

Appendix A — Transportation Services Used by U.S. Agriculture

Background

The U.S. agricultural sector depends extensively upon transportation for a number of reasons. Agricultural production typically occurs in areas substantially removed from the final markets for products. Production is generally dispersed over wide areas or regions. Agricultural commodities and products also tend to require a wide range of transportation services. Some products, such as grains, are bulky and of low value. Others, such as fresh fruits, vegetables, and meats, are highly perishable and of high value. Still others, such as livestock, require specialized handling and equipment. Modern commercial agriculture is also input-intensive, using a broad range of products from fertilizers to feed additives. These inputs generate demand for transportation services that vary by product and market.

The ability to measure the importance of the agricultural sector's transportation demands relative to those of other sectors of the U.S. economy is useful from a public policy perspective. Such a comparison, however, is difficult because of the diversity of U.S. agriculture, with its many inputs, products, and markets. In an effort to make such a comparison, the following discussion relies upon data from the 1993 Census of Transportation Commodity Flow Survey combined with additional data and analysis provided by Oak Ridge National Laboratory (ORNL). The following discussion and tables present ton-mile,³¹ tonnage, value, and distance of shipment comparisons for agricultural and nonagricultural commodities by mode of transport for 1993.

Presented below is the USDA's initial findings as to how U.S. agriculture uses transportation services based upon the ORNL data in appendix tables A1-A4.

Findings

Major commodity movements – In 1993, the U.S. transportation system carried more than 10.7 billion tons of goods and generated almost 2.5 trillion ton-miles in transportation services. Major commodity movements on a ton-mile basis include agricultural commodities (769 billion ton-miles, (BTM)), coal (488 BTM), petroleum and coal products (287 BTM), and chemicals (198 BTM). These four commodity groupings accounted for about 71 percent of the 2,456 BTM of commodity movements.³²

Agricultural share of total movements — From the data provided above, the transport of agricultural products is revealed to account for a significant portion of all U.S. freight traffic. In fact, defining agricultural movement to include movements of farm inputs, raw agricultural

³¹ Boyer, Kenneth, D, *Principles of Transportation Economics*, (Reading, MA: Addison-Wesley, 1998), p. 28. Ton-miles are calculated as the product of the tonnage of the shipment and the distance traveled.

³² Note that these totals do not include crude petroleum, natural gas, or gasoline moved by pipeline.

commodities, and processed agricultural commodities, agriculture is shown to be the primary user of transportation services in the United States at 32 percent of the total tonnage and 31 percent of the total ton-miles.³³

Transport modes used by agriculture — The leading agricultural ton-mile provider is trucks, with about 45 percent of total ton-miles (345 BTM). Railroads and barges provide another 32 and 12 percent of the ton-miles of transportation services used by U.S. agriculture, respectively. The remaining 11 percent of freight requirements is handled through air freight, pipeline, multiple modes, and other carriers. In contrast to the dominance of agricultural movements by trucks, railroads are the leading provider of transport services on a ton-mile basis for the nonagricultural shipments.

Commodities shipped by agriculture — Of all agricultural commodity groups, field crops (grain, oilseeds, cotton, peanuts, potatoes, beet or cane sugar, and hay) are the largest consumer of transportation services, as measured on a ton-mile basis. Field crops are generally unprocessed, low-value, and bulky materials that need to be transported long distances. In 1993, field crops accounted for 35 percent of the total agricultural ton-miles and 29 percent of the total agricultural tonnage shipped. Other important agricultural commodity groups being shipped and their share of total agricultural ton-miles include lumber, pulp, and wood (12 percent); fertilizers and pesticides (11 percent); and grain mill products (8 percent). Field crops and grain mill products together account for over 45 percent of agricultural ton-miles.

As shown in table A2, total tonnages for field crops amounted to 986 million tons or 9 percent of total tons. The next largest agricultural commodity in terms of tonnage was raw lumber and pulp materials, at 599 million tons. The ton-mile measure for raw lumber and pulp materials was relatively small because these commodities are generally shipped short distances.

Trucks are the leading transport mode for the movement of fresh fruits and vegetables in the United States, with a market share of almost 90 percent based on ton-miles and a 99 percent share based on tons shipped. Similarly, the movement of livestock (cattle, swine, sheep, poultry, fresh dairy products, and goats) is primarily handled by truck and shipped relatively short distances.

Table A3 shows the dollar value of all commodities by mode. This was defined as the net selling price value without any freight charges or excise taxes. Generally, as would be expected, the greater the degree of processing, the higher the total dollar value of the shipment. Canned or preserved foods (includes frozen prepared foods) is the highest dollar value category of all agricultural goods shipped and is worth \$171 billion in the aggregate. Fresh or frozen meats and poultry are a close second, with \$167 billion worth shipped. Trucks handled most of the shipments of meats and canned foods.

Explanation of Data

³³ Farm inputs include movements of agricultural chemicals, fertilizers, and machinery.

The four tables in appendix A were prepared by the Center for Transportation Analysis of the ORNL. At the request of the USDA, ORNL prepared a retabulation of the 1993 Commodity Flow Survey data (CFS) for use in this analysis. The CFS, part of the 1992 Census of Transportation, Communications, and Utilities, is a major source of data on the structure and productive activity of the U.S. economy. The CFS contains data on commodity shipments initiated by establishments engaged in manufacturing, mining, wholesale, and selected retail, service, and auxiliary activities. Such data include the tons, ton-miles, average miles, and value of shipments by commodity shipped and transportation mode. Farm-based shipments (production sites to processing facility or local elevator) that are not included in the CFS were added by ORNL for this analysis.

The following explanation is provided for the terms and abbreviations used in these tables.

“Water” refers to the barges, ships, or ferries operating on the inland waterways, Great Lakes, the St. Lawrence Seaway, the Intracoastal Waterway, the Inside Passage to Alaska, major bays and inlets, or on the ocean close to the shoreline. “Other” refers to delivery services that carry letters, parcels, and packages generally weighing less than 100 pounds. “Other” also includes air freight and air express, multiple modes, and pipelines. Data for pipelines do not show ton-miles, since the shipment destination may be a facility on a main pipeline network and resulting mileage may only represent the access distance through a feeder system and not the actual distance traveled.

Ton-miles and miles are based on the estimated distance traveled, not on “great circle” distance. Truck includes private truck, for-hire truck, and private and for-hire truck combinations. Water includes inland water, Great Lakes, and deep sea water.

* Portions of the data in the truck, rail, and water columns may be suppressed due to statistical or disclosure reasons and, therefore, the total does not necessarily equal the sum of the remaining four columns.

- Represents zero or less than 1 unit of measure.

(d) Denotes figures withheld to avoid disclosing data for individual companies.

(s) Data do not meet publication standards due to high sampling variability or other reasons. Some unpublished estimates can be derived by subtracting published data from their totals. However, the figures obtained by such subtraction are subject to these same limitations.

Table A1—Ton-miles of agricultural and nonagricultural commodities by mode of transportation, 1993

Commodity Groups	Truck	Rail	Water	Other	Total
	<i>Billion ton-miles</i>				
Agricultural commodities					
Field crops	43.97	117.03	72.58	31.67	266.42
Fresh fruit & vegetables	23.13	1.09	(s)	1.49	25.75
Livestock or livestock products	8.33	(s)	-	0.20	8.56
Other farm products	10.08	(s)	-	0.96	11.22
Meat, poultry, fresh or frozen	31.97	3.80	-	1.15	36.92
Dairy products	15.34	1.21	-	0.57	17.16
Canned or preserved foods	37.10	10.83	(s)	3.15	51.12
Grain mill products	29.03	30.09	1.71	2.09	62.92
Bakery products	7.38	0.17	-	0.61	8.15
Sugar, beet, or cane	3.43	4.76	(s)	7.28	15.56
Confectionery products	4.44	0.13	-	0.15	4.72
Beverages	25.06	7.75	1.10	2.96	36.87
Misc. food products	20.19	13.29	2.09	1.98	37.56
Lumber, pulp & wood products (raw)	60.44	20.71	1.22	6.76	93.30
Fertilizers and pesticides	10.34	31.96	14.53	23.49	83.96
Farm machinery and equipment	1.99	0.07	-	0.54	2.60
Major miscellaneous ag. Products	4.80	(s)	0.03	0.98	6.31
Sub-total	344.86	243.62	94.57	86.06	769.11
Non-agricultural commodities					
Metallic ores	0.84	11.97	(s)	19.88	36.89
Coal	7.24	393.12	20.39	64.84	487.78
Crude petroleum, natural gas, or gasoline	(s)	(s)	(s)	(s)	(s)
Nonmetallic minerals	62.69	23.57	12.29	11.93	110.48
Ordnance	0.41	0.16	-	0.05	0.63
Textiles	10.23	(d)	(s)	0.84	11.34
Apparel	6.86	0.17	-	1.80	9.96
Lumber or wood products (processed)	19.46	15.09	-	2.22	36.77
Furniture or fixtures	8.50	(d)	(d)	0.94	9.79
Paper & allied products	52.30	32.34	(s)	6.51	91.32
Printed matter	(s)	(s)	(s)	(s)	(s)
Chemicals	69.07	100.54	12.25	15.97	197.84
Petroleum & coal products	55.51	47.56	22.81	140.88	287.08
Rubber and plastics	22.26	1.10	-	2.16	25.53
Leather	1.62	(s)	-	0.50	2.18
Clay, concrete, glass & stone	40.67	17.27	8.25	5.46	84.03
Primary metal products	58.66	31.20	2.97	4.43	97.27
Fabricated metal products	25.59	2.03	(s)	2.58	30.45
Machinery	13.55	(s)	-	2.38	16.54
Electrical machinery	14.83	(s)	-	3.52	19.59
Transportation equipment	24.42	(s)	(d)	15.84	49.10
Instruments, optical or photographic	4.13	(s)	-	1.09	5.39
Miscellaneous products	8.70	(d)	(d)	1.88	10.99
Waste and scrap	13.25	10.40	1.76	2.18	27.59
Mixed freight	4.80	0.02	-	0.22	5.04
Containers (empty)	0.13	(s)	-	-	0.23
Hazardous materials	0.12	0.10	-	0.02	0.31
Unknown	1.55	0.59	-	0.36	2.52
Sub-total	560.36	698.93	106.46	321.71	1,687.47
All Commodities	905.22	942.55	201.04	407.77	2,456.58

See appendix note for explanation of terms and meaning of abbreviations. Totals may not add because of rounding.

Source: USDOT, Bureau of Transportation Statistics, Commodity Flow Survey, 1993 & special farm-based transportation survey conducted by the Center for Transportation Analysis, Oak Ridge National Laboratory.

Table A2—Tons of agricultural and non-agricultural commodities, by mode of transportation, 1993

Commodity Groups	Truck	Rail	Water	Other	Total
	<i>Million tons</i>				
Agricultural commodities					
Field crops	655.51	174.05	80.82	74.73	986.15
Fresh fruit & vegetables	254.20	0.58	(s)	1.67	256.74
Livestock or livestock products	161.94	(s)	-	0.30	162.29
Other farm products	231.81	(s)	-	0.63	232.58
Meat, poultry, fresh or frozen	83.71	3.19	-	1.79	88.70
Dairy products	75.36	0.82	-	2.58	78.85
Canned or preserved foods	115.10	5.11	(s)	2.19	122.73
Grain mill products	158.88	35.13	4.83	7.09	205.93
Bakery products	28.14	0.09	-	0.52	28.77
Sugar, beet, or cane	16.82	5.10	(s)	5.92	28.07
Confectionery products	8.25	0.06	-	0.14	8.45
Beverages	160.97	8.59	0.84	6.18	177.14
Misc. food products	96.70	17.75	2.68	4.23	121.36
Lumber, pulp & wood products (raw)	519.49	32.66	8.89	24.43	599.38
Fertilizers and pesticides	152.05	87.04	26.93	33.73	299.76
Farm machinery and equipment	4.92	0.07	-	0.57	5.56
Major miscellaneous ag. Products	34.77	0.32	0.02	1.63	36.74
Sub-total	2,773.27	370.88	126.50	168.32	3,438.97
Non-agricultural commodities					
Metallic ores	6.55	53.05	(s)	84.80	149.53
Coal	194.29	631.04	54.02	222.01	1,129.93
Crude petroleum, natural gas, or gasoline	(s)	(s)	(s)	(s)	(s)
Nonmetallic minerals	1,408.86	77.67	39.12	56.94	1,582.58
Ordnance	0.40	0.12	-	0.05	0.66
Textiles	23.44	(d)	(s)	1.16	24.76
Apparel	9.81	0.08	-	1.95	15.13
Lumber or wood products (processed)	71.77	11.05	(s)	2.02	84.86
Furniture or fixtures	15.55	(d)	(d)	0.77	16.57
Paper & allied products	151.15	37.34	0.67	7.03	196.35
Printed matter	(s)	(s)	(s)	(s)	(s)
Chemicals	260.77	110.48	20.80	57.39	449.44
Petroleum & coal products	992.69	136.24	116.04	617.27	1,885.83
Rubber and plastics	49.07	0.86	-	2.42	52.35
Leather	2.00	(s)	-	0.37	2.40
Clay, concrete, glass & stone	179.55	29.66	24.12	15.38	799.48
Primary metal products	214.56	41.25	3.29	7.30	266.41
Fabricated metal products	77.57	2.92	0.38	3.96	84.84
Machinery	24.96	0.46	-	3.23	28.67
Electrical machinery	26.02	0.91	-	3.22	30.16
Transportation equipment	59.49	9.53	(d)	17.20	87.62
Instruments, optical or photographic	7.21	0.11	-	1.28	8.60
Miscellaneous products	18.11	(d)	(d)	2.03	20.73
Waste and scrap	96.43	28.83	2.22	3.41	130.89
Mixed freight	20.55	0.03	-	0.25	20.83
Containers (empty)	0.38	0.10	-	0.01	0.70
Hazardous materials	0.29	0.07	-	0.08	0.81
Unknown	5.61	0.69	0.04	1.37	7.80
Sub-total	4,613.78	1,173.24	282.53	1,181.05	7,250.60
All Commodities	7,387.05	1,544.12	409.02	1,349.37	10,689.57

See appendix note for explanation of terms and meaning of abbreviations. Totals may not add because of rounding.

Source: USDOT, Bureau of Transportation Statistics, Commodity Flow Survey, 1993 & special farm-based transportation survey conducted by the Center for Transportation Analysis, Oak Ridge National Laboratory.

Table A3—Values of agricultural and non-agricultural commodities by mode of transportation, 1993

Commodity Groups	Truck	Rail	Water	Other	Total
	<i>Billion dollars</i>				
Agricultural commodities					
Field crops	85.17	20.28	9.80	10.33	125.69
Fresh fruit & vegetables	40.02	0.21	(s)	2.03	52.45
Livestock or livestock products	101.59	(s)	-	0.38	102.11
Other farm products	23.02	0.02	-	1.75	24.79
Meat, poultry, fresh or frozen	161.69	2.60	-	3.15	167.43
Dairy products	75.36	1.51	-	2.33	79.37
Canned or preserved foods	162.89	4.57	0.11	3.28	170.85
Grain mill products	64.82	8.56	0.58	2.00	75.96
Bakery products	46.75	0.19	-	1.11	48.05
Sugar, beet, or cane	9.31	1.99	0.09	1.97	13.37
Confectionery products	27.51	(s)	-	0.69	28.43
Beverages	127.47	4.00	0.07	4.25	135.80
Misc. food products	127.14	5.92	0.82	3.75	137.63
Lumber, pulp & wood products (raw)	51.36	6.28	0.57	4.14	62.35
Fertilizers and pesticides	31.92	5.20	1.10	3.51	43.18
Farm machinery and equipment	25.66	0.56	-	5.20	31.42
Major miscellaneous ag. Products	65.16	1.58	0.04	6.63	73.40
Sub-total	1,238.57	63.87	13.34	56.50	1,372.28
Non-agricultural commodities					
Metallic ores	13.06	2.80	(s)	3.70	20.28
Coal	3.78	12.29	1.69	5.00	23.45
Crude petroleum, natural gas, or gasoline	(s)	(s)	(s)	(s)	(s)
Nonmetallic minerals	11.79	0.94	0.16	0.50	13.39
Ordnance	13.65	1.09	-	2.44	17.17
Textiles	89.65	(d)	(s)	11.08	102.19
Apparel	184.02	(s)	-	57.57	291.18
Lumber or wood products (processed)	59.36	5.09	0.01	4.40	68.86
Furniture or fixtures	64.53	(d)	(d)	4.13	69.47
Paper & allied products	158.16	17.68	0.68	14.02	190.46
Printed matter	(s)	(s)	(s)	(s)	(s)
Chemicals	371.03	46.99	5.69	73.32	497.03
Petroleum & coal products	214.11	12.89	16.40	110.70	359.47
Rubber and plastics	152.30	2.85	-	20.12	175.27
Leather	39.90	(s)	-	10.20	50.64
Clay, concrete, glass & stone	40.67	2.22	0.41	8.73	91.37
Primary metal products	192.52	20.27	1.21	14.61	228.61
Fabricated metal products	192.54	3.92	0.30	40.27	237.03
Machinery	274.78	5.13	(s)	131.76	411.64
Electrical machinery	246.43	3.61	-	160.99	411.03
Transportation equipment	416.49	37.71	(d)	196.36	652.48
Instruments, optical or photographic	116.98	0.96	-	80.53	198.49
Miscellaneous products	129.43	(d)	(d)	62.74	200.80
Waste and scrap	14.40	3.11	0.29	0.46	18.26
Mixed freight	74.63	(s)	-	6.62	81.30
Containers (empty)	0.57	(s)	-	0.02	1.14
Hazardous materials	0.28	0.01	-	0.06	0.56
Unknown	15.70	0.32	-	5.17	21.94
Sub-total	3,327.51	183.52	31.05	1,094.55	4,636.63
All Commodities	4,566.08	247.39	44.39	1,151.05	6,008.91

See appendix note for explanation of terms and meaning of abbreviations. Totals may not add because of rounding.

Source: USDOT, Bureau of Transportation Statistics, Commodity Flow Survey, 1993 & special farm-based transportation survey conducted by the Center for Transportation Analysis, Oak Ridge National Laboratory.

Table A4 — Average shipment distance of agricultural and non-agricultural commodities, by mode of transportation, 1993

Commodity Groups	Truck	Rail	Water	Other	All modes
	<i>Miles</i>				
Agricultural commodities					
Field crops	86	674	891	570	153
Fresh fruit & vegetables	84	898	252	913	191
Livestock or livestock products	61	335	-	336	72
Other farm products	156	851	-	904	386
Meat, poultry, fresh or frozen	101	1,388	913	617	119
Dairy products	58	1,474	-	354	82
Canned or preserved foods	139	2,067	719	1,173	206
Grain mill products	86	891	1,029	196	105
Bakery products	58	1,551	-	803	74
Sugar, beet, or cane	132	1,041	475	895	175
Confectionery products	128	1,868	-	875	338
Beverages	38	997	1,232	303	43
Misc. food products	90	817	514	547	145
Lumber, pulp & wood products (raw)	89	766	133	280	103
Fertilizers and pesticides	88	738	632	454	138
Farm machinery and equipment	687	1,230	-	997	876
Major miscellaneous ag. Products	79	1,595	495	806	155
Non-agricultural commodities					
Metallic ores	230	436	864	561	358
Coal	39	297	453	299	86
Crude petroleum, natural gas, or gasoline	(s)	(s)	(s)	(s)	(s)
Nonmetallic minerals	39	342	219	1,519	114
Ordnance	649	1,230	-	950	919
Textiles	463	672	-	861	711
Apparel	793	629	170	947	925
Lumber or wood products (processed)	173	1,333	76	680	306
Furniture or fixtures	361	1,560	148	901	547
Paper & allied products	73	881	89	310	186
Printed matter	(s)	(s)	(s)	(s)	(s)
Chemicals	138	893	12	634	359
Petroleum & coal products	41	535	224	725	101
Rubber and plastics	215	1,294	162	748	466
Leather	837	1,774	-	959	941
Clay, concrete, glass & stone	131	642	410	822	349
Primary metal products	188	794	906	523	275
Fabricated metal products	199	680	598	588	395
Machinery	224	1,028	1,002	675	546
Electrical machinery	241	1,270	102	821	660
Transportation equipment	115	849	371	656	339
Instruments, optical or photographic	270	777	-	732	656
Miscellaneous products	344	1,185	243	954	864
Waste and scrap	131	375	674	481	160
Mixed freight	227	648	-	727	510
Containers (empty)	210	733	686	296	229
Hazardous materials	126	1,618	-	257	190
Unknown	160	868	115	692	477

See appendix note for explanation of terms and meaning of abbreviations. Totals may not add because of rounding.

Source: USDOT, Bureau of Transportation Statistics, Commodity Flow Survey, 1993 & special farm-based transportation survey conducted by the Center for Transportation Analysis, Oak Ridge National Laboratory.