AN ECONOMIC ANALYSIS OF REDUCING STORAGE LOSSES IN POTATOES

by
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Introduction

Quality deterioration and shrinkage of potatoes while in storage constitute substantial economic losses to the Washington potato industry and to the economy of the state. They are especially important in Washington since such a large proportion of the total crop is stored to provide a flow of potatoes for processing throughout the year.

When a crop is destroyed or abandoned at an early stage in the production cycle, only the resources used up to that point are lost. For this reason, storage losses (of any commodity) are especially punishing since the entire bundle of resources required to grow the crop have been employed. Thus, the total cost of production has been incurred.

The production costs embodied in potatoes lost in storage are damaging to both producers and processors. The impact of losses is felt more widely in a time of increasing resource scarcity as we realize that resources committed to potato production are unavailable for other uses. The biological nature of the potato makes some level of storage loss unavoidable, and, therefore, a necessary cost of doing business. Beyond these losses, however, reducing losses is an important economic issue.

The magnitude of the storage loss problem can be considered first from a statewide perspective. If 75 percent of a 50 million hundredweight crop is placed in storage, and if the potatoes are worth $50 per ton, a one percent storage loss represents nearly a million dollar reduction in the crop's value. Just as storage losses represent a cost to the industry, reducing losses from current levels can be viewed as an opportunity to increase the value of the crop in the future. At a potato value of $50 per ton, reducing losses on 1.875 million tons by three percent would increase the value of the crop by $2.8 million. Reducing losses by five percent would be worth nearly $5 million under the same conditions. This may be a more profitable way to increase industry profits than by growing more potatoes.

While the magnitude of losses at the state level can be impressive, excessive storage losses can be especially damaging to the individual producer. Serious loss in a facility in any year can be devastating to a producer's financial health. More modest losses (both of quality and quantity) on a year to year basis can exert a less critical, but nevertheless significant impact of long-term farm profits. Annual loss reductions can add appreciably to the farms financial well-being. Table 1 indicates the annual value of alternate loss reduction levels at various potato market prices.

Calculations in Table 1 indicate that reducing losses by one percent on 8000 tons of potatoes would be worth $2400 per year at $30 per ton, and $4800 per year at $60 per ton. When large loss reductions are combined with strong potato prices, substantial annual benefits can accrue to the operator that can achieve them. Whether these potential benefits are worth seeking through investment in more elaborate facilities is the subject of this analysis.

Costs of Obtaining Loss Reduction Benefits

Storage losses arise from numerous factors working both jointly and independently. The finest storage facility, operated exactly as it was designed cannot store poorly grown, harvest damaged potatoes for long periods of time. Likewise, well grown, bruise free

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potatoes cannot be maintained for several months in poorly designed or poorly managed storage warehouses. Only by combining optimal growing and handling practices with careful management of a minimum loss facility can overall storage loss reductions be assured.

There are numerous ways of reducing losses. Among them, the capability of the environmental control system to provide temperature and humidity conditions ideal for maintaining tuber quality is of critical importance. This analysis was not designed to evaluate the economic feasibility of constructing a storage facility. It was designed to determine on the basis of costs, the relative loss reductions one would have to experience to justify additional capital investment in environmental control systems.

Several assumptions underlie the analysis. The more important of them are.

1. Three environmental control systems are considered:
   a. Air and humidity (used as basis of comparison)
   b. Air and humidity with push-through air washer
   c. Air and humidity with refrigeration

2. Facility capacity is 8000 tons

3. Air delivery in all systems is 17 c.f.m.

4. Storage period is 180 days, although some systems have longer storage capability.

5. Potato handling costs are the same in all systems and are not included in the analysis.

6. Building cost is not affected by choice of system except for $2,000 additional fan house cost with air washer.

7. Prices reflecting 1977 installation costs were collected from system suppliers.

Data in Table 2 indicate the investment levels and estimated average annual overhead and operating costs for the three systems.

Table 1. Annual Potato Loss Reductions in an 8,000 Ton Capacity Warehouse at Alternate Loss Reductions and Potato Prices.

Loss Reduction (%)	Potato Prices ($/Ton) 30	40	50	60
1	2,400	3,200	4,000	4,800
3	7,200	9,600	12,000	14,400
5	12,000	16,000	20,000	24,000
7	16,800	22,400	28,000	33,600
9	21,600	28,800	36,000	43,200
11	26,400	35,200	44,000	52,800

Table 2. Initial Investment Levels and Estimated Annual Costs for Ownership and Operation of Three Environmental Control Systems in an 8,000 Ton Capacity Potato Warehouse, 1977.

Cost Category	System: Air & Humidity	Air Wash	Refrigerated
	$	$	$
Initial Investment			
Per Ton	2.875	5.75[A]	7.75
Total	23,000.	48,000.[A]	62,000.
Annual Fixed Costs			
Depreciation[B]	3,286	6,857	8,857
Interest on Ave. Investment @ .10	1,150.	2,400.	3,100.
Insurance[C]	180	374	484
Taxes[D]	161	336	434
Total	4,777	9,967	12,875
Annual Operating Costs[E]			
Repair & Maint.	250.	250.	350.
Power @ $.01/Kwh	967.	1,611.	1,289.
Total	1,217.	1,861.	1,639.
Total Annual Cost	5,994	11,828	14,514

[A] $5.75 + $2,000 Additional Fan House Cost.

[B] Based on 7 Year Useful Life Due to Rapidly Advancing Technology in the Field.

[C] $1.56/$100 of Average Value.

[D] $14/$1,000 of Average Value.

[E] For 180 Day Storage Period.

Initial investment levels used in the analysis were: $23,000 for the air-humidity system; $48,000 for the air-humidity with air washer system; and $62,000 for the air-humidity with refrigeration system.

Annual fixed ownership costs include charges for depreciation; interest on invested capital, hazard insurance, and property taxes. These charges amounted to nearly $5,000 for the air-humidity system, nearly $10,000 for the air washer system, and almost $13,000 per year for the refrigerated system.

Annual operating costs (primarily for electricity) for the 180 day storage period were estimated at $1,217 for the air-humidity system, $1,861 for the air wash system, and $1,639 for the refrigerated system. Adding the ownership and operating costs resulted in the total estimated annual costs for a 180 day storage period. The total amounted to $5,994 for the air-humidity system, to $11,828 for the air washer system, and to $14,514 for the refrigerated system. Remember, these annual costs include no charges for the storage facility itself, or handling charges to move the potatoes in and out of storage.

For purposes of comparison, the estimated average annual cost of the air wash system is $5,834 greater than that for the air-humidity system. At $50 per ton, 117 tons of potatoes saved would offset this increased annual cost. The estimated average annual cost of the refrigerated system is $8,520 greater than for the air-humidity system. This increased cost would be offset by 170 tons of $50 per ton potatoes. This amounts to about two percent of an 8,000 ton capacity warehouse.

Information in Table 3 indicates the loss reduction percentages (from those with an air-humidity system), at various potato prices, required to offset the increased annual costs of the air washer and refrigerated systems. For example, if potatoes were priced at $50 per ton, losses with an air washer system would have to be at least 1/5% smaller than with the air-humidity system to make the air washer a viable economic option. Under the same conditions the required loss reduction for the refrigerated system is 2.1%.

Conclusion

Several methods are available to capture the benefits available through reducing storage losses in potatoes. Some methods, such as cultural practices to grow more storable potatoes, or careful harvesting and handling may be very inexpensive ways to achieve the benefits. A method examined here is to invest in more technically advanced environmental control systems for storage warehouses.

Based on the relative average annual costs of ownership and operation, additions of either air washer or refrigeration facilities to a basic air-humidity system could be economically justified with loss reductions of less than 3% at current potato prices.

Circumstances that would alter this conclusion include: different anticipated storage periods; management capability to load and maintain the storage facility; and quality of tubers as they are initially stored.

Table 3. Breakeven Percentage Loss Reductions to Equate Annual Costs of Air Washer and Refrigerated Systems to Air-Humidity at Alternate Potato Prices, 8,000 Ton Warehouse.

Potato Prices	System	
$/ton	Air Washer	Refrigerated
30	2.4	3.6
40	1.8	2.7
50	1.5	2.1
60	1.2	1.8
70	1.0	1.5
80	.9	1.3