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COST OF STORING AND HANDLING GRAIN AND CONTROLLING DUST IN COMMERCIAL ELEVATORS, 1971-72 ... PROJECTIONS FOR 1973-74

U.S. DEPARTMENT OF AGRICULTURE / ECONOMIC RESEARCH SERVICE

ABSTRACT

This report develops the 1971-72 handling and storage costs associated with operating 175 commercial grain elevators in the United States. Standardized book costs for grain storage were 8.3 cents per bushel. Based on 1971-72 replacement value of the elevator's physical plant, the average yearly storage cost per bushel was 14.9 cents. Projecting storage costs to 1973-74 price levels and volumes shows an estimated 15 percent increase to 17.2 cents per bushel. A special study of 37 inland and port terminals shows capital and operating costs for dust control systems averaged 6.58 cents and 1.54 cents per bushel of storage capacity, respectively, and 1.16 and 0.27 cents per bushel of grain handled.

Keywords: Grain elevators, average costs, grain handling, dust control.

PREFACE

Grain handling and storage cost studies have been updated periodically and published by USDA's Economic Research Service as Cost of Storing and Handling Grain in Commercial Elevators, ERS-288, April 1966; ERS-401, February 1969; ERS-475, March 1971; and ERS-501, March 1972. Continued interest in these research results by Government and grain industry organizations has helped to improve the updating procedure. Costs can now be based on more timely data collected from industry firms; therefore, projections of future costs can be estimated with more confidence. This report is based on elevator cost data collected from 175 elevators in 1972 and represents costs associated with 1971-72 structure and practices of commercial grain elevators.

The authors gratefully acknowledge the cooperation of the individuals in the grain elevator industry who took valuable time from busy work schedules to provide the cost and operating data necessary for this study.

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HIGHLIGHTS

The average cost of 14.9 cents per bushel associated with storing grain in commercial elevators in fiscal 1971-72 remained unchanged from fiscal 1970-71, although there were some changes in costs for specific areas and/or types of facility. Dollar expenditures rose in this period, but increased average occupancy was sufficient to offset these expenses, so that average cost per bushel remained about the same. However, the pressure of increasing costs for major inputs is expected to continue and to cause higher operating costs for handling and storing grain during the 1973-74 season. These increases in costs, combined with a slightly lower projected average yearly storage volume show the average annual cost of storing a bushel of grain in commercial elevators to increase more than 15 percent above the 1971-72 level.

Based on projected changes in cost and volume between 1971-72 and 1973-74, the average replacement cost for storing grain at all types of elevator facilities during 1973-74 is estimated to be 17.2 cents per bushel (table 1). 1/ Estimated average occupancy level will be 54.7 percent compared with 55.3 percent in 1971-72 (table 4).

When facilities are utilized at projected 1973-74 storage volume levels as shown in table 4, the average yearly storage cost per bushel will be 16.8 cents at country elevators, 15.8 cents at inland terminals, and 24.0 cents at port terminal elevators (table 1). Comparable costs for 1971-72 were 14.5, 13.7, and 21.3 cents per bushel, respectively (table 3).

An increase of 10 percent in the 1973-74 projected volumes to be stored shows storage costs of 15.7 cents at country elevators, 14.7 cents at inland terminals, and 22.2 cents at port terminals (table 13). Likewise, a decrease of 10 percent in projected volumes results in storage costs of 18.2, 17.2, and 26.3 cents per bushel at country elevators, inland terminals, and port terminals, respectively.

1/ Replacement costs reflect expenses for depreciation and interest on investment when replacing the elevator's physical plant assets at the indicated year's price levels. Comparison of costs in tables 2 and 3 shows the relation of this replacement costing procedure to the standardized book costs.

For country elevators, the 1973-74 combined costs of handling and storing grain are estimated at 22.1 cents per bushel (table 1). This amount includes the cost of storage for 1 year plus the cost of receiving by truck and shipping by rail, an increase of 15 percent (2.8 cents) above costs in 1971-72.

At inland terminals, the 1973-74 combined cost of receiving and shipping by rail plus storage for 1 year is estimated to average 21.1 cents per bushel or 14 percent (2.6 cents) above 1971-72 costs.

For port terminals, the cost of receiving by rail, storing for 1 year, and shipping by water is estimated at 27.2 cents per bushel in 1973-74, an increase of nearly 11 percent (2.7 cents).

The 1971-72 and estimated 1973-74 costs for each expense item by function and type of facility are shown in tables 5-12.

Active dust-control programs were in operation in 28 percent of the 175 elevators responding to the 1972 survey, compared with 20 percent of the elevators in the 1971 survey (table 14). An additional 20 percent of the facilities had plans for installing dust-control equipment, and the remaining 52 percent reported no plans for dust control.

Capital investment and annual operating costs incurred for complying with pollution control requirements of the Clean Air Act were estimated from a special study of 37 inland and port terminals (tables 15 and 16). Capital investment requirements for all facilities were 6.58 cents per bushel of storage capacity, 1.16 cents per bushel of grain handled in 1971-72, and $2.79 per cubic foot of air per minute (c.f.m.) moving through dust-controlling equipment.

Annual operating costs for dust-control systems at these terminal elevators were 1.54 cents per bushel of storage capacity, 0.27 cent per bushel of grain handled in 1971-72, and 0.61 cent per c.f.m. of dust-controlled air.

Table 1 - Estimated weighted average replacement costs per bushel for storing and handling grain by area, type of facility, and handling method, United States, fiscal 1973-74

Area, type of facility, and handling method	Average costs for--							
	Receiving		Shipping		Storage		Combined	
	Out-of-pocket cost 2/	Total cost 3/	Out-of-pocket cost 2/	Total cost 3/	Out-of-pocket cost 2/	Total cost 3/	Out-of-pocket cost 2/	Total cost 3/
	Cents							
North Plains								
Country:								
Truck & rail 4/	1.9	2.2	1.8	2.2	8.0	17.0	11.7	21.4
Inland terminal:								
Rail & rail 5/	1.9	2.6	1.7	2.4	3.8	10.7	7.4	23.1
Mid-Plains								
Country:								
Truck & rail	2.1	2.6	2.1	2.9	5.5	15.5	9.7	21.0
Inland terminal:								
Rail & rail	2.2	3.4	1.7	2.4	4.9	16.6	8.8	22.4
South Plains								
Country:								
Truck & rail	2.3	3.1	2.9	4.5	4.5	16.5	9.7	24.1
Inland terminal:								
Rail & rail	1.7	3.5	1.4	2.9	5.2	21.2	8.3	27.6
Port terminal:								
Rail & water 6/	1.1	1.9	0.7	0.9	6.2	25.9	8.0	28.7
West								
Country:								
Truck & rail	1.9	2.5	2.7	3.4	6.4	17.3	11.0	23.2
Inland terminal:								
Rail & rail	1.3	1.7	1.2	1.5	6.3	15.1	8.8	18.3
Port terminal:								
Rail & water	1.7	2.3	1.0	1.3	7.9	28.7	10.6	32.3
Great Lakes								
Country:								
Truck & rail	1.9	2.1	2.7	3.0	8.5	18.2	13.1	23.3
Inland terminal:								
Rail & rail	1.6	2.2	1.3	1.9	4.5	14.1	7.4	18.2
Port terminal:								
Rail & water	1.4	2.4	0.8	1.3	5.0	22.0	7.2	25.7
South & East								
Country:								
Truck & rail	1.2	1.5	2.7	3.4	9.8	23.6	13.7	28.5
Inland terminal:								
Rail & rail	1.4	1.7	2.5	3.2	4.3	12.4	8.2	17.3
Port terminal:								
Rail & water	1.0	1.9	1.3	2.0	4.2	22.0	6.5	25.9
United States								
Country:								
Truck & rail	1.9	2.3	2.3	3.0	6.5	16.8	10.7	22.1
Inland terminal:								
Rail & rail	1.9	2.9	1.6	2.4	4.7	15.8	8.2	21.1
Port terminal:								
Rail & water	1.3	2.1	0.8	1.1	5.7	24.0	7.8	27.2
All facilities 7/	--	--	--	--	6.0	17.2	--	--

1/ Cost based on estimated 1973-74 replacement values and volumes assumed to be distributed as in 1971-72. 2/ Excludes depreciation and interest on investment. 3/ Includes depreciation and interest on investment. 4/ Grain received by truck, stored, and shipped by rail. 5/ Grain received by rail, stored, and shipped by rail. 6/ Grain received by rail, stored, and shipped by water. 7/ Average handling costs omitted due to different receiving and shipping methods for each type of facility.

Note: See table 4 for delineation of areas.

Table 2 - Standardized book costs, weighted average cost per bushel, for storing and handling grain, by area and type of facility, United States, fiscal 1971-72 1/

Area and type of facility	Received by--			Loadout by--			Storage
	Truck	Rail	Water	Truck	Rail	Water	
	Cents						
North Plains:							
Country	1.86	--	--	1.51	1.80	--	9.09
Inland terminal	1.16	2.00	--	2.75	1.66	.98	4.45
Port terminal	--	--	--	--	--	--	--
Mid-Plains:							
Country	2.19	1.92	--	2.63	2.25	.64	7.99
Inland terminal	1.85	2.08	--	1.56	1.68	.63	6.20
Port terminal	--	--	--	--	--	--	--
South Plains:							
Country	2.32	17.29	--	2.01	2.99	--	6.69
Inland terminal	1.85	1.97	--	1.91	1.47	--	6.76
Gulf port terminal	1.04	1.37	1.42	3.09	1.01	.73	17.74
West:							
Country	1.87	--	--	2.35	2.65	--	7.33
Inland terminal	1.61	1.25	--	1.66	1.12	.67	8.26
Port terminal	2.02	1.75	1.70	2.08	1.92	.99	14.71
Great Lakes:							
Country	1.85	--	--	2.32	2.66	1.68	12.74
Inland terminal	1.51	1.56	3.81	.57	1.40	.27	7.33
Port terminal	1.34	1.37	1.76	1.42	1.47	.82	6.19
South and East:							
Country	1.41	1.66	3.93	2.73	2.89	.98	14.28
Inland terminal	1.86	1.29	3.67	2.05	2.58	2.01	6.21
East port terminal	2.29	1.02	2.32	3.57	2.76	1.28	6.01
United States:							
Country	1.95	1.91	3.93	2.24	2.38	1.05	8.99
Inland terminal	1.56	1.89	3.70	1.18	1.63	.72	6.11
Port terminal	1.33	1.37	1.45	2.59	1.48	.81	10.17
All facilities	1.88	1.60	1.64	2.16	2.13	.83	8.32

1/ Depreciation based on standardized depreciation rates applied to original acquisition cost of buildings and equipment.

Note: See table 4 for delineation of areas.

Table 3 - Replacement costs, estimated weighted average cost per bushel, for storing and handling grain, by area and type of facility, United States, fiscal 1971-72 1/

Area and type of facility	Received by--			Loadout by--			Storage
	Truck	Rail	Water	Truck	Rail	Water	
	Cents						
North Plains:							
Country	2.02	--	--	1.61	1.96	--	14.26
Inland terminal	1.35	2.35	--	4.85	2.21	1.18	8.19
Port terminal	--	--	--	--	--	--	--
Mid-Plains:							
Country	2.31	2.03	--	2.77	2.59	.66	13.45
Inland terminal	2.74	3.05	--	2.21	2.19	.80	14.95
Port terminal	--	--	--	--	--	--	--
South Plains:							
Country	2.75	17.29	--	2.31	4.10	--	14.34
Inland terminal	2.86	3.19	--	3.56	2.63	--	19.68
Gulf port terminal	1.39	1.93	1.55	4.91	1.42	.90	24.58
West:							
Country	2.22	--	--	2.90	3.01	--	14.24
Inland terminal	2.00	1.48	--	2.37	1.32	.91	12.73
Port terminal	3.22	2.26	2.42	3.68	3.05	1.31	25.07
Great Lakes:							
Country	1.87	--	--	2.42	2.73	1.54	15.83
Inland terminal	1.73	2.00	5.33	.70	1.72	.30	12.48
Port terminal	2.75	2.38	3.63	3.59	2.43	1.29	19.17
South and East:							
Country	1.32	1.72	3.95	2.94	3.08	.91	20.65
Inland terminal	1.95	1.54	3.35	2.86	2.84	1.83	10.79
East port terminal	3.94	2.00	3.83	9.41	5.74	1.98	19.13
United States:							
Country	2.08	2.02	3.95	2.42	2.66	1.00	14.47
Inland terminal	2.02	2.63	3.73	1.82	2.21	.83	13.75
Port terminal	2.51	2.14	1.65	5.59	2.45	1.08	21.35
All facilities	2.10	2.36	1.82	2.38	2.53	1.01	14.88

1/ Depreciation and interest on investment based on replacing building and equipment at 1971-72 price levels.

Note: See table 4 for delineation of areas.

Table 4 - Average occupancy levels by area and type of facility, United States, fiscal 1971-72 and 1973-74

Area and type of facility	Average occupancy	
	1971-72 1/	1973-74 2/
	Percent	
North Plains 3/	80.1	72.6
Mid-Plains 4/	53.9	54.1
South Plains 5/	38.8	42.1
West 6/	58.5	55.1
Great Lakes 7/	60.7	60.9
South and East 8/	53.5	53.4
United States	55.3	54.7
Country	55.5	54.4
Inland terminal	51.7	51.7
Port terminal	67.4	69.0

1/ Plants surveyed by mail in 1972.
2/ Projections for 1973-74.
3/ N. Dak., S. Dak., and Minn., (excluding port facilities).
4/ Nebr., Kans., Colo., Wyo., Iowa, and Mo.
5/ Okla., N. Mex., and Texas plus all Gulf port facilities.
6/ Wash., Oreg., Idaho, Mont., Calif., Ariz., Nev., and Utah.
7/ Wis., Ill., Ind., Ohio, Mich., and Minn. port facilities.
8/ Ark., Miss., S.C., Tenn., Ky., N.Y., Va., Pa., N.J., Md., Del., La., Ala., Ga., N.C., W. Va., and New England. (All Gulf ports are included in the South Plains.)

Table 5 - All facilities: Weighted average cost per bushel for storing and handling grain, United States, fiscal 1971-72

Cost item	Received by--			Loadout by--			Storage
	Truck	Rail	Water	Truck	Rail	Water	
	Cents						
Fixed costs							
Building & equipment:							
Depreciation 1/	0.277	0.613	0.279	0.332	0.409	0.197	4.244
Insurance	.019	.015	.018	.028	.026	.008	.492
Taxes	.031	.038	.012	.046	.044	.013	.945
Licenses & bonds	--	--	--	--	--	--	.116
Interest on investment 2/	.160	.337	.159	.191	.231	.118	5.416
Total fixed cost per bushel	.487	1.003	.468	.597	.710	.336	11.213
Variable costs							
Direct labor	.629	.704	.621	.582	.745	.319	1.322
Administrative overhead	.447	.220	.087	.454	.410	.120	.862
Electricity, heat, etc.	.078	.072	.062	.111	.102	.034	.075
Truck expenses	.103	.011	.005	.180	.078	.007	--
Building repairs	.003	.002	.001	.005	.003	.001	.415
Equipment repairs	.099	.072	.109	.137	.135	.052	.083
Insurance on grain	--	--	--	--	--	--	.347
Taxes on grain	--	--	--	--	--	--	.116
Fumigation	--	--	--	--	--	.017	.149
Other 3/	.218	.253	.447	.278	.305	.114	.186
Interest on working capital 4/	.032	.024	.024	.040	.040	.012	.112
Total variable cost per bushel	1.609	1.358	1.356	1.787	1.818	.676	3.667
Total cost per bushel	2.096	2.361	1.824	2.384	2.528	1.012	14.880

1/ Calculations based on replacing building and equipment at 1971-72 construction costs and using standardized depreciation rates.

2/ Calculated at 8.0 percent of one-half of the 1971-72 replacement value of building and equipment.

3/ Includes such items as supplies, audit, legal, protective services, dues, subscriptions, travel, advertising, donations, etc.

4/ Calculated at 7.0 percent per annum, borrowed quarterly, of the total out-of-pocket cost.

Table 6 - All facilities: Weighted average cost per bushel for storing and handling grain, United States, fiscal 1973-74

Cost item	Received by--			Loadout by--			Storage
	Truck	Rail	Water	Truck	Rail	Water	
	Cents						
Fixed costs							
Building & equipment:							
Depreciation 1/	0.298	0.580	0.242	0.362	0.446	0.171	4.935
Insurance	.021	.014	.016	.030	.029	.007	.572
Taxes	.034	.037	.011	.051	.049	.011	1.118
Licenses & bonds	--	--	--	--	--	--	.126
Interest on investment 2/	.172	.318	.138	.208	.252	.103	6.297
Total fixed cost per bushel	.525	.949	.407	.651	.776	.292	13.048
Variable costs							
Direct labor	.710	.784	.688	.657	.842	.359	1.504
Administrative overhead	.500	.233	.096	.513	.464	.134	.974
Electricity, heat, etc.	.086	.077	.064	.122	.112	.038	.083
Truck expenses	.108	.011	.005	.193	.084	.007	--
Building repairs	.004	.002	.002	.005	.004	.002	.475
Equipment repairs	.114	.081	.116	.157	.156	.060	.097
Insurance on grain	--	--	--	--	--	--	.423
Taxes on grain	--	--	--	--	--	--	.123
Fumigation	--	--	--	--	--	.018	.160
Other 3/	.231	.267	.474	.298	.326	.123	.202
Interest on working capital 4/	.032	.024	.023	.040	.040	.012	.111
Total variable cost per bushel	1.785	1.479	1.468	1.985	2.028	.753	4.152
Total cost per bushel	2.310	2.428	1.875	2.636	2.804	1.045	17.200

1/ Calculations based on replacing building and equipment at construction costs and using standardized depreciation rates.

2/ Calculated at 8.0 percent of one-half of the 1973-74 replacement value of building and equipment.

3/ Includes such items as supplies, audit, legal, protective services, dues, subscriptions, travel, advertising, donations, etc.

4/ Calculated at 7.0 percent per annum, borrowed quarterly, of the total out-of-pocket cost.

Table 7 - Country facilities: Weighted average cost per bushel for storing and handling grain, United States, fiscal 1971-72

Cost item 1/	Received by--			Loadout by--			Storage
	Truck	Rail	Water	Truck	Rail	Water	
	Cents						
Fixed costs							
Building & equipment:							
Depreciation	0.212	0.162	0.230	0.308	0.357	0.111	3.867
Insurance	.020	.011	.023	.029	.034	.008	.611
Taxes	.030	.026	.005	.046	.049	.012	1.028
Licenses & bonds	--	--	--	--	--	--	.142
Interest on investment	.127	.099	.135	.179	.204	.065	4.908
Total fixed cost per bushel	.389	.298	.393	.562	.644	.196	10.556
Variable costs							
Direct labor	.641	.255	.760	.607	.837	.327	1.286
Administrative overhead	.479	.767	.204	.465	.446	.125	.970
Electricity, heat, etc.	.076	.071	.136	.112	.118	.052	.067
Truck expenses	.119	.179	.041	.194	.106	.015	--
Building repairs	.004	.001	.003	.005	.004	.001	.503
Equipment repairs	.102	.055	.204	.143	.166	.105	.078
Insurance on grain	--	--	--	--	--	--	.412
Taxes on grain	--	--	--	--	--	--	.134
Fumigation	--	--	--	--	--	--	.142
Other	.234	.361	2.152	.290	.292	.167	.185
Interest on working capital	.034	.030	.062	.042	.047	.014	.133
Total variable cost per bushel	1.689	1.719	3.562	1.858	2.016	.806	3.910
Total cost per bushel	2.078	2.017	3.955	2.420	2.660	1.002	14.466

1/ See footnotes, table 5, for explanation of various cost items.

Table 8 - Country facilities: Weighted average cost per bushel for storing and handling grain, United States, fiscal 1973-74

Cost item 1/	Received by--			Loadout by--			Storage
	Truck	Rail	Water	Truck	Rail	Water	
	Cents						
Fixed costs							
Building & equipment:							
Depreciation	0.232	0.179	0.248	0.335	0.389	0.094	4.539
Insurance	.022	.012	.024	.031	.037	.007	.717
Taxes	.033	.029	.005	.051	.055	.011	1.227
Licenses & bonds	--	--	--	--	--	--	.155
Interest on investment	.139	.109	.145	.195	.223	.055	5.761
Total fixed cost per bushel	.426	.329	.422	.612	.704	.167	12.399
Variable costs							
Direct labor	.724	.288	.859	.685	.945	.370	1.457
Administrative overhead	.541	.867	.230	.526	.504	.141	1.094
Electricity, heat, etc.	.084	.078	.149	.123	.129	.057	.074
Truck expenses	.127	.191	.044	.207	.113	.016	--
Building repairs	.004	.002	.003	.006	.005	.001	.577
Equipment repairs	.117	.064	.234	.165	.191	.121	.091
Insurance on grain	--	--	--	--	--	--	.501
Taxes on grain	--	--	--	--	--	--	.141
Fumigation	--	--	--	--	--	--	.151
Other	.251	.387	2.302	.311	.313	.179	.198
Interest on working capital	.034	.030	.062	.042	.047	.014	.131
Total variable cost per bushel	1.882	1.907	3.883	2.065	2.247	.899	4.415
Total cost per bushel	2.308	2.236	4.305	2.677	2.951	1.066	16.814

1/ See footnotes, table 6, for explanation of various cost items.

Table 9 - Inland terminals: Weighted average cost per bushel for storing and handling grain, United States, fiscal 1971-72

Cost item 1/	Received by--			Loadout by--			Storage
	Truck	Rail	Water	Truck	Rail	Water	
	Cents						
Fixed costs							
Building & equipment:							
Depreciation	0.445	0.602	0.537	0.519	0.489	0.140	4.241
Insurance	.012	.013	.027	.012	.008	.006	.201
Taxes	.040	.047	.029	.040	.032	.019	.748
Licenses & bonds	--	--	--	--	--	--	.069
Interest on investment	.243	.329	.287	.283	.270	.084	5.362
Total fixed cost per bushel	.740	.991	.880	.854	.799	.249	10.621
Variable costs							
Direct labor	.571	.794	1.238	.282	.524	.279	1.285
Administrative overhead	.346	.340	.175	.331	.356	.140	.686
Electricity, heat, etc.	.087	.093	.227	.090	.068	.041	.091
Truck expenses	.021	.015	.013	.035	.022	.003	--
Building repairs	.001.	.002	.003	.001	.002	.001	.191
Equipment repairs	.068	.088	.581	.058	.068	.048	.092
Insurance on grain	--	--	--	--	--	--	.193
Taxes on grain	--	--	--	--	--	--	.100
Fumigation	--	--	--	--	--	--	.202
Other	.165	.280	.562	.150	.350	.060	.213
Interest on working capital	.023	.029	.050	.017	.025	.010	.071
Total variable cost per bushel	1.282	1.641	2.849	.964	1.415	.582	3.124
Total cost per bushel	2.022	2.632	3.729	1.818	2.214	.831	13.745

1/ See footnotes, table 5, for explanation of various cost items.

Table 10 - Inland terminals: Weighted average cost per bushel for storing and handling grain, United States, fiscal 1973-74

Cost item 1/	Received by--			Loadout by--			Storage
	Truck	Rail	Water	Truck	Rail	Water	
	Cents						
Fixed costs							
Building & equipment:							
Depreciation	0.487	0.659	0.593	0.566	0.532	0.132	4 878
Insurance	.013	.014	.030	.013	.009	.006	.231
Taxes	.045	.053	.033	.044	.036	.019	.876
Licenses & bonds	--	--	--	--	--	--	.074
Interest on investment	.266	.360	.317	.308	.294	.079	6.167
Total fixed cost per bushel	.811	1.086	.973	.931	.871	.236	12.226
Variable costs							
Direct labor	.645	.897	1.389	.318	.592	.306	1.476
Administrative overhead	.391	.384	.196	.374	.402	.150	.785
Electricity, heat, etc.	.096	.102	.249	.099	.075	.043	.102
Truck expenses	.023	.016	.014	.037	.024	.003	--
Building repairs	.001	.003	.004	.001	.002	.001	.218
Equipment repairs	.078	.101	.671	.067	.078	.054	.108
Insurance on grain	--	--	--	--	--	--	.240
Taxes on grain	--	--	--	--	--	--	.109
Fumigation	--	--	--	--	--	--	.221
Other	.177	.300	.603	.160	.375	.061	.234
Interest on working capital	.023	.029	.050	.017	.025	.010	.072
Total variable cost per bushel	1.434	1.832	3.176	1.073	1.573	.628	3.565
Total cost per bushel	2.245	2.918	4.149	2.004	2.444	.864	15.791

1/ See footnotes, table 6, for explanation of various cost items.

Table 11 - Port terminals: Weighted average cost per bushel for storing and handling grain, United States, fiscal 1971-72

Cost item 1/	Received by--			Loadout by--			Storage
	Truck	Rail	Water	Truck	Rail	Water	
	Cents						
Fixed costs							
Building & equipment:							
Depreciation	0.924	0.626	0.257	2.366	0.707	0.241	7.014
Insurance	.017	.016	.017	.035	.017	.009	.498
Taxes	.041	.030	.011	.078	.034	.011	.928
Licenses & bonds	--	--	--	--	--	--	.069
Interest on investment	.487	.345	.148	1.250	.388	.145	9.297
Total fixed cost per bushel	1.469	1.017	.433	3.729	1.146	.406	17.806
Variable costs							
Direct labor	.566	.635	.566	.947	.712	.329	1.698
Administrative overhead	.165	.120	.079	.272	.198	.113	.609
Electricity, heat, etc.	.094	.056	.047	.254	.068	.027	.085
Truck expenses	.007	.006	.004	.022	.005	.005	--
Building repairs	.003	.002	.001	.002	.003	.002	.449
Equipment repairs	.109	.059	.068	.225	.073	.038	.091
Insurance on grain	--	--	--	---	--	--	.333
Taxes on grain	--	--	--	--	--	--	.035
Fumigation	--	--	--	--	--	.027	.036
Other	.080	.229	.427	.108	.225	.116	.119
Interest on working capital	.019	.020	.021	.034	.023	.012	.087
Total variable cost per bushel	1.043	1.127	1.213	1.864	1.307	.669	3.542
Total cost per bushel	2.512	2.144	1.646	5.593	2.453	1.075	21.348

1/ See footnotes, table 5, for explanation of various cost items.

Table 12 - Port terminals: Weighted average cost per bushel for storing and handling grain, United States, fiscal 1973-74

Cost item 1/	Received by--			Loadout by--			Storage
	Truck	Rail	Water	Truck	Rail	Water	
	Cents						
Fixed costs							
Building & equipment:							
Depreciation	0.787	0.533	0.219	2.541	0.802	0.205	7,878
Insurance	.015	.014	.015	.038	.019	.007	.559
Taxes	.035	.026	.010	.086	.039	.010	1.061
Licenses & bonds	--	--	--	--	--	--	.072
Interest on investment	.415	.294	.126	1.342	.440	.124	10.442
Total fixed cost per bushel	1.252	.867	.370	4.007	1.300	.346	20.012
Variable costs							
Direct labor	.640	.717	.640	1.050	.804	.372	1.909
Administrative overhead	.186	.135	.089	.309	.224	.127	.693
Electricity, heat, etc.	.104	.062	.051	.270	.075	.030	.092
Truck expenses	.007	.006	.004	.024	.006	.006	--
Building repairs	.003	.002	.001	.002	.003	.002	.517
Equipment repairs	.125	.068	.078	.255	.084	.044	.104
Insurance on grain	--	--	--	--	--	--	.411
Taxes on grain	--	--	--	--	--	--	.037
Fumigation	--	--	--	--	--	.029	.039
Other	.086	.245	.457	.113	.240	.124	.127
Interest on working capital	.019	.020	.021	.033	.023	.012	.087
Total variable cost per bushel	1.170	1.255	1.341	2.056	1.459	.746	4.016
Total cost per bushel	2.422	2.122	1.711	6.063	2.759	1.092	24.028

1/ See footnotes, table 6, for explanation of various cost items.

Table 13 - Weighted average cost per bushel for storing and handling grain with 10-percent increase and decrease in volumes, by type of facility, United States, fiscal 1973-74 1/

Type of facility	Received by--						Loadout by--						Storage	
	Truck		Rail		Water		Truck		Rail		Water			
	Volume change of--													
	-10%	+10%	-10%	+10%	-10%	+10%	-10%	+10%	-10%	+10%	-10%	+10%	-10%	+10%
	Cents													
Country	2.4	2.3	2.3	2.2	4.4	4.3	2.7	2.6	3.0	2.9	1.1	1.0	18.2	15.7
Inland terminal	2.3	2.2	3.1	2.8	4.3	4.1	2.1	1.9	2.5	2.4	0.9	0.8	17.2	14.7
Port terminal	2.6	2.3	2.2	2.0	1.8	1.7	6.5	5.7	2.9	2.6	1.1	1.0	26.3	22.2
All facilities	2.4	2.3	2.6	2.3	1.9	1.8	2.7	2.6	2.9	2.7	1.1	1.0	18.7	16.0

1/ Costs were developed from the data used for tables 6, 8, 10, and 12 with an increase and decrease of 10 percent in volumes received, shipped, and stored.

COST OF DUST-CONTROL SYSTEMS IN GRAIN ELEVATORS

General Survey

Managers of 251 grain elevators were contacted in 1971 to determine investment and operating costs for 1970-71 relating to pollution control. The same managers were sent questionnaires by mail in 1972, to determine investments made since 1970 or plans for investments in 1973 in compliance with regulations set forth in Public Law 90-148, the Clean Air Act. Elevators were classified as country, inland, or port terminals. The respondents were grouped in three dust-control program categories: (1) program in progress, (2) program in planning stage, or (3) no definite program (table 14).

Managers of 49 facilities indicated active programs were in progress. In 2 years, 1970-71 and 1971-72 these firms had invested and contracted for dust-control equipment and services amounting to about $4,350,000. Sixteen country facilities accounted for about $373,000 of this total, with individual expenditures ranging from $10,000 to $105,000.

Eighteen inland terminals had active programs in which they had allocated about $1,270,000 during this same period. Individual elevators had costs ranging from $20,000 to $320,000. About a third of the managers indicated that this expenditure concluded the dust-control programs started 2 to 4 years earlier. These managers also indicated that other dust-control programs were being developed.

Fifteen port terminals in 1971-72 had dust-control expenditures amounting to $2,707,000. Individual elevators had costs ranging from $40,000 to $525,000. About one-half of the managers in this group indicated that their initial dust-control program was completed and that additional dust-control programs were being developed. Two-thirds of the respondents indicated that major emphasis in continuing control programs relates to barge unloading and ship loadout.

Managers of 35 facilities with no dust-control programs indicated that they had plans for or were developing a program for initiation within the next 12 months. Twenty-five of the 49 firms with dust-control programs indicated that they expect to continue these programs or plan to develop new programs during the next year. These firms will be contracting for about $537,000 in dust-control programs in 1973.

Of the 60 facilities with plans for 1973, 17 country facilities expected the programs to cost a total of $693,000. Individual programs would range between $5,000 and $360,000. Thirty-two inland terminals projected their expenditures for programs to be started in 1973 at about $2,529,000. Estimates of cost per facility ranged from $25,000 up to $400,000.

Eleven port facilities planned programs for 1973 with an overall cost of $2,315,000. Estimates of cost ranged from $50,000 to $750,000 per plant. Many managers indicated that these costs are estimates and that they could be expected to increase as the work is completed.

The remaining 91 elevator managers who responded indicated no plans for control programs in the near future. About a third of the managers responded

Table 14 - Response of grain elevators to 1972 survey of compliance under the Clean Air Act

Area and type of facility	Dust control program in progress	Dust control program in planning stage	No dust control program or plans reported	Total
	Number			
North Plains:				
Country	2	1	13	16
Inland terminal	4	3	1	8
Total	6	4	14	24
Mid-Plains:				
Country	5	2	22	29
Inland terminal	5	4	1	10
Total	10	6	23	39
South Plains:				
Country	4	1	12	17
Inland terminal	3	4	3	10
Port terminal	4	--	3	7
Total	11	5	18	34
West:				
Country	1	1	12	14
Inland terminal	2	1	1	4
Port terminal	4	--	2	6
Total	7	2	15	24
Great Lakes:				
Country	2	4	9	15
Inland terminal	3	5	1	9
Port terminal	6	1	--	7
Total	11	10	10	31
South and East:				
Country	2	4	7	13
Inland terminal	1	2	4	7
Port terminal	1	2	--	3
Total	4	8	11	23
United States:				
Country	16	13	75	104
Inland terminal	18	19	11	48
Port terminal	15	3	5	23
Total	49	35	91	175

in 1972, as they did in 1971, that they were waiting for direction from their local control board. Others stated they did not have a dust-control problem and could not foresee any need for control programs in their elevators.

Pollution Control Costs

An updating of the 1970-71 detailed cost information, engineering data, and operating data was undertaken for selected grain elevators. The same eight firms were contacted and provided data for 37 facilities. These data provided information on investments and operating costs for total dust-control programs for inland and port terminal elevators. Included was information for relatively new facilities as well as facilities which are 30 to 50 years old. In most cases, the data reflect a total dust-control program or a major share of the total requirements for the facility. These firms report that the greastest difficulty is the control of dust from barge unloading and ship loadout operations, because these operations are carried out in the open rather than in enclosed areas. All elevators for which costs were obtained were using some type of bag or cloth filter.

These firms reported that large expenditures are being devoted to control of pollution, primarily dust, at inland and port terminals and that pollution-control systems are being installed or planned. In some firms, priorities are being estabilished among locations, with those having the more serious dust problems being handled first. Some of the decisive factors are the elevator's proximity to a residential area and whether it is considered a nuisance to the surrounding community.

Capital Costs

Cost data obtained for the 37 facilities were used to estimate capital investment requirements and operating costs (tables 15 and 16). Investment requirements per bushel of storage capacity of the elevator, per bushel of grain handled in 1971-72, and per cubic foot of air per minute (c.f.m.) in the system are shown in table 15.

Investment cost per bushel of storage capacity was estimated to average 5.10 cents for inland terminals and 8.53 cents for port terminals. The weighted average investment cost per bushel of storage space was 6.58 cents for both facilities.

Relating investment cost to the volume of grain handled, the inland terminals had an average cost of 1.71 cents per bushel, compared with 0.92 cent a bushel for port terminals. Combined, the costs for both inland and port terminals were estimated to be 1.16 cents per bushel of grain handled.

Investment costs for dust-control systems are usually thought of by the grain trade in dollars per c.f.m. Total c.f.m. are derived by combining the quantities of air required to control dust emissions from each piece of equipment with its respective handling operation in the elevator.

Inland terminals had an estimated investment cost of $2.41 per c.f.m. and port locations $3.18 per c.f.m. The combined weighted average cost for both types of facility was $2.79.

Operating Costs

Average annual operating costs of dust-control systems are summarized in table 16. Operating costs per bushel of storage capacity were estimated to be 1.21 cents for inland terminals and 2.00 cents for port elevators. The weighted average cost of both types was estimated to be 1.54 cents per bushel of storage capacity.

Operating costs for the dust-control systems relative to volume of grain handled were estimated to be 0.41 cent per bushel for inland terminals and 0.22 cent a bushel for port terminals. The average cost for both types of elevators was 0.27 cent per bushel handled. Operating costs per c.f.m. were 57 cents for inland terminals and 74 cents for port terminals. Combined, these facilities had an average operating cost of 65 cents per c.f.m.

Changes From Previous Year

Seven of the 37 elevators were added in 1972, resulting in a slightly different blend of inland and port facilities. The analysis in this report is based on data from 22 inland and 15 port elevators. The majority of facilities added were at ports.

Both inland and port facilities reported a higher rate of grain turnover in 1971-72 than in 1970-71. Total capacity of all facilities in 1971-72 was 22 percent greater than in 1970-71. Volume of grain handled was 33 percent higher and the number of c.f.m. increased about 24 percent. These changes resulted, in part, from the additional seven elevators.

Capital costs (per bushel of storage capacity and per c.f.m.) were higher in 1971-72 than in 1970-71. Cost per bushel of storage increased about 3 percent and cost per c.f.m. about 2 percent. However, capital costs decreased about 6 percent per bushel of grain handled, due primarily to the higher turnover in 1971-72.

Essentially the same relationship exists with operating costs. Operating cost per bushel of capacity increased about 8 percent and cost per c.f.m. 7 percent. Cost per bushel handled was the same as in 1970-71.

Table 15.--Capital cost in dust control systems at terminal grain elevators, by storage capacity, volume handled, and c.f.m. 1971-72 1/

Type of terminal	Per bushel of storage capacity	Per bushel of grain handled	Per c.f.m. 2/
	Cents		Dollars
Inland	5.10	1.71	2.41
Port	8.53	.92	3.18
Weighted average	6.58	1.16	2.79

1/ Capital investment reported by eight firms for 37 elevators. Investment represents cost of dust control system; no building cost is included.
2/ Cubic feet of air delivered per minute by the dust control system in the elevator.

Table 16.--Operating cost of dust control systems at terminal grain elevators, by storage capacity, volume handled, and c.f.m., 1971-72 1/

Type of terminal	Per bushel of storage capacity	Per bushel of grain handled	Per c.f.m. 2/
	Cents		Dollars
Inland	1.21	0.41	0.57
Port	2.00	.22	.74
Weighted average	1.54	.27	.65

1/ Operating costs reported by eight firms for 37 elevators. Depreciation is standardized to 10 years for all facilities. Only operating cost relating to dust control system is included. No building cost is included.
2/ Cubic feet of air delivered per minute by the dust control system in the elevator.

APPENDIX: METHODOLOGY

Sampling

Commercial grain elevators are classified into three types--country, inland terminal, and port terminal. Because each type of facility generally serves a distinct function in the grain marketing system, the plants in the 1970-71 survey were selected from an independent universe of 7,492 country, 435 inland terminal, and 62 port terminal grain elevators. All elevators were approved to store and handle Commodity Credit Corporation (CCC) grain under the Uniform Grain Storage Agreement during the 1970-71 season.

Plants in each universe were stratified by total capacity and divided into four equal-capacity groups. Plants in each capacity group were divided into six geographic regions. A sample of 168 country, 59 inland terminal, and 24 port terminal grain elevators was then randomly selected within each region and capacity level. These 251 plants surveyed for the 1970-71 season 1/ are the basis for the 1971-72 survey presented in this report.

In the 1971-72 survey, all 251 plants were asked to update their 1970-71 cost and volume data. Responses were received from 175 plants representing 85 percent of the total capacity surveyed in 1971 (app. table 1). The replies from 104 country elevators represented 72 percent of 1970-71 surveyed capacity, 48 inland terminals represented 85 percent of capacity, and 23 port terminals represented 99 percent of 1970-71 survey capacity.

In the survey for 1970-71, detailed operating costs were obtained by personal interviews with officials of each plant in the sample. Additional information on operating equipment, types and capacity of structures, volumes handled and stored, handling rates, crew sizes (by functions), and other labor requirements were established for each elevator. Using the cost accounting approach, all costs were tabulated and allocated to specific grain functions performed by the facility. Plant cost data were summarized by area and for the United States.

The 1971-72 data were collected by mail survey, with particular emphasis on 1971-72 operating costs and corresponding grain volumes handled and stored. These new data and the same cost accounting procedures used in tabulating the 1970-71 survey results were used to develop estimates of costs per bushel which reflect operations in 1971-72.

Depreciation and Interest

Plant data showed many differences in depreciation rates applied to identical assets. To eliminate the effects of these variations, depreciation allowances for all elevators were calculated using the straight-line method

1/ Cost of Storing and Handling Grain in Commercial Elevators, 1970-71, and Projections for 1972-73, U.S. Dept. Agr., Econ. Res. Serv., ERS-501, March 1972.

Appendix table 1 - Sample number and capacity of commercial grain elevators, by area and type of facility, United States, 1971-72

Area and type of facility	Sample plants	Total capacity	Working capacity 1/	Storage capacity 2/	Universe capacity 3/
	Number	1,000 bushels			
North Plains:					
Country	16	7,038	479	6,559	343,800
Inland terminal	8	45,737	2,282	43,455	145,344
Port terminal	--	--	--	--	--
Mid-Plains:					
Country	29	27,229	1,192	26,037	1,172,243
Inland terminal	10	99,285	5,954	93,331	606,456
Port terminal	--	--	--	--	--
South Plains:					
Country	17	28,607	1,937	26,670	523,425
Inland terminal	10	130,398	3,490	126,908	336,366
Gulf port terminal	7	39,333	5,381	33,952	104,500
West:					
Country	14	18,760	1,408	17,352	260,464
Inland terminal	4	11,011	714	10,297	32,512
Port terminal	6	19,362	1,623	17,739	63,896
Great Lakes:					
Country	15	13,338	586	12,552	478,525
Inland terminal	9	38,649	2,878	35,771	108,904
Port terminal	7	54,467	5,086	49,381	147,061
South and East:					
Country	13	16,334	3,801	12,533	177,542
Inland terminal	7	28,603	1,461	27,142	82,857
East port terminal	3	21,500	4,025	17,475	38,368
United States					
Country	104	111,306	9,403	101,903	2,955,999
Inland terminal	48	353,683	16,779	336,904	1,312,439
Port terminal	23	134,662	16,115	118,547	353,825
All facilities	175	599,651	42,297	557,354	4,622,263

1/ Warehouse operator's estimate of space needed to handle grain within the plant.

2/ Warehouse operator's estimate of space used primarily to store grain.

3/ Capacity approved to store and handle Commodity Credit Corporation grain.

Note: See table 4 for delineation of areas.

and the standard rates shown in the rate schedule below. These rates were applied to the acquisition cost of building and equipment as follows:

	Percent
Concrete	2.5
Metal	4.0
Wood	3.3
Grain handling machinery and equipment	8.0
Office building (concrete, steel, wood)	4.0
Office furniture and equipment	8.0
Depreciable land improvement--driveway, fence, railroad siding and trackage, parking lots, etc	4.0

Some facilities--newly constructed plants and plants that had recently changed ownership--showed substantial interest expenses; many facilities of comparable age and structure showed no interest expense because company money was used for investment or no capital debt existed. To minimize these variations, an allowance for interest on capital investment was computed at 8 percent of one-half the original acquisition cost of building and equipment.

Interest on working capital was computed for each plant using a uniform procedure. This cost was calculated at 7 percent per year on one-fourth of the out-of-pocket expenses.

Replacement Costs

Even by standardizing the rates of depreciation and interest on investment, considerable variations existed among plants because some assets had been entirely depreciated, while other plants recently built or reorganize had much higher depreciation expenses. To more accurately estimate costs which would induce longrun investment or reinvestment in the commercial grain elevator industry, the physical plant replacement value was computed and used as a basis for recomputing depreciation and interest on investment expenses. Data from construction companies, engineering firms, and newly built elevator facilities were used to develop 1971-72 estimated average replacement costs of each type of structure--upright/flat, concrete, or steel. The capacity of each specific type of structure was multiplied by the appropriate replacement cost per bushel. The total plant replacement value was then used to calculate depreciation and interest on investment applicable to individual plants. The standard depreciation rates and 8 percent of one-half of the total replacement value were used to compute depreciation and interest on investment, respectively.

Method of Cost Allocation

The following procedures were used to allocate cost items among each of the plant's operating functions:

A. Fixed expenses

1. Building depreciation--Based on estimates obtained from the elevator operator as to the portion of each building's total capacity utilized for storage and working purposes. The storage ratio was applied to the total building depreciation expense and this amount was allocated to the storage function. The working portion was divided among all handling functions--receiving, shipping, turning, cleaning, and drying--according to the volume handled.
2. Equipment depreciation--Ratio of hours of operation for each handling function to the total operating hours of all functions. Hours of operation were ascertained by applying the warehouseman's estimate of the handling rate per hour for each function to the actual volume handled in that function.
3. Insurance and taxes--Total insurance and tax expenses were proportioned between building and equipment in the same ratio as the total asset acquisition value is divided between building and equipment values. The building portion of insurance and tax expenses was allocated to storage and handling in the same manner as building depreciation. The equipment portion of insurance and tax expenses was allocated in the same manner as equipment depreciation.
4. Leases and rentals--Building leases were allocated to functions in the same way as building depreciation. Leases of equipment were allocated in the same way as equipment depreciation. It should be noted that actual building and equipment lease expenses were eliminated in the asset replacement cost concept for computing depreciation and interest on investment.
5. Licenses and bonds--All to the storage function.
6. Interest on investment--Same as insurance and taxes.

B. Variable expenses

1. Direct labor--Ratio of man-hours required for each function to the total man-hours required for all functions. Man-hours were determined by multiplying the operator's estimate of the number of men (crew) utilized in performing each function by hours of operation.
2. Administrative overhead--Management, clerical, and home office expenses are included. Allocation is based on estimates by elevator management. Volume ratio is used as a basis for distributing costs to a specific function, such as receiving grain by truck and by rail.
3. Electricity and utilities--Based on the ratio of hours of operation for each function to the total operating hours for all functions.
4. Truck expense--Based on volume of receipts and shipments.
5. Building repairs--Same as building depreciation.
6. Equipment repairs--Same as equipment depreciation.
7. Insurance on grain--All to storage.
8. Taxes on grain--All to storage.
9. Fumigation--All to storage except in port terminals where a portion is also allocated to water shipments.
10. Other--Ratio of volume handled in each function to total volume handled.
11. Interest on working capital--Based on total out-of-pocket applicable to each function.

Projecting 1973-74 Storage and Handling Volumes

Per bushel costs of storing and handling grain are highly dependent on the volume of grain stored and handled in the elevator. Thus, to estimate costs for some future fiscal period, it is necessary to make predictions of anticipated volume changes.

Storage and handling volumes were estimated by projecting production, disappearance, and carryover on a quarterly basis for fiscal 1973-74. These estimates take into consideration the latest available USDA projections for the eight major grains reported in the Wheat, Feed, and Fats and Oils Situation reports. 2/ Also considered are historical trends and distribution patterns that might indicate 1973-74 storage and handling volumes at commercial grain elevators.

Because these volume forecasts may be somewhat different from the actual volumes produced by the end of 1973-74, a range of estimated unit costs per bushel was developed for each function. The projected volumes were increased by 10 percent and decreased by 10 percent and costs were recalculated on the basis of each volume level. The real costs for 1973-74 will probably be within these high and low cost limits.

Projecting 1971-72 Costs to 1973-74

The following percentage increases in cost were used to project handling and storage costs expected to prevail in 1973-74. These estimates were applied to the sample plants from which actual 1971-72 cost data were collected.

Cost item	Estimated percentage increase from 1971-72
	Percent
Fixed costs:	
Building and equipment depreciation	15
Building and equipment insurance	15
Building and equipment taxes	17
Building and equipment interest on invested capital 3/	15
Variable costs:	
Direct labor	13
Administrative overhead	13
Electricity, heat, etc.	10
Building and equipment repairs	15
Insurance on grain	22
All other items	7

2/ Reports published periodically by U.S. Department of Agriculture, Economic Research Service.

3/ Interest on invested capital was calculated at 8.0 percent of one-half of the 1971-72 and 1973-74 replacement value of building and equipment.