The economic feasibility of on-farm storage for Arizona poultry ranches

THE ECONOMIC FEASIBILITY OF ON-FARM STORAGE FOR ARIZONA POULTRY RANCHES

by

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ABSTRACT

Arizona poultry ranchers are at a comparitive disadvantage in the local egg market because California egg producers have lower feed costs. On-farm storage was explored as an economically feasible method of reducing high feed costs in Arizona. Storage systems were designed and budgeted for three representative flock sizes. Optimal acquisition strategies were calculated for corn, grain sorghum and soybean meal using historical price data. Risk and uncertainty factors associated with these optimal acquisition strategies were provided for the analysis. The objective of this study was to determine the least cost alternative between on-farm processed feed and commercial laying feed.

On-farm storage in conjunction with on-farm milling was feasible for all model flocks since costs for on-farm processed feed was less than the cost of commercial feed. Economies of size existed in on-farm storage systems and cost-savings were greatest for larger volume egg producers requiring greater feed tonnages. Permanent storage systems proved more profitable than the temporary storage systems, which required extensively more grain-handling equipment. On-farm storage systems for the three model flocks eliminated the competitive disadvantage of Arizona egg producers by reducing feed costs sufficiently to compete with eggs produced in California.

CHAPTER 1

INTRODUCTION

Arizona poultry ranches have been decreasing in number over the last 15 years. The major reason is low profits and anticipated low profits in the near future. High feed costs and unstable egg prices have made it increasingly difficult for Arizona egg producers to rationalize long-term investments.

Arizona egg producers are at a competitive disadvantage with California producers because of higher production costs (Wilson 1975). Layer feed accounts for approximately two-thirds of the total production cost incurred by an egg producing operation. Arizona poultry ranchers generally, have paid 15 percent more for laying feed than have their counterparts in California (Table 1). This competitive advantage of California egg producers makes it possible for them to supply a sizeable portion of the eggs demanded in Arizona.

The quantity of eggs demanded in Arizona has increased 16 percent since 1970 (Table 2), as a result of a 41 percent increase in population. This increase occurred even though national per capita consumption of eggs has dropped 13 percent. In the last ten years, the percentage of eggs supplied to the state by Arizona producers has dropped from 46 percent to 22 percent (Table 2).

Table 1. Comparative Average Cost of Laying Feed for California and Arizona

Year	California $/Ton	Arizona $/Ton	Feed Cost Advantage for Calif. $/Ton	Arizona Cost as percent of Calif. Cost
1963	88	96	8	109%
1964	74	94	20	127%
1965	75	98	23	131%
1966	74	98	24	132%
1967	75	82	7	109%
1968	71	78	7	110%
1969	72	78	6	108%
1970	73	86	13	118%
1971	77	90	13	117%
1972	79	88	9	111%
1973	120	132	12	110%
1974	140	156	16	111%
1975	136	147	11	108%
1976	139	159	20	114%
1977	136	157	21	115%
		Average:	14	115%

Source: U.S. Department of Agriculture (1978).

Table 2. Arizona's Deficit Position in the Production of Eggs

Year	Population[a]	Production[b] (Million Eggs)	Demand[c] (Million Eggs)	Deficit (Million Eggs)	Production as Percent of Demand
1968	1,682,000	244.0	531.5	287.5	46%
1969	1,737,000	227.0	538.5	311.5	42%
1970	1,775,399	226.0	552.1	326.1	41%
1971	1,869,000	195.0	586.9	391.9	33%
1972	1,963,000	164.0	604.6	440.6	27%
1973	2,073,000	154.0	609.5	455.5	25%
1974	2,158,000	149.0	621.5	472.5	24%
1975	2,212,000	159.0	617.1	458.1	26%
1976	2,270,000	143.0	626.5	483.5	23%
1977	2,364,000	140.0	643.0	503.0	22%

[a]Valley National Bank (1978).

[b]Arizona Crop & Livestock Reporting Service (1978).

[c]Demand = Population x National Per Capita Consumption of Eggs for the Year.

The sensitivity of Arizona's competitive position was analyzed in the form of a linear programming transportation model by Wilson (1975). He evaluated the state's competitive advantages and disadvantages with respect to changes in feed cost, transportation cost and demand. Wilson (1975) concluded that feed cost is the major factor influencing Arizona egg producers' competitive position in local markets. It was noted that changes in demand for eggs in Arizona and increased transportation rates had very little impact on the competitive structure.

Wilson's (1975) claim that high feed costs give Arizona egg producers a competitive disadvantage has long been recognized. Arizona is a deficit producing state in grain and obtains grain from surplus areas, such as Texas and Kansas (Robertson 1978). This pattern is not likely to change in the foreseeable future. Thus, methods of reducing high feed costs are of major concern to not only poultry ranchers, but to all ranchers in Arizona.

Objective

This study evaluates the economic feasibility of on-farm storage as a way to minimize feed costs for Arizona Poultry ranches. By reducing feed costs, the competitive position of Arizona producers will be improved. Wes McCartney (1978), Production Manager of Valley View Egg Farm in Tucson, Arizona, supported on-farm storage and milling practices as a viable method for reducing poultry feed costs.

A major reason for high feed costs is the transportation cost involved with delivering the feed grains from sources outside the state. These hauling charges along with charges for storing and processing the grains into a complete feed by commercial firms are eventually passed on to the poultry operator in the form of high prices for a complete lay mash.

On-farm storage allows the poultry operator to take advantage of the relative ingredient price fluctuations during the year in order to minimize ingredient acquisition cost and thereby reduce feed cost. Seasonal price fluctuations of the major feed ingredients, namely grain sorghum, soybean meal, and corn will be examined to determine feasible acquisition strategies which will allow the poultry operator a minimal cost for ingredients. Two types of storage systems, temporary and permanent, are evaluated at four capacity levels for three flock sizes in order to determine total costs for on-farm processed feed. These estimates, when compared with cost of commercial feed, indicate whether or not on-farm storage is a feasible procedure for reducing feed costs.

Seasonal price movements and on-farm storage are important factors which have a direct bearing on the cost of feed (Rowe 1955). Most agricultural products are characterized by some kind of seasonal price pattern. For crops, seasonality arises from climatic factors and the biological growth process of the plants. Many crops are harvested once a year and, depending on perishability, may be stored for sale through a marketing season. The classic example is the commodity whose price increases after harvest time just enough to cover storage costs (Tomek and Robinson 1975).

Reducing feed costs through the use of on-farm storage facilities would increase the profitability of egg production in Arizona if other factors remained the same. This study will examine on-farm storage for Arizona poultry ranches, so as to estimate any cost-savings resulting from storage. Types of storage systems and sizes of storage systems will be evaluated on the basis of their economic feasibility in regards to Arizona poultry operations.

Review of the Literature

Economic feasibility studies concerning on-farm storage and milling usually deal with specific geographic regions. Virtually all of the previous research evaluating on-farm storage systems approaches the storage subject from a grain producer's point of view, as opposed to the grain consumer's point of view (Malphrus and Boyleston 1977).

Vertical integration of storage by grain producers or grain consumers is motivated by profitability as well as the convenience of farm storage (Hawthorn 1978). Wilson (1975) determined feed cost to be the primary factor affecting Arizona producers' competitive position. Increasing demand had only a slight influence since California producers responded to this increase. Higher transportation costs had no affect at all. Wilson (1975) concluded that the California competitive advantage could be eliminated by decreasing Arizona feed costs by 7.8 percent.

Raising the level of profitability by milling feed on Arizona poultry ranches was investigated by Schwabe (1977). This study evaluated the cost alternative between on-farm feed milling and commercial feed acquisition for three flock size models (75,000, 150,000 and 300,000). It was concluded that on-farm feed milling was more profitable than commercial feed acquisition on a cost per ton basis. Increased profits calculated for the larger two model sizes removed the competitive disadvantage that Arizona egg producers had with California producers. Schwabe assumed feed ingredients to be available at all times, using a constant price which he determined as being representative. Storage facilities and grain-handling equipment were kept at a minimal, allowing for a seven day capacity of grain supplies. Schwabe's feed mixing facilities are incorporated in this study to determine the economic feasibility of on-farm milling with storage facilities.

The economic feasibility of general on-farm grain storage in Arizona was analyzed by Stults (1962). This study compared costs and benefits accruing from on-farm storage facilities through the use of grain storage budgets. Stults' results support the hypothesis that Arizona farmers would profit from investing in on-farm grain storage facilities. Stults (1962) reports that under normal circumstances, returns from seasonal price variation were very favorable for barley and adequate to pay all storage costs for grain sorghum. The decision to invest in on-farm storage facilities is based on long-run expectations concerning future costs and returns unique to every operation.

According to Faltis (1978), total U.S. grain storage capacity as of April 1, 1978, includes 9.9 billion bushels on-farm storage and almost 7 billion bushels off-farm commercial storage. Thus, 59 "representative" system developed from survey data and current practices of representative farms in Christian County, and 2) a "recommended system theoretically generated on the basis of engineering recommendations. Returns to each grain system were compared with costs associated with storing and drying grain in each system in order to determine the profitability of constructing grain systems. Cash grain price patterns were analyzed to determine optimal selling strategies for this region. When selling at recommended dates, the returns to representative systems were substantial, but net returns to recommended systems were even higher for the three grains. Finally, their research suggested evidence that the recent growth in on-farm storage is not unique to Christian County or even to western Kentucky, but is in fact, a national trend.

Previous studies done by Clemson University (Bauer, Donald and Smith 1977) and Mississippi State University (Holder, Usman and Parvin 1976), emphasized methods for cost/benefit evaluation of on-farm storage alternatives as opposed to actual detailed analysis of existing on-farm storage facilities. These studies presented a methodology that individual farm operators could use to generate their own fixed and variable cost budgets associated with on-farm storage. The budgets enabled the respective farmers to determine the lowest possible price, as compared to harvest price, that they could sell their grain and still recover their storage expense. Information concerning commercial storage services and historical price movements percent of the nations grain storage capacity is on-farm storage, whereas only 16 percent of Arizona's grain storage capacity is on-farm storage. Expansion of on-farm storage seems logical if Arizona is to follow the national trend.

Different types of grain storage systems and their specific characteristics are discussed by J. E. Bailey (1974). "On the ground" storage practices are feasible for a short period of time, usually associated with the coordination of transportation. "Underground" systems are very primitive entailing a high cost of handling. "Bagged" storing of grains is a convenient method in regards to small flocks and nominal shelter, but both bags and space become expensive. "Upright bins" are by far the predominant styles for modern grain storage. They are easily adapted to modern grain handling equipment; space and costs are minimal with the larger models. "Flat bins" have received much attention recently due to the pressure of grain surpluses and the need for storing large quantities of grain. They are built wider and lower than conventional "upright bins". "Flat bins" provide ample storage at the lowest possible cost but do present some problems in relation to the space occupied and the handling of grains. Both types of bin systems are currently used in Arizona with the particular type being determined by individual needs.

Costs and returns associated with on-farm storage in Christian County, Kentucky, were analyzed by Skees et al. (1978). This study evaluated the economic feasibility of storing corn, wheat and soybeans on the farm. Two types of storage systems were developed: 1) A for the particular region is considered essential to the investment decision.

Past studies evaluating the economic feasibility of on-farm storage as a viable means of increasing profits have generally been positive. The main exception being small storage systems with less than 100 percent utilization. Although on-farm storage serves a different purpose for the grain producers as compared to consumers such as Arizona poultry ranchers, many of the economic aspects concerning investment are the same.

CHAPTER 2

EXPERIMENTAL DESIGN

This chapter outlines the analysis and the related assumptions pertaining to this study. Model flock sizes represent the range of size in the major egg producing counties in Arizona and feed requirements are calculated for each flock size. Feed acquisition alternatives are analyzed using the designated set of activities. On-farm milling systems developed by Schwabe (1977) and storage systems for each flock are designed to estimate initial investment costs, ownership costs and operating costs. Historical feed ingredient prices were used to determine average monthly prices expected to be paid for the designated commodities.

Model Flocks

Maricopa, Pinal and Pima Counties supply approximately 95 percent of the eggs produced in Arizona. The mean flock size for these three counties is slightly below 100,000 birds. Flock size models of 75,000, 150,000 and 300,000 birds are used to represent current and anticipated enterprises and to match the feed mills developed by Schwabe (1977). The budgets for feed mills and storage units were constructed under the assumption that the number of birds remained constant throughout the year.

Feed Requirements

A feed consumption rate of 100 pounds per bird per year was assumed to determine the annual feed requirements of each flock size. Annual feed requirements for the representative flocks are shown in Table 3. Feed requirements for the on-farm milling systems were derived by dividing the annual requirements by 253 days, assuming an eight hour operating schedule of five days per week less six non-operating holidays and one non-operating day for repairs.

A representative layer diet is presented in Table 4, where each ingredient is shown as a percentage of the total feed composition. Annual and daily ingredient requirements are shown in Table 5. These requirements include a three percent weight loss due to handling, storage and milling. Corn and grain sorghum were assumed to be perfect substitutes.

Feed Acquisition Alternatives

The various acquisition alternatives evaluated in this study are listed below. Each of the alternatives is considered for each of the three model flock sizes. The feed acquisition alternatives examined are as follows:

1. Buy commercial feed and have it delivered--no storage or milling facilities required.

2. Buy grain sorghum, soybean meal and the remaining ingredients when needed for milling--thirty day storage facilities required for grain sorghum and soybean meal; milling facilities required.

3. Buy corn, soybean meal and the remaining ingredients when needed for milling--thirty day storage facilities required for corn and soybean meal; milling facilities required.

Table 3. On-Farm Feed Requirements by Flock Size for Arizona Poultry Ranches.

Flock Size	Feed Requirements: Feed Needed Per Year[a] (tons)	Feed Requirements: Feed Needed Per Day (tons)
75,000 (Flock A)	3,750	10.3
150,000 (Flock B)	7,500	20.5
300,000 (Flock C)	15,500	41.1

[a]Based upon a consumption rate of 100 pounds per bird per year.

Table 4. Layer Diet for Arizona Poultry Ranches

Layer Diet: Ingredient	Percent
Ground milo (or corn)	65.15
Soybean meal (dehulled)	18.00
Animal fat	1.00
Alfalfa meal (dehydrated)	5.00
Calcium carbonate	5.40
Dicalcium phosphate	2.70
Salt	0.50
Trace mineral mix	0.20
Vitamin mix (Pr-9)	2.00
DL-Methionine	0.05
Total	100.00

Source: Reid (1978).

Table 5. Storage Requirements by Flock Sizes for Arizona Poultry Ranches[a]

	Storage Requirements (Tons)					
	75,000 (A)		150,000 (B)		300,000 (C)	
	Amount needed per year (Tons)	Amount needed per day (Tons)	Amount needed per year (Tons)	Amount needed per day (Tons)	Amount needed per year (Tons)	Amount needed per day (Tons)
Ground Milo	2518.4	6.9	5036.7	13.8	10,073.4	27.6
Cracked Corn	2518.4	6.9	5036.7	13.8	10,073.4	27.6
Soybean Meal (dehulled)	695.2	1.9	1390.5	3.8	2,781.0	7.6
Animal Fat	38.6	.1	77.2	.2	154.5	.4
Alfalfa Meal (dehy.)	193.1	.5	386.2	1.0	772.5	2.1
Dicalcium Phosphate	104.3	.3	208.6	.6	417.2	1.1
Calcium Carbonate	208.6	.6	417.2	1.1	834.3	2.3
Salt	19.3	.1	38.6	.1	77.2	.2
Trace Mineral Mix	7.7	.1	15.4	.1	30.9	.1
Vitamin Mix (PR-9)	77.2	.2	154.5	.4	309.0	.8
DL-Methionine	1.9	.1	3.9	.1	7.7	.1
Finished Feed	3862.5	10.6	7725.0	21.2	15,450.0	42.3

[a]Includes for 3 percent shrinkage in the handling and storage process.

4. Buy grain sorghum and store up to ninety days; buy soybean meal and the remaining ingredients when needed for milling--ninety day storage facilities required for grain sorghum and thirty day storage facilities required for soybean meal; milling facilities required.

5. Buy corn and store up to ninety days, but soybean meal and the remaining ingredients when needed for milling--ninety day storage facilities required for corn and thirty day storage facilities required for soybean meal; milling facilities required.

6. Buy grain sorghum and store up to 180 days, buy soybean meal and the remaining ingredients when needed for milling--180 day storage facilities required for grain sorghum and thirty day storage facilities required for soybean meal; milling facilities required.

7. Buy corn and store up to 180 days, buy soybean meal and the remaining ingredients when needed for milling--180 day storage facilities required for grain sorghum and thirty day storage facilities required for soybean meal; milling facilities required.

8. Buy soybean meal and store up to 90 days, buy grain sorghum and the remaining ingredients when needed for milling--90 day storage facilities required for soybean meal and thirty day storage facilities required for grain sorghum; milling facilities required.

9. Buy soybean meal and store up to 90 days, buy corn and the remaining ingredients when needed for milling--90 day storage facilities required for soybean meal and thirty day storage facilities required for corn; milling facilities required.

10. Buy soybean meal and store up to 180 days, buy grain sorghum and the remaining ingredients when needed for milling--180 day storage facilities required for soybean meal and thirty day storage facilities required for grain sorghum; milling facilities required.

11. Buy soybean meal and store up to 180 days, buy corn and the remaining ingredients when needed for milling--180 day storage facilities required for soybean meal and 30 day storage facilities required for corn; milling facilities required.

12. Buy grain sorghum and soybean meal and store up to 90 days, buy the remaining ingredients when needed for milling--90 day storage facilities required for grain sorghum and soybean meal; milling facilities required.

13. Buy corn and soybean meal and store up to 90 days, buy the remaining ingredients when needed for milling--90 day storage facilities required for corn and soybean meal; milling facilities required.

14. Buy grain sorghum and soybean meal and store up to 180 days, buy the remaining ingredients when needed for milling--180 day storage facilities required for grain sorghum and soybean meal; milling facilities required.

15. Buy corn and soybean meal and store up to 180 days, but the remaining ingredients when needed for milling--180 day storage facilities required for grain sorghum and soybean meal; milling facilities required.

16. Buy grain sorghum and store up to 120 days, buy soybean meal and store up to 150 days, buy the remaining ingredients when needed for milling--120 day storage facilities required for grain sorghum and 150 day storage required for soybean meal; milling facilities required.

17. Buy corn and store up to 120 days, buy soybean meal and store up to 150 days, buy the remaining ingredients when needed for milling--120 day storage facilities required for corn and 150 day storage facilities required for soybean meal; milling facilities required.

Mill Design and Costs

Schwabe (1977) designed physical plants for model on-farm feed mills using an economic-engineering approach. Planning guides from the U.S.D.A., American Feed Manufacturers Association and various other studies, provided a basis for the Arizona designs. Each of the three model on-farm feed mills consisted of a facilities section and an equipment section. The facilities section is composed of a sheet metal mill building with a steel frame, supported on a concrete floor. Ingredient storage bins and steel bulk tanks on concrete pads were also included in the facilities section. The equipment section is composed of a receiving center, a processing center and a mixing center. The receiving center entails a truck receiving hopper, bucket elevator, distributor and spouting. The processing center functions around an inclined screw conveyor from the whole milo tank to the hammermill and a horizontal screw conveyor from the hammermill to the bucket elevator. A one-half ton weight buggy, vertical mixer, bucket elevator, discharge pipe, valves and spouting are the components which make up the mixing center.

Schwabe generated budgets associated with the construction and operation of the 15 ton, 30 ton, and 60 ton on-farm feed mills (Table 6). Initial investment in on-farm feed milling for the 15 tons per milling day operation is \$85,683, \$95,905 for the 30 ton operation, and \$105,671 for the 60 ton operation. Ingredient requirements per milling day for the three model flock sizes are given in Table 5. This allows each rancher to coordinate his storage operation with his milling operation to efficiently utilize both. Average annual production cost of the 30 and 60 ton operations were \$33,199 and \$38,720, respectively. Costs for buildings and mills is obtained from equipment dealers and related suppliers of factory items. An 8-1/2 percent interest rate was used, assuming equity financing, to represent the interest rate on long-term safe investments realized in 1977. Due to the unique physical and financial requirements of each poultry ranch in Arizona, slight differences would be required in mill design and costs.

Table 6. Initial Investment and Average Annual Production Costs for On-Farm Feed Milling on Arizona Poultry Ranches by Daily Tonnage Produced

	Cost Components	
Tons per day	Initial Investment Cost	Average Annual Production Cost
15 (15,000-Flock A)	$ 85,683	$29,692
30 (150,000-Flock B)	95,905	33,199
60 (300,000-Flock C)	105,671	38,720

Source: Schwabe (1977)

Storage Systems Design

Storage system design and their related cost budgets were developed for each model flock size. Storage system designs were developed from previous engineering studies done by W. T. Welchert (1976), Extension Agricultural Engineer at The University of Arizona, B. A. McKenzie et al. (1978), Extension Agricultural Engineers at Purdue University, H. D. Bouland and L. L. Smith (1960), Extension Agricultural Engineers at the University of Georgia. Recommendations from these sources, as well as from Robert Maienschein (1978), Vice President of Butler Manufacturing Company's Agricultural Division, were used in developing storage systems unique to Arizona poultry industry. Dry climate is a characteristic of Arizona which is conducive to grain storage (Stults 1962). High moisture content of grain storage is associated with rapid deterioration, as well as infestation by insects or fungi. Arizona poultry ranchers seldom need to be concerned with grain losses due to moisture, especially since most of the grains coming into the state are dried before shipping.

Two types of on-farm storage systems were considered in this analysis, temporary storage and permanent storage. The dry climate of Arizona, as was mentioned earlier, allows the poultry operator the flexibility in choosing which type of storage system is best for his operation. The humidity and higher levels of precipitation in other parts of the United States prohibit the use of a temporary storage system.

Temporary Storage

There are three basic kinds of temporary storage systems for feed grains currently used in the southwest. They are the "Suction Controlled Plastic Grain Storage System", the "Plastic Tent Grain Storage System", and the "Ground Piles Grain Storage System" (Welchert 1976). Rodent and weather losses for the "Plastic Tent Grain Storage System" are about equal to permanent storage, assuming the grain is at a safe moisture level when purchased. The other two systems have somewhat higher weather and rodent risks associated with them. The "Plastic Tent Grain Storage System" is the only temporary storage system evaluated in this study. The term "temporary storage system" describes the time a grain is optimally stored as well as the longevity of the particular storage structure's useful life.

The plastic tent system consists of a round concrete slab with a utility pole erected in the center. Twenty-five railroad ties are evenly spaced around the perimeter of the concrete slab with steel cable running from the utility pole to each railroad tie. A polyethylene plastic cover is placed over these cables to protect the grain from rain and birds. A sheet of hardware cloth is wrapped along the inside and a sheet of steel mesh along the outside of the railroad ties.

The grain handling equipment section of this system includes two horizontal (screw type) conveyors, two motors, one swivel screw (center-pivoting) and one hopper bin. (See Appendix A for material specifications.) All horizontal conveyors in the storage systems are six inches wide and of varying lengths due to the specific needs of the particular system. The uniform auger width allows for easier comparisons of the production factors, even though this width may not be practical for a particular entrepreneur (Calendar 1979). Each storage facility was designed with a center-pivoting swivel screw on the inside to minimize labor. The auger systems are powered by explosion-proof 3-phase electric motors, assuming one horsepower per ten feet of auger (Grainger 1977).

Permanent Storage

The permanent storage system considered in this study consists of a round steel bin resting on a concrete floor. Sides of the bin are reinforced with a steel frame and a maintenance door is located near the bottom. Specific permanent storage systems for milo have been designed for the three model flocks (Appendix B).

Permanent storage is normally required for long-term storage of a commodity. The disadvantage of permanent storage as compared to temporary storage is the initial investment cost, assuming the quantity and type of grain-handling equipment is equal for both. On the other hand, the amount of space required for a round bin storage facility is much less than that required for a tent storage system. Which is optimal depends in part upon the individual poultry operation's particular circumstances.

Storage facilities were considered for the three flock sizes to handle 30 days, 90 days, 120 days and 180 days supply of grain sorghum respectfully (See Appendices A and B for a detailed description.) Storage facilities were also considered for the three flock sizes to handle 30 days, 90 days, 150 days and 180 days supply of soybean meal respectfully (See Appendix C). The remaining ingredients which make up less than 17 percent of the layer diet, are assumed to be placed in existing storage space of procurred as needed. On-farm storage facilities for commercial feed were not investigated due to the infeasibility of long-term storage.

Storage capacity considered for each system of the three flock sizes is shown in Table 7. In determining the volume that is required for each storage system, one ton of grain sorghum is assumed to be equal to 33.3 bushels. The dimensions of a bushel is approximately 1.24 cubic feet.

Storage System Costs

Budgets for initial investment cost and average annual storage costs were generated for each of the four storage systems for each of the three flock sizes considered. Prices for 1977 were used to facilitate Schwabe's 1977 on-farm milling data. Materials prices for the temporary tent storage systems were acquired from Wood Brothers Lumber Company in Tucson (Arnez 1978). Butler grain bin prices for the permanent storage systems were acquired from Jack Schumacher (1979) of Wamsley's Building Company in Phoenix. Prices received from these two sources account for standard equipment and facilities, but do not reflect the higher priced custom-designed equipment and facilities necessary for certain poultry operations. Initial investment costs

Table 7. Storage Capacity Required for Specific Lengths of Storage

Supply of Ingredients	Flock Size 75,000 birds	150,000 birds	300,000 birds
Milo	Tons	Tons	Tons
30 days	207.0	414.0	828.0
90 days	621.0	1,242.0	2,484.0
120 days	828.0	1,656.0	3,312.0
180 days	1,242.0	2,484.0	4,968.0
Soybean Meal			
30 days	57.2	114.4	228.8
90 days	171.6	343.2	686.4
150 days	286.0	572.0	1,144.0
180 days	343.2	686.4	1,372.8

for the storage systems are detailed in Appendices A, B and C. The design of the various systems were developed using the least cost approach; i.e., two small bins have the same capacity as one large bin, but the larger bin requires a lower initial capital investment and a smaller grain conveying system. Storage system location was assumed to be satisfactory for construction and accessible to a highway.

Average annual storage costs are defined in this study as the costs incurred in providing storage space for the ingredients necessary to manufacture finished feed on Arizona poultry ranches. These costs do not include the actual cost of ingredients nor the interest expense incurred with storing. These costs will be presented later in this study and are categorized as variable costs associated with on-farm storage. For purposes of this study, all other costs are assumed to be fixed and do not vary with the quantity stored, even though in the long run all costs are variable.

Depreciation

The initial investment of the facility and equipment is spread over the useful or productive life of the durable input. The useful life for facilities and equipment is assumed to be twenty-five years and seventeen years, respectfully. A salvage value of five percent is used (Vosloh 1976). Average annual depreciation using the straight-line method is computed by dividing total depreciation by the years of useful life:

$$\text{Average Annual Depreciation} = \frac{PC-SV}{N}$$

where

PC = Purchase Cost
SV = Salvage Value
N = Years

Interest

Interest on investment is an important cost in each system. It reflects the opportunity cost incurred by the investor; i.e., the implicit cost incurred by the entrepreneur consisting of income foregone had he used his time and money another way. The average annual investment method for calculating average annual interest costs is:

$$\text{Average Annual Interest Cost} = \frac{(PC + SV)}{2} r$$

where

PC = Purchase Cost
SV = Salvage Value
r = Interest Rate

Another method that can be used to evaluate investment costs is the "Present Value Method", which takes into account the time value of money; i.e., discounting of future cash flows to the present. The present value method is proposed by many as the "exact" method for investment analysis because the investor recovers all of his investment. For purposes of this study though, a third method of calculating average annual investment cost, the "Arithmetic Average Method", is used:

$$\text{Arithmetic Average Annual Interest Cost} = \frac{(PC + SV + \frac{PC-SV}{N}}{2} r$$

where

PC = Purchase Cost
SV = Salvage Value
N = Years of Useful Life
r = Interest Rate

This method allows for ease of calculation provided by the average annual investment method, but accounts for repayments on an annual basis rather than a continuous flow of payments (Selley 1979).

Insurance

Insurance costs for the facilities and equipment are derived from initial investment cost. Insurance cost is computed at one percent for equipment and one-half of one percent for facility investment cost (McGhee 1979). Insurance costs for ingredients are calculated at \$2.50 per \$100.00 value of grain (Pan American Insurance Co. 1979). The amount of stored grain for each system was assumed to be 100 percent of storage capacity and then, this amount was multiplied by the 1977 average annual price in order to determine a net value of stored grain to be insured. An "all-risk" type of insurance policy was used for this study.

Taxes

Personal property taxes were derived by taking eighteen percent of one-half the initial investment to compute assessed value, Assessed value divided by 1.15 is net assessed value, which is then multiplied by nine percent to estimate the tax bill (Larson 1979).

Labor

The feed industry, over recent years, has attempted to increase efficiency through a reduction in production labor (Vosloh 1976). Industry management has made great strides implementing push button automated mills and storage systems. This is done not only to reduce production costs, but to eliminate opportunities for human error. The storage systems in this study are completely automated and thus, require little labor. A labor expense has been computed for the supervisory (managerial) tasks associated with the automated storage system's operation. Flock A is charged with twenty man hours a week; Flock B with thirty; and Flock C with forty. The labor wage rate is set at $4.00 per hour, with FICA and Workmen's Compensation set at 5.85 percent and 10.15 percent of salary respectively (Poppe 1977). Part-time labor for Flocks A and B is the ideal situation, but if it isn't realistically possible, then the unused part of hired help can focus on other responsibilities.

Maintenance

Maintenance costs vary greatly from operation to operation. Average annual maintenance costs are computed as five and one-half percent of initial investment (Vosloh 1976).

Electrical

Electrical cost is a significant cost factor due to the complete automation of the storage systems. One horsepower was assumed to use one kilowatt of electrical power per hour. Horsepower hours are calculated for each system by multiplying total horsepower by the number of operational hours. Operational hours were assumed to be the same as labor hours for each system. Charges for the electricity were estimated from Tucson Gas and Electric rates. Average electrical bills were determined according to rate number ten. The monthly charges associated with rate number ten are as follows:

Service Charge	-- $12.80
0-100 KWH	-- $ .0008 per KWH
101-400 KWH	-- $ .07025 per KWH
401-3000 KWH	-- $ .06316 per KWH

Tax assessed on electric usage is 4.1 percent.

Commercial Feed

Total cost per ton of a commercial feed formula equivalent to the layer formula produced on-farm was supplied by the U.S. Department of Agriculture (Table 8). This price was selected as the representative price for 1977 charged by feed dealers throughout Arizona for a complete lay mash. Total cost per ton included a delivery charge and state tax. Volume discounts were not considered because they vary among egg ranchers.

Table 8. Total Costs Per Ton of Commercial Feed Formula by Flock Size--1977 Average Prices

Cost Components	Flock Size 75,000 (A)	150,000 (B)	300,000 (C)
Commercial Feed Formula	$157.25	$157.25	$157.25
Delivery Charge[a]	6.50	6.50	6.50
Tax[b]	.61	.61	.61
Total	$164.36	$164.36	$164.36

[a]Assuming a 30-mile one-way haul from commercial plant to poultry ranch.

[b]Tax -- 3/8 of one percent.

[c]Source: U.S.D.A. (1978).

Corn, Grain Sorghum and Soybean Meal Price Data

The monthly cash prices, for the years 1962-1977, of the three main ingredients in the average layer diet were taken from the U.S. Department of Agriculture (1978), Statistical Reporting Service. Monthly prices of commercial laying feed for these years were also supplied. These prices reflect the monthly average price paid by ranchers in the state of Arizona.

Feed Ingredient Prices

Prices for other feed ingredients were acquired from Feeder's Grain in Phoenix (Samuelson 1978). Quotations were given for 1977 annual price per ton paid by Arizona poultry ranchers, assuming delivery and tax (Table 9). These ingredient costs comprise less than 20 percent of the total on-farm finished feed cost and thus, are not analyzed for seasonal variation. Also, these prices may differ from those paid by Arizona poultry ranchers due to volume purchases, hedging and rach location. Nevertheless, they provide a useful estimate which ranchers can easily adjust to reflect their own prices.

Seasonal Price Variation

Seasonal price variation enables a grain buyer to take advantage of low grain prices during certain periods of the calendar year. Twelve months is often used as the time framework in which to study price patterns of storable grains, due to climatic factors and the biological growth process of annual plants. The normal price

Table 9. Feed Ingredient Prices for On-Farm Storage on Arizona Poultry Ranches--1977 Average Prices

Ingredient	Price ($ per ton)	Tax[a] ($)	Total Cost ($ per ton)	Ingredient as percent of layer diet (%)	Ingr. cost as percent of finished feed ($)
Grain Sorghum (Milo)	96.40	.36	96.76	.6515	63.04
Corn	93.80	.35	94.15	.6515	61.34
Soybean Meal (dehulled)	259.20	.97	260.17	.1800	46.83
Animal Fat (scrap)	200.00	.75	200.75	.0100	2.01
Alfalfa Meal (dehydrated)	125.00	.47	125.47	.0500	6.27
Calcium Carbonate	11.00	.04	11.04	.0540	.60
Dicalcium Phosphate	221.00	.83	221.83	.0170	5.99
Vitamin Mix (PR-9)	480.00	1.80	481.80	.0200	9.64
Salt	20.00	.08	20.08	.0050	.10
Trace Mineral Mix	236.00	.88	236.88	.0020	.47
DL-Methionine	2034.00	7.63	2041.63	.0005	1.02
On-Farm Finished Feed (Milo)	135.97				
On-Farm Finished Feed (Corn)	134.27				

[a]Tax equals 3/8 of one percent.

Source: Samuelson (1978).

pattern of grains is for the price to rise during the time after harvest by just enough to cover storage costs. Sharp and Rungdanay (1977) and Sinha and Muir (1973) verified existing seasonal price patterns for grains. But these patterns vary depending on the type of grain, the time period analyzed and the location.

Regular seasonal variation may be removed approximately from a series by many different methods. Usually each method has some feature of merit, relating to the simplicity or exactness, which makes it preferable in certain types of analytical problems. Differences in results obtained from the use of these alternative methods are frequently small and of little importance.

This study uses the Foote and Fox (1952) method to compute indices of average seasonal price variations for soybeans, corn, grain sorghum and commercial laying feed. This index of seasonal variation is defined as the adjusted arithmetic mean of the ratios of the monthly data to the corresponding "normal" or "trend value". The twelve month moving average is used as an approximation to the trend (Foote and Fox 1952). The Foote and Fox method automatically adjusts for the effects of trends and cycles, as well as escaping the mathematical complexities of many "modern" methods.

The Foote and Fox method used to compute indices of seasonal price variations consist of these six steps:

1. A 12-month total of the monthly prices was calculated and centered on the 6th month.

2. A 2-month moving total of the 12-month totals was then computed and centered on the 7th month.
3. Totals in Step 2 were divided by 24 and used as a properly centered 12-month moving average.
4. Ratios were computed by dividing the original data by the moving average for the same month.
5. An arithmetic mean of the ratios was computed for each month.
6. The 12 monthly means were adjusted so that they totaled 1200.

Foote and Fox did not attach a name to their method of measuring seasonal price variation, but this document has been referred to several times in various technical reports. The United States Department of Agriculture and other various state governmental agencies have used their method as a standard on which to base technical publications. A doctoral dissertation by Rowe (1955) used the Foote and Fox method to determine seasonal variation in prices of New Mexico farm and ranch products. Seasonal price variations using this technique appear in numerous agricultural price reports and thus verify its use as a feasible analytical tool.

Procedure for the Analysis

Average monthly prices of grain sorghum, corn, soybean meal and commercial laying feed for the years 1962-1977 were used to develop seasonal price variation indices. Actual computation of seasonal price indices was accomplished through the aid of the Cyber 175 Computer System at the University of Arizona using "A Programming

Language" on the Foote and Fox (1952) method. These indices were used in the evaluation of a least-cost method for acquiring feed ingredients.

Storage systems, temporary and permanent, were designed so that each flock could store 30 days, 90 days, 120 days and 180 days supply of corn or grain sorghum. Permanent storage systems were designed so that each flock could store 30 days, 90 days, 150 days and 180 days supply of soybean meal. These systems were set up so that poultry operations in the state could take advantage of price shifts for the main laying feed ingredients.

A total investment cost was calculated for each storage system. Depreciation charges, interest on investment for facilities and equipment, insurance on the storage system and grain, taxes, labor, maintenance and electrical costs, were determined based upon assumptions and sources given in Appendix D. Average annual costs were then evaluated to determine storage costs.

A linear programming model was set up to determine an optimal ingredient acquisition strategy for the four different storage capacities for each flock size. The "Rades" program used the simplex algorithm to minimize cost for the acquisition alternatives. Average annual commodity prices for 1977 were multiplied by each commodity's seasonal index to ascertain a monthly price. An annual interest rate of 9.5 percent compounded monthly was then added to each monthly price, making ingredient costs more realistic (Chilton 1978). Restraints on the acquisition model included monthly storage system capacity for corn, grain, sorghum and soybean meal.

The optimal acquisition strategy for each system allows the poultry operator to determine a least-cost purchasing schedule. Annual storage costs were added to the total grain costs, along with the costs of the other ingredients to determine total costs associated with on-farm storage. Finally, total on-farm milling costs (Schwabe 1977) were added together with total on-farm storage costs, representing a total cost of on-farm processed feed.

The basic criterion used for evaluating the economic feasibility of on-farm storing and milling was total cost. The risk associated with a particular acquisition strategy is also evaluated. This supplies a more realistic guide to the storage investment decision. Risk evaluation also allows the poultry operator to choose the level of uncertainty that he desires. Thus, this investigation should provide a framework to reduce feed costs and consequently, improve their competitive position in the Arizona egg market.

CHAPTER 3

ANALYSIS

Costs involved with on-farm processed feed are compared in this chapter to costs associated with commercial layer feed acquisition. The quantifiable benefits accruing to on-farm processed feed are stated later in this chapter. This study was not concerned with the qualitative costs and benefits involved with on-farm processed feed. On-farm storage was analyzed with on-farm milling due to their complimentarity.

Initial investment costs for permanent and temporary storage systems with different storage capacities are examined. Budgets for average annual storage costs generated in Chapter 2 are evaluated. Seasonal price indices for corn, grain sorghum, soybean meal and laying feed that represent monthly price movements, are presented and are used to help determine the economic feasibility of on-farm storage. Optimal ingredient acquisition strategies are then analyzed to discover the least cost means of procuring the ingredients for on-farm processed feeds. The results are presented in a decision-making framework which relates procurement and storage strategies to the expected cost and risk involved. Ingredient cost, average annual storage costs, and average annual milling costs are combined to estimate total costs associated with on-farm processed layer feed. These costs are compared with commercial layer feed acquisitions in order to appraise on-farm storage and mixing as a possibility for reducing feed costs for Arizona poultry ranchers.

Initial Investment Costs Associated with On-Farm Storage

Initial investment costs of temporary and permanent storage systems for each flock size are given in Table 10. Detailed descriptions of the temporary and permanent systems are given in Appencices A, B and C. Temporary flat storage systems for soybean meal were assumed to be infeasible. This is basically due to the high value and physical nature of processed soybean meal. Thus, investment costs are presented for grain sorghum and corn using permanent and temporary storage systems, but only investment costs for permanent storage systems are given in the case of soybean meal.

For simplicity purposes, the 75,000 bird flock will be labeled flock A, and the 150,000 bird flock and 300,000 bird flock will be labeled flock B and flock C respectively. Flock A's and flock B's initial investment costs for temporary flat storage systems were slightly higher than the costs involved with permanent bin storage systems except for the thirty day storage capacity designs where temporary storage investment cost was roughly three-fourths of permanent storage investment cost. This is due to the large amounts of grain handling equipment needed with the temporary systems. Temporary flat storage systems for flock C have consistently higher initial investment costs than permanent bin systems with the identical storage

Table 10. Initial Investment Cost by Flock Size for Storage Systems

System		Flock 75,000 (A)	150,000 (B)	300,000 (C)
		($)	($)	($)
Milo	30 days	6,051	12,102	24,204
Temporary Flat	90 days	18,153	33,501	64,420
	180 days	33,501	64,420	124,700
Milo	30 days	7,999	15,801	21,659
Permanent Bin	90 days	17,814	33,013	58,217
	120 days	21,659	41,429	76,946
	180 days	33,013	58,217	120,346
Soybean Meal	30 days	5,344	6,661	9,499
Permanent Bin	90 days	7,699	13,901	20,314
	150 days	10,999	16,714	29,613
	180 days	13,901	20,314	43,318

capacity. Economies of scale exist for both types of systems as storage capacities are increased. Finally, initial investment costs can be minimized in most cases, by selecting the permanent bin system as opposed to the temporary flat system.

Average Annual On-Farm Storage Costs

Average annual storage costs are defined in this study to include all storage costs except the ingredient costs and interest on the purchase cost of the ingredients stored. Average annual storage costs by flock size for the designated storage systems are given in Table 11. Further detailed descriptions are given in Appendix D. Average annual storage costs for flock A and flock B exhibited the same pattern as initial investment costs, with permanent bin systems costs lower than temporary flat systems costs, except for 30 day storage capacities. Economies of scale existed as storage systems increased in capacity for both flock sizes. Flock C's average annual storage costs for the permanent bin storage systems are consistently lower than the temporary flat storage systems for all storage capacity levels. This was mainly due to the high initial investment and operating expenses involved with the large amounts of grain-handling equipment necessary for the temporary flat systems. Therefore, investing in permanent bin storage systems as opposed to temporary flat storage systems is more profitable for flock C regardless of the storage capacity.

All permanent storage systems have lower storage costs than temporary storage systems, except for flock A's and B's 30 day storage

Table 11. Total Average Annual Storage Costs by Flock Size

System		Flock 75,000 (A)	150,000 (B)	300,000 (C)
		($)	($)	($)
Milo	30 days	5,588	9,113	14,315
Temporary Flat	90 days	9,282	18,562	35,084
	180 days	16,766	33,275	58,120
Milo	30 days	5,738	9,513	13,471
Permanent Bin	90 days	8,391	14,231	23,078
	120 days	9,489	16,515	27,933
	180 days	12,435	21,269	38,931
Soybean Meal	30 days	2,757	4,043	5,920
	90 days	3,834	6,757	10,679
	150 days	5,125	8,819	15,313
	180 days	6,158	10,076	19,240

capacity systems. Thus, small to medium sized flocks are able to take advantage of the temporary storage system costs when storage capacity is kept at a minimal level. All large flock sizes, no matter what storage capacity system is used and all small and medium sized flocks using storage capacity systems of 90 days or greater, will minimize costs by investing in permanent bin storage systems. Economies of scale are reflected in the storage cost budgets. These costs assume readily available financing with no concern for quantity discounts and the "bargaining-ability" of each entrepreneur. The costs used in these budgets may change depending on a poultry operation's physical characteristics and particular needs.

Analysis of Price Seasonality

The seasonal price fluctuation of commodities provides the incentive for on-farm storage. Prices are low at harvest time and rise through the year as a function of the cost of storing for the "normal" seasonal pattern (Tomek and Robinson 1975). Average seasonal price indices for grain sorghum, soybean meal and laying feed were computed using fifteen years of average monthly prices paid by farmers in Arizona. Monthly price data for corn was only available for the last ten years. Representative seasonal prices were calculated for each commodity, by multiplying the monthly index by the 1977 average annual price for that commodity. These prices reflect a charge for cleaning and hauling to the point of destination.

The average seasonal price index for grain sorghum is presented in Table 12. The index shows that the season's low price

Table 12. Grain Sorghum Prices Per Ton Paid by Arizona Ranchers

Item	Average Seasonal Index	1977 Avg. Annual Price w/Index
July	103.1	99.76
Aug.	102.0	98.70
Sept.	99.3	96.08
Oct.	97.8	94.63
Nov.	98.0	94.82
Dec.	99.5	96.28
Jan.	100.3	97.05
Feb.	99.7	96.47
Mar.	99.5	96.28
Apr.	99.1	95.89
May	100.7	97.44
June	101.0	97.73
Aug.	100.0	96.76

usually occurs in October and November, which corresponds to the usual harvest period. Sorghum prices typically rise through January and then fall back slightly by April. Prices climb sharply from April to July, where they peak out, and then fall back in August and September. This pattern fairly resembles the "normal seasonal pattern with the price fluctuation magnitude directly influenced by the average yearly price level.

Corn's average seasonal price index is shown in Table 13. The index suggests that corn has basically the same seasonal price pattern as grain sorghum, but slightly less fluctuation. Prices are low from September through November and rise to their peak in January. Corn's index declines from January through April and then rises from April through June, with July's price declining slightly. Corn's secondary peak occurs during the June and July period. Grain sorghum on the other hand had a secondary peak in January and a primary peak in July.

The average seasonal index and the representative seasonal price for soybean meal is given in Table 14. Price is low from February through May and increases to a plateau from June through September. Price gradually falls back starting in October until it hits the low months of February through May. Of all the commodities analyzed, soybean meal has the most distinct seasonal pattern.

Laying feed prices paid by Arizona ranchers reflect processing costs as well as ingredient costs. The average seasonal index and representative seasonal price for laying feed is presented in Table 15.

Table 13. Corn Prices Per Ton Paid by Arizona Ranchers

Item	Average Seasonal Index	1977 Avg. Annual Price w/Index
July	100.8	94.90
Aug.	99.9	94.06
Sept.	98.0	92.27
Oct.	98.3	92.55
Nov.	97.7	91.98
Dec.	100.7	94.81
Jan.	101.7	95.75
Feb.	100.6	94.71
Mar.	100.4	94.53
Apr.	99.4	93.59
May	100.3	94.43
June	101.0	95.09
Aug.	100.0	94.15

Table 14. Soybean Meal Prices Per Ton Paid by Arizona Ranchers

Item	Average Seasonal Index	1977 Avg. Annual Price w/Index
July	101.3	263.55
Aug.	101.9	265.11
Sept.	101.8	264.85
Oct.	100.8	262.25
Nov.	99.9	259.91
Dec.	100.0	260.17
Jan.	99.1	257.83
Feb.	97.7	254.19
Mar.	97.2	252.89
Apr.	97.7	254.19
May	97.8	254.45
June	101.9	265.11
Aug.	100.0	260.17

Table 15. Laying Feed Prices Per Ton Paid by Arizona Ranchers

Item	Average Seasonal Index	1977 Avg. Annual Price w/Index
July	99.5	163.57
Aug.	101.1	166.09
Sept.	101.0	165.93
Oct.	99.8	164.05
Nov.	99.7	163.89
Dec.	99.8	164.05
Jan.	100.4	164.99
Feb.	100.0	164.36
Mar.	100.8	165.62
Apr.	100.4	164.99
May	98.6	162.16
June	99.3	163.26
Aug.	100.0	164.36

Commercial laying feed prices are somewhat more stable than commodity prices. The only major fluctuations occur during the summer months.

The similarity between the seasonal price indices of corn and grain sorghum helps to simplify the poultry ranchers' procurement decision. It allows him to choose one based upon current or anticipated comparative price levels. Simplification of the poultry manager's decision concerning grain sorghum vs. corn is also made possible due to the almost perfect nutritional equality of the two. Each commodity's percentage composition of the diet is the same. Chickens will accept both equally well in their diet and egg production shows no preference between the two grains.

Ingredient Acquisition Strategy Analysis

Representative seasonal prices for the three main feed ingredients (Tables 12, 13 and 14) were used as the basis for calculating an optimal acquisition strategy for each storage capacity level. A linear programming algorithm entitled "Rades" was used to determine the optimal acquisition strategy which minimizes costs. These costs were a function of the representative seasonal prices, the amounts of grain purchased and an annual interest rate of 9.5% compounded monthly.

The optimal acquisition strategy by storage capacities for flock A are given in Table 16. The symbols B and S represent the buying period and the number of months stored respectively. For example:

Table 16. Optimal Ingredient Acquisition Strategies for Flock A

	30 Day Milo	30 Day Corn	90 Day Milo	90 Day Corn	120 & 180 Day Milo	120 & 180 Day Corn	30 Day SBM	90 Day SBM	150 & 180 Day SBM
	B1 S1	B1 S1	B11 S3	B11 S3	B11 S3	B11 S3	B1 S1	B1 S1	B1 S1
	B2 S1	B2 S1	B2 S1	B2 S1	B2 S1	B11 S4	B2 S1	B2 S1	B2 S1
	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1
	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1
	B5 S1	B5 S1	B4 S2	B4 S2	B4 S2	B4 S2	B5 S1	B5 S1	B5 S1
	B6 S1	B6 S1	B6 S1	B4 S3	B4 S3	B4 S3	B6 S1	B5 S2	B5 S2
	B7 S1	B7 S1	B4 S4	B7 S1	B4 S4	B7 S1	B7 S1	B5 S3	B5 S3
	B8 S1	B8 S1	B8 S1	B8 S1	B8 S1	B8 S1	B8 S1	B8 S1	B5 S4
	B9 S1	B9 S1	B9 S1	B9 S1	B9 S1	B9 S1	B9 S1	B9 S1	B5 S5
	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1
	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1
	B12 S1	B12 S1	B11 S2	B11 S2	B11 S2	B11 S2	B12 S1	B12 S1	B12 S1
Yearly Cost ($)	242,249	235,668	241,458	234,723	241,392	234,612	179,556	178,766	178,371

B2 S6

where B2 = grain purchased in February

S6 = six months stored (fed in July).

Optimal acquisition strategies for flock B (Table 17) and flock C (Table 18) are identical to the strategies of flock A.

The optimal acquisition strategy for grain sorghum, corn and soybean meal with storage capacities of thirty days is the only procurement schedule possible due to the storage constraint. The ingredients need to be purchased once a month because storage capacity is set at thirty days. Thirty days' storage capacity is also assumed to be the lowest level allowable with on-farm milling. Yearly costs of the three ingredient acquisition strategies using thirty day storage are given in Tables 16, 17 and 18.

The optimal acquisition strategies for milo, corn and soybean meal utilizing ninety day storage systems are also given in Tables 16 17 and 18. The optimal procurement strategy for milo takes advantage of low cash prices in November and April. The strategy for procuring corn also takes advantage of low prices in November and April. On the other hand, the optimal strategy for soybean meal shows that May is the only month in which prices justify the buying of extra meal. Annual ingredient cost savings for flock A due to the increased storage capacities is $790 for milo, $945 for corn and $790 for soybean meal. The cost savings for flock B is twice these amounts and four times these amounts for flock C.

Table 17. Optimal Ingredient Acquisition Strategies for Flock B

	30 Day Milo	30 Day Corn	90 Day Milo	90 Day Corn	120 & 180 Day Milo	120 & 180 Day Corn	30 Day SBM	90 Day SBM	150 & 180 Day SBM
	B1 S1	B1 S1	B11 S3	B11 S3	B11 S3	B11 S3	B1 S1	B1 S1	B1 S1
	B2 S1	B2 S1	B2 S1	B2 S1	B2 S1	B11 S4	B2 S1	B2 S1	B2 S1
	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1
	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1
	B5 S1	B5 S1	B4 S2	B4 S2	B4 S2	B4 S2	B5 S1	B5 S1	B5 S1
	B6 S1	B6 S1	B6 S1	B4 S3	B4 S3	B4 S3	B6 S1	B5 S2	B5 S2
	B7 S1	B7 S1	B4 S4	B7 S1	B4 S4	B7 S1	B7 S1	B5 S3	B5 S3
	B8 S1	B8 S1	B8 S1	B8 S1	B8 S1	B8 S1	B8 S1	B8 S1	B5 S4
	B9 S1	B9 S1	B9 S1	B9 S1	B9 S1	B9 S1	B9 S1	B9 S1	B5 S5
	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1
	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1
	B12 S1	B12 S1	B11 S2	B11 S2	B11 S2	B11 S2	B12 S1	B12 S1	B12 S1
Yearly Cost ($)	484,498	471,336	482,917	469,446	482,784	469,224	359,113	357,532	356,743

Table 18. Optimal Ingredient Acquisition Strategies for Flock C

	30 Day Milo	30 Day Corn	90 Day Milo	90 Day Corn	120 & 180 Day Milo	120 & 180 Day Corn	30 Day SBM	90 Day SBM	150 & 180 Day SBM
	B1 S1	B1 S1	B11 S3	B11 S3	B11 S3	B11 S3	B1 S1	B1 S1	B1 S1
	B2 S1	B2 S1	B2 S1	B2 S1	B2 S1	B11 S4	B2 S1	B2 S1	B2 S1
	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1	B3 S1
	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1	B4 S1
	B5 S1	B5 S1	B4 S2	B4 S2	B4 S2	B4 S2	B5 S1	B5 S1	B5 S1
	B6 S1	B6 S1	B6 S1	B4 S3	B4 S3	B4 S3	B6 S1	B5 S2	B5 S2
	B7 S1	B7 S1	B4 S4	B7 S1	B4 S4	B7 S1	B7 S1	B5 S3	B5 S3
	B8 S1	B8 S1	B8 S1	B8 S1	B8 S1	B8 S1	B8 S1	B8 S1	B5 S4
	B9 S1	B9 S1	B9 S1	B9 S1	B9 S1	B9 S1	B9 S1	B9 S1	B5 S5
	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1	B10 S1
	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1	B11 S1
	B12 S1	B12 S1	B11 S2	B11 S2	B11 S2	B11 S2	B12 S1	B12 S1	B12 S1
Yearly Cost ($)	968,995	942,672	965,833	938,892	965,567	938,448	718,227	715,064	713,486

The optimal procurement strategies computed for the three feed ingredients utilizing 180 day storage capacities are given in Tables 16, 17 and 18. The 180 day storage capacity strategy for corn and milo is identical to the 120 day storage capacity strategy. These strategies take advantage of the low cash prices in November and April, as was the case with the 90 day storage strategies. The 180 day storage capacity strategy for soybean meal is identical to the 150 day storage capacity strategy. This strategy shows the month of May as being the only time to purchase extra soybean meal. Annual ingredient cost savings as a result of the increase in storage capacity from 90 days to 150 days is $395. Ingredient cost savings resulting from the increase in storage capacities for flock B are twice as much as for flock A and four times as much for flock C. Thus, optimum levels of storage based on the minimization of ingredient procurement costs are as follows:

grain sorghum -- 120 day storage capacity
corn -- 120 day storage capacity
soybean -- 150 day storage capacity

It must be remembered however, that these strategies do not include storage costs. Thus, "optimal" strategy is somewhat misleading as we will see later in this chapter.

Total Analysis of On-Farm Processed Feed Compared to Commercial Feed Acquisition

Total acquisition costs of grain sorghum, corn and soybean meal by flock size are given in Tables 19 through 24. These costs not

Table 19. Total On-Farm Processed Feed Cost for Flock A, Milo Ration

Item	Storage Capacity 30 Day	90 Day	180 Day	Optimal
	($)	($)	($)	($)
Milo	242,249	241,458	241,392	241,392
SBM	179,557	178,766	178,371	178,371
Animal Fat	7,754	7,754	7,754	7,754
Alfalfa Ml.	24,231	24,231	24,231	24,231
DiCal-Ph	23,134	23,134	23,134	23,134
Ca-Carb.	2,303	2,303	2,303	2,303
Salt	388	388	388	388
Trace Min. Mix	1,830	1,830	1,830	1,830
Vita-Mix	37,219	37,219	37,219	37,219
DL-Meth	3,943	3,943	3,943	3,943
Yearly Ing. Total Cost	522,607	521,026	520,565	520,565
Annual Milo Storage Cost	5,738	8,391	12,435	9,489
Annual Soybean Meal Total Cost	2,757	3,834	6,158	5,125
Total Annual Storage Cost	8,495	12,225	18,593	14,614
Total On-Farm Feed Cost Before Milling	531,102	533,251	539,158	535,179
15 Ton Milling Cost	29,692	29,692	29,692	29,692
Total On-Farm Processed Feed Cost	560,794	562,943	568,850	564,871

Table 20. Total On-Farm Processed Feed Cost for Flock A, Corn Ration

Item	Storage Capacity 30 Day	90 Day	180 Day	Optimal
	($)	($)	($)	($)
Corn	235,668	234,723	234,612	234,612
SBM	179,557	178,766	178,371	178,371
Animal Fat	7,754	7,754	7,754	7,754
Alfalfa Ml.	24,231	24,231	24,231	24,231
DiCal-Ph	23,134	23,134	23,134	23,134
Cal-Carb.	2,303	2,303	2,303	2,303
Salt	388	388	388	388
Trace Min. Mix	1,830	1,830	1,830	1,830
Vita-Mix	37,219	37,219	37,219	37,219
DL-Meth	3,943	3,943	3,943	3,943
Yearly Ing. Total Cost	516,026	514,291	513,785	513,785
Annual Milo Storage Cost	5,738	8,391	12,435	9,489
Annual Soybean Meal Total Cost	2,757	3,834	6,158	5,125
Total Annual Storage Cost	8,495	12,225	18,593	14,614
Total On-Farm Feed Cost Before Milling	524,521	526,516	532,378	528,399
15 Ton Milling Cost	29,692	29,692	29,692	29,692
Total On-Farm Processed Feed Cost	554,213	556,208	562,070	558,091

Table 21. Total On-Farm Processed Feed Cost for Flock B, Milo Ration

Item	Storage Capacity 30 Day	90 Day	180 Day	Optimal
	($)	($)	($)	($)
Milo	484,498	482,917	482,784	482,784
SBM	359,113	357,532	356,743	356,743
Animal Fat	15,508	15,508	15,508	15,508
Alfalfa Ml.	48,463	48,463	48,463	48,463
DiCal-Ph	46,268	46,268	46,268	46,268
Cal-Carb.	4,605	4,605	4,605	4,605
Salt	776	776	776	776
Trace Min. Mix	3,660	3,660	3,660	3,660
Vita-Mix	74,438	74,438	74,438	74,438
DL-Meth	7,886	7,886	7,886	7,886
Yearly Ing. Total Cost	1,045,215	1,042,052	1,041,130	1,041,130
Annual Milo Storage Cost	9,513	14,231	21,269	16,515
Annual Soybean Meal Total Cost	4,043	6,757	10,076	8,819
Total Annual Storage Cost	13,556	20,991	31,345	25,334
Total On-Farm Feed Cost Before Milling	1,058,771	1,063,043	1,072,475	1,066,464
30 Ton Milling Cost	33,199	33,199	33,199	33,199
Total On-Farm Processed Feed Cost	1,091,970	1,096,242	1,105,674	1,099,663

Table 22. Total On-Farm Processed Feed Cost for Flock B, Corn Ration

Item	Storage Capacity 30 Day	90 Day	180 Day	Optimal
	($)	($)	($)	($)
Corn	471,336	469,446	469,224	469,224
SBM	359,113	357,532	356,743	356,743
Animal Fat	15,508	15,508	15,508	15,508
Alfalfa Ml.	48,463	48,463	48,463	48,463
DiCal-Ph	46,268	46,268	46,268	46,268
Cal-Carb.	4,605	4,605	4,605	4,605
Salt	776	776	776	776
Trace Min. Mix	3,660	3,660	3,660	3,660
Vita-Mix	74,438	74,438	74,438	74,438
DL-Meth	7,886	7,886	7,886	7,886
Yearly Ing. Total Cost	1,032,053	1,028,582	1,027,570	1,027,570
Annual Milo Storage Cost	9,513	14,231	21,269	16,515
Annual Soybean Meal Total Cost	4,043	6,757	10,076	8,819
Total Annual Storage Cost	13,556	20,991	31,345	25,334
Total On-Farm Feed Cost Before Milling	1,045,609	1,049,573	1,058,915	1,052,904
30 Ton Milling Cost	33,199	33,199	33,199	33,199
Total On-Farm Processed Feed Cost	1,078,808	1,082,778	1,092,114	1,086,103

Table 23. Total On-Farm Processed Feed Cost for Flock C, Milo Ration

Item	Storage Capacity 30 Day	90 Day	180 Day	Optimal
	($)	($)	($)	($)
Milo	968,995	965,883	965,567	965,567
SBM	718,227	715,064	713,486	713,486
Animal Fat	31,016	31,016	31,016	31,016
Alfalfa Ml.	96,926	96,926	96,926	96,926
DiCal-Ph.	92,536	92,536	92,536	92,536
Cal-Carb.	9,211	9,211	9,211	9,211
Salt	1,551	1,551	1,551	1,551
Trace Min. Mix	7,320	7,320	7,320	7,320
Vita-Mix	148,876	148,876	148,876	148,876
DL-Meth	15,772	15,772	15,772	15,772
Yearly Ing. Total Cost	2,090,429	2,084,104	2,082,260	2,082,260
Annual Milo Storage Cost	13,471	23,078	38,931	27,933
Annual Soybean Meal Total Cost	5,920	10,679	19,240	15,313
Total Annual Storage Cost	19,391	33,757	58,171	43,246
Total On-Farm Feed Cost Before Milling	2,109,820	2,117,861	2,140,431	2,125,506
60 Ton Milling Cost	38,720	38,720	38,720	38,720
Total On-Farm Processed Feed Cost	2,148,540	2,156,581	2,179,151	2,164,226

Table 24. Total On-Farm Processed Feed Cost for Flock C, Corn Ration

Item	Storage Capacity 30 Day	90 Day	180 Day	Optimal
	($)	($)	($)	($)
Corn	942,672	938,892	938,448	938,448
SBM	718,227	715,064	713,486	713,486
Animal Fat	31,016	31,016	31,016	31,016
Alfalfa Ml.	96,926	96,926	96,926	96,926
DiCal-Ph	92,536	92,536	92,536	92,536
Cal-Carb.	9,211	9,211	9,211	9,211
Salt	1,551	1,551	1,551	1,551
Trace Min. Mix	7,320	7,320	7,320	7,320
Vita-Mix	148,876	148,876	148,876	148,876
DL-Meth	15,772	15,772	15,772	15,772
Yearly Ing. Total Cost	2,064,106	2,057,164	2,055,141	2,055,141
Annual Milo Storage Cost	13,471	23,078	38,931	27,933
Annual Soybean Meal Total Cost	5,920	10,679	19,240	15,313
Total Annual Storage Cost	19,391	33,757	58,171	43,246
Total On-Farm Feed Cost Before Milling	2,083,497	2,090,921	2,113,312	2,098,387
60 Ton Milling Cost	38,720	38,720	38,720	38,720
Total On-Farm Processed Feed Cost	2,122,217	2,129,641	2,152,032	2,137,107

only vary according to flock size, but also according to storage capacity levels. The remaining ingredient acquisition costs are listed on a yearly basis independent of the storage strategies. Each flock's total annual ingredient costs decreased slightly as storage capacity increased. This reflects the fact that seasonality exists for ingredient prices allowing the ingredient buyer to take advantage of low prices. Annual storage costs for permanent systems were then added to yearly ingredient costs--each storage strategy computed separately so as to analyze the difference between strategies. The result is total on-farm processed feed costs before milling for the permanent storage systems. These permanent storage systems showed increasing total costs of feed as storage capacities increased. Thus, ingredient cost savings arising from larger storage systems and price seasonality were less than increasing annual storage costs associated with the same increase in storage capacity levels.

Representative commercial feed costs by flock size are given in Table 25 for a 1977 base period. These costs are compared to 1977 base period total costs of on-farm processed feed in order to evaluate the economic feasibility of on-farm storage and on-farm milling as a means of reducing poultry feed costs. The final evaluation of on-farm processed feed for the various flock sizes is presented in Tables 26 through 31. Feed cost savings were determined according to storage capacity levels and whether corn or grain sorghum was employed as the main ingredient.

Table 25. Representative Commercial Feed Cost by Flock Size

1977	Representative Cost Per Ton	Flock A 75,000	Flock B 150,000	Flock C 300,000
January	164.99	51,559	103,119	206,238
February	164.36	51,363	102,725	205,450
March	165.62	51,756	103,513	207,025
April	164.99	51,559	103,119	206,238
May	162.16	50,675	101,350	202,700
June	163.26	51,019	102,038	204,075
July	163.57	51,116	102,231	204,463
August	166.09	51,903	103,806	207,613
September	165.93	51,853	103,706	207,413
October	164.05	51,266	102,531	205,063
November	163.89	51,216	102,431	204,863
December	164.05	51,266	102,531	205,063
Average Yearly Cost		616,550	1,233,100	2,466,200
Average Yearly Cost Per Ton		164	164	164

Table 26. Average Annual Cost Savings from On-Farm Processing and Storage for Flock A, Milo Ration

Item	Storage Capacity 30 Day	90 Day	180 Day	Optimal
	($)	($)	($)	($)
Total Annual On-Farm Feed Cost	560,794	562,943	568,850	564,871
Commercial Feed Cost	616,550	616,550	616,550	616,550
Annual Cost Savings	55,756	53,607	47,700	51,679
Annual Cost Savings Per Ton	15	14	13	14

Table 27. Average Annual Cost Savings from On-Farm Processing and Storage for Flock A, Corn Ration

Item	Storage Capacity 30 Day	90 Day	180 Day	Optimal
	($)	($)	($)	($)
Total Annual On-Farm Feed Cost	554,213	556,208	562,070	558,091
Commercial Feed Cost	616,550	616,550	616,550	616,550
Annual Cost Savings	62,337	60,342	54,480	58,459
Annual Cost Savings Per Ton	17	16	15	16

Table 28. Average Annual Cost Savings from On-Farm Processing and Storage for Flock B, Milo Ration

Item	Storage Capacity 30 Day	90 Day	180 Day	Optimal
	($)	($)	($)	($)
Total Annual On-Farm Feed Cost	1,091,970	1,096,242	1,105,674	1,099,663
Commercial Feed Cost	1,233,100	1,233,100	1,233,100	1,233,100
Annual Cost Savings	141,931	137,678	128,226	134,237
Annual Cost Savings Per Ton	19	18	17	18

Table 29. Average Annual Cost Savings From On-Farm Processing and Storage for Flock B, Corn Ration

Item	Storage Capacity 30 Day	90 Day	180 Day	Optimal
	($)	($)	($)	($)
Total Annual On-Farm Feed Cost	1,078,808	1,082,772	1,092,114	1,086,103
Commercial Feed Cost	1,233,100	1,233,100	1,233,100	1,233,100
Annual Cost Savings	155,092	151,128	141,786	147,797
Annual Cost Savings Per Ton	21	20	19	20

Table 30. Average Annual Cost Savings from On-Farm Processing and Storage for Flock C, Milo Ration

Item	30 Day	90 Day	180 Day	Optimal
	Storage Capacity			
	($)	($)	($)	($)
Total Annual On-Farm Feed Cost	2,148,540	2,156,581	2,179,151	2,164,226
Commercial Feed Cost	2,466,200	2,466,200	2,466,200	2,466,200
Annual Cost Savings	317,660	309,619	287,049	301,974
Annual Cost Savings Per Ton	20	20	19	19

Table 31. Average Annual Cost Savings From On-Farm Processing and Storage for Flock C, Corn Ration

Item	30 Day	90 Day	180 Day	Optimal
	Storage Capacity			
	($)	($)	($)	($)
Total Annual On-Farm Feed Cost	2,122,217	2,129,641	2,152,032	2,137,107
Commercial Feed Cost	2,466,200	2,466,200	2,466,200	2,466,200
Annual Cost Savings	343,983	336,559	314,168	320,093
Annual Cost Savings Per Ton	22	22	20	21

The cost savings associated with all flock sizes and their respective storage systems effectively ascertained the economic feasibility of on-farm processed feed as compared to commercial feed acquisition. The seasonal price variation of grains alone is not enough to offset the costs of storage. It is concluded that storing grains for any period greater than thirty days involves an increase in total costs. Thus, the optimal storage capacity, in terms of cost savings, is just enough to satisfy the requirements of on-farm milling systems.

The importance of using corn in the layer diet is illustrated in Tables 26 through 31. The average corn price for 1977 was $2.61 less per ton than the 1977 average grain sorghum price. This results in an approximate reduction in total cost savings, for those poultry ranchers that would have used corn, of 10 percent. Storage beyond 30 days results in a greater total cost of on-farm processed feed.

The reductions in feed costs due to 30 day on-farm storage and on-farm milling were approximately 10 percent. These cost reductions exceeded the 7.8 percent cost reduction in feed cost necessary to become competitive with California egg producers as determined by Wilson (1975).

The level of storage capacity for each flock size determined as optimal, from a cost minimization standpoint, is thirty days. The thirty day storage capacity, on the other hand, has varying degrees of uncertainty compared to the ninety day and 120/150 day. Tables 32 through 34, present two risk factors for the three flock sizes,

Table 32. Risks Involved with Ingredient Storage for Flock A[1]

Item		30 Day Storage System	90 Day Storage System	120/150 Day Storage System
		($)	($)	($)
Milo	Annual Mean Cost	247,987	249,849	250,880
	Standard Deviation	52,036	54,040	54,952
	Avg. Yearly Cost for Years Exceeding Mean Cost[2]	327,033	331,488	333,995
Corn	Annual Mean Cost	241,406	243,114	244,101
	Standard Deviation	52,138	51,776	49,207
	Avg. Yearly Cost for Years Exceeding Mean Cost[2]	296,323	297,802	295,596
Soybean Meal	Annual Mean Cost	182,314	182,600	183,496
	Standard Deviation	41,539	44,008	48,279
	Avg. Yearly Cost for Years Exceeding Mean Cost[2]	239,782	242,423	246,205

[1]Includes ingredient and storage costs.

[2]Average annual cost for those years whose annual cost exceeds the overall average.

Table 33. Risks Involved with Ingredient Storage for Flock B[1]

Item		30 Day Storage System	90 Day Storage System	120/150 Day Storage System
		($)	($)	($)
Milo	Annual Mean Cost	494,011	497,148	499,298
	Standard Deviation	104,073	108,080	109,903
	Yearly Cost For Years Exceeding Mean Cost[2]	652,104	660,425	665,527
Corn	Annual Mean Cost	480,849	483,677	485,739
	Standard Deviation	104,276	103,553	98,414
	Yearly Cost For Years Exceeding Mean Cost[2]	590,683	593,047	588,729
Soybean Meal	Annual Mean Cost	363,156	364,289	365,562
	Standard Deviation	83,078	88,015	96,558
	Yearly Cost For Years Exceeding Mean Cost[2]	478,092	483,935	490,979

[1]Includes ingredient and storage costs.

[2]Average annual cost for those years whose annual cost exceeds the overall average.

Table 34. Risks Involved with Ingredient Storage for Flock C[1]

Item		30 Day Storage System	90 Day Storage System	120/150 Day Storage System
		($)	($)	($)
Milo	Annual Mean Cost	982,466	988,911	993,500
	Standard Deviation	208,146	216,161	219,806
	Avg. Yearly Cost for Years Exceeding Mean Cost[2]	1,298,652	1,315,466	1,325,960
Corn	Annual Mean Cost	956,143	961,970	966,381
	Standard Deviation	208,552	207,106	196,827
	Avg. Yearly Cost for Years Exceeding Mean Cost[2]	1,175,810	1,180,720	1,172,362
Soybean Meal	Annual Mean Cost	724,147	725,743	728,799
	Standard Deviation	166,157	176,030	193,115
	Avg. Yearly Cost for Years Exceeding Mean Cost[2]	954,021	939,759	979,633

[1]Includes ingredient and storage costs.

[2]Average annual cost for those years whose annual cost exceeds the overall average.

standard deviation and the average yearly cost for years exceeding the mean cost.

The standard deviation and the average yearly cost for the years exceeding the mean cost for grain sorghum and soybean meal rise as storage capacities are increased. This reflects rising risks associated with increasing amounts of grain stored, even though in previous years the situation has been just opposite due to fluctuating commodity price levels. The standard deviation decreased for corn as amounts purchased increased. Average yearly cost for the years exceeding the mean cost was lowest for the 120 day storage system. The 90 day storage system was the highest with the 30 day storage system falling right behind. A poultry rancher procuring corn and averse to price uncertainty may prefer the 120 day storage system due to its comparatively low level of risk of a bad year even though average annual acquisition costs are higher than for the smaller storage systems.

CHAPTER 4

SUMMARY AND CONCLUSIONS

The purpose of this study was to determine the economic feasibility of on-farm storage combined with on-farm milling for Arizona poultry ranches. Specifically, total on-farm processed feed costs were compared to commercial feed acquisition for three flock sizes. Costs were calculated for on-farm storage systems, feed ingredients, and combined with on-farm milling costs reported by Schwabe (1977), to estimate the total on-farm processed feed costs. Representative commercial feed costs for 1977 were used to determine the average annual feed costs savings by flock size.

As is the case in any study involving budget generation, assumptions were inherent in their representation. Great care was taken to insure a solid foundation from which to make the necessary assumptions. The results contribute information for poultry ranchers evaluating alternatives to reduce feed costs, which according to Wilson (1975) would improve their competitive position in the Arizona egg market. Furthermore, this study supplies a method for poultry operators to assess their operations by substituting their ingredient requirements and related prices into the feasibility framework.

An economic-engineering approach was used to develop model designs and costs for on-farm storage facilities at flock sizes of

75,000, 150,000 and 300,000 birds. Seasonal price indices of grain sorghum, corn, soybean meal and laying feed were generated from monthly prices quoted for Arizona ranchers. Optimal acquisition strategies for the three flock sizes were calculated by minimizing total procurement costs through the use of a linear programming algorithm called "Rades". Average annual production costs for on-farm milling according to flock size were supplied by Schwabe (1977).

Feasibility of on-farm storage in conjunction with on-farm milling was analyzed for all model flock sizes. The initial assumption concerning this feasibility was correct since total cost of on-farm processed feed was less than the commercial feed. The largest flock size at 300,000 birds yielded the lowest cost per ton and thereby, the greatest feed cost-savings when compared to commercial feed. Storage capacities of thirty days showed the highest cost-savings for each flock as compared with storage capacities of greater magnitude. Permanent bin storage systems were determined to be more profitable than temporary flat storage systems, due to the increased amount of equipment necessary for the large grain tents. Corn substitution for grain sorghum allowed roughly a ten percent reduction in feed costs, but the relative prices need to be compared closely by the poultry manager so as to determine which ingredient costs less at a particular time.

The risk of high annual costs increased as storage capacity for grain sorghum and soybean meal increased. These increasing levels of risk necessarily nullify any possible benefits derived from extended storage capacities. On the other hand, Arizona poultry ranchers utilizing corn as opposed to grain sorghum could have reduced their cost uncertainty by employing larger storage systems. This situation was unique in this study because the farmer was faced with the decision of whether to accept a higher annual mean cost and a lower level of risk or vice versa.

This study was not meant to be comprehensive in nature and thus leaves various areas of research for further investigation. Other methods of ingredient acquisition such as forward contracting and hedging could be evaluated according to their risks and profitability. These procurement methods might easily allow the poultry operator to shift price uncertainty to the respective grain suppliers. Problems associated with the monthly acquisition of feed grains might be analyzed, so as to determine the feasibility of readily available sources of grains throughout the year. A study involving acquisition strategies based on expected prices rather than historical prices might prove beneficial. It would provide the poultry entrepreneur with an analytical framework needed for anticipated feed cost savings. The importance and nature of services which are provided by commercial feed processing plants deserve further attention. Also, the quality differences between commercial layer feed and on-farm processed feed deserves a closer look. Finally, further investigation is needed to evaluate the risks associated with discontinuing operations before equipment fully amortizes, equipment breakdown, increasing managerial problems due to on-farm feed processing and changing profit levels of storing and milling.

In conclusion, Arizona egg producers can reduce their feed costs by processing and storing feed ingredients on-farm rather than acquiring commercial feed. Economies of size were present for on-farm storage and on-farm milling. No diseconomies of size were found for the production levels examined in this study. On-farm processed feed eliminated the competitive disadvantage of Arizona egg producers in regards to California producers, who according to Wilson (1975), have lower average feed costs.

APPENDIX A

INITIAL INVESTMENT COSTS FOR PLASTIC TENT STORAGE SYSTEMS ON ARIZONA POULTRY RANCHES

Table A-1. Initial Investment Cost for Plastic Tent System, Flock A--30 Day Storage System[a]

Item	Price
A. Facilities	
I. Concrete slab--42' diameter, 5" thick; includes support footings	$2,078
II. R.R. ties--9'; 25 ties	150
III. Steel mesh--6'x6'x10'x10'; 792'	49
IV. Hardware cloth--1/8"; 792'	158
V. Utility pole--25'	14
VI. Steel cable--30' x 3/8"; 750'	232
VII. Polyethylene plastic--1500'^{2}	19
Total Facilities Cost	$2,700
B. Equipment[c]	
I. Screw conveyor, horizontal--6"x40'; includes supporting frame, two systems	$2,000
(a) Belt drive sheave	500
(b) 3 h.p. motor; push button with magnetic starter	280
II. Spouting	20
III. Hopper bin--4' x 2' x 4'	70
IV. Swivel screw, center-pivoting--6" x 21'; includes drive assembly with gear box	355
(a) 2 h.p. motor; push button with magnetic starter	126
Total Equipment Cost	$3,351
TOTAL INVESTMENT COST	$6,051

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table A-2. Initial Investment Cost for Plastic Tent System, Flock A--90 Day Storage System[a]

Item	Price
A. Facilities[b]	
Three systems (Table A-1)	
Total Facilities Cost	$ 8,100
B. Equipment[c]	
Three systems (Table A-1)	
Total Equipment Cost	$10,053
TOTAL INVESTMENT COST	$18,053

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table A-3. Initial Investment Cost for Plastic Tent System, Flock A--180 Day Storage System[a]

Item	Price
A. Facilities[b]	
Three double systems (Table A-1)	
Total Facilities Cost	$16,200
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 85'; includes supporting frame.	
Six systems	10,230
(a) Drive assembly including gear box.	
Six systems	1,650
(b) 10 h.p. motor; push button with magnetic starter	
Six systems	1,686
II. Spouting and Valves. Three systems	369
III. Hopper bin--2' x 4' x 2' Six systems	420
IV. Swivel Screw, center-pivoting--6" x 21' includes drive assembly with gear box. Six systems	2,190
(a) 2 h.p. motor; push button with magnetic starter. Six systems	756
Total Equipment Cost	$17,301
TOTAL INVESTMENT COST	$33,501

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table A-4. Initial Investment Cost for Plastic Tent System, Flock B--30 Day Storage System[a]

Item	Price
A. Facilities[b]	
Two systems (Table A-1)	
Total Facilities Cost	$ 5,400
B. Equipment[c]	
Two systems (Table	
Total Equipment Cost (Table A-1)	$ 6,702
TOTAL INVESTMENT COST	$12,102

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table A-5. Initial Investment Cost for Plastic Tent System, Flock B--90 Day Storage System[a]

Item	Price
A. Facilities[b]	
Three double systems (Table A-1)	
Total Facilities Cost	$16,200
B. Equipment[c]	
Three double systems (Table A-3)	
Total Equipment Cost	$17,301
TOTAL INVESTMENT COST	$33,501

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table A-6. Initial Investment Cost for Plastic Tent System, Flock B--180 Day Storage System[a]

Item	Price
A. Facilities[b]	
Twelve systems (Table A-1)	
Total Facilities Cost	$32,400
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 125'; includes support frame. Eight systems	18,360
(a) Drive assembly including gear box. Eight systems	3,200
(b) 15 h.p. motor; push button with magnetic starter. Eight systems	2,784
II. Spouting and valves. Four systems	944
III. Hopper bin--2' x 4' x 2'. Twelve systems	840
IV. Swivel screw, center-pivoting--6" x 21'; includes drive assembly with gear box. Twelve systems	4,380
(a) 2 h.p. motor; push button with magnetic starter. Twelve systems.	1,512
Total Equipment Cost	$32,020
TOTAL INVESTMENT COST	$64,420

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table A-7. Initial Investment Cost for Plastic Tent System, Flock C--30 Day Storage System[a]

Item	Price
A. Facilities[b]	
Four systems (Table A-1)	
Total Facilities Cost	$10,800
B. Equipment[c]	
Four systems (Table A-1)	
Total Equipment Cost	13,404
TOTAL INVESTMENT COST	$24,204

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table A-8. Initial Investment Cost for Plastic Tent System, Flock C--90 Day Storage System[a]

Item	Price
A. Facilities[b]	
Twelve systems (Table A-1)	
Total Facility Cost	$32,400
B. Equipment[c]	
Four piggy-back systems (Table A-6)	
Total Equipment Cost	32,020
TOTAL INVESTMENT COST	$64,420

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table A-9. Initial Investment Cost for Plastic Tent System, Flock C--180 Day Storage System[a]

Item	Price
A. Facilities[b]	
Twenty-four systems (Table A-1)	
Total Facility Cost	$64,800
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 250'; includes supporting frame. Eight systems	33,600
(a) Drive sheave assembly. Eight systems	6,400
(b) 25 h.p. motor; push button with magnetic starter. Eight systems	4,136
II. Spouting and valves Four systems	2,300
III. Hopper bin--2' x 4' x 2'. Twenty-four systems	1,680
IV. Swivel screw, center-pivoting--6" x 21'. Includes drive assembly with gear box. Twenty-four systems.	8,760
(a) 2 h.p. motor; push button with magnetic starter. Twenty-four systems	3,024
Total Equipment Cost	$59,900
TOTAL INVESTMENT COST	$124,700

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

APPENDIX B

INITIAL INVESTMENT COSTS FOR ROUND BIN MILO STORAGE SYSTEMS ON ARIZONA POULTRY RANCHES

Table B-1. Initial Investment Cost for Round Bin System, Flock A--30 Day Storage System[a]

Item	Price
A. Facilities	
I. Steel round bin--21' x 26'	$5,700
II. Concrete slab--21' diameter; 5" thick, including support footings	520
Total Facility Cost	$6,220
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 30'; includes supporting frame. Two systems	$ 980
(a) Belt drive sheaves. Two systems	88
(b) 2 h.p. motor; push button with magnetic starter. Two systems	252
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6' x 10.5'; includes drive assembly with gear box	265
(a) 1.5 h.p. motor; push button with magnetic starter	114
Total Equipment Cost	$1,779
TOTAL INVESTMENT COST	$7,999

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table B-2. Initial Investment Cost for Round Bin System, Flock A--90 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--30' x 36'	$14,300
II. Concrete slab--30' diameter; 5" thick; includes support footings	1,060
Total Facilities Cost	$15,360
B. Equipment[c]	
I. Screw Conveyor, horizontal--6" x 35'; includes supporting frame. Two systems	$1,580
(a) Belt drive sheave. Two systems	88
(b) 3 h.p. motor; push button with magnetic starter. Two systems	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 15'; includes drive assembly with gear box.	300
(a) 2 h.p. motor; push button with magnetic starter.	126
Total Equipment Cost	$ 2,454
TOTAL INVESTMENT COST	$17,814

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table B-3. Initial Investment Cost for Round Bin System, Flock A--180 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--36' x 54'	$28,200
II. Concrete slab--36' diameter; 5" thick, includes support footings.	1,527
Total Facilities Cost	$29,727
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 40'; includes supporting frame. Two systems	$ 2,000
(a) Belt drive sheave. Two systems	500
(b) 3 h.p. motor; push button with magnetic starter.	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel Screw, center-pivoting--6" x 18'; drive assembly with gear box.	300
(a) 2 h.p. motor; push button with magnetic starter.	126
Total Equipment Cost	$ 3,286
TOTAL INVESTMENT COST	$33,013

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table B-4. Initial Investment Cost for Round Bin System, Flock B--30 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--27' x 33'	$12,500
II. Concrete slab--27' diameter; 5" thick; includes support footings	859
Total Facilities Cost	$13,359
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 35'; includes supporting frame. Two systems	$ 1,580
(a) Belt drive sheave. Two systems	88
(b) 3 h.p. motor; push button with magnetic starter.	280
II. Spouting	10
III. Hopper Bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 13.5'; includes drive assembly with gear box.	300
(a) 1.5 h.p. motor; push button with magnetic starter	114
Total Equipment Cost	$ 2,442
TOTAL INVESTMENT COST	$15,801

[a]Includes 5% sales tax, erection and freight

[b]Schumacher (1979).

[c]Calendar (1979).

Table B-5. Initial Investment Cost for Round Bin System, Flock B--90 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--36' x 54'	$28,200
II. Concrete slab--36' diameter; 5" thick includes support footing	1,527
Total Facilities Cost	$29,727
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 40'; includes supporting frame. Two systems	$ 2,000
(a) Belt drive sheave. Two systems	500
(b) 3 h.p. motor; push button with magnetic starter. Two systems	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 18'; includes drive assembly with gear box.	300
(a) 2 h.p. motor; push button with magnetic starter.	126
Total Equipment Cost	$ 3,286
TOTAL INVESTMENT COST	$33,013

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table B-6. Initial Investment Cost for Round Bin System, Flock B--180 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--45' x 66'	$52,300
II. Concrete slab--45' diameter; 5" thick, includes support footings	2,386
Total Facilities Cost	$54,686
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 45'; includes supporting frame. Two systems	$ 1,180
(a) Belt drive sheave. Two systems	500
(b) 3 h.p. motor; push button with magnetic starter. Two systems	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 22.5' includes drive assembly with gear box.	365
(a) 2 h.p. motor; push button with magnetic starter.	126
Total Equipment Cost	$ 3,531
TOTAL INVESTMENT COST	$58,217

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table B-7. Initial Investment Cost for Round Bin System, Flock C--30 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--30' x 48'	$18,145
II. Concrete slab--30' diameter; 5" thick, includes support footings	1,060
Total Facilities Cost	$19,205
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 35'; includes supporting frame. Two systems	$ 1,580
(a) Belt drive sheave. Two systems	88
(b) 3 h.p. motor; push button with magnetic starter. Two systems	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 15'; includes drive assembly with gear box.	300
(a) 2 h.p. motor; push button with magnetic starter.	126
Total Equipment Cost	$ 2,454
TOTAL INVESTMENT COST	$21,659

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table B-8. Initial Investment Cost for Round Bin System, Flock C--90 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--45' x 66'	$52,300
II. Concrete slab--45' diameter; 5" thick, includes support footings	2,386
Total Facilities Cost	$54,686
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 45'; includes supporting frame. Two systems	$ 2,180
(a) Belt drive sheave. Two systems	500
(b) 3 h.p. motor; push button with magnetic starter. Two systems	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting 6" x 22.5'; includes drive assembly with gear box.	365
(a) 2 h.p. motor; push button with magnetic starter.	126
Total Equipment Costs	$ 3,531
TOTAL INVESTMENT COST	$58,217

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table B-9. Initial Investment Cost for Round Bin System, Flock C--180 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin	
1 - 42' x 66'	$49,000
1 - 45' x 80'	60,000
II. Concrete slab--5" thick, includes support footings.	
1 - 42' diameter	2,078
1 - 45' diameter	2,386
Total Facilities Cost	$113,464
B. Equipment[c]	
I. Screw conveyor, horizontal--includes supporting frame.	
1 - 6" x 40' -- Two systems	$ 2,000
1 - 6" x 45' -- Two systems	2,180
(a) Belt drive sheave--Two systems	500
(b) 3 h.p. motor; push button with magnetic starter--Two systems	280
(c) Belt drive sheave--Two systems	500
(d) 3 h.p. motor; push button with magnetic starter--Two systems	280
II. Spouting	20
III. Hopper bin--2' x 4' x 2' -- Two systems	140
IV. Swivel screw, center-pivoting--includes drive assembly with gear box:	
1 - 6" x 21'	365
1 - 6" x 22.5'	365
(a) 2 h.p. motor; push button with magnetic starter--Two systems	252
Total Equipment Cost	$ 6,882
TOTAL INVESTMENT COSTS	$120,346

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table B-10. Initial Investment Cost for Round Bin System, Flock A--120 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--20' x 48'	$18,145
II. Concrete slab--30' diameter; 5" thick, includes support footings	1,060
Total Facilities Cost	$19,205
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 35'; includes supporting frame. Two systems	$ 1,580
(a) Belt drive sheave--Two systems	88
(b) 3 h.p. motor; push button with magnetic starter--Two systems	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--includes drive assembly with gear box.	300
(a) 2 h.p. motor; push button with magnetic starter	126
Total Equipment Cost	$ 2,454
TOTAL INVESTMENT COST	$21,659

[a]Includes 5% sales Tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table B-11. Initial Investment Cost for Round Bin System, Flock B--120 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--42' x 54'	$36,000
II. Concrete slab--42' diameter; 5" thick, includes support footings	2,078
Total Facilities Cost	$38,078
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 40'; includes supporting frame. Two systems	$ 2,000
(a) Belt drive sheave. Two systems	500
(b) 3 h.p. motor; push button with magnetic starter. Two systems	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 21'; includes drive assembly with gear box.	365
(a) 2 h.p. motor; push button with magnetic starter	126
Total Equipment Cost	$ 3,351
TOTAL INVESTMENT COST	$41,429

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table B-12. Initial Investment Cost for Round Bin System, Flock C--120 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--48' x 80'	$70,700
II. Concrete slab--48' diameter; 5" thick, includes support footings	2,715
Total Facilities Cost	$73,415
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 45'; includes support frame. Two systems	$ 2,180
(a) Belt drive sheave. Two systems	500
(b) 3 h.p. motor; push button with magnetic starter. Two systems	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 24'; includes drive assembly with gear box.	365
(a) 2 h.p. motor; push button with magnetic starter	126
Total Equipment Cost	$ 3,531
TOTAL INVESTMENT COST	$76,946

[a]Includes 5% sales tax, freight and erection.

[b]Schumacher (1979).

[c]Calendar (1979).

APPENDIX C

INITIAL INVESTMENT COSTS FOR ROUND BIN SOYBEAN MEAL STORAGE SYSTEMS ON ARIZONA POULTRY RANCHES

Table C-1. Initial Investment Cost for Round Bin System, Flock A--30 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--15' x 15'	$3,300
II. Concrete slab--15' diameter; 5" thick, includes support footings	265
Total Facilities Cost	$3,565
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 30'; includes supporting frame. Two systems	$ 980
(a) Belt drive sheave. Two systems	88
(b) 2 h.p. motor; push button with magnetic starter. Two systems	252
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 7.5'; includes drive assembly with gear box	265
(a) 1.5 h.p. motor; push button with magnetic starter	114
Total Equipment Cost	$1,779
TOTAL INVESTMENT COST	$5,344

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table C-2. Initial Investment Cost for Round Bin System, Flock A--90 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--21' x 24'	$5,400
II. Concrete slab--21' diameter; 5" thick, includes support footings	520
Total Facilities Cost	$5,920
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 30'; includes supporting frame. Two systems	$ 980
(a) Belt drive sheave. Two systems	88
(b) 2 h.p. motor; push button with magnetic starter. Two systems	252
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 10.5'; includes drive assembly with gear box.	265
(a) 1.5 h.p. motor; push button with magnetic starter.	114
Total Equipment Cost	$1,779
TOTAL INVESTMENT COST	$7,699

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table C-3. Initial Investment Cost for Round Bin System, Flock A--180 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--24' x 33'	$10,800
II. Concrete slab--24' diameter, 5" thick; includes support footings	679
Total Facilities Cost	$11,479
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 35'; includes supporting frame. Two systems	$ 1,580
(a) Belt drive sheave. Two systems	88
(b) 3 h.p. motor; push button with magnetic starter. Two systems	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 12'; includes drive assembly with gear box.	280
(a) 1.5 h.p. motor; push button with magnetic starter	114
Total Equipment Cost	$ 2,422
TOTAL INVESTMENT COST	$13,901

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table C-4. Initial Investment Cost for Round Bin System, Flock B--30 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--18' x 22'	$4,500
II. Concrete slab--18' diameter; 5" thick, includes support footings	382
Total Facilities Cost	$4,882
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 30'; includes supporting frame. Two systems	$ 980
(a) Belt drive sheave. Two systems	88
(b) 2 h.p. motor; push button with magnetic starter	252
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 9'; includes drive assembly with gear box.	265
(a) 1.5 h.p. motor; push button with magnetic starter	114
Total Equipment Cost	$1,779
TOTAL INVESTMENT COST	$6,661

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table C-5. Initial Investment Cost for Round Bin System, Flock B--90 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--24' x 33'	$10,800
II. Concrete slab--24' diameter, 5" thick; includes support footings	679
Total Facilities Cost	$11,479
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 35'; includes supporting frame. Two systems	$ 1,580
(a) Belt drive sheave. Two systems	88
(b) 3 h.p. motor; push button with magnetic starter. Two systems	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 12'; includes drive assembly with gear box.	280
(a) 1.5 h.p. motor; push button with magnetic starter	114
Total Equipment Cost	$ 2,422
TOTAL INVESTMENT COST	$13,901

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table C-6. Initial Investment Cost for Round Bin System, Flock B--180 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--30' x 45'	$16,800
II. Concrete slab--30' diameter, 5" thick; includes support footings	1,060
Total Facilities Cost	$17,860
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 35'; includes supporting frame. Two systems	$ 1,580
(a) Belt drive sheave. Two systems	88
(b) 3 h.p. motor; push button with magnetic starter. Two systems	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 15'; includes drive assembly with gear box.	300
(a) 2 h.p. motor; push button with magnetic starter	126
Total Equipment Cost	$ 2,454
TOTAL INVESTMENT COST	$20,314

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table C-7. Initial Investment Cost for Round Bin System, Flock C--30 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel Round Bin--21' x 30'	$7,200
II. Concrete Slab--21' diameter; 5" thick; includes support footings	520
Total Facilities Cost	$7,720
B. Equipment[c]	
I. Screw Conveyor, Horizontal--6" x 30'; includes supporting frame; Two systems	$ 980
(a) Belt drive sheave--two systems	88
(b) 2 h.p. motor; push button with magnetic starter. Two systems	252
II. Spouting	10
III. Hopper Bin--2' x 4' x 2'	70
IV. Swivel Screw, Center-pivoting--6" x 10.5'; includes drive assembly with gear box	265
(a) 1.5 h.p. motor; push button with magnetic starter	114
Total Equipment Cost	$1,779
TOTAL INVESTMENT COST	$9,499

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table C-8. Initial Investment Cost for Round Bin System, Flock C--90 Day Storage System[a]

Item	Price
A. Facilities	
I. Steel Round Bin--30' x 45'	$16,800
II. Concrete Slab--30' diameter; 5" thick; includes support footings	1,060
Total Facilities Cost	$17,860
B. Equipment[c]	
I. Screw Conveyor, Horizontal--6" x 35'; Includes supporting frame; Two systems	$ 1,580
(a) Belt drive sheave--two systems	88
(b) 3 h.p. motor; push button with magnetic starter; two systems	280
II. Spouting	10
III. Hopper Bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 15'; includes drive assembly with gear box	300
(a) 2 h.p. motor; push button with magnetic starter	126
Total Equipment Cost	$ 2,454
TOTAL INVESTMENT COST	$20,314

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table C-9. Initial Investment Cost for Round Bin System, Flock C—180 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bins--30' x 48'; Two systems	$36,290
II. Concrete slabs--30' diameter; 5" thick; includes support footings Two systems	2,120
Total Facilities Cost	$38,410
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 35'; includes supporting frame Four systems	$ 3,160
(a) Belt drive sheave--four systems	176
(b) 3 h.p. motor; push button with magnetic starter; Four systems	560
II. Spouting	20
III. Hopper bin--2' x 4' x 2'	140
IV. Swivel screw, center-pivoting--6" x 15'; includes drive assembly with gear box; Two systems	600
(a) 2 h.p. motor; push button with magnetic starter; Two systems	252
Total Equipment Cost	$ 4,908
TOTAL INVESTMENT COST	$43,318

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table C-10. Initial Investment Cost for Round Bin System, Flock A--150 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--21' x 33'	$ 8,700
II. Concrete slab--21' diameter; 5" thick; includes supporting footings	520
Total Facilities Cost	$ 9,220
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 30'; includes supporting frame Two systems	$ 980
(a) Belt drive sheave--two systems	88
(b) 2 h.p. motor; push button with magnetic starter; two systems	252
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 10.5'; includes drive assembly with gear box	265
(a) 1.5 h.p. motor; push button with magnetic starter	114
Total Equipment Cost	$ 1,779
TOTAL INVESTMENT COST	$10,999

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table C-11. Initial Investment Cost for Round Bin System, Flock B--150 Day Storage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--30' x 33'	$13,200
II. Concrete slab--30' diameter; 5" thick; includes support footings	1,060
Total Facilities Cost	$14,260
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 35'; includes supporting frame; Two systems	$ 1,580
(a) Belt drive sheave--two systems	88
(b) 3 h.p. motor; push button with magnetic starter; two systems	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 15'; includes drive assembly with gear box	300
(a) 2 h.p. motor; push button with magnetic starter	126
Total Equipment Cost	$ 2,454
TOTAL INVESTMENT COST	$16,714

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

Table C-12. Initial Investment Cost for Round Bin System, Flock C--150 Day STorage System[a]

Item	Price
A. Facilities[b]	
I. Steel round bin--36' x 48'	$24,800
II. Concrete slab--36' diameter; 5" thick; includes support footings	1,527
Total Facilities Cost	$26,327
B. Equipment[c]	
I. Screw conveyor, horizontal--6" x 40'; includes supporting frame; two systems	$ 2,000
(a) Belt drive sheave--two systems	500
(b) 3 h.p. motor; push button with magnetic starter; two systems	280
II. Spouting	10
III. Hopper bin--2' x 4' x 2'	70
IV. Swivel screw, center-pivoting--6" x 18'; includes drive assembly with gear box	300
(a) 2 h.p. motor; push button with magnetic starter	126
Total Equipment Cost	$ 3,286
TOTAL INVESTMENT COST	$29,613

[a]Includes 5% sales tax, erection and freight.

[b]Schumacher (1979).

[c]Calendar (1979).

APPENDIX D

AVERAGE ANNUAL OPERATING COSTS FOR STORAGE SYSTEMS ON ARIZONA POULTRY RANCHES

Table D-1. Average Annual Operating Costs for 30 Day Storage Systems, Flock A

Cost Components	Milo Bin	Flat Storage	SBM Bin
Fixed Costs			
Investment			
Depreciation			
Facilities[a]	$ 236	$ 103	$ 135
Equipment[b]	99	187	99
TOTAL	335	290	234
Interest on Investment			
Storage System[c]	374	283	250
Insurance			
Storage System[d]	49	47	36
Grain[e]	500	500	360
TOTAL	549	547	396
Taxes[f]	62	47	41
Labor			
Wage[g]	3,132	3,132	1,044
FICA, Workmen's Comp.[h]	501	501	167
TOTAL	3,633	3,633	1,211
Maintenance[i]	440	333	294
Electrical[j]	345	455	331
Total Average Annual Production Costs	$5,738	$5,588	$2,757

[a]Depreciation -- 25 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[b]Depreciation -- 17 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[c]Interest on investment -- 8-1/2 percent on one-half initial investment, salvage value, and depreciation charge.

Table D-1. (continued)

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[d]Insurance — initial investment multiplied by .5 percent for facilities and 1 percent for equipment (McGhee 1979).

[e]Insurance -- $2.50 per $100 value; monthly investment times this rate. (Pan American Insurance Co. 1979).

[f]Taxes -- one-half initial investment and salvage value multiplied by 18 percent to compute assessed value. Assessed value divided by 1.15 is net assessed value, which is then multiplied by 9 percent to estimate tax bill (Larson 1979).

[g]Labor -- one man at $4.00 per hour, 20 hours per week (Poppe 1977).

[h]FICA, Workmen's Compensation -- 5.85 percent and 10.15 percent of salary respectively.

[i]Maintenance -- 5-1/2 percent on initial investment (Vosloh 1976).

[j]Electrical — estimate from Tucson Gas and Electric, including Rate No. 10 and tax (1979).

Table D-2. Average Annual Operating Costs for 90 Day Storage Systems, Flock A

Cost Components	Milo Bin	Flat Storage	SBM Bin
Fixed Costs			
Investment			
Depreciation			
Facilities[a]	$ 584	$ 308	$ 225
Equipment[b]	137	562	99
TOTAL	721	870	324
Interest on Investment			
Storage System[c]	833	849	360
Insurance			
Storage System[d]	91	141	47
Grain[e]	1,502	1,502	1,078
TOTAL	1,593	1,643	1,125
Taxes[f]	138	141	60
Labor			
Wage[g]	3,132	3,132	1,044
FICA, Workmen's Comp.[h]	501	501	167
TOTAL	3,633	3,633	1,211
Maintenance[i]	980	998	423
Electrical[j]	493	1,148	331
Total Average Annual Production Costs	$8,391	$9,282	$3,834

[a]Depreciation -- 25 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[b]Depreciation -- 17 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[c]Interest on investment -- 8-1/2 percent on one-half initial investment, salvage value and depreciation charge.

Table D-2. (continued)

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[d]Insurance -- initial investment multiplied by .5 percent for facilities and 1 percent for equipment (McGhee 1979).

[e]Insurance -- $2.50 per $100 value; monthly investment times this rate. (Pan American Insurance Co. 1979).

[f]Taxes -- one-half initial investment and salvage value multiplied by 18 percent to compute assessed value. Assessed value divided by 1.15 is net assessed value, which is then multiplied by 9 percent to estimate tax bill (Larson 1979).

[g]Labor -- one man at $4.00 per hour, 20 hours per week (Poppe 1977).

[h]FICA, Workmen's Compensation -- 5.85 percent and 10.15 percent of salary respectively.

[i]Maintenance -- 5-1/2 percent on initial investment (Vosloh 1976).

[j]Electrical -- Estimate from Tucson Gas and Electric, including Rate No. 10 and tax (1979).

Table D-3. Average Annual Operating Costs for 180 Day Storage Systems, Flock A

Cost Components	Milo Bin	Flat Storage	SBM Bin
<u>Fixed Costs</u>			
Investment			
Depreciation			
Facilities[a]	$ 1,130	$ 616	$ 436
Equipment[b]	184	967	135
TOTAL	1,314	1,583	571
Interest on Investment			
Storage System[c]	1,543	1,566	650
Insurance			
Storage System[d]	182	254	82
Grain[e]	3,006	3,006	2,156
TOTAL	3,188	3,260	2,238
Taxes[f]	256	260	108
Labor			
Wage[g]	3,132	3,132	1,044
FICA, Workmen's Comp.[h]	501	501	167
TOTAL	3,633	3,633	1,211
Maintenance[i]	1,816	1,843	765
Electrical[j]	685	4,621	615
<u>Total Average Annual Production Costs</u>	$12,435	$16,766	$6,158

[a]Depreciation -- 25 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[b]Depreciation -- 17 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[c]Interest on investment -- 8-1/2 percent on one-half initial investment, salvage value and depreciation charge.

Table D-3. (continued)

[d]Insurance -- initial investment multiplied by .5 percent for facilities and 1 percent for equipment (McGhee 1979).

[e]Insurance -- $2.50 per $100 value; monthly investment times this rate (Pan American Insurance Co. 1979)

[f]Taxes -- one-half initial investment and salvage value multiplied by 18 percent to compute assessed value. Assessed value divided by 1.15 is net assessed value, which is then multiplied by 9 percent to estimate tax bill (Larson 1979).

[g]Labor -- one man at $4.00 per hour, 20 hours per week (Poppe 1977).

[h]FICA, Workmen's Compensation -- 5.85 percent and 10.15 percent of salary respectively.

[i]Maintenance -- 5-1/2 percent on initial investment (Vosloh 1976).

[j]Electrical -- Estimate from Tucson Gas and Electric, including Rate No. 10 and tax (1979).

Table D-4. Average Annual Operating Costs for 30 Day Storage Systems, Flock B

Cost Components	Milo Bin	Flat Storage	SBM Bin
<u>Fixed Costs</u>			
Investment			
Depreciation			
Facilities[a]	$ 508	$ 205	$ 186
Equipment[b]	136	375	99
TOTAL	644	580	285
Interest on Investment			
Storage System[c]	739	566	311
Insurance			
Storage System[d]	91	94	42
Grain[e]	1,002	1,002	718
TOTAL	1,093	1,096	760
Taxes[f]	122	94	52
Labor			
Wage[g]	4,680	4,680	1,560
FICA, Workmen's Comp.[h]	748	748	250
TOTAL	5,428	5,428	1,810
Maintenance[i]	869	666	366
Electrical[j]	618	683	459
<u>Total Average Annual Production Cost</u>	$9,513	$9,113	$4,043

[a]Depreciation -- 25 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[b]Depreciation -- 17 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[c]Interest on investment -- 8-1/2 percent on one-half initial investment, salvage value, and depreciation charge.

Table D-4. (continued)

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[d]Insurance -- initial investment multiplied by .5 percent for facilities and 1 percent for equipment (McGhee 1979).

[e]Insurance -- $2.50 per $100 value; monthly investment times this rate (Pan American Insurance Co. 1979).

[f]Taxes -- one-half initial investment and salvage value multiplied by 18 percent to compute assessed value. Assessed value divided by 1.15 is net assessed value, which is then multiplied by 9 percent to estimate tax bill (Larson 1979).

[g]Labor -- one man at $4.00 per hour, 30 hours per week (Poppe 1977).

[h]FICA, Workmen's Compensation -- 5.85 percent and 10.15 percent of salary respectively.

[i]Maintenance -- 5-1/2 percent on initial investment (Vosloh 1976).

[j]Electrical -- Estimate from Tucson Gas and Electric, including Rate No. 10 and tax (1979).

Table D-5. Average Annual Operating Costs for 90 Day Storage Systems, Flock B

Cost Components	Milo Bin	Flat Storage	SBM Bin
Fixed Costs			
Investment			
Depreciation			
Facilities[a]	$ 1,130	$ 616	$ 436
Equipment[b]	184	967	135
TOTAL	1,314	1,583	571
Interest on Investment			
Storage System[c]	1,543	1,566	650
Insurance			
Storage System[d]	182	254	82
Grain[e]	3,006	3,006	2,156
TOTAL	3,188	3,260	2,238
Taxes[f]	256	260	108
Labor			
Wage[g]	4,680	4,680	1,560
FICA, Workmen's Comp.[h]	749	749	250
TOTAL	5,429	5,429	1,810
Maintenance[i]	1,816	1,843	765
Electrical[j]	685	4,621	615
Total Average Annual Production Costs	$14,231	$18,562	$6,757

[a]Depreciation -- 25 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[b]Depreciation -- 17 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[c]Interest on investment -- 8-1/2 percent on one-half initial investment, salvage value, and depreciation charge.

Table D-5. (continued)

[d]Insurance -- initial investment multiplied by .5 percent for facilities and 1 percent for equipment (McGhee 1979).

[e]Insurance -- $2.50 per $100 value; monthly investment times this rate (Pan American Insurance Co. 1979).

[f]Taxes -- one-half initial investment and salvage value multiplied by 18 percent to compute assessed value. Assessed value divided by 1.15 is net assessed value, which is then multiplied by 9 percent to estimate tax bill (Larson 1979).

[g]Labor -- one man at $4.00 per hour, 30 hours per week (Poppe 1977).

[h]FICA, Workmen's Compensation -- 5.85 percent and 10.15 percent of salary respectively.

[i]Maintenance -- 5-1/2 percent on initial investment (Vosloh 1976).

[j]Electrical -- Estimate from Tucson Gas and Electric, including Rate No. 10 and tax (1979).

Table D-6. Average Annual Operating Costs for 180 Day Storage Systems, Flock B

Cost Components	Milo Bin	Flat Storage	SBM Bin
Fixed Costs			
Investment			
Depreciation			
Facilities[a]	$ 2,078	$ 1,231	$ 678
Equipment[b]	197	1,789	137
TOTAL	2,275	3,020	815
Interest on Investment			
Storage System[c]	2,722	3,182	950
Insurance			
Storage System[d]	309	482	114
Grain[e]	6,012	6,012	4,312
TOTAL	6,321	6,494	4,426
Taxes[f]	451	527	157
Labor			
Wage[g]	4,680	4,680	1,560
FICA, Workmen's Comp.[h]	749	749	250
TOTAL	5,429	5,429	1,810
Maintenance[i]	3,202	3,543	1,117
Electrical[j]	869	11,080	801
Total Average Annual Production Costs	$21,269	$33,275	$10,076

[a]Depreciation -- 25 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[b]Depreciation -- 17 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[c]Interest on investment -- 8-1/2 percent on one-half initial investment, salvage value and depreciation charge.

Table D-6. (continued)

[d] Insurance -- initial investment multiplied by .5 percent for facilities and 1 percent for equipment (McGhee 1979).

[e] Insurance -- $2.50 per $100 value; monthly investment times this rate (Pan American Insurance Co. 1979).

[f] Taxes -- one-half initial investment and salvage value multiplied by 18 percent to compute assessed value. Assessed value divided by 1.15 is net assessed value, which is then multiplied by 9 percent to estimate tax bill (Larson 1979).

[g] Labor -- one man at $4.00 per hour, 30 hours per week (Poppe 1977).

[h] FICA, Workmen's Compensation -- 5.85 percent and 10.15 percent of salary respectively.

[i] Maintenance -- 5-1/2 percent on initial investment (Vosloh 1976).

[j] Electrical -- estimate from Tucson Gas and Electric, including Rate No. 10 and tax (1979).

Table D-7. Average Annual Operating Costs for 30 Day Storage Systems, Flock C

Cost Components	Milo Bin	Flat Storage	SBM Bin
Fixed Costs			
Investment			
Depreciation			
Facilities[a]	$ 730	$ 410	$ 293
Equipment[b]	137	749	99
TOTAL	867	1,159	392
Interest on Investment			
Storage System[c]	1,013	1,132	444
Insurance			
Storage System[d]	121	188	56
Grain[e]	2,004	2,004	1,440
TOTAL	2,125	2,192	1,496
Taxes[f]	168	188	74
Labor			
Wage[g]	6,240	6,240	2,080
FICA, Workmen's Comp.[h]	998	998	333
TOTAL	7,238	7,238	2,413
Maintenance[i]	1,191	1,331	522
Electrical[j]	869	1,075	579
Total Average Annual Production Costs	$13,471	$14,315	$5,920

[a]Depreciation — 25 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[b]Depreciation — 17 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[c]Interest on investment -- 8-1/2 percent on one-half initial investment, salvage value, and depreciation charge.

Table D-7. (continued)

[d]Insurance -- initial investment multiplied by .5 percent for facilities and 1 percent for equipment (McGhee 1979).

[e]Insurance -- $2.50 per $100 value; monthly investment times this rate (Pan American Insurance Co. 1979).

[f]Taxes -- one-half initial investment and salvage value multiplied by 18 percent to compute assessed value. Assessed value divided by 1.15 is net assessed value, which is then multiplied by 9 percent to estimate tax bill (Larson 1979).

[g]Labor -- one man at $4.00 per hour, 40 hours per week (Poppe 1977).

[h]FICA, Workmen's Compensation -- 5.85 percent and 10.15 percent of salary respectively.

[i]Maintenance -- 5-1/2 percent on initial investment (Vosloh 1976).

[j]Electrical -- estimate from Tucson Gas and Electric, including Rate No. 10 and tax (1979).

Table D-8. Average Annual Operating Costs for 90 Day Storage Systems, Flock C

Cost Components	Milo Bin	Flat Storage	SBM Bin
Fixed Costs			
Investment			
Depreciation			
Facilities[a]	$ 2,078	$ 1,231	$ 678
Equipment[b]	197	1,789	137
TOTAL	2,275	3,020	815
Interest on Investment			
Storage System[c]	2,722	3,182	950
Insurance			
Storage System[d]	309	482	114
Grain[e]	6,012	6,012	4,312
TOTAL	6,321	6,494	4,426
Taxes[f]	451	527	157
Labor			
Wage[g]	6,240	6,240	2,080
FICA, Workmen's Comp.[h]	998	998	333
TOTAL	7,238	7,238	2,413
Maintenance[i]	3,202	3,543	1,117
Electrical[j]	869	11,080	801
Total Average Annual Production Costs	$23,078	$35,084	$10,679

[a]Depreciation -- 25 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[b]Depreciation -- 17 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[c]Interest on investment -- 8-1/2 percent on one-half initial investment, salvage value and depreciation charge.

Table D-8. (continued)

[d]Insurance -- initial investment multiplied by .5 percent for facilities and 1 percent for equipment (McGhee 1979).

[e]Insurance -- $2.50 per $100 value; monthly investment times this rate (Pan American Insurance Co. 1979).

[f]Taxes -- one-half initial investment and salvage value multiplied by 18 percent to compute assessed value. Assessed value divided by 1.15 is net assessed value, which is then multiplied by 9 percent to estimate tax bill (Larson 1979).

[g]Labor -- one man at $4.00 per hour, 40 hours per week (Poppe 1977).

[h]FICA, Workmen's Compensation -- 5.85 percent and 10.15 percent of salary respectively.

[i]Maintenance -- 5-1/2 percent on initial investment (Vosloh 1976).

[j]Electrical -- estimate from Tucson Gas and Electric, including Rate No. 10 and tax (1979).

Table D-9. Average Annual Operating Costs for 180 Day Storage Systems, Flock C

Cost Components	Milo Bin	Flat Storage	SBM Bin
<u>Fixed Costs</u>			
Investment			
Depreciation			
Facilities[a]	$ 4,312	$ 2,462	$ 1,460
Equipment[b]	385	3,347	274
TOTAL	4,697	5,809	1,734
Interest on Investment			
Storage System[c]	5,488	5,830	2,025
Insurance			
Storage System[d]	636	923	241
Grain[e]	12,022	12,022	8,624
TOTAL	12,658	12,945	8,865
Taxes[f]	909	966	336
Labor			
Wage[g]	6,240	6,240	2,080
FICA, Workmen's Comp.[h]	998	998	333
TOTAL	7,238	7,238	2,413
Maintenance[i]	6,456	6,858	2,382
Electrical[j]	1,485	18,474	1,485
<u>Total Average Annual Production Costs</u>	$38,931	$58,120	$19,240

[a]Depreciation -- 25 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[b]Depreciation -- 17 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[c]Interest on investment -- 8-1/2 percent on one-half initial investment, salvage value and depreciation charge.

Table D-9. (continued)

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[d]Insurance -- initial investment multiplied by .5 percent for facilities and 1 percent for equipment (McGhee 1979).

[e]Insurance -- $2.50 per $100 value; monthly investment times this rate (Pan American Insurance Co. 1979).

[f]Taxes — one-half initial investment and salvage value multiplied by 18 percent to compute assessed value. Assessed value divided by 1.15 is net assessed value, which is then multiplied by 9 percent to estimate tax bill (Larson 1979).

[g]Labor -- one man at $4.00 per hour, 40 hours per week (Poppe 1977).

[h]FICA, Workmen's Compensation — 5.85 percent and 10.15 percent of salary respectively.

[i]Maintenance -- 5-1/2 percent on initial investment (Vosloh 1976).

[j]Electrical -- estimate from Tucson Gas and Electric, including Rate No. 10 and tax (1979).

Table D-10. Average Annual Operating Costs for 120 Day Milo and 150 Day Storage Systems, Flock A

Cost Components	Milo Bin	SBM Bin
Fixed Costs		
Investment		
Depreciation		
Facilities[a]	$ 730	$ 350
Equipment[b]	137	99
TOTAL	867	449
Interest on Investment		
Storage System[c]	1,013	514
Insurance		
Storage System[d]	121	64
Grain[e]	2,003	1,860
TOTAL	2,124	1,924
Taxes[f]	168	85
Labor		
Wage[g]	3,132	1,044
FICA, Workmen's Comp.[h]	501	167
TOTAL	3,633	1,211
Maintenance[i]	1,191	605
Electrical[j]	493	337
Total Average Annual Production Costs	$9,489	$5,125

[a]Depreciation -- 25 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[b]Depreciation -- 17 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[c]Interest on investment -- 8-1/2 percent on one-half initial investment, salvage value and depreciation charge.

Table D-10. (continued)

[d]Insurance -- initial investment multiplied by .5 percent for facilities and 1 percent for equipment (McGhee 1979).

[e]Insurance -- $2.50 per $100 value; monthly investment times this rate (Pan American Insurance Co. 1979).

[f]Taxes -- one-half initial investment and salvage value multiplied by 18 percent to compute assessed value. Assessed value divided by 1.15 is net assessed value, which is then multiplied by 9 percent to estimate tax bill (Larson 1979).

[g]Labor -- one man at $4.00 per hour, 20 hours per week (Poppe 1977).

[h]FICA, Workmen's Compensation -- 5.85 percent and 10.15 percent of salary respectively.

[i]Maintenance -- 4-1/2 percent on initial investment (Vosloh 1976).

[j]Electrical -- estimate from Tucson Gas and Electric, including Rate No. 10 and tax (1979).

Table D-11. Average Annual Operating Costs for 120 Day Milo and 150 Day SBM Storage Systems, Flock B

Cost Components	Milo Bin	SBM Bin
Fixed Costs		
Investment		
Depreciation		
Facilities[a]	$ 1,447	$ 542
Equipment[b]	187	137
TOTAL	1,634	679
Interest on Investment		
Storage System[c]	1,937	781
Insurance		
Storage System[d]	224	96
Grain[e]	4,006	3,720
TOTAL	4,230	3,816
Taxes[f]	321	129
Labor		
Wage[g]	4,680	1,560
FICA, Workmen's Comp.[h]	749	250
TOTAL	5,429	1,810
Maintenance[i]	2,279	919
Electrical[j]	685	685
Total Average Annual Production Costs	$16,515	$8,819

[a] Depreciation -- 25 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[b] Depreciation -- 17 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[c] Interest on investment -- 8-1/2 percent on one-half initial investment, salvage value and depreciation charge.

Table D-11. (continued)

[d]Insurance -- initial investment multiplied by .5 percent for facilities and 1 percent for equipment (McGhee 1979).

[e]Insurance -- $2.50 per $100 value; monthly investment times this rate (Pan American Insurance Co. 1979).

[f]Taxes -- one-half initial investment and salvage value multiplied by 18 percent to compute assessed value. Assessed value divided by 1.15 is net assessed value, which is then multiplied by 9 percent to estimate tax bill (Larson 1979).

[g]Labor -- one man at $4.00 per hour, 30 hours per week (Poppe 1977).

[h]FICA, Workmen's Compensation -- 5.85 percent and 10.15 percent of salary respectively.

[i]Maintenance -- 5-1/2 percent on initial investment (Vosloh 1976).

[j]Electrical -- estimate from Tucson Gas and Electric, including Rate No. 10 and tax (1979).

Table D-12. Average Annual Operating Costs for 120 Day Milo and 150 Day SBM Storage Systems, Flock C

Cost Components	Milo Bin	SBM Bin
Fixed Costs		
Investment		
Depreciation		
Facilities[a]	$ 2,790	$ 1,000
Equipment[b]	197	184
TOTAL	2,987	1,184
Interest on Investment		
Storage System[c]	3,597	1,384
Insurance		
Storage System[d]	402	164
Grain[e]	8,012	7,441
TOTAL	8,414	7,605
Taxes[f]	596	229
Labor		
Wage[g]	6,240	2,080
FICA, Workmen's Comp.[h]	998	333
TOTAL	7,238	2,413
Maintenance[i]	4,232	1,629
Electrical[j]	869	869
Total Average Annual Production Costs	$27,933	$15,313

[a]Depreciation -- 25 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[b]Depreciation -- 17 years straight line depreciation (Vosloh 1976), 5 percent salvage value matches IRS allowance.

[c]Interest on investment -- 8-1/2 percent on one-half initial investment, salvage value and depreciation charge.

Table D-12. (continued)

[d]Insurance -- initial investment multiplied by .5 percent for facilities and 1 percent for equipment (McGhee 1979).

[e]Insurance $2.50 per $100 value; monthly investment times this rate (Pan American Insurance Co. 1979).

[f]Taxes -- one-half initial investment and salvage value multiplied by 18 percent to compute assessed value. Assessed value divided by 1.15 is net assessed value, which is then multiplied by 9 percent to estimate tax bill (Larson 1979).

[g]Labor -- one man at $4.00 per hour, 40 hours per week (Poppe 1977).

[h]FICA, Workmen's Compensation -- 5.85 percent and 10.15 percent of salary respectively.

[i]Maintenance -- 5-1/2 percent on initial investment (Vosloh 1976).

[j]Electrical -- estimate from Tucson Gas and Electric, including Rate No. 10 and tax (1979).

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