

On-Farm Soybean Storage: Cost and Potential Returns

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Summary

Results of this study suggest that returns from on-farm storage are likely to exceed storage costs (amortized investment and operating costs). However, we used mid-1976 data to estimate investment and operating costs and based our estimates of returns from storage on the assumption that expected seasonal price changes in the future will be similar to those in the five-year period (1971-72 through 1975-76).

Actual future storage costs and seasonal price patterns can be expected to differ from those of the past. Therefore, a producer interested in using our results in deciding whether to invest in on-farm storage facilities *needs* to adjust our estimates of costs for changes in prices of purchased

inputs and *must* make his own assessment of future seasonal price patterns.

Also, this publication does not include commercial storage as an alternative. Therefore, producers in areas where commercial storage is adequate need to compare costs of commercial storage with their estimates of on-farm storage costs. However, factors other than comparative costs merit consideration. One in particular is the possibility of costly time delays at commercial elevators that may make it necessary to "stop the combines" during critical harvest days. Also, the present investment tax credit of ten percent was not included and this is a partial offset of the initial investment cost.

On-Farm Soybean Storage: Cost and Potential Returns

Marketing alternatives available to soybean producers include (1) forward selling, (2) selling immediately after harvest or (3) storing in on-farm or commercial facilities and selling later in the marketing year. Storage, either on or off farm, increases farmer participation in the marketing process and generally is based on expected lower prices at harvest

than at some time later in the marketing year.

The purpose of the research reported in this publication was to develop part of the information that farmers need in selecting the marketing alternative or combination of alternatives that most nearly satisfy their individual needs. Specific objectives of this study were to develop detailed cost

estimates for on-farm soybean storage facilities of selected sizes and to evaluate the economic feasibility of constructing such facilities. This involved (1) estimation of capital investment, (2) estimation of annual ownership and operating costs and (3) evaluation of the potential profitability of storage.

Procedure

Investment requirements and annual operating costs were developed for storage systems with capacities of 15,000, 30,000, 45,000, and 60,000 bushels, using mid-1976 prices obtained from secondary sources and commercial companies. Facilities of each size were metal bins on concrete foundations. Bins were arranged in a semi-circle around a dump pit with transport augers. All systems included heated-air drying facilities. Storage costs were estimated at capacity utilization and were based on the assumption that only

soybeans would be stored for a six-month period.

Annual costs were classified as fixed¹ and variable². Monthly estimates were made of costs that are fixed, fixed if facilities are used³ and variable by time of use⁴. Storage costs were compared with changes in soybean prices from the normal harvest months (October and November) until later in the crop year, using an average of monthly prices for the past five marketing years⁵.

Payback potential was evaluated for all systems considered, using

calculations of payback periods and discounted cash flows. Expected returns were based on the assumption that the average price spread (for the past five marketing years) may continue in the future. However, the use of the previous price spreads should not be interpreted as a definite forecast of future price movements. Also, some events that are not considered normal occurred in soybean markets (and other areas) in the early 1970's.

¹Fixed costs are costs incurred whether or not systems are used.

²Variable costs are costs incurred only when the systems are used.

³Fixed if facilities are used costs are variable costs that become fixed (sunk) once soybeans are placed in storage.

⁴Variable by time of use costs are costs that vary with length of storage time.

⁵Average monthly prices received by Mississippi farmers during the crop years 1971-72 through 1975-76 are presented in Appendix Table 1.

Estimated Storage Costs

Investment costs ranged from \$21,050 for the 15,000 bushel facility to \$49,150 for the 60,000 bushel facility (Table 1). These costs represent "lock and key" estimates, except for electrical hook-up and site preparation. Investment costs per bushel declined from \$1.40 for the smallest facility to \$.82 for the largest. The declines resulted from

economies in the use of larger bins and from more complete use of the dump pit, concrete circle, dryers and conveying equipment.

Annual total cost of using facilities at capacity ranged from \$7,058 for the 15,000 bushel facility to \$22,252 for the largest facility (Table 2). Costs of storing a bushel of soybeans for six months were 47.3, 40.3, 39.0 and 37.1 cents, respectively, for the 15,000, 30,000, 45,000, and 60,000 bushel capacity facilities. The added cost is approximately 3.1 cents per bushel per month for periods of storage longer than six months (Appendix Table 2).

Table 1. Estimated investment in on-farm soybean storage facilities of selected capacities, Mississippi, Mid-1976.

Item	Bushel Storage Capacity ¹			
	15,000	30,000	45,000	60,000
	-----dollars-----			
Storage units:				
Bins ²	7,300	14,500	21,850	25,900
Foundation ³	6,050	7,700	9,600	10,800
	13,350	22,200	31,450	36,700
Equipment:				
Drying and testing ⁴	1,550	1,900	3,300	3,900
Conveying ⁵	4,490	4,490	4,490	5,300
Electrical ⁶	1,510	1,950	2,700	3,000
	7,550	8,340	10,490	12,200
Sub-total	20,900	30,540	41,940	48,900
Land ⁷	150	150	150	250
Total investment cost	21,050	30,690	42,090	49,150
Cost per bushel of capacity	1.40	1.02	.94	.82

¹Approximate capacities are based on the following systems:

- a) 15,000 - one bin of size 30' x 24'
- b) 30,000 - two bins of size 30' x 24'
- c) 45,000 - three bins of size 30' x 24'
- d) 60,000 - three bins of size 36' x 24'

²Includes bins, catwalks, ladders, perforated floor and construction.

³Foundation, dump pit and concrete circle. Part of the concrete circle can be made optional.

⁴20 horsepower (h.p.) fan and heater with thermostat and humidistat for the 15,000 and 30,000 bushel units; two fans and heaters for the three bin systems. One moisture probe and tester is included for each system. The heater may be considered optional.

⁵10 inch transport auger and eight inch unload auger plus one portable bin sweep for each system.

⁶Electric panels and wiring. These estimates do not include power lines to the site.

⁷Does not include the cost of site preparation.

Seasonal Prices and Returns from Storage

Average monthly prices received by Mississippi farmers increased from October until August in four of the five marketing years, 1971-72 through 1975-76 (Appendix Table 1). The average price increase for the five years was greater than the estimated per bushel cost of constructing and operating on-farm soybean storage facilities (Table 2). The difference between prices and storage costs was slightly higher for beans placed in storage in November because November prices usually were lower than October prices.

Evaluation of Investment

Soybean producers face problems in making capital expenditure decisions even when reliable estimates of costs and returns are available. This difficulty arises from uncertainty associated with the planning horizon and from the fact that capital expenditures are incurred immediately while returns accrue over time. The element of uncertainty never can

Table 2. Estimated total and per bushel costs of on-farm soybean storage facilities of selected capacities, Mississippi, 1976.

Cost Item	Bushel Storage Capacity							
	15,000	30,000	45,000	60,000	15,000	30,000	45,000	60,000
	---annual total cost (\$)--				---cost per bushel (¢)*---			
Fixed costs:								
Building depreciation ¹	668	1,110	1,572	1,836	4.5	3.7	3.5	3.1
Equip. depreciation ²	506	558	702	816	3.4	1.9	1.6	1.4
Insurance on facilities ³	165	241	331	386	1.1	.8	.7	.6
Interest on investment ⁴	954	1,388	1,901	2,223	6.4	4.6	4.2	3.7
Taxes ⁵	316	460	631	737	2.1	1.5	1.4	1.2
Total fixed cost	2,609	3,757	5,137	5,998	17.5	12.5	11.4	10.0
Variable costs:								
Direct labor ⁶	188	270	360	402	1.3	.9	.8	.7
Electricity ⁷	328	536	863	993	2.2	1.8	1.9	1.7
Fuel ⁸	392	784	1,176	1,568	2.7	2.6	2.6	2.6
Bldg. repairs ⁹	68	111	158	186	.5	.4	.4	.3
Equip. repairs ¹⁰	302	333	419	486	2.0	1.1	.9	.8
Insurance—soybeans ¹¹	396	792	1,188	1,584	2.6	2.6	2.6	2.6
Interest on operating capital ¹²	75	127	187	235	.5	.4	.4	.4
Shrink and other loss ¹³	450	900	1,350	1,800	3.0	3.0	3.0	3.0
Total variable cost	2,199	3,853	5,701	7,254	14.8	12.8	12.6	12.1
Total cost	4,808	7,610	10,838	13,252	32.3	25.3	24.0	22.1
Opportunity cost ¹⁴	2,250	4,500	6,750	9,000	15.0	15.0	15.0	15.0
Total annual ownership operating, & opportunity cost	7,058	12,110	17,588	22,252	47.3	40.3	39.0	37.1

¹Straight line depreciation for 20 years

²Straight line depreciation for 15 years

³Includes fire and extended coverage at \$7.90/\$1,000 valuation

⁴Calculated at nine percent on one half of the new cost of building and equipment and nine percent on the total land cost.

⁵Property tax estimates are based on 30 percent assessment and 50 mills.

⁶Based on \$2.50 per hour for the following:

- a) 75 hours — 15,000 system
- b) 129 hours — 30,000 system
- c) 145 hours — 45,000 system
- d) 160 hours — 60,000 system

⁷Includes electricity @ four cents per kilowatt hour for drying, aeration, loading, unloading and a charge of one dollar per month for fans with more than 10 horsepower requirement. Even if no heated air drying is used, the fans would be used for increased aeration and the electrical cost would remain approximately the same.

⁸Fuel for drying purposes only. Drying time is estimated at 125 hours per bin. Propane-butane usage was estimated at 7.85 gallons per hour at a cost of \$.40 per gallon.

⁹10 percent of new cost allocated equally over 20 years.

¹⁰60 percent of new cost allocated equally over 15 years.

¹¹Insurance on soybeans is based on a rate of \$4.40 per \$1,000 valuation for six months and assumes soybean value of \$6.00 per bushel.

¹²Assumes a loan period of six months at nine percent annual interest and covers costs for labor, electricity, fuel, repairs and insurance.

¹³Shrink is estimated to be 0.5 percent with soybeans valued at \$6.00 per bushel.

¹⁴Opportunity cost is the cost of holding soybeans six months rather than selling at harvest. This cost is charged on the basis of five percent annual interest and a soybean price of \$6.00 per bushel.

*Cost of storing for six months. The per bushel cost of storing increased about \$.03 for each additional month of storage.

be completely removed, but decision making can be improved by comprehensive feasibility analysis. We approached the problem of balancing expected future returns against immediate capital expenditures by employing two analytical techniques: (1) payback period analysis and (2) discounted cash flow analysis (present value).

Payback Period---The simple payback period is calculated by dividing the initial capital investment by estimated cash earnings⁶. It is the time required to recover the initial investment. Our estimates indicate that the payback period ranged from 1.7 years for the 60,000 bushel facility to five years for the 15,000 bushel facility (beans placed in storage in October and removed from storage the following June or July). Assuming that beans were placed in storage in November and removed the following summer resulted in shorter estimated payback periods (Tables 3 and 4).

Discounted Cash Flows---The discounted cash flow method is a more precise tool for determining the economic worth of an investment because it allows for reflection of time preference for money; i.e., the fact that dollars in hand are more valuable than future dollars. Discounted cash flows are calculated by discounting annual cash earnings by a factor for each year for a given interest rate. Economically feasible alternatives yield accumulated discounted flows in excess of the required investment at any time during the economic life of a business venture. However, potential investors usually have a specified planning horizon to fit their particular investment needs.

We used a 7-year planning horizon and a nine percent discount rate to translate our estimates of future earnings from storage into net 1976 values⁷ of

Table 3. Estimate payback periods for farm storage facilities used to store soybeans from October until June or July, by size of facility (estimates based on average price differentials prevailing in Mississippi during the 1971-76 crop years).

System Size	Removed from Storage	
	June	July
Bushels	----years----	
15,000	3.1	5.0
30,000	2.1	3.3
45,000	2.0	3.0
60,000	1.7	2.6

Table 4. Estimated payback periods for farm storage facilities used to store soybeans from November until June or July, by size of facility (estimates based on average price differentials prevailing in Mississippi during the 1971-76 crop years).

System Size	Remove from Storage	
	June	July
Bushels	----years----	
15,000	1.9	2.5
30,000	1.3	1.7
45,000	1.2	1.6
60,000	1.1	1.4

Table 5. Estimated net present values¹ of farm storage facilities used to store soybeans from October until June or July, by size of facility (estimates based on average price differentials prevailing in Mississippi during the 1971-76 crop years).

System size, by area	Remove from Storage	
	June	July
Bushels	----\$/bu----	
15,000	.85	-.01
30,000	1.38	.52
45,000	1.48	.62
60,000	1.64	.78

¹Net present value = calculated value (discounted earnings) of the investment minus the investment cost. Opportunity cost is considered a real cost in calculating returns even though it is not an "out-of-pocket" cost.

⁶Annual cash earnings include net operating returns, depreciation, and interest on investment.

⁷Net 1976 values equal calculated values (discounted earnings) of investments minus investment costs.

investment in on-farm soybean storage facilities. Net 1976 values ranged from minus 1 cent per bushel for the 15,000 bushel facility

(Table 5) to \$1.64 per bushel for the 60,000 bushel facility (beans placed in storage in October and removed from storage in June or July).

Placing the beans in storage in November and removing them the following June or July increased net 1976 values (Table 6.)⁸

Table 6. Estimated net present values¹ of farm storage facilities used to store soybeans from November until June or July, by size of facility (estimates based on average price differentials prevailing in Mississippi during the 1971-76 crop years).

System size, by area Bushels	Remove from Storage	
	June	July
	----\$/bu----	
15,000	2.42	1.56
30,000	2.94	2.08
45,000	3.04	2.18
60,000	3.20	2.34

¹See footnote, Table 5.

⁸Removal of beans in April and May was also examined. April removal was not profitable and May removal generally resulted in returns in excess of storage cost only when November harvest was considered.

Appendix Tables

Appendix Table 1. Monthly average soybean prices received by Mississippi farmers, selected months, 1971-76 crop years.*

Crop Year	October	November	April	May	June	July	August
-----DOLLARS PER BUSHEL-----							
1971-72	3.00	2.90	3.49	3.30	3.35	3.30	3.30
1972-73	3.20	3.44	5.95	8.20	9.50	6.80	8.30
1973-74	5.65	5.15	5.28	5.30	5.23	6.26	7.56
1974-75	8.20	7.51	5.57	4.99	4.93	5.33	5.83
1975-76	4.94	4.55	4.59	4.95	6.21	6.70	6.08
Average	4.99	4.71	4.98	5.35	5.84	5.69	6.21
Averaged spread from October	---	---	.01	.36	.84	.70	1.22
Average spread from November	---	---	.27	.64	1.12	.98	1.50

*Average monthly price reported by the Mississippi Crop and Livestock Reporting Service, USDA, SRS, Jackson, Mississippi.

Appendix Tables

(continued)

Appendix Table 2. Storage costs per bushel, by length of storage period and size of storage system, Mississippi, 1976.

System Size	Storage period, months					
	5	6	7	8	9	10
Bushels	-----cents per bushel*-----					
15,000	44.2	47.3	50.5	53.6	56.8	59.9
30,000	37.2	40.3	43.4	46.5	49.6	52.7
45,000	35.8	39.0	42.1	45.3	48.4	51.5
60,000	34.1	37.1	40.2	43.3	46.4	49.5

*The monthly per bushel cost of owning and operating storage facilities. Computed as follows:

15,000 bushel system: Storage cost = 28.4 + 3.15 X

30,000 bushel system: Storage cost = 21.6 + 3.11 X

45,000 bushel system: Storage cost = 20.3 + 3.12 X

60,000 bushel system: Storage cost = 18.5 + 3.10 X

where

X = number of months in storage

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