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ECONOMIC EFFICIENCY OF SEED CONDITIONING PLANTS IN MISSISSIPPI

Warren C. Couvillion and Naraseeyappa Rajanikanth[1]

The seed conditioning industry has both technical and economic significance. From a technical point of view, it is through seed that genetic characteristics are transmitted from research results into applied technology. Additionally, through seed this applied technology is transmitted from one crop generation to the next. From an economic standpoint, improved seed increase the productivity of crop agriculture and the production and processing of seed contribute importantly to income and employment.

The conditioning sector of the seed industry is characterized by wide variations in efficiency. While unforeseen changes and differences in financial position and managerial ability of owner-operators are important, a lack of information can account for much of the variation in efficiency. Individual plant managers normally are not aware of the costs of alternative ways of performing a given operation nor of the costs associated with plants of different capacities. In fact, some owner-operators may not know about some of the available technologies.

The study on which this paper is based was designed to help improve the efficiency of the delivery system for improved crop seed in Mississippi.

The study will make available information on the costs associated with owning and operating alternative sizes of seed conditioning firms, operating for varying lengths of time during the year.

The structure of the seed industry is such that seed conditioning plants are not entities within themselves. In almost all cases, seed conditioning is an enterprise within a firm. Usually firms have some complementarity with the conditioning of seeds. For example, seed conditioning units are found on large farms, farm supply businesses, in conjunction with grain elevators or some combination of these enterprises. A seed conditioning plant fits well with other related businesses since the "busy times" in seed conditioning may correspond to "slack times" in other areas.

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Due to consideration discussed above, a modified version of the economic-engineering technique was used in the study. This permitted the specification of a fixed combination of resources for plants of different sizes while holding constant the level of management.

Information on management practices and operational characteristics of the industry was solicited from selected seed processors in the State (15%). Using this information as a base, three sizes of seed processing firms were specified: firms with hourly capacities of 100 (Plant I); 200 (Plant II); and 300 (Plant III) bushels for soybean, rice, or wheat. These capacities are based on a 40 hour work week. Three levels of operation were assumed; 15; 30; and 40 weeks of operation.

The engineering specifications and most technical coefficients for the model seed processing plants were obtained from the Seed Technology Laboratory of Mississippi State University. The remainder of the technical coefficients were developed from data obtained from equipment manufacturers, agribusiness firms, professional workers, and published material.

The operation of a seed conditioning plant was divided into five major components or stages: receiving; drying and bulk storage; conditioning; bagging; and bag storage. The fixed and variable costs of conditioning seed at each stage were developed by applying prices to the relevant factor inputs. The costs arising from both durable and nondurable inputs were summed over all stages for each plant. Total processing costs were then estimated by adding certain costs not readily identified with specific plant stages. Costs were summarized into fixed cost, and total cost. Costs assumed did not include a cost for management.

Cost Analysis

Initial Investment Requirements

The total initial investment requirements for the three plants operating for 15, 30, and 40 weeks per year are shown in Table 1. These data indicate that there are economies in both size and period of operation. Total initial investment ranged from $7.60 cents per bushel for the 100 bushel per hour plant operating 15 weeks to $2.74 per bushel for the 300 bushel per hour plant operating 40 weeks per year.

Operating Costs

Costs of operation were divided into fixed, variable, and total costs. These data are shown in Table 2 in terms of total dollars and costs per bushel. Fixed costs per bushel ranged from $1.49 for Plant I (100 bushels/hour) operating 15 weeks to $0.53 for Plant III (300

Table 1. Summary of initial investment, total and dollars per bushel, by capacity utilization for Plant I, Plant II, and Plant III.

Weeks of Operation	Capacity Utilization	Initial Investment	Initial Investment Per-bushel
		---------(dollars)--------	
Plant-I			
15	60,000	455,925	7.60
30	120,000	553,613	4.60
40	160,000	606,594	3.63
Plant-II			
15	120,000	621,763	5.18
30	240,000	804,734	3.35
40	320,000	946,992	2.96
Plant-III			
15	180,000	823,182	4.57
30	360,000	1,160,849	3.22
40	480,000	1,315,080	2.74

Table 2. Summary of annual operating costs by capacity utilization in dollars and costs per bushel for Plant I, Plant II, and Plant III.

Weeks of Operation	Capacity Utilization	Fixed Per-year	Costs Per-bushel	Variable Per-year	Costs Per-bushel	Total Per-year	Costs Per-bushel
		(dollars)					
Plant-I							
15	60,000	89,213	1.49	32,548	0.54	121,761	2.03
30	120,000	108,053	0.90	62,252	0.52	170,805	1.42
40	160,000	118,078	0.73	81,986	0.51	200,064	1.25
Plant -II							
15	120,000	121.239	1.01	58,747	0.49	179,986	1.50
30	240.000	156,527	0.65	111,681	0.47	268,208	1.12
40	320,000	183,963	0.57	150,866	0.47	334,829	1.05
Plant -III							
15	180,000	160,535	0.89	85,278	0.47	245,813	1.37
30	360,000	225,657	0.62	165,598	0.46	391,255	1.09
40	480,000	255,403	0.53	221,202	0.46	476,605	0.99

bushels per hour) operating 40 weeks per year. Variable costs ranged from $0.54 to $0.46 for the above mentioned plants. These were smaller economies associated with either side or length of operation in variable costs. Virtually all efficiency in variable costs are associated with size (Table 2).

Economic Feasibility

Often, management faces a variety of problems in making capital expenditure decisions even when reliable estimates of costs and benefits are readily available. this difficulty arises from the uncertainty associated with the planning period and from the fact that capital expenditures are incurred immediately while benefits accrue overtime. The uncertainty element can never be completely eliminated. However, decision making can be improved by a comprehensive feasibility analysis. In this study, the problem was approached by balancing expected future returns against immediate capital expenditures. Three quantitative techniques were employed: (1) breakeven analysis, (2) simple payback period analysis, and (3) discounted cash flow analysis.

Returns were calculated for each of the plants using five assumed levels of merging and three levels of plant operations. Plants were assumed to have outputs of 100, 200, and 300 bushels per hour for 40 hours per week. Plants were assumed to operate for 15, 30, or 40 weeks per year. Revenues were computed for gross conditioning margins of $1.00, $1.25, $1.50, $1.75, and $2.00 per bushel.

Breakeven

Breakeven points are those points where the cost per bushel is equivalent to the conditioning margin.[2] The total annual operating costs are equivalent to the breakeven margin (Table 2.)

The analysis emphasizes the sensitivity of returns to the volume of product handled and the length of time plants operate. Data indicate that the 300 bushel per hour plant (Plant III) operating 40 weeks requires a margin of $0.99 per bushel to breakeven whereas Plant I (100 bushels per hour) operating for 15 weeks would require a $2.03 margin to breakeven under the assumed conditions.

The Payback Period

The simple payback period is calculated by dividing the amount of capital required for the investment by the estimated annual cash earnings. The payback period is the time required to recover the

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[2]Annual cash earnings include net operating returns, depreciation funds, and interest on investment.

initial investment out of the earnings expected to result from the investment. To accept or reject potential investments would necessitate the establishment of some maximum acceptable payback period and rejection of all investment alternatives that exceed this maximum.

For the purpose of this study, a 10 year planning horizon was used to determine feasibility. Data calculations at selected rates for all three plants operated at selected margins are shown in Table 3.

Discounted Cash Flow

Based on the assumptions, Plant I operating 15 weeks appears to be feasible at a margin of $1.75 per bushel. At 30 weeks and a margin of $1.25 the estimated payback is 8.7 years. If Plant I is operated for 40 weeks, the estimated payback period would be 6.7 years at $1.25 margin.

Plant II and Plant III appear feasible at margins of $1.50 and $1.25 and 15 weeks of operation and $1.25 and $1.00 for 30 and 40 week operations, respectively. Estimated payback periods are shorter for Plant III than Plant II as shown in Table 4.

Conclusions and Implications

The economies associated with increases in plant size are due substantially to increases in the efficiency in the use of the fixed factors, or stated in a more common terminology, the "spreading of fixed cost". Additional increases in efficiency (reductions in per bushel costs) appear to be attainable by increasing the annual output of plants. This may be accomplished by increasing the number of hours of operation per day, such as double-shift operations or extending the time of operation. Another possible method by which plants could increase volume would be "in and out" custom work. An arrangement of this type would increase the volume of the plants while avoiding storage restrictions. Incorporation of other crops into the product mix to take advantage of seasonalities of the soybean-rice-wheat product mix offer additional opportunities for increasing volume. While these alternatives appear to be reasonable means of capturing some of the economies associated with increased utilization, the determination of the economic feasibility of each alternative was beyond the scope of this paper.

If a large percentage of conditioned seed can be marketed in bulk, it appears that individual firms may obtain significant cost reductions by eliminating much of the cost associated with the bagging stage and related operations.

As indicated, plant size and length of operation have substantial effect on cost per bushel. the economies associated with size are

Table 3. Summary table showing simple payback period at selected margins.

Weeks of Operation	Margins									
	Margin	Payback Period	Margin	Payback Period	Margin	Payback Period	Margin	Payback Period	Margin	Payback Period
	(dollars)	(years)	(dollars)	(years)	(dollars)	(years)	(dollars)	(years)	(dollars	(years)
Plant I										
15	1.75	7.9	2.00	6.3						
30	1.25	8.7	1.50	5.6	1.75	4.3	2.00	3.5		
40	1.25	6.7	1.50	4.4	1.75	4.4	2.00	2.8		
Plant II										
15	1.50	6.2	1.75	4.8	2.00	3.9				
30	1.25	5.0	1.50	3.6	1.75	2.9	2.00	2.4		
40	1.25	4.5	1.50	3.2	1.75	2.5	2.00	2.1		
Plant III										
15	1.25	7.3	1.50	5.2	1.75	4.1	2.00	3.3		
30	1.00	7.4	1.25	4.7	1.50	3.4	1.75	2.7	2.00	2.2
40	1.00	6.1	1.25	3.9	1.50	2.9	1.75	2.3	2.00	1.9

Source: Summarized from the Appendix Tables 54-57 (14).

Table 4. Year in which payback occurs by plant size and weeks of operation using discounted cash flow analysis.

Weeks of Operation	Margins				
	$2.00	$1.75	$1.50	$1.25	$1.00
	---------------------------(years)--------------------				
Plant-I					
15	10.0	*	*	*	*
30	5.0	6.0	8.0	*	*
40	4.0	5.0	6.0	10.0	*
Plant-II					
15	5.0	7.0	10.0	*	*
30	3.0	4.0	5.0	7.0	*
40	3.0	3.0	4.0	6.0	*
Plant-III					
15	4.0	6.0	8.0	*	*
30	3.0	3.0	5.0	7.0	*
40	2.0	3.0	4.0	5.0	10.0

[1]Ten year planning horizon using a 12 percent interest rate.

*Indicates that the (discounted) payback period would be beyond 10 years.

Source: Summarized from Appendix Tables 58-66 (14).

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Plant II and Plant III were feasible at margins of $1.50,
for 15, 30, and 40 weeks of operation using discounted cash
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