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Post-Harvest Management
The Economics of Grain Transportation

Jordan Shockley, Agricultural Economics

While transporting grain to the market may be the last input cost in the production of grain, it is a critical decision a producer has to make, especially when margins are thin. Determining which market to sell your grain (if you have options) can be a complex decision. Most producers in Western Kentucky have multiple potential markets to deliver their grain. This leads to the question of, "Should I sell my grain to the closest elevator or should I transport it a further distance to an elevator offering a higher price?" What market you choose not only will determine the price you receive but will also determine the cost associated with transportation. The market that provides the highest price is not always the most profitable price. The tradeoff between maximizing price per bushel received from the buyer and minimizing transportation costs could be the difference between making a profit that year or being in the red.

Many factors will impact the transportation cost of grain and determine the most profitable option. Those factors include grain price, distance, fuel price, wait time, quality discounts, labor, and truck capacity. It is common for most producers to make their market decision based on only one of these factors. However, all of these factors need to be considered simultaneously when determining the most profitable market option. This publication develops a framework to determine the net price received per load of grain from each potential market along with an example in the appendix. In addition, a Microsoft Excel–based decision tool for comparing up to six potential markets and determining the most profitable option is presented.

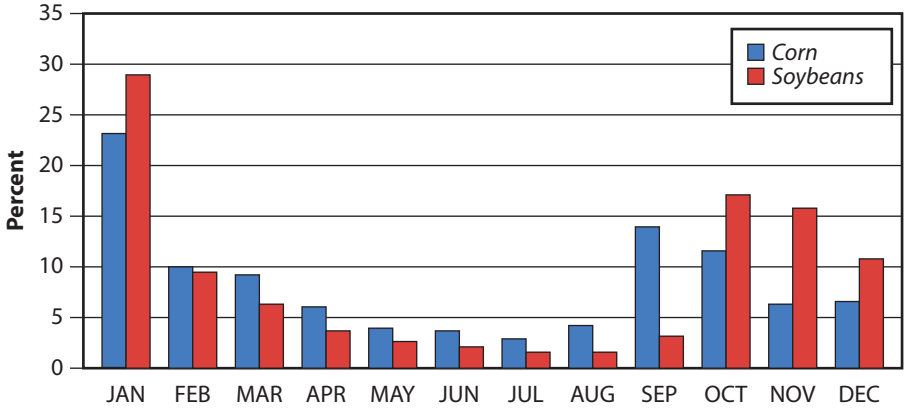

Figure 1. Average percent of grain marketed off-farm by month in Kentucky
Source: USDA National Agriculture Statistics Service 2005-2014

How and When Is Grain Transported?

In Kentucky, most producers transport grain by way of a semi-truck with either a double hopper or an open bed trailer. Transporting with a semi-truck allows for the greatest grain capacity of approximately 1,000 bushels which reduces the per bushel cost of transportation. Other transportation options in Kentucky include grain trucks with either single or tandem axles that have the ability to transport 300 bushels and 600 bushels of grain, respectively. Transporting grain to the market immediately after harvest is not the only option for Kentucky producers. Due to the increased investment in on-farm storage in Kentucky, producers have the ability to transport grain to market year-round and to potentially capture higher grain prices than selling at harvest. Figure 1 illustrates the percentage of grain marketed off-farm by month in Kentucky. Most grain in Kentucky is held until January with the intention of capturing higher prices or carry in the market and for accounting (tax) purposes.

Grain Price and Discounts

One major component in determining the most profitable marketing option is the grain price that is offered at the elevator. Kentucky producers have the ability to lock in forward contracts with a particular elevator for a set price or deliver grain on a cash plus/minus local basis. In addition to the price variations at different buyers, quality discount methods will vary. The primary quality discount for Kentucky grain producers is for grain moisture content. Three moisture discount methods are commonly used by buyers in Kentucky:

- A set $/bu discount per percentage point over the base requirement (*e.g. discount schedule might say "$0.05 per bushel for each 0.5% over 15% moisture"*)
- A percent of weight or price per percentage point over the base (*e.g. discount schedule might say "Shrink to 15% at 2.5% per point*)
- A shrink plus drying charge per percentage point over the base (*e.g. discount schedule might say "Shrink to 15% at 1.25% per point with a drying charge of $0.025 per bushel for each point above 15%."*)

Grain price received, including anticipated discounts, plays a critical role in deciding to which market to deliver a load of grain. In addition to the price received, the transportation costs must also be considered to determine the most profitable market for your grain.

Grain Transportation Costs

Each potential market will have a different transportation cost depending on a number of factors. Using the cost calculations below, the total cost for owning and operating a grain truck can be determined. Ownership and operating cost can then be compared to custom haul rates in your area.

Ownership Costs

The ownership costs (a.k.a. fixed cost, overhead, indirect cost, or sunk cost) associated with grain transportation are those costs that occur even if your grain truck sits idle and is not in use. In other words, the costs are incurred regardless of annual usage. Ownership costs include depreciation, interest, taxes, insurance, and storage. Depreciation and interest contribute to the bulk of ownership costs.

Depreciation is a non-cash cost that takes into consideration the value lost in a piece of machinery due to age, use, and/or becoming obsolete. Economic depreciation, discussed here, is not the same as tax depreciation. The average annual economic depreciation can be calculated using a straight-line depreciation method. To determine economic depreciation, the purchase price of the truck, the salvage value, and the ownership life are required. The salvage value is what the truck would sell for after the ownership life is reached. The ownership life is the number of years the truck will be owned. The average annual economic depreciation can be calculated using the formula in *Equation 1*.

Interest. When purchasing a truck to transport grain, that capital also could be used for alternative investments. This is also known as the opportunity cost of capital and is also a non-cash cost. The opportunity cost of capital represents the expected return if the capital that was used to purchase a grain truck was invested in the next best alternative. Since the value of the grain truck is decreasing throughout the time of ownership, an average value needs to be determined or a value at halfway through ownership. This is calculated using the first formula in *Equation 2*. The interest portion of the ownership cost can then be calculated using the average value from the first formula and an interest rate. The appropriate rate to use in determining the interest portion of ownership costs would be to use the expected rate on borrowed capital or the rate of return on the next best alternative investment.

Taxes, Insurance, and Housing

Taxes, insurance, and storage for a grain truck represent a relatively small portion of the ownership costs when comparted to depreciation and interest. In Kentucky, property tax is charged to all farm machinery. Also, insurance for a grain truck is required for liability coverage, collision, and property damage since it is an on-road vehicle. In addition, storing a grain truck comes at a cost. Even if a grain truck is not stored, a cost is associated with a decrease in value based on keeping the grain truck outside (weather wear and tear). The annual ownership cost for taxes, insurance, and storing is about 1%-1.5% of the average value determined above.

Operating Costs

Fuel

Fuel costs for transporting a load of grain depend on the fuel consumption of the grain truck (miles per gallon) and miles traveled to and from the buyer, as well as fuel price. *Equation 3* will allow you to calculate the fuel cost for transporting a load of grain.

Equation 3 determines the fuel cost ($) for transporting a load of grain. To determine the fuel cost per bushel for transporting a load of grain, divide the fuel cost by the number of bushels transported during that load, adjusted for the base moisture content required by the buyer. This is referred to as dry grain bushels. To determine the number of dry grain bushels transported to market, use *Equation 4*.

Labor

The labor cost for transporting a load of grain depends on the travel time to and from the buyer, the wait and unload time at the buyer, and the wage rate for the driver. To determine the total travel time required to deliver a load of grain, the round trip miles traveled to the buyer, the average road speed (mph) during the delivery, and the wait and unload time (in hours) are required. The total travel time is calculated using *Equation 5*.

Use *Equation 6* to determine total labor cost in dollars for delivering a load of grain. Multiply the wage rate ($/hr) by the total travel time calculated in *Equation 5*.

Similar to fuel cost, to determine the labor cost per bushel of grain, divide the labor cost by the number of dry grain bushels transported during that load.

Equation 1. Depreciation

$$\text{Depreciation} = \frac{\text{Purchase Price - Salvage Value}}{\text{Ownership Life}}$$

Example: *If a grain truck has a purchase price of $50,000, a salvage value of $10,000 and an estimated ownership life of 8 years, then the estimated annual economic depreciation would be: ($50,000-$10,000)/8 = $5,000.*

Equation 2. Interest

$$\text{Average Value} = \frac{\text{Purchase Price + Salvage Value}}{2}$$

$$\text{Interest} = \text{Average Value x Interest Rate}$$

Example: *Using the same grain truck in the depreciation example, the average value would be: ($50,000 + $10,000)/2 = $30,000. If the interest rate is 6%, then the annual interest cost for owning the grain truck would be $30,000 x 0.06% = $1,800.*

Equation 3. Fuel costs per load

$$\text{Fuel Cost} = \frac{\text{Fuel Price x Round Trip Miles}}{\text{Fuel Consumption (MPG)}}$$

Example: *If fuel price is $3.00 and the grain truck gets 8 miles per gallon, a 30 mile round trip grain delivery would have a fuel cost of ($3.00 x 30)/8 = $11.25.*

Other Operating Costs

Other operating costs to consider for transporting grain are repairs and maintenance on the truck and tires, as well as variable depreciation (different from ownership depreciation). Repairs, maintenance, and tire expenditures are typically determined from owner's records. If annual records are kept on the truck, take the total cost per year spent on repairs, maintenance, and tires and divide the cost by the total bushels the truck transported for the year. If records do not exist, industry standards can be used as an estimate. The American Transportation Research Institute (ATRI) releases annual estimates for the repairs, maintenance, and tire costs per mile to transport agricultural freight. On average, repairs and maintenance cost $0.15/mile and tires cost $0.05/mile. Variable depreciation is another operating expense to consider for grain transportation, but it is a non-cash cost. This non-cash cost accounts for the decrease in value due to the number of miles on the truck. This is estimated today to be $0.10/mile. So the average for other operating costs is $0.30/mile. *Equation 7* will allow you to calculate the cost per bushel for other operating costs.

Net Price Received

To determine the net price received for a bushel of grain from a potential buyer, the grain price (forward contract or cash plus basis price), anticipated discounts, and the total transportation cost are required. The net price received is calculated by subtracting the total quality discount ($/bu), fuel ($/bu), labor ($/bu), and other operating costs ($/bu) from the grain price. The estimated net price received from a potential buyer can then be compared with other markets to determine the most profitable option to sell the load of grain. A step-by-step example in can be found in the appendix.

Determining the net price received for a particular buyer will change from field to field (distance from the buyer changing) and load by load (moisture content of each load changing). Therefore, it is difficult to calculate each net price received per load with pen and paper. Therefore, a Microsoft Excel–based decision tool was developed to allow producers to compare up to six markets to determine the most profitable option. By entering the required inputs and utilizing the formulas above, the estimated transportation cost and net price received is calculated for each buyer. This tool, called **Grain Hauling Decision Guide** can be found on the following website: http://www.uky.edu/Ag/AgEcon/shockley_jordan.php.

Equation 4. Fuel costs per bushel

$$\text{Dry Grain (bu)} = \frac{\text{(1 - Wet Grain Moisture Content)}}{\text{(1 - Buyer Grain Moisture Content Requirement)}} \text{ x Wet Grain (bu)}$$

Example: *If a grain truck is hauling 900 bushels of corn that has a moisture content of 18% and the buyer grain moisture content requirement is 15% then the amount of dry grain in the grain truck is [(1 - .18)/(1 - .15)] x 900 = 868 bu. Therefore, the fuel cost per bushel is $12.25/868 = $0.014/bu.*

Equation 5. Total travel time

$$\text{Total Travel Time} = \left(\frac{\text{Round Trip Miles}}{\text{MPH}}\right) + \text{Wait and Unload Time (hrs)}$$

Example: *The grain truck travelled 30 miles at 50 miles per hour to an elevator and it took 1 hour with waiting and unloading the truck. The total travel time is (30/50) + 1 = 1.6 hours.*

Conclusion

While grain transportation is the last cost in production, determining the most profitable option to market your grain can be a complex decision where price, quality discount, and transportation costs should all be considered. In addition, the most profitable option could change from field to field and load by load. Each field harvested will be a different distance away from potential markets and each load will have a different moisture content. With the price and cost descriptions above, a net price received for a load of grain can be calculated. However, for dynamic situations, the Grain Hauling Decision Guide can be used to determine the most profitable market for your grain.

Equation 6. Total labor cost per load

$$\text{Labor Cost (\$)} = \text{Total Travel Time (hrs)} \times \text{Wage Rate (\$/hr)}$$

Example: *The driver of the grain truck charges $15/hour. Therefore, the labor cost to deliver that load of grain would be 1.6 x $15 = $24.00.*

Equation 7. Cost per bushel, other operating costs

$$\text{\$/Bushel} = ((\text{\$/Mile}) \times \text{Round Trip Miles})/(\text{Dry Bushels of Grain})$$

Example: *If the Other Operating Cost is $0.30 per mile with 30 mile round trip, the cost would be ($0.30 x 30)/868 dry bushels = $0.010/bu.*

References

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Torrey, W. Ford, and Dan Murray. 2015. An Analysis of the Operational Costs of Trucking: 2015 Update. American Transportation Research Institute. http://atri-online.org/2015/09/29/an-analysis-of-the-operational-costs-of-trucking-2015-update/.

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Appendix

Example in Calculating Net Price Received

To determine the net price received for the potential buyer, transportation inputs, buyer inputs, and moisture discount inputs are required. The net price received can then be compared to other potential buyers by repeating the example below. For this example, the truck is already owned therefore only operating costs for transportation are required.

Transportation Inputs	Example	Your Farm
Wage Rate ($/hr)	$12.50	
Fuel Price ($/gal)	$2.50	
Other Operating Costs ($/mile)	$0.30	
Fuel Consumption (MPG)	6	
Average Truck Speed (MPH)	45	
Truck Capacity (bu)	1000	
Grain Moisture	16.5%	

Buyer inputs are those associated with buyer characteristics and grain requirements upon delivery.

Buyer Inputs	Example	Your Buyer
Round Trip Miles (miles)	50	
Wait + Unload Time (hrs)	0.5	
Buyer Market Price ($/bu)	$3.85	
Base Moisture Requirement (%)	15%	
Discount Method	$ per bu point	
Discount Amount (per point)	$0.05	

Utilizing the equations in the document and the example inputs above, the moisture discount, total fuel cost, total labor cost, and other operating costs can be calculated. First, dry grain bushels need to be calculated to convert costs into $/bu.

Example	Your Farm	
Dry Grain (bu) = ((1 - 0.165) ÷ (1 - 0.150)) x 1,000 = 982		Dry Grain (bu)
Moisture Discount		
Buyer Market Price = $3.85/bu		Buyer Market Price ($/bu)
Discount per Bushel Point = $0.05		Discount per Bushel Point ($)
Total Points Discounted = 16.5 - 15 = 1.5		Total Points Discounted
Total Discount = $0.05 × 1.5 = $0.075/bu		Total Discount ($/bu)
Fuel Cost		
Fuel Cost ($) = ($2.50 x 50) ÷ 6 = $20.83		Fuel Cost ($)
Fuel Cost ($/bu) = $20.83 ÷ 982 bu = $0.021/bu		Fuel Cost ($/bu)
Labor Cost		
Total Travel Time = (50 ÷ 45) + 0.5 = 1.6 (hrs)		Total Travel Time (hrs)
Labor Cost = 1.6 x $12.50 = $20.00		Labor Cost ($)
Labor Cost ($/bu) = $20.00 ÷ 982 bu = $0.020/bu		Labor Cost ($/bu)
Other Operating Cost		
Other Operating Cost = $0.30 x 50 miles = $15.00		Other Operating Cost ($)
Other Operating Cost ($/bu) = $15.00 ÷ 982 bu = $0.008/bu		Other Operating Cost ($/bu)
Net Price Received		
$3.775 - $0.021 - $0.020 - $0.008 = $3.726/bu		Net Price Received ($/bu)

This process can be repeated for other potential buyers to compare the net price received to determine the most profitable market for a load of grain.

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