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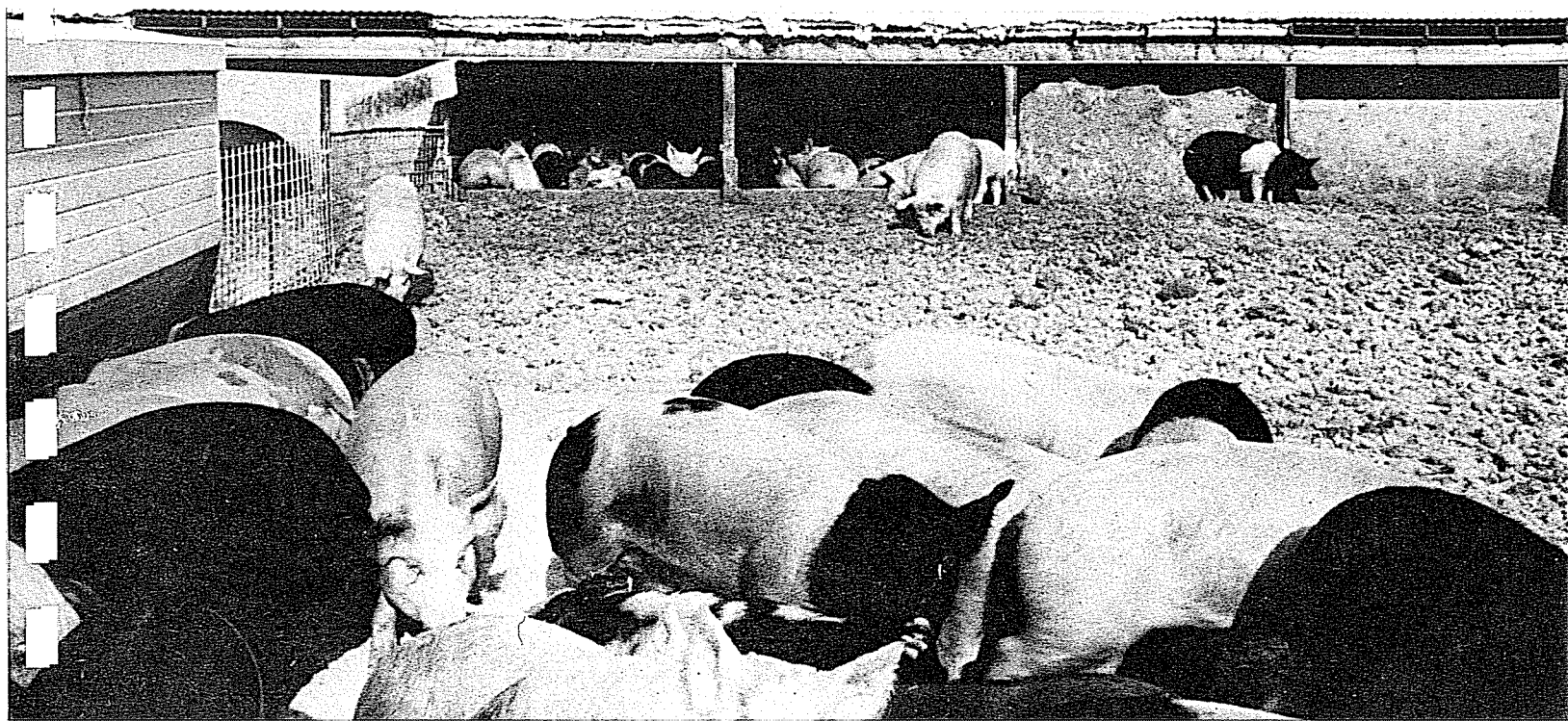
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# ECONOMICS OF PORK PRODUCTION

in North Dakota

By  
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#### FOREWORD

This report represents a continuation of investigation of factors influencing the profitability of livestock production in North Dakota.

The authors wish to extend their appreciation to the pork producers who were interviewed. Without their help, this study would not have been possible.

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## HIGHLIGHTS

The purpose of this study is to provide pork producers with information useful in decision making and to provide public policy makers with a better understanding of the pork industry. The basic data were obtained from a survey of pork producers. Fifty-six farrow to finish producers were able to provide all the information requested, and these were stratified by size of hog enterprise into four groups.

Spring was the most common farrowing period for producers of all but the largest size group. However, producers with a large hog operation typically farrowed year around. The average number of pigs saved per litter was 8.3.

Total investment for the hog enterprise averaged \$18,632 for all producers. The breeding herd represented the largest component of the total investment for all size groups, followed closely by buildings.

The labor used for the hog enterprise averaged 891 hours for all producers, or 1.11 hours per hundredweight of pork produced. Producers with larger hog enterprises had much smaller labor requirements per unit of pork produced.

The total cost of pork production averaged \$17.96 per hundredweight, consisting of \$14.77 of variable costs and \$3.16 of fixed costs. The largest variable cost item was feed, averaging \$9.64 per hundredweight or 53.7 percent of total production costs. Both interest on investment and depreciation were important fixed costs.

Substantial economies of size were found in pork production. The relation between production costs per hundredweight and the amount of production was estimated statistically. The cost estimates ranged from \$22.90 per hundredweight at a production level of 25,000 pounds to \$15.60 at a production level of 250,000 pounds. The primary source of cost advantage for larger producers was lower labor costs per unit of output.

The rate of return on investment in the hog enterprise averaged 12.7 percent, ranging from a negative return for the group of producers with the smallest hog enterprises to 17.2 percent for the group with the largest enterprises.

# ECONOMICS OF PORK PRODUCTION IN NORTH DAKOTA

by  
Bernhard Huber and F. Larry Leistritz

## INTRODUCTION

Hogs provide North Dakota farmers with an important source of income. In 1971, total receipts from sales of hogs and pigs were \$25.8 million. This amounts to 12 percent of all income received from livestock production or about 2.5 percent of North Dakota's total agricultural income.<sup>1</sup> Hogs are produced in every North Dakota county; however, hog production is concentrated in the southern part of the state (see Appendix Table 1). Hog production in the state has fluctuated considerably during the past 30 years and has increased substantially since 1967.

Production of hogs has undergone many technological changes in recent years. Specialized machinery, equipment, and buildings have been substituted for labor, while purchased feeds have been substituted for homegrown grains. The number of hog producers in North Dakota has declined sharply in the past decade. While 21,500 farmers produced hogs in 1960, only 9,500 produced hogs in 1971.<sup>2</sup> Meanwhile, the average number of hogs per farm increased from 13 in 1960 to 42 in 1971.<sup>3</sup> Thus, the trend in the North Dakota pork industry is toward fewer but larger and more specialized hog producing farms. The technological and organizational changes in pork production have rendered previous information on production practices, investments, and costs out of date. On the other hand, rapid changes in technology and the economic environment make it essential that information on the costs and resource requirements of pork production be current and accurate.

### Objectives of the Study

The primary purpose of this report is to determine the factors affecting the costs and profits of North Dakota pork producers. The specific objectives of the study are to:

1. Determine the labor and capital requirements for hog production.
2. Determine the costs of producing hogs and the variables that affect cost per unit of pork produced.
3. Determine the returns from hog production.

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<sup>1</sup>United States Department of Agriculture, Statistical Reporting Service, North Dakota Crop and Livestock Statistics, 1971, Agricultural Statistics No. 26, in cooperation with the Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota, May, 1972, pp. 55 and 66.

<sup>2</sup>Ibid., p. 56.

<sup>3</sup>Ibid., p. 53.

### Procedure

The data summarized in this report were obtained through personal interviews with hog producers. County agents throughout North Dakota provided names of the hog producers in their respective areas. The study area selected included 33 counties (see Figure 1). The 20 counties in the north-central and western parts of the state that were omitted from the survey account for only a minor portion of North Dakota's hog production.

A preliminary mail survey was taken to determine the basic production system and size of hog enterprise for each producer. The responses from this preliminary survey provided a list of producers from which a subsample stratified according to size of hog enterprise was selected for personal interviews.

Among the producers interviewed, 56 farrow-finish producers provided sufficient data to be included in the study. The information provided by these producers for the 1971 production year forms the basis for this report.

### Hog Prices

The cost and return data used were for a single year, 1971. A comparison of prices received by pork producers in 1971 with corresponding prices for other recent years is of interest to determine whether 1971 was financially favorable or unfavorable for pork producers.

Prices received for hogs in 1971 by North Dakota producers were somewhat lower than in other recent years, averaging \$17.00 per hundredweight. Not since 1964 had hog prices been this low. By contrast, in 1972 North Dakota hog prices averaged \$24.20 per hundredweight--the highest on record (see Appendix Table 2).

## PRODUCTION AND MARKETING PRACTICES

Farrow-finish pork producers were divided into four size groups on the basis of the number of butcher hogs produced in 1971. Producers of 100 or fewer hogs were placed in Group I and those raising 101 to 200 butcher hogs were assigned to Group II. Group III includes producers of 201 to 500 butcher hogs, while producers with more than 501 hogs made up Group IV. In Table 1 a summary of information concerning swine enterprise size and management practices is presented.

### Sow Herd Management

The average size of sow herd ranged from 9.8 sows for Group I to 54.8 sows for Group IV. All 56 producers owned boars, and the average number of sows per boar increased sharply between Groups II and III.

Spring was the most common farrowing period for producers of the first three size groups. However, a relationship appears to exist between size of pork enterprise and farrowing practices. Group I producers typically farrowed only in the spring, while the typical producer in Groups III and IV had farrowings in all four farrowing periods (Table 1). The average number of pigs saved per litter was greatest in Group II and least in Group I. Considering all producers, an average of 8.3 pigs were saved per litter.





Feeds and Feeding Systems

Feeding practices of pork producers appear to be related to enterprise size. Self-feeding systems were used by most producers in Groups I and II, and by all producers in Groups III and IV (Table 2). All producers used some purchased feeds to supplement their homegrown grains, and a few producers (14 percent) used purchased feeds exclusively. In each size group, protein supplements were the type of feed most commonly purchased, followed by pig starter. Oats and barley were the homegrown feeds used most commonly, while less than one-third of the producers (32 percent) fed corn to their hogs.

TABLE 1. CHARACTERISTICS OF FARROW-FINISH PORK OPERATIONS, NORTH DAKOTA, 1971

Item	Unit	Farm Size Group				All Producers
		I	II	III	IV	
Number of producers	Number	11	16	16	13	56
Average amount of pork produced	Cwt.	206.7	402.6	797.6	1,795.9	800.4
Average size of sow herd	Number	9.8	10.8	30.3	54.8	25.3
Average number of boars	Number	1.2	1.1	1.8	3.2	1.6
Average number of sows per boar	Number	8.2	9.5	16.8	17.4	13.0
Percent of producers farrowing in:						
Spring	Percent	90.9	93.8	81.3	84.5	87.5
Summer	Percent	9.1	25.0	62.5	100.0	50.0
Fall	Percent	18.2	50.0	56.3	92.3	55.4
Winter	Percent	18.2	31.3	81.3	84.5	55.3
Average pigs saved per litter	Number	7.7	8.6	8.3	8.3	8.3

Homegrown feed made up the majority of all feed used for each size group. However, there was a definite tendency toward less reliance on homegrown feed as the size of the hog enterprise increased. While Group I producers obtained only 17.5 percent of their total feed requirements from purchased feeds, Group IV producers relied on purchased feeds for 49.1 percent of their feed requirements.

Buildings and Equipment

A definite relationship exists between the size of the hog enterprise and the type of buildings and equipment used. Table 3 is a summary of the major buildings and equipment items used for hog production. As the size of the hog operation increases, specialized buildings and automated equipment are used more frequently. For example, only 27.3 percent of Group I producers

used special sow barns; whereas, 76.9 percent of Group IV producers had a sow barn. A similar pattern is observed with regard to finishing barns. Only 18.2 percent of Group I producers had finishing barns compared to 92.3 percent for the Group IV producers.

Automated equipment is used more frequently by producers with larger hog enterprises. Automatic waterers were used much more frequently by larger producers. Heating systems and feed mills were items used by all groups, and no clear pattern could be observed among groups with respect to usage of these items. Farrowing crates, on the other hand, were used much more frequently by producers in Groups III and IV.

TABLE 2. FEEDING PRACTICES OF FARROW-FINISH PORK PRODUCERS, NORTH DAKOTA, 1971

Item	Unit	Farm Size Group				All Producers
		I	II	III	IV	
Feeding system:						
Hand-feeding	Percent	45.5	12.5	0.0	0.0	12.5
Self-feeding	Percent	54.5	87.5	100.0	100.0	87.5
Percent of producers using:						
Homegrown feed:						
Barley	Percent	72.7	43.8	43.8	69.2	55.4
Corn	Percent	36.4	37.5	25.0	30.8	32.1
Oats	Percent	90.9	75.0	68.0	69.2	75.0
Alfalfa	Percent	27.3	50.0	25.0	30.8	33.9
Purchased feed:						
Grain	Percent	9.1	31.3	37.5	53.8	33.9
Starter	Percent	18.2	37.5	62.5	61.5	46.4
Grower	Percent	0.0	25.0	43.8	46.2	30.4
Finisher	Percent	18.2	18.8	43.8	38.5	30.4
Supplement	Percent	36.4	56.3	56.3	69.2	55.4
Percent of feed:						
Homegrown	Percent	82.5	67.3	52.7	50.9	56.1
Purchased	Percent	17.5	33.7	47.3	49.1	43.9

TABLE 3. BUILDINGS AND EQUIPMENT USED BY FARROW-FINISH PORK PRODUCERS, NORTH DAKOTA, 1971

Item	Unit	Farm Size Group				All Producers
		I	II	III	IV	
Percent of producers using:						
Farrowing houses	Percent	81.8	93.8	100.0	100.0	94.6
Finishing barns	Percent	18.2	43.8	68.8	92.3	57.1
Sow barns	Percent	27.3	43.8	68.8	76.9	55.4
Nursery	Percent	0.0	12.5	25.0	30.8	17.9
Farrowing crates	Percent	27.3	25.0	75.0	92.6	55.4
Feed mill	Percent	63.6	62.5	50.8	76.9	62.5
Automatic waterers	Percent	54.5	68.8	81.3	100.0	76.8
Heating system	Percent	81.8	100.0	81.3	76.9	85.7

### Disease Prevention

Maintenance of animal health is one of the major concerns of any pork producer. In addition to immediate death losses, swine diseases may lead to stunting and depression of growth which may be even more serious than the losses through death.<sup>4</sup> Only 25 percent of the farmers interviewed did not report any disease problems. The overall death loss was 9 percent, and no definite relationship between enterprise size and level of death loss could be identified. Most producers (79 percent) vaccinated their pigs against erysipelas and 25 percent also vaccinated against leptospirosis. The major diseases reported were scours and erysipelas, which were reported by 27 and 14 percent of the producers, respectively.

### Marketing Practices

Direct marketing was the most common marketing practice among producers interviewed. Considering all producers, 59 percent marketed their hogs direct, 32 percent sold their hogs through a terminal market, and 9 percent sold through an auction market.

## RESOURCE REQUIREMENTS OF HOG PRODUCTION

Production of hogs requires a large investment in specialized buildings and equipment. A substantial amount of labor also is needed to operate a successful hog operation. This section summarizes the labor and capital requirements of hog production.

### Investment Requirements

The average producer had \$18,632 invested in his hog operation (Table 4). The investment figures summarized in Table 4 refer to the present value of buildings, machinery and equipment, and the hog inventory. Some buildings and machinery items were used partly for the hog enterprise and partly for other enterprises on the farm. The investment for these items represents only the portion that they were used for the hog enterprise.

The investment per hundredweight of pork produced is summarized in Table 4. The average investment per hundredweight for all producers was \$23.28, and no clear relationship was observed between enterprise size and per unit capital requirements. Producers in Group I had the lowest investment, but this is probably explained by the fact that these producers did less fall and winter farrowing, and in general, had older buildings and less automated operations than producers in the other groups. The breeding herd represented the largest component of the total investment for all size groups, followed closely by buildings.

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<sup>4</sup>Glenn, W.M., "Swine Diseases--Prevention and Control," in Practical Hog Production and Marketing for South Dakota Farmers, EC649, Cooperative Extension Service, South Dakota State University, Brookings, South Dakota, 1970, p. 49.

TABLE 4. INVESTMENT OF FARROW-FINISH PORK PRODUCERS, NORTH DAKOTA, 1971

Item	Unit	Farm Size Group				All Producers
		I	II	III	IV	
Investment per farm in:						
Buildings	Dollars	1,199	4,414	8,862	15,979	7,792
Machinery and equipment	Dollars	681	1,529	1,774	4,362	2,090
Breeding herd	Dollars	2,065	4,028	9,872	18,839	8,750
Total investment per farm	Dollars	3,945	9,971	20,508	39,180	18,632
Investment per hundredweight of pork produced	Dollars	19.08	24.77	25.71	21.82	23.28

Labor Requirements

The average producer used 890.9 hours of labor for his hog enterprise in 1971 (Table 5). This amounted to 1.11 hours per hundredweight of pork produced. The labor requirement per unit of pork produced declined rapidly as the size of hog enterprise increased. Producers in Group I used 2.61

TABLE 5. LABOR USED BY FARROW-FINISH PORK PRODUCERS, NORTH DAKOTA, 1971

Item	Unit	Farm Size Group				All Producers
		I	II	III	IV	
Labor used per hundredweight of pork produced:						
Daily care of hogs <sup>a</sup>	Hours	1.53	0.94	0.46	0.35	0.52
Farrowing	Hours	0.48	0.35	0.12	0.09	0.15
Feed grinding	Hours	0.16	0.13	0.08	0.05	0.07
Repairs	Hours	0.14	0.08	0.10	0.04	0.06
Cleaning and sanitation <sup>b</sup>	Hours	0.17	0.26	0.29	0.19	0.23
Marketing	Hours	<u>0.14</u>	<u>0.11</u>	<u>0.07</u>	<u>0.06</u>	<u>0.08</u>
Total	Hours	2.62	1.87	1.12	0.78	1.11
Total labor used per farm		540.0	752.3	864.1	1,388.8	890.9

<sup>a</sup>Includes feeding, watering, etc.

<sup>b</sup>Includes barn cleaning, manure hauling, etc.

SOURCE: Appendix Table 3.

hours of labor per hundredweight; whereas, Group IV producers used only 0.77 hours. Reduced labor requirements per unit are one of the primary advantages realized by large hog operations.

PRODUCTION COSTS

Production of hogs in any one year results in fixed and variable costs being incurred by the producer. Variable costs are the only costs to be considered in deciding whether or not to produce hogs in the short run.<sup>5</sup> If the revenue from producing hogs is greater than the costs of the variable resources (variable costs), then it is rational to produce hogs in the short run, even if the revenue is less than the total of variable and fixed costs. In making long-run planning decisions, however, the producer must consider both fixed and variable costs and should not plan to produce in the long run unless both sets of costs can be covered.<sup>6</sup> A summary of the fixed and variable costs of hog production is presented in Table 6.

TABLE 6. COSTS PER HUNDREDWEIGHT OF PORK PRODUCED, FARROW-FINISH PORK PRODUCERS, NORTH DAKOTA, 1971

Item	Unit	Farm Size Group				All Producers
		I	II	III	IV	
Fixed costs:						
Interest <sup>a</sup>	Dollars	1.36	1.73	1.76	1.53	1.60
Depreciation	Dollars	1.60	1.91	1.48	1.27	1.43
Insurance	Dollars	0.11	0.11	0.12	0.11	0.11
Land charge <sup>b</sup>	Dollars	0.10	0.02	c	0.01	0.02
Total fixed costs	Dollars	3.17	3.78	3.36	2.93	3.16
Variable costs:						
Feed	Dollars	10.79	9.23	10.68	9.13	9.64
Repairs	Dollars	0.41	0.39	0.49	0.82	0.66
Labor <sup>d</sup>	Dollars	5.22	3.75	2.16	1.57	2.23
Miscellaneous costs <sup>e</sup>	Dollars	1.75	1.69	1.37	1.08	1.28
Interest on operating capital <sup>f</sup>	Dollars	1.04	1.01	1.01	0.87	0.98
Total variable costs	Dollars	19.21	16.06	15.71	13.49	14.77
Total annual costs	Dollars	22.38	19.84	19.07	16.41	17.96

<sup>a</sup>Includes interest on buildings, machinery, and equipment at a rate of 7 percent.

<sup>b</sup>Land charge for pasture was computed at a rate of \$3.80 per acre (1971 average cash rental rate).

<sup>c</sup>Less than \$0.01.

<sup>d</sup>Labor charge was \$2 per hour for all labor.

<sup>e</sup>Includes veterinary expense, electricity, fuel, association fees, and transportation and marketing costs.

<sup>f</sup>Calculated as 8 percent of operating capital.

SOURCE: Appendix Table 4.

<sup>5</sup>The short run is a period of time which is not long enough for the producer to vary all the resources used in producing pork.

<sup>6</sup>The long run is a period of time long enough for all productive resources to be varied.

Fixed Costs

Fixed costs of hog production include interest and depreciation on buildings, equipment and machinery, insurance, and a land charge for the pasture used by hogs. Interest on investment, the largest component of fixed costs, was calculated by taking 7 percent of the present value of buildings, machinery, and equipment. Depreciation was the next largest component of fixed costs. Depreciation for buildings was computed using the straight line method and a 20-year life. For buildings older than 20 years, the present value was depreciated over a 10-year life by the straight line method. Machinery and equipment were depreciated over a 15-year period using the declining balance method. For machinery and equipment over 15 years old, the present value was depreciated over a three-year period using the straight line method.

Fixed costs per pound of pork produced are presented in Table 6, and the percentage distribution of fixed and variable costs is presented in Table 7.

TABLE 7. PERCENTAGE DISTRIBUTION OF PORK PRODUCTION COSTS, NORTH DAKOTA, 1971

Item	Percent of Total Cost
Fixed costs:	
Interest on investment	8.9
Depreciation	7.9
Insurance	0.1
Land charge	<u>a</u>
All fixed costs <sup>b</sup>	17.6
Variable costs:	
Feed	53.7
Repairs	3.7
Labor	12.4
Interest on operating capital	5.4
Miscellaneous costs	<u>7.1</u>
All variable costs <sup>b</sup>	82.4

<sup>a</sup>Less than 0.05 percent.

<sup>b</sup>May not add to totals because of rounding.

Table 6 shows that fixed costs of all producers amount to \$3.16 per hundred-weight of pork produced. No clear relationship between enterprise size and fixed costs exists. Fixed costs, however, comprise only 17.6 percent of total per unit pork production costs (Table 7). Interest, which was the most important fixed cost item, represented 8.9 percent of total costs.

### Variable Costs

Variable costs of pork production include feed, repairs, labor, interest on operating capital, and other miscellaneous costs. Variable costs accounted for \$14.77 of the \$17.94 total cost, or 82.4 percent (Table 6). The largest variable cost item was feed, which amounted to \$9.64 per hundred pounds of pork produced, or 53.7 percent of the total production costs.<sup>7</sup>

Variable costs were found to decline substantially as enterprise size increased. Producers in Group I incurred average variable costs of \$19.21 per hundredweight, while Group IV producers' variable costs were only \$13.49. The major source of cost reduction as enterprise size increased was labor cost, which fell from \$5.22 for Group I to \$1.57 for Group IV.<sup>8</sup>

### FACTORS AFFECTING PORK PRODUCTION COSTS

The interaction of numerous physical, biological, and economic factors results in wide cost differences among pork producers. To obtain an initial evaluation of the factors affecting production costs, the 14 pork producers (25 percent) having highest production costs per hundredweight were compared to the 14 with lowest costs. The results of this comparison are presented in Table 8.

### Comparison of High- and Low-Cost Producers

When the characteristics of high- and low-cost pork producers are compared, a striking difference in output level is noted. While the low-cost producers produced an average of 1,016.4 hundredweights of pork in 1971, the high-cost producers averaged only 417.5 hundredweights of pork produced. While the low-cost producers produced more than twice as much pork, they used only about one-third more capital than the high-cost producers and actually used less labor for the hog enterprise.

Measures of production efficiency give further indications of the reasons for the cost advantage of the low-cost producers. The feed cost of the low-cost producers was only 60 percent of that for the high-cost producers (\$7.60 per hundredweight compared to \$12.70 for high-cost producers). Low-cost producers also had substantially lower investments per unit of output, lower death losses, and more farrowings per year.

The cost advantage of low-cost producers was the result of both lower fixed costs and lower variable costs per hundredweight. The lower fixed costs resulted primarily from smaller interest and depreciation charges, while lower variable costs were the result of substantially lower feed and labor costs.

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<sup>7</sup> Feed costs were determined by using average 1971 market prices for homegrown feeds and reported cost for purchased feeds.

<sup>8</sup> Labor cost was calculated by charging \$2 per hour for all labor (hired or family) devoted to the hog enterprise.



TABLE 8. CHARACTERISTICS OF FARROW-FINISH PORK PRODUCERS WITH HIGHEST AND LOWEST COSTS PER HUNDREDWEIGHT, NORTH DAKOTA, 1971

Item	Unit	Averages for Producers With:	
		Highest Costs <sup>a</sup>	Lowest Costs
<b>Enterprise size:</b>			
Total quantity of pork produced	Cwt.	417.5	1,016.4
Total investment	Dollars	16,282.50	21,344.40
Total labor used	Hours	1,169.0	863.9
<b>Efficiency of production:</b>			
Feed cost per hundredweight of pork produced	Dollars	12.70	7.60
Investment per hundredweight of pork produced	Dollars	39.00	21.00
Labor used per hundredweight of pork produced	Hours	2.8	0.85
Percent death loss	Percent	8.2	7.5
Farrowings per year	Number	2.0	2.3
Pigs saved per litter	Number	8.06	8.06
<b>Production costs:</b>			
Fixed costs per hundredweight of pork produced	Dollars	6.50	3.40
Variable costs per hundredweight of pork produced	Dollars	21.00	10.70
Total costs per hundredweight of pork produced	Dollars	27.50	14.10

<sup>a</sup>Based on total costs per hundredweight of pork produced.

#### Economies of Size in Pork Production

The comparison of high- and low-cost producers indicates that low-cost producers tend to have larger operations. One objective of this study was to determine the extent of the cost advantages or economies of size of larger producers. If cost economies of size were found to exist, the size range over which they were greatest and the cost items most affected would be determined.

To determine if trends in production costs exist as the amount of production increases, the average total costs per hundredweight for all 56 producers were computed and plotted on scatter diagrams. By visual inspection, a downward trend in cost as pork production increased could be detected. The relationship between production costs and size of the pork enterprise was then estimated statistically for total production costs and certain major cost components.

Total Production Costs

The relation between production costs per hundredweight and the amount of production was estimated statistically.<sup>9</sup> The total cost estimates ranged from \$22.90 per hundredweight for a production level of 25,000 pounds to \$15.60 for 250,000 pounds as shown in Table 9.

TABLE 9. ESTIMATED TOTAL COST PER HUNDREDWEIGHT OF PORK PRODUCED IN RELATION TO VARIOUS LEVELS OF PORK OUTPUT<sup>a</sup>

Pounds of Pork Produced	Total Cost Per Hundredweight
25,000	\$22.90
50,000	20.70
100,000	18.50
150,000	17.20
200,000	16.30
250,000	15.60

<sup>a</sup>These costs were estimated with the equation  $Y = 54.89 - 7.28 \log X$ ; where  $Y$  = total cost per hundredweight and  $X$  = total pounds of pork produced.  $R^2$  equals 0.21.

Fixed Costs

Eight different regression equations were tested to determine which one would give the highest explained variation in total fixed costs per hundredweight. However, when the F test was used to test the hypothesis that the relationship between fixed cost and size was due only to chance, the hypothesis was not rejected for any of the eight equations. Hence, fixed cost cannot be said to be related to enterprise size to a statistically significant degree.

Variable Costs

Variable costs appeared to account for most of the decline in total cost as hog enterprise size increased. The variable cost estimates ranged from \$18.10 per hundredweight for 25,000 pounds to \$11.30 for 250,000 pounds as shown in Table 10.

Labor Costs

Decreases in labor costs appeared to be the largest single item contributing to decreases in variable costs as pork output increased. Therefore, the relationship between labor cost per hundredweight and enterprise size was estimated. The labor cost estimates ranged from \$4.70 per hundredweight for 25,000 pounds to \$1.70 per hundredweight for 250,000 pounds (see Table 11).

<sup>9</sup>Eight different regression equations were tested to determine which one would give the highest explained variation. The equation selected to give the cost estimates shown later was of the form:  $Y = a + b \log X$ .

TABLE 10. ESTIMATED VARIABLE COST PER HUNDREDWEIGHT OF PORK PRODUCED IN RELATION TO VARIOUS LEVELS OF PORK PRODUCED<sup>a</sup>

Pounds of Pork Produced	Variable Cost Per Hundredweight
25,000	\$18.10
50,000	16.00
100,000	14.00
150,000	12.80
200,000	11.90
250,000	11.30

<sup>a</sup>These costs were estimated with the equation  $Y = 47.35 - 6.68 \log X$ ; where  $Y$  = total variable cost per hundredweight and  $X$  = pounds of pork produced.  $R^2$  equals 0.26.

TABLE 11. ESTIMATED LABOR COST PER HUNDREDWEIGHT OF PORK PRODUCED IN RELATION TO VARIOUS LEVELS OF PORK PRODUCED<sup>a</sup>

Pounds of Pork Produced	Labor Cost Per Hundredweight
25,000	\$4.70
50,000	3.00
100,000	2.20
150,000	1.90
200,000	1.80
250,000	1.70

<sup>a</sup>These costs were estimated with the equation  $Y = 1.38 + 82,094.76 (1/X)$ ; where  $Y$  = labor cost per hundredweight and  $X$  = pounds of pork produced.  $R^2$  equals 0.45.

#### RETURNS FROM HOG PRODUCTION

Returns from hog production for a given year include receipts from the sale of butcher hogs and feeder pigs, receipts from sales of sows and boars, and increases in the inventory of hogs on hand. The total return from the hog enterprise in 1971 ranged from \$4,051 for Group I to \$33,478 for Group IV and averaged \$15,433 for all producers surveyed (Table 12).

The return to capital, labor, and management increased sharply with increases in enterprise size, rising from \$787 for Group I to \$9,567 for Group IV. Returns to capital and management followed a similar pattern, ranging from a negative return of \$293 for Group I to \$6,743 for Group IV. The rate of return on investment averaged 12.7 percent, ranging from a negative return for Group I to 17.2 percent for Group IV.

TABLE 12. TOTAL RETURN PER FARM, RETURN TO CAPITAL, LABOR AND MANAGEMENT, AND RATE OF RETURN ON INVESTMENT, FARROW-FINISH PRODUCERS, NORTH DAKOTA, 1971

Item	Unit	Farm Size Group				All Producers
		I	II	III	IV	
Total return per farm	Dollars	4,051	8,046	15,985	33,478	15,433
Sales of butcher hogs <sup>a</sup>	Dollars	3,118	6,529	13,614	29,859	13,299
Miscellaneous sales <sup>a</sup>	Dollars	444	729	1,078	2,506	1,186
Feeder pigs <sup>a</sup>	Dollars	76	317	893	933	577
Breeding stock <sup>a</sup>	Dollars	290	342	259	--	229
Home use	Dollars	121	129	141	180	143
Total return per hundred-weight		19.60	19.99	20.04	18.64	19.28
Return to capital, labor, and management <sup>b</sup>	Dollars	787	2,264	3,907	9,567	4,143
Return to capital and management <sup>c</sup>	Dollars	-293	755	2,185	6,743	2,359
Rate of return on investment <sup>d</sup>	Dollars	e	7.6	10.7	17.2	12.7

<sup>a</sup>May not add to total due to rounding.

<sup>b</sup>Total receipts less feed costs, repairs, miscellaneous variable costs, depreciation, insurance, land charge, and interest on operating capital.

<sup>c</sup>Return to capital, labor, and management less labor charge.

<sup>d</sup>Return to capital and management divided by total investment.

<sup>e</sup>Return on investment is negative.

APPENDIX

APPENDIX TABLE 1. NUMBER AND PERCENT OF ALL HOGS ON NORTH DAKOTA FARMS, 1940-1970

Crop Reporting District	1940 <sup>a</sup>	1950 <sup>a</sup>	1960 <sup>a</sup>	1964 <sup>b</sup>	1967 <sup>c</sup>	1970 <sup>d</sup>
- Number of Hogs -						
Northwest	27,000	19,600	8,500	9,300	7,200	16,000
North central	37,500	26,300	13,000	12,100	10,400	18,000
Northeast	61,000	30,800	24,500	28,500	21,900	34,000
West central	37,500	39,900	20,000	23,000	18,100	30,000
Central	34,000	38,700	24,000	24,600	19,100	31,000
East central	79,000	63,600	52,000	49,000	39,300	65,000
Southwest	33,000	28,100	21,000	20,800	19,500	38,000
South central	44,000	55,100	30,000	39,200	46,300	56,000
Southeast	111,000	110,900	95,000	97,500	86,200	137,000
State	464,000	413,000	288,000	304,000	268,000	425,000
<u>Percent of state total:</u>						
Northwest	5.8	4.7	3.0	3.1	2.7	3.8
North central	8.1	6.4	4.2	4.0	3.9	4.2
Northeast	13.1	7.5	8.5	9.3	8.2	8.0
West central	8.1	9.6	6.9	7.6	6.8	7.1
Central	7.4	9.4	8.4	8.1	7.1	7.3
East central	17.0	15.4	18.2	16.1	14.7	15.3
Southwest	7.1	6.8	7.2	6.8	7.2	8.9
South central	9.5	13.2	10.6	12.9	17.2	13.2
Southeast	23.9	26.9	33.0	32.1	32.2	32.2
State	100.0	100.0	100.0	100.0	100.0	100.0

<sup>a</sup>North Dakota Livestock 1925-61, Agricultural Statistics No. 7, Statistical Reporting Service, United States Department of Agriculture and Department of Agricultural Economics, North Dakota State University, cooperating, Fargo, North Dakota, December, 1961, pp. 25-28.

<sup>b</sup>North Dakota Crop and Livestock Statistics, Annual Summary for 1965, Agricultural Statistics No. 15, Statistical Reporting Service, United States Department of Agriculture and Department of Agricultural Economics, North Dakota State University, cooperating, Fargo, North Dakota, May, 1965, p. 31.

<sup>c</sup>North Dakota Crop and Livestock Statistics, Annual Summary for 1968, Agricultural Statistics No. 19, Statistical Reporting Service, United States Department of Agriculture and Department of Agricultural Economics, North Dakota State University, cooperating, Fargo, North Dakota, May, 1968, p. 55.

<sup>d</sup>North Dakota Crop and Livestock Statistics, Annual Summary for 1971, Agricultural Statistics No. 26, Statistical Reporting Service, United States Department of Agriculture and Department of Agricultural Economics, North Dakota State University, cooperating, Fargo, North Dakota, May, 1971, p. 53.

APPENDIX TABLE 2. ANNUAL AVERAGE PRICES RECEIVED FOR HOGS, NORTH DAKOTA, 1960-1972.

Year	Dollars Per 100 Pounds Liveweight
1972	\$24.20
1971	17.00
1970	21.80
1969	21.70
1968	18.00
1967	18.30
1966	21.50
1965	19.30
1964	14.00
1963	14.50
1962	15.60
1961	15.80
1960	14.60

SOURCE: Price, J. R., and Fred R. Taylor, North Dakota Crop and Livestock Statistics, various issues, Statistical Reporting Service, USDA, and Department of Agricultural Economics, North Dakota State University, Fargo, North Dakota.

APPENDIX TABLE 3. LABOR USED BY FARROW-FINISH PORK PRODUCERS, NORTH DAKOTA, 1971

Item	Unit	Farm Size Group				All Producers
		I	II	III	IV	
Labor used per farm for:						
Daily care of hogs <sup>a</sup>	Hours	315.4	380.2	366.3	617.2	419.4
Farrowing	Hours	99.7	140.4	92.6	155.4	122.2
Feed grinding	Hours	33.3	51.6	63.9	86.3	58.7
Repairs	Hours	28.9	33.5	57.5	77.1	49.6
Cleaning and sanitation <sup>b</sup>	Hours	34.8	104.3	230.3	336.9	180.7
Marketing	Hours	27.9	44.3	53.5	115.9	60.3
Total	Hours	540.0	754.3	864.1	1,388.8	890.9
Total labor used per hundred-weight of pork sold	Hours	2.61	1.87	1.08	0.77	1.11
Total labor used per sow	Hours	55.1	69.8	28.5	25.3	35.2

<sup>a</sup>Includes feeding, watering, etc.

<sup>b</sup>Includes barn cleaning, manure hauling, etc.

APPENDIX TABLE 4. TOTAL ANNUAL COSTS OF FARROW-FINISH PORK PRODUCERS, NORTH DAKOTA, 1971

Item	Unit	Farm Size Group				All Producers
		I	II	III	IV	
<b>Fixed costs:</b>						
Interest <sup>a</sup>	Dollars	281	698	1,406	2,743	1,282
Depreciation	Dollars	331	770	1,177	2,289	1,142
Insurance	Dollars	22	45	94	200	90
Land charge	Dollars	21	9	3	25	13
Total fixed costs	Dollars	655	1,522	2,680	5,257	2,527
<b>Variable costs:</b>						
Feed	Dollars	2,230	3,715	8,519	16,406	7,717
Repairs	Dollars	84	159	388	1,472	526
Labor <sup>b</sup>	Dollars	1,080	1,509	1,722	2,824	1,784
Miscellaneous costs <sup>c</sup>	Dollars	362	679	1,094	1,948	1,021
Interest on operating capital <sup>d</sup>	Dollars	214	405	803	1,571	781
Total variable costs	Dollars	3,970	6,467	12,526	24,221	11,829
Total annual costs	Dollars	4,625	7,989	15,206	29,478	14,379

<sup>a</sup>Includes interest on buildings, machinery, and equipment at a rate of 7 percent.

<sup>b</sup>Labor charge computed as \$2 per hour for all labor.

<sup>c</sup>Includes veterinary expense, electricity, fuel, association fees, and marketing and transportation costs.

<sup>d</sup>Calculated as 8 percent of operating capital.