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Economics of Grain Drying Potential at Minnesota Country Elevators

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The grain combine with a corn head is continuing to replace the mechanical corn picker as a method of harvesting corn. In Minnesota, the fourth largest corn producing state, corn accounted for 24 percent of the cash receipts from marketing farm crops in 1966.

In 1968, 48 percent of the Minnesota corn crop was field-shelled, whereas only 13 percent was field-shelled in 1960. The mechanical corn picker, which replaced the hand method of husking corn in the thirties and forties, currently is being replaced by the grain combine with a corn head. The trend to field-shelled corn is expected to continue.

High moisture field-shelled corn is delivered to the country elevator in increasing quantities each year. As a result, farmers are passing many corn drying and storage problems on to the elevator operator. The response of operators has been to make substantial investments in corn dryers, grain storage space, aeration systems, and grain handling equipment. The cost and efficiency of these changes are very important to the state's corn producers.

When investing in grain drying and handling equipment, an elevator manager should evaluate the competition. And he should examine the profit potential from alternative grain dryer installations.

The following discussion is based on research done in 1966-69 on grain elevators in southern Minnesota.[1]

COMPETITION

Competition for country elevator grain drying originates from farm grain drying and storage systems and from other country elevators. In many instances, elevator grain drying can be priced to discourage installation of farm drying facilities. It generally is easier to discourage farm drying systems before they are installed by consistently offering good service at a reasonable price than to build patronage from farmers who have grain drying systems.

With the trend to harvesting field-shelled corn, competition among country elevators has become keen. Service seems to be more important to many farmers than loyalty to a particular elevator. Hence, some elevators have grown faster than others and trade areas also have changed somewhat. When an elevator receives grain from the trade area of a competitor, the question is whether the new patrons will be temporary or permanent. Of course, it depends somewhat on the competitor and the farmers. Extensive study has shown that it is not economically feasible for farmers to deliver their grain consistently more than 7-10 miles to a country elevator. So if grain comes from beyond 10 miles of the elevator, the question of patron permanency should be raised.

The competitive country elevator usually has good management and efficient facilities, resulting in a relatively low cost per bushel. To decide whether or not a firm should expand, grain drying costs and revenues need to be examined.

GRAIN DRYING COSTS

Grain drying costs are estimated for corn dried in portable batch dryers, portable continuous flow grain dryers, and upright commercial continuous flow grain dryers.

Among the variables in grain drying costs are the capacity of the grain dryer, the moisture extraction range, annual utilization of the dryer, the fuel, the weather, and management. To make grain drying costs comparable, the cost per bushel is based on grain dried from 25 to 13 percent moisture content, an average amount of drying for southern Minnesota corn. In some cases, both the initial and final moisture content are higher, but the grain drying time is comparable.

Annual utilization of the grain dryer is based on 600 hours operation per season. This figure approximates the time guide farmers use for their corn harvest. In 1968 and 1969, the average corn harvest season lasted considerably longer than 4 weeks due to field conditions, inclement weather, and/or the relatively high moisture content of the corn.

Before attempting to estimate grain drying costs, grain dryers representative of those being purchased by country elevator operators were selected. Operators were buying portable dryers and commercial upright continuous flow grain dryers. Generally, portable dryers are purchased in the small sizes and commercial dryers are purchased for hourly rated capacities of 1,000 bushels per hour (BPH) or more. The model dryers selected for the cost analysis are listed in table 1. All prices include installation. The commercial dryers include two elevator legs as part of the installation.

The installed price of the model grain dryers provides a base for estimating depreciation, interest, property tax, and insurance costs. These costs are not dependent upon the volume of corn dried annually and collectively are known as fixed costs. In contrast, costs that vary directly with the volume of corn dried annually are known as variable costs. These include such costs as labor, fuel, electric power, and repairs.

Fixed Costs

Annual depreciation of a dryer depends on its expected life. Experience suggests a life expectancy of 12 years for upright commercial grain dryers and 6 years for portable grain dryers.

Because of high interest rates during 1969, interest costs for grain dryers were calculated at 8 percent of the average value of the dryer throughout its expected life.

Property taxes for the model grain dryers were based on a market value that is one-half of the installation cost and a millage rate of 250 mills, the average for southern Minnesota.

Insurance for the grain dryers was based on the rate for a grain dryer attached to a wooden-cribbed elevator, or 85 cents per $100 value.

Variable Costs

The labor requirements for grain drying include management, a periodic check of the dryer when it is operating,

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[1] Ronald E. Kaldenberg, "Economic Analysis of the Optimal Size and Location of Southern Minnesota Country Elevators." Unpublished Ph.D. dissertation, Univ. of Minn., 1969.

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Table 1. Grain dryer costs for model grain dryers, 1969

Grain dryer rate, BPH	Cost, in-stalled	Depre-ciation	Insur-ance	Prop-erty tax	Inter-est	Annual fixed costs	La-bor	Fuel	Power	Re-pair	Vari-able costs	Annual total costs
					dollars							
					Portable grain dryers							
250	9,500	1,583	81	133	380	2,177	800	684	270	55	1,809	3,986
500	14,200	2,350	121	199	568	3,238	800	1,380	408	65	2,653	5,891
1,000	25,200	3,200	164	353	1,008	4,725	800	2,754	720	85	4,359	9,084
					Commercial grain dryers							
250	16,800	1,400	143	235	672	2,450	800	684	180	55	1,719	4,169
500	23,100	1,925	196	323	924	3,369	800	1,380	270	65	2,515	5,884
750	32,500	2,708	276	455	1,300	4,740	800	2,064	360	75	3,299	8,039
1,000	42,000	3,500	357	588	1,680	6,125	800	2,754	540	85	4,179	10,304
1,500	50,400	4,200	428	706	2,016	7,350	800	4,128	900	95	5,923	13,273
2,000	65,100	5,425	553	911	2,604	9,494	800	5,508	1,080	105	7,493	16,987
2,500	74,500	6,208	633	1,043	2,980	10,865	800	6,882	1,410	115	9,207	20,072
3,000	89,300	7,442	759	1,250	3,572	13,023	800	8,262	1,800	125	10,987	24,010
4,000	118,700	9,892	1,009	1,662	4,748	17,310	800	11,016	2,160	145	14,121	31,431

and the office bookkeeping time directly associated with grain drying. Since only the additional labor cost incurred by an elevator was included, the labor cost is limited to the minimum overtime wage paid to the nightwatchman. The watchman often spends as much time at other tasks as the day crew spends checking on the grain dryer. Hence, the two may offset each other. Management and bookkeeping costs tend to be fixed and therefore were omitted.

The grain drying costs developed were based on natural gas fuel, which generally costs 1.7 cents per bushel less than LP gas purchased at 13 cents per gallon. Consequently, for corn dried in an LP gas dryer, 1.7 cents per wet bushel must be added to the grain drying costs in figures 1 and 2. In general, the fuel oil cost per bushel dried is between the natural and LP gas costs per bushel.

The cost of grain dryer repairs was estimated from the records of numerous southern Minnesota grain dryers.

Analysis of Costs

All of the above costs are incurred in the grain drying operation. Additional costs are incurred for receiving high moisture corn, management, bookkeeping, grade loss, risk, etc. Since such costs are difficult to quantify, they were not included. But they must be covered for a profitable grain drying operation.

From the annual total cost of operating the grain dryer 600 hours, the cost per bushel for drying grain was calculated for grain dried from an average of 25 to 13 percent moisture. Over this moisture range, only 39 percent of the rated grain dryer capacity on a 5 percentage point removal was realized because of the additional drying per bushel and the colder ambient air temperature.

The calculated grain drying costs for the model grain dryers are summarized in figure 1. The horizontal scale shows both the rated hourly capacities of the dryers and the bushels of corn dried, given an average realized dryer capacity of 39 percent for the corn drying season.

Examination of figure 1 reveals that the per bushel cost of drying grain decreases significantly for large dryers up to the 2,000 BPH dryer. The savings for dryers larger than 2,000 BPH are relatively small and perhaps more than offset by the loss of flexibility. Large grain dryers are not well suited for either drying small quantities of grain or for segregated grain lots with substantial moisture differences. Hence, the 2,000 BPH dryer is the optimal size unit.

In the smaller grain dryers, the cost of drying grain is slightly lower with portable dryers. Due to the lower initial investment and the shorter time period selected to depreciate the dryer, the portable dryer was the better choice for most installations where less than 1,000 BPH of rated capacity was needed.

Grain drying costs are influenced by annual utilization. As utilization of the dryer increases, fixed costs are distributed over more bushels of corn. Consequently, the cost per bushel is lowered as more bushels of corn are dried annually.

Figure 2 shows how the grain drying cost for a 2,000 BPH dryer varies with the hours of operation per year. Note that the cost per bushel does not decrease significantly beyond 1,000 hours. When a dryer is operated fewer than 600 hours annually, the cost per bushel increases substantially. Therefore, the elevator manager should attempt to operate his grain dryer 4-6 weeks in a normal year. In years when both corn yield and moisture content are high, the corn harvest season will extend beyond a 4-6 week period. The manager then has to compromise between enough drying capacity to provide reasonably good service during the harvest season and a lower investment system so his costs per unit are reasonable.

The amount of moisture removed from corn has considerable impact on the drying cost per bushel. Generally, the elevator manager has very little control over the moisture content of the corn he receives. The cost of drying increases as the amount of moisture removed increases (table 2). Below 15.5 percent moisture, water becomes increasingly difficult to remove and the cost per bushel increases.

By removing corn from the dryer at 15 to 16 percent moisture, the dryer capacity is increased substantially, and grain drying costs are reduced significantly.

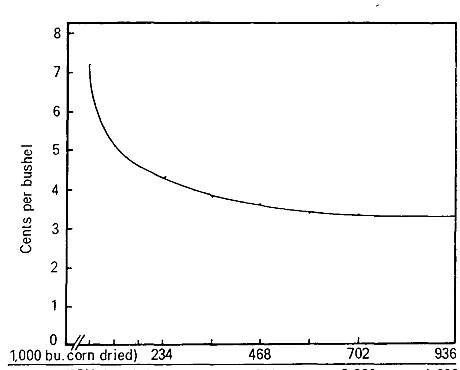

Figure 1. Grain drying costs for different capacity natural gas dryers operated 600 hours annually.

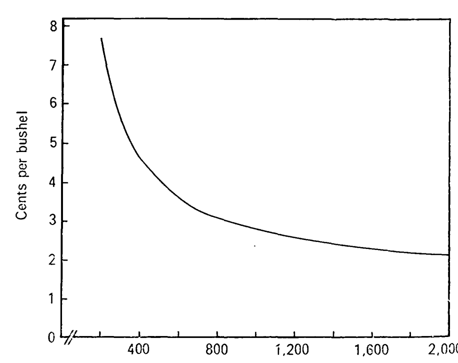

Figure 2. Grain drying costs for a 2,000 BPH natural gas grain dryer operated 200-2,000 hours annually.

Table 2. Relative grain dryer capacity and cost for different moisture reductions

Moisture reduction, percent	Percent rated dryer capacity	Percent of cost drying from 25 to 13 percent moisture
35-15	30	130
30-15	37	105
25-15	51	76
20-15	80	49
35-13	27	144
30-13	31	126
25-13	39	100
20-13	56	70

When merchandising corn or storing corn on aeration, it is not necessary to dry the corn to 13 percent moisture. This saves both drying time and excess weight loss from removing moisture below 15.5 percent. A good manager will not dry corn any more than necessary for marketing or reasonably safe storage.

GRAIN DRYING REVENUE

Elevator grain drying revenue comes from custom drying farmers' corn and from drying purchased high moisture corn. The revenue earned on custom dried corn is determined by the custom drying rate. For example, if the custom drying charge is ¾ cent per percentage point of moisture removed with a minimum of 5 cents, then the custom drying revenue and profit per wet bushel are as listed in table 3.

Note that the profit per bushel of corn dried increases as the capacity of the dryer increases. In other words, the profit potential for larger dryers is greater due both to the higher annual volumes of grain dried and the higher profit per bushel dried.

When the elevator purchases high moisture corn on a moisture discount scale, the moisture discount covers the weight loss in grain drying and the cost of operating the grain dryer. After the value of the moisture lost in drying is deducted from the moisture discount, the remaining part of the moisture discount is revenue to cover the direct and indirect costs of grain drying. The part of the moisture discount that covers the cost of the drying operation is known as the implied drying charge. After the cost of drying is subtracted from the implied drying charge, the result is the "profit" for drying the elevator's high moisture corn. This "profit" per bushel is listed in table 3.

When selling artificially dried corn, the best price is received for corn with not over 15.5 percent moisture. Corn containing more moisture is discounted for the excess. Corn sold with less than 15.5 percent moisture is overdried for the No. 2 basis without receiving a premium for the lower moisture content. Corn containing 15.5 percent moisture sometimes is preferred by terminal elevators over drier corn because it is not as brittle and therefore does not break as easily. The greater the difference between the moisture content of a given lot of corn and 15.5 percent, the lower is the net price received for the lot. Net grain drying "profit" is reduced substantially if corn is consistently sold at moisture levels differing significantly from 15.5 percent.

To avoid the difficult calculations for finding the implied drying charge and for fairer prices, some elevators are charging producers the custom drying charge and then buying the dry corn. The advantage of this method is that both parties know the drying charge and the method is equitable for all No. 2 yellow corn prices. Hence the moisture discount scale does not have to be adjusted for changes in the No. 2 yellow corn price.

Table 3. Grain drying profit on custom dried corn and purchased corn on a No. 2 basis of $1 per bushel

Commercial grain dryer, BPH	Profit from custom drying corn to 13 percent moisture				Profit from drying purchased corn*			
	Initial moisture, percent				Initial moisture, percent			
	20	25	30	35	20	25	30	35
	cents per bushel							
250	0.29	1.84	3.84	6.28	0.13	2.27	4.15	5.74
500	1.75	3.97	6.42	9.24	1.15	3.85	6.40	8.46
750	2.06	4.43	7.00	9.90	1.37	4.20	6.88	9.05
1,000	2.18	4.60	7.21	10.14	1.45	4.33	7.06	9.28
1,500	2.62	5.22	7.99	11.04	1.76	4.81	7.71	10.08
2,000	2.72	5.37	8.18	11.26	1.83	4.92	7.87	10.28
2,500	2.86	5.57	8.43	11.54	1.93	5.08	7.88	10.54
Grain drying revenue	5.25	9.00	12.75	16.50	3.60	7.70	11.70	15.00

* No. 2 yellow corn at $1 per bushel and a moisture discount scale of 1 cent for each percent moisture over 15.5. Profit decreases as the No. 2 yellow corn price increases. As the No. 2 yellow corn price decreases, profit increases.

GRAIN DRYING SYSTEM

When changes in corn drying or storage facilities are being considered, the entire system of receiving, handling, drying, storage, and merchandising must be included in the plans. A grain dryer is not advantageous to an elevator unless it fits into the system. An entire system does not need to be constructed at one time, but plans should be made so that a coordinated and efficient grain handling and drying system evolves. If present facilities do not fit into a future system, a manager should consider temporary adjustments until he can either construct adequate facilities in a choice location or discontinue grain operations.

For receiving high moisture corn, a high capacity leg is needed to accept the grain as fast as the farmers can deliver it. By using a 5,000-6,000 BPH elevator leg, one or two men can receive as much corn as a 2,000-4,000 BPH dryer can dry. The receiving crew with the 5,000-6,000 BPH elevator leg is most efficient, which means a low cost per bushel received.

With the trend to field-shelled corn, increased storage capacity is necessary to hold grain that cannot be shipped immediately. Country elevators are entering a period when their grain storage capacity cannot be turned as often as in the past. Consequently, there is a need for efficient low investment grain storage capacity that provides a low cost per bushel of grain stored.

An elevator system should be automated as much as possible at a reasonable cost. The only system operated by a normal size crew with a chance of keeping up with the harvesting pace of farmers is the automated system.

SUMMARY

The potential profit from grain drying is greater for high capacity grain dryers because the profit per bushel of grain dried is higher and more bushels of corn can be dried per season. Grain drying costs per bushel are not reduced significantly for dryers with over 2,000 BPH rated capacity. In general, corn drying costs per bushel can be lowered by increasing the length of the corn drying season, reducing the amount of drying per bushel, and removing corn from the dryer at a higher final moisture content.

Elevator managers should plan a complete corn drying, storage, and handling system to efficiently handle field-shelled corn at harvest. ■

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IN PERSPECTIVE

Trends in Corn Harvesting and Handling

Ronald E. Kaldenberg

Field shelling started replacing ear corn handling as a method of harvesting corn grain in the fifties. In Minnesota, the rate of change has been relatively rapid in the sixties. Most field shelling now is done by combines.

The trend to field shelling corn is taking place in the entire Corn Belt (see the table). In general, field shelling has progressed from east to west within the Belt, although Iowa now has the lowest field shelling rate, probably because of the high rate of livestock feeding on its farms. Economic advantages of field shelling appear to be greatest for cash grain farms.

The rate of change to field shelling may have slowed down in Illinois and Indiana at the 65-70 percent field shelled corn level. Based on the past trend of corn harvesting methods in Illinois and Indiana and the current rate of change in Minnesota, the percentage of the Minnesota corn crop that is field shelled is expected to continue increasing. If the pattern of adjustment in Minnesota is similar to the eastern part of the Corn Belt, it appears that Minnesota trails Illinois by 3-4 years. This lag means that about two-thirds of Minnesota's corn acreage might be field shelled by 1972. On the other hand, the adjustment in Minnesota could follow the Iowa trend if livestock feeding patterns do affect the field shelling trend and if they are similar in Iowa and Minnesota.

In Minnesota, the adjustment to field shelled corn has been greatest in the west central and south central crop reporting districts (see the map).

From 1967 to 1968, the percentage of field shelled corn in southwestern Minnesota increased from 35 to 52 percent, a 49 percent increase. But last year, the rate of increase in field shelled corn was highest in northern Minnesota, where 15 percent of the corn crop was field shelled in 1967 compared to 30 percent in 1968, a 100 percent increase.

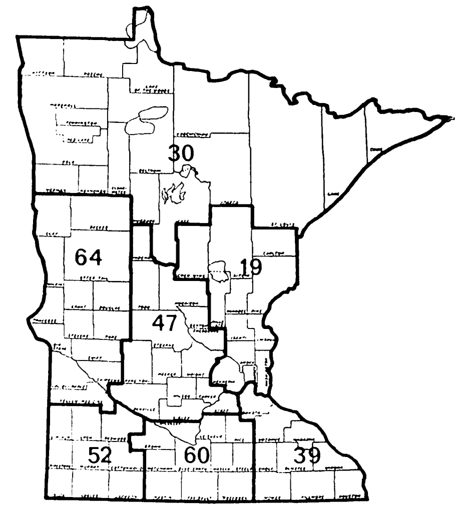
Percentage of corn acreage field shelled and moved directly off-farm at harvest*

State and year	Corn acreage field shelled	Field shelled corn moved directly off-farm†
	......percent.....	
Minnesota		
1960	13.0	NA‡
1967	40.8	40
1968	48.3	39
Iowa		
1964	18.7	52
1965	24.7	42
1966	33.7	47
1967	39.2	43
1968	42.5	43
Illinois		
1960	18.0	NA
1962	24.0	NA
1963	34.5	NA
1964	45.0	56
1965	53.5	52
1966	57.0	46
1967	64.0	49
1968	65.0	42
Indiana		
1964	52.1	57
1965	55.3	73
1966	66.0	62
1967	70.9	62
1968	72.2	51

* Source: *Corn Harvesting and Drying Methods*, Crop and Livestock Reporting Service, Minnesota Department of Agriculture and U.S. Department of Agriculture, 1969.

† Includes percentage of field shelled corn that is marketed directly from the field and stored off-farm at harvest by producers.

‡ NA indicates that these data were not available.



Percentages of Minnesota corn crop taken from the field as shelled corn, 1968.

The percentage of field shelled corn moved directly off-farm from the field varies considerably across the Corn Belt (see the table). In Iowa, Illinois, and Indiana, the percentage of the field shelled corn moved off-farm at harvest appears to be decreasing slightly. In Minnesota, where 40 percent of the field shelled corn moved off-farm in 1967 and 1968, a smaller percentage of the field shelled corn has been moved off-farm at harvest than in other areas of the Corn Belt.

Off-farm movement at harvest is a function of grain elevator handling capacity, farm investment in drying and storage facilities, and volume of farm livestock feeding. ■

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