. How has the percent of your annual grain shipments transported by truck changed over the past five years?

Decreased ☐ Remained the Same ☐ Increased ☐

4-3. Estimate % change in truck shipments over the past five years: _____ %

4-4. If your use of truck has changed, what are the reasons for this change? (Circle)

Rail Abandonment Change in Location of Markets Better/Worse Truck Service and Rates
Better/Worse Rail Service and Rates Other _____

The following questions deal with railroads and the recent performance of the railroad industry as you have experienced it.

5-1. Has railroad service to your elevator ceased as a result of rail line abandonment?

Yes _____ No _____ If your answer is Yes, please go to Question 6-1 on the last page.

5-2. Which railroads currently serve your elevator? (Circle) Union Pacific Burlington Northern

Other (specify) _____

5-3. Rail track capacity at your elevator _____ cars

Railcar unloader? Yes _____ No _____

Texas Rail Industry Service Quality

5-4. Please circle the number which best shows **rail** service quality you have experienced in recent years.

Service Attribute	Poor				Excellent
Readily Available	1	2	3	4	5
Ease of Arranging Shipment	1	2	3	4	5
Prompt Pick-up and Delivery	1	2	3	4	5
Transit Time	1	2	3	4	5
Reasonable Rates for Service Provided	1	2	3	4	5
Financially Responsible	1	2	3	4	5
Flexible Accommodating Service	1	2	3	4	5
Equipment Quality	1	2	3	4	5
Loss and Damage Claims	1	2	3	4	5
Overall Quality of Service	1	2	3	4	5

5-5. How has the percent of your annual grain shipments transported by rail changed over the past five years?

Decreased ☐ Remained the Same ☐ Increased ☐

5-6. Estimate % change in rail shipments over the past five years: _____%

5-7. If your use of rail has changed, what are the reasons for this change? (Circle)

Rail Abandonment Change in Location of Markets Better/Worse Rail Service and Rates
Better/Worse Truck Service and Rates Other _____

Estimate the Percent of Each Grain's Rail-transported Receipts and Shipments That Are in the Following Carlot Sizes in a Representative Year?

SHIPMENTS	NUMBER OF CARS					
	≤5	6-25	26-51	52-103	>103	
Wheat	_____ %	_____ %	_____ %	_____ %	_____ %	100%
Sorghum	_____ %	_____ %	_____ %	_____ %	_____ %	100%
Corn	_____ %	_____ %	_____ %	_____ %	_____ %	100%
RECEIPTS						
Wheat	_____ %	_____ %	_____ %	_____ %	_____ %	100%
Sorghum	_____ %	_____ %	_____ %	_____ %	_____ %	100%
Corn	_____ %	_____ %	_____ %	_____ %	_____ %	100%

5-9. If you are served by only one railroad, what is the distance (miles) between your elevator and an elevator served by a competing railroad? _____

5-10. Is your elevator located on a rail line where trackage rights have been made available to another rail carrier? Yes _____ No _____ Do not know _____

If Yes, does the railroad with trackage rights compete with the owning railroad for your business?

Yes _____ No _____ Do not know _____

5-11. Does your serving railroad(s) now offer elevator co-loading so smaller shippers may obtain rail rates of the larger multi-car shipper?

Yes _____ No _____ Do not know _____

5-12. Have you ever entered into guaranteed equipment contracts (e.g., COTS) with your serving railroad?

Yes _____ No _____

5-13. Has inadequate rail service forced you to use a shipping method that lowered your bid price to farmers?

Yes _____ No _____

If Yes, what portion of your annual rail grain shipments are affected by inadequate rail service in a representative year?

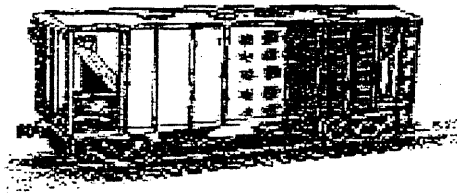
_____ %

On average, what is the per bushel cost of the inadequate rail service for affected shipments in a representative year? \$ _____ /bu

5-14. If you are served by a recently-merged railroad, has service **improved**, **deteriorated**, or **been unchanged** since the merger? _____

6-1. Is containerization of your grain shipments increasingly likely in view of the development of speciality grain markets?

Yes _____ No _____



7-1. Are you willing to answer additional related questions in a follow-up phone survey?

Yes _____ No _____

Questions? Please contact either Stephen Fuller at (979) 845-1941 or Rob Harrison at (512) 232-3113.

Thank you for your participation!

Appendix D — Trucking Survey Results

1. Trucking Survey

Good morning (afternoon). My name is Jerry Jamieson with the Center for Transportation Research at The University of Texas at Austin. The Center has been commissioned by the Texas Department of Transportation to conduct a study on grain transportation issues.

As part of our study, we are conducting surveys of rail and trucking firms, and users of grain transportation services. Ben Boerner of the Texas Grain and Feed Association suggested you might be able to help with our survey of trucking companies.

Do you mind if I ask some questions about your firm's grain transportation practices?

1. First, I need to ask a few general questions about your firm.
How long has your firm been in the business of transporting grain?
How many power units does your firm employ for transporting grain?
How many trailers do you have for transporting grain?
2. What is the typical gross vehicle weight of one of your tractor-trailer combinations?
Where do your trucks usually transport grain?
What is the usually trip length?
What is the longest trip that one of your trucks might make? (clarify if response is one-way or delivery and return)
3. A recent survey of grain elevators indicated greater satisfaction with truck service compared to rail service. What advantages would you say you have over rail?
4. How do your rates compare with rail? (clarify instances in which trucking is cheaper or more expensive) How have increases in fuel costs affected your competitive position?
5. Have you seen an increase your grain transport business in the last five years? Why do you think this is so?
6. Does your firm ever coordinate with rail firms for more efficient grain transportation?
7. What infrastructure improvements would help your firm transport grain in a more efficient manner? (better bridges, better roads, better access to major arterials)

Do you have any additional comments that might help us in our study?

Thanks for participating in this survey. If you don't mind, can I have your e-mail for any follow-up questions that might arise.

2. Discussion of Survey Results

In November 2000, a telephone survey of fourteen companies using trucks for grain transport was conducted. The Texas Feed and Grain Association provided a selective list of company contacts to be interviewed; thus, the survey was non-random.

The survey was designed to gather information on trucking fleet characteristics, transportation destinations, trip lengths, advantages of trucks over rail, truck rates versus rail rates, changes in truck usage, the existence of truck-rail coordination for more efficient transport of grain, and governmental action that might help with improved truck transportation.

Survey Responses

Five companies out of the nineteen provided were non-contactable. Three failed to return messages, one was constantly out on the road making deliveries, and one could not be contacted owing to a non-working number.

Of the fourteen companies contacted, three were discarded from the survey results. Two of the discards were grain brokers who did not arrange the grain transportation; the other contracted out its transportation and was unable to answer the questions posed for the survey. However, the eleven companies used in the survey results varied considerably in their size and trucking fleet. Thus, although the survey is small and unscientific, the insights gained from this survey account for variations in responses due to differing company characteristics.

The contacts interviewed were company owners, presidents, safety directors, or general managers — individuals who had wide knowledge about their firm's grain transportation practices.

Survey Results

Nine companies were located in Texas, one in Oklahoma, and one in Tennessee. The non-Texan companies delivered grain into Texas and the contacts were knowledgeable about their firms transport practices in Texas. The companies have been in the grain transportation business anywhere from 5 to 150 years. The median number of years in business is 20.

The number of power units and trailers used by each company varied considerably. The median number of power units is 70. However, many answers regarding the number of power units were not straightforward. The larger companies could only answer by giving the number of annual trips. Some companies own their power units and trailers, while others use contract services for their transportation needs. See Table B1 for the responses given when asked for the number of power units and trailers that the firms employ.

All respondents reported typical truck gross vehicle weights of 80,000 pounds, except the company based in Oklahoma, which reported 85,000 pounds¹, and another company reporting

¹ While most states, including Texas, have set their general maximum gross vehicle weight limit at 80,000 pounds, Oklahoma allows travel at 85,000 pounds on its state roads.

84,000 pounds. One company reported traveling at over 80,000 pounds sometimes, and another reported traveling at over 84,000 pounds in certain instances. Three of the companies, including the one reporting the typical weight of 84,000 pounds, use the 2060 overweight permit, which allows travel at a GVW of 84,000 pounds.

The average one-way trip length ranged from 65 to 500 miles, with 150 miles as the median. The response for the longest one-way trip ranged from 125 to 2,500² miles, with the median at 450 miles. Thus, trucks were generally making fairly short, same-day trips of grain. This finding coincides with the Class I railroads' claims that rail is not cost efficient for shorter routes.

Deliveries are usually being made to export elevators and terminal elevators. Dairies were reported by two respondents, and feed mills, feed yards, and flourmills were each mentioned once (see Table B2). Two respondents gave only geographic information for their delivery sights. One reported delivering grain to the central U.S. and the other to Texas, Oklahoma, and Arkansas.

The reported advantages of truck over rail were what one would expect: on-time delivery, greater control of delivery, delivery to more locations, a constant rate schedule, and easier ability to make logistic changes in delivery patterns.

All valid responses indicated that trucking rates were higher than those for rail, except for the following: trucking is cheaper on short trips and trucking is cheaper at 100 miles or closer. However, most respondents agreed that truck rates are, in effect, cheaper in many instances because faster delivery creates a cost advantage. Two companies had never used rail and therefore could not provide an answer to truck versus rail costs.

All respondents reported an increase in rates resulting from recent higher fuel costs except one, which will institute an increase for the next harvest season. Another respondent reported that the fuel increase has improved their competitive position, since some of the competing firms have gone under.

Five companies reported an increase in their trucking business over the last 5 years. Reasons for the increase were more overseas demand, loss of faith in rail service, and rail abandonment. Two reported decreased business because of stiff competition from other trucking firms and the closure of an export elevator. Four reported steady business. These companies were generally interested in serving their established customer base and not expanding.

Most companies had no coordination between truck and rail transportation. One reported problems with trying to coordinate with rail, and another reported that rail sees trucking as competition and thus will not work with trucking firms. Two companies reported coordinating truck and rail service. Two respondents did not answer the truck-rail coordination question.

The question about infrastructure improvements or TxDOT action that could help in the efficiency of trucking elicited varied responses, some of which were not directly related to the question. Some responses included the following: Trucking firms should better coordinate their

² 2,500 miles seems like an extreme outlier. The next longest one-way trip was 1000 miles.

routing to avoid overlapping routes, brokers and shippers should better coordinate their loads, and some type of industrywide increase in rates is needed to offset rising fuel costs. Most respondents reported satisfaction with the road network, with upgrading the road network mentioned only twice. Four respondents reported that changes in maximum weight policy are needed. Responses along this line included the need for more cost-effective overload permits, more allowable weight, and greater leniency on weight violations. Two companies reported receiving numerous overweight fines recently; they argued that such fines were unfair, given that weight scales are not available in the field and bushel weights are not very accurate.

One other bit of information was obtained from this survey regarding trucking grain into Mexico. Two respondents noted that grain is transferred onto Mexican trucks before delivery into Mexico. Another respondent noted that there are agreements between U.S. and Mexican trucking firms for transporting grain into Mexico.

3. Tables of Survey Results

Table D1: Responses to the Number of Power Units and Trailers Employed by Each Firm

<u>Respondent #</u>	<u>Power Units</u>	<u>Trailers</u>
1	1	4
2	3 owned, contracts others as needed	3 owned, contracts others as needed
3	5	5
4	8-10	2 owned, 4 leased
5	18	18
6	70	62
7	70	100
8	7 owned, contract about 40, hire additional 45 transportation cos. per week through brokerage co.	30 owned, plus those hired have own trailer
9	About 40 loads per week	
10	2,000 trips annually	
11	55,000 trips contracted	

Table D2: Survey Responses to Truck Transport Destinations^a

	<u>Number of Responses</u>
Export Elevators	4
Terminal Elevators	4
Dairies	2
Feed mills	1
Feed yards	1
Flourmills	1

^a Some respondents reported more than one delivery destination

Remaining Contacts:

Hill Grain Co. – left messages

Belcher, E.W. Trucking – left message (not reachable because always out on the road)

Texoma Ag-Products – left messages

BGR Trucking – bad number

Moon Mullins of Dreyfus – left messages

Exclude –

Western Feeders – transported cottonseed since 1912; contract out trucking; do not have any useful information.

Schmitt & Kern – Grain brokers; do not handle transportation.

J.W. Nutt Co. – Grain brokers, unable to answer specific transportation questions. However, Mr. Nutt said he would be happy to discuss any general types of issues related to the grain industry (seems very knowledgeable).

Company Location

Titan	- Levelland, TX
Vista Trading	- Houston, TX
L&S	- Edinburg, TX
Dodson, Glynn	- Royse City, TX
Southwest Interstate	- Cumby, TX
Friemel Bros.	- Groom, TX
S.O.O. Trucking	- Okeene, OK
Sofico	- Memphis, TN
Ray Hutchinson	- Paris, TX
Dreyfus	- Ft. Worth, TX
Lehman	- Iowa City, TX

How long in business (yrs.)?

Titan	- 5
Vista Trading	- 6
L&S	- 13
Dodson, Glynn	- 14
Southwest Interstate	- 15
Friemel Bros.	- 20
S.O.O. Trucking	- 22
Sofico	- 25
Lehman	- 26
Ray Hutchinson	- 30
Dreyfus	- 150

How many power units and trailers?

	<u>Power Units</u>	<u>Trailers</u>
Lehman	1	4
Friemel Bros.	3 owned, contracts others as needed	3 owned, contracts others as needed
Hutchinson	5	5
Dobson, Glynn	8-10	2 owned, 4 leased
S.O.O. Trucking	18	18
L&S	70	62
Southwest Interstate	70	100
Titan	7 owned, contract about 40, hire additional 45 transportation cos. per week through brokerage co.	30 owned, plus those hired have own trailer
Sofico	About 40 loads per week	
Vista Trading	2000 trips annually	
Dreyfus	55,000 trips contracted	

Typical GVW

All reported 80,000 except Titan (30,000?), S.O.O. Trucking (85,000, but OK; has higher limits.), and Dodson, Glynn, and Lehman (84,000). L&S reported traveling over 80,000 sometimes, and Titan reported traveling over 84,000 sometimes. Vista Trading, Dodson, Glynn, and Lehman use 2060 permits.

Where Transport Grain

Dodson, Glynn elevators	- Mainly to Cargill Elevator near Ft. Worth and other terminal
L&S	- Cargill Elevator near Houston and ADM Elevators in the Panhandle
Southwest Interstate	- Terminal elevators
Hutchinson	- Terminal elevators and individual dairies
Vista Trading	- Elevators near Corpus Christi
Dreyfus	- Dreyfus export elevators in Beaumont and Houston
Lehman	- Export elevator in Houston and flourmills
Titan	- Central U.S.
Sofico	- TX, OK, and AR
S.O.O.	- Feed mills and farmer's dairies
Friemel Bros.	- Feed yards

Avg. Trip Length (one way)

Friemel Bros.	- 65
Dodson, Glynn	- 75
Vista Trading	- 100
Titan	- Local under 150; long-haul 150 to 1000
L&S	- 150
Hutchinson	- 150
Dreyfus	- 150
Sofico	- 350
Lehman	- 400
Southwest Interstate	- 500
S.O.O.	- dk

Longest Trip (one way)

Friemel Bros.	- 125
Dodson, Glynn	- 175
Vista Trading	- 200
Dreyfus	- 250
L&S	- 450
Lehman	- 450
Sofico	- 600
S.O.O.	- 600
Hutchinson	- 600
Titan	- 1000
Southwest Interstate	- 2500

Advantages over Rail

The responses varied little:

- On-time delivery
- Delivery time
- Constant rate
- If load is diverted by destination, it is easier logistically for trucks to make such changes
- More control
- Dependability of delivery
- Can deliver to more locations

Rate Comparison

All respondents replied that trucking rates were higher than those for rail except Sofico (trucking cheaper on short trips) and Vista Trading (trucking cheaper at 100 miles or closer). Dodson, Glynn did not give an answer and Friemel Bros. had never used rail and could not answer.

However, truck rates are cheaper, in effect, in many instances because faster delivery creates a cost advantage.

Increases in Fuel Cost Effects

All respondents reported an increase in rates resulting from recent higher fuel costs, except Dodson, Glynn, which will institute an increase for the next harvest season. Titan reported that the fuel increase has improved their competitive position, since some of the competing firms have gone under.

Increase in Business

Friemel Bros., Sofico, L&S, and Dodson Glynn reported steady business in the last 5 years, mostly owing to servicing an established customer base.

Dreyfus, Hutchison, S.O.O., Titan, and Vista Trading reported an increase in business. Vista Trading cited more overseas demand as the reason; the others cited loss of faith in rail service and rail abandonment.

Southwest Trucking reported a slight decrease in business owing to stiff competition from other trucking firms.

Lehman reported a decrease in business due to the closure of an export elevator; however, Dreyfus' new export elevator should help business.

Coordinate with Rail

Most answered no coordination with rail. Vista Trading reported problems trying to coordinate with rail, and Titan reported that rail sees trucking as competition and thus will not work with trucking, but Titan would welcome coordination.

Dreyfus and S.O.O. reported truck and rail coordination.

Two firms did not answer this question.

Infrastructure or DOT Improvements

Some firms responded to this question by suggesting logistical improvements within the trucking industry.

Dodson, Glynn and L&S – TxDOT should be more lenient on weight violations. Both firms received numerous overweight violations recently. No scales are available in the field to measure weight, and bushel weights are not always accurate.

Vista Trading – Better roads and more allowable weight.

Titan – Cost-effective overload permits.

Dreyfus – Upgrade roads around ports with export elevators.

Southwest Transportation – Trucking firms should coordinate their routing; much overlapping.

Hutchinson – Would like to see more coordination of loads by brokers and shippers.

Lehman – Need some type of industry increase in rates to offset fuel costs.

Most firms reported satisfaction with roads and access to arterials.

Comments

Sofico — Delivers cottonseed and rice byproducts.

Vista Trading — Transfers load to Mexican trucks when delivering to Mexico.

Dreyfus — Sends most of its grain by vessel, but knows of agreements between U.S. and Mexican firms for trucking grain into Mexico.

Lehman — Used to deliver to Brownsville and unload for Mexican trucks to carry cargo into Mexico.

