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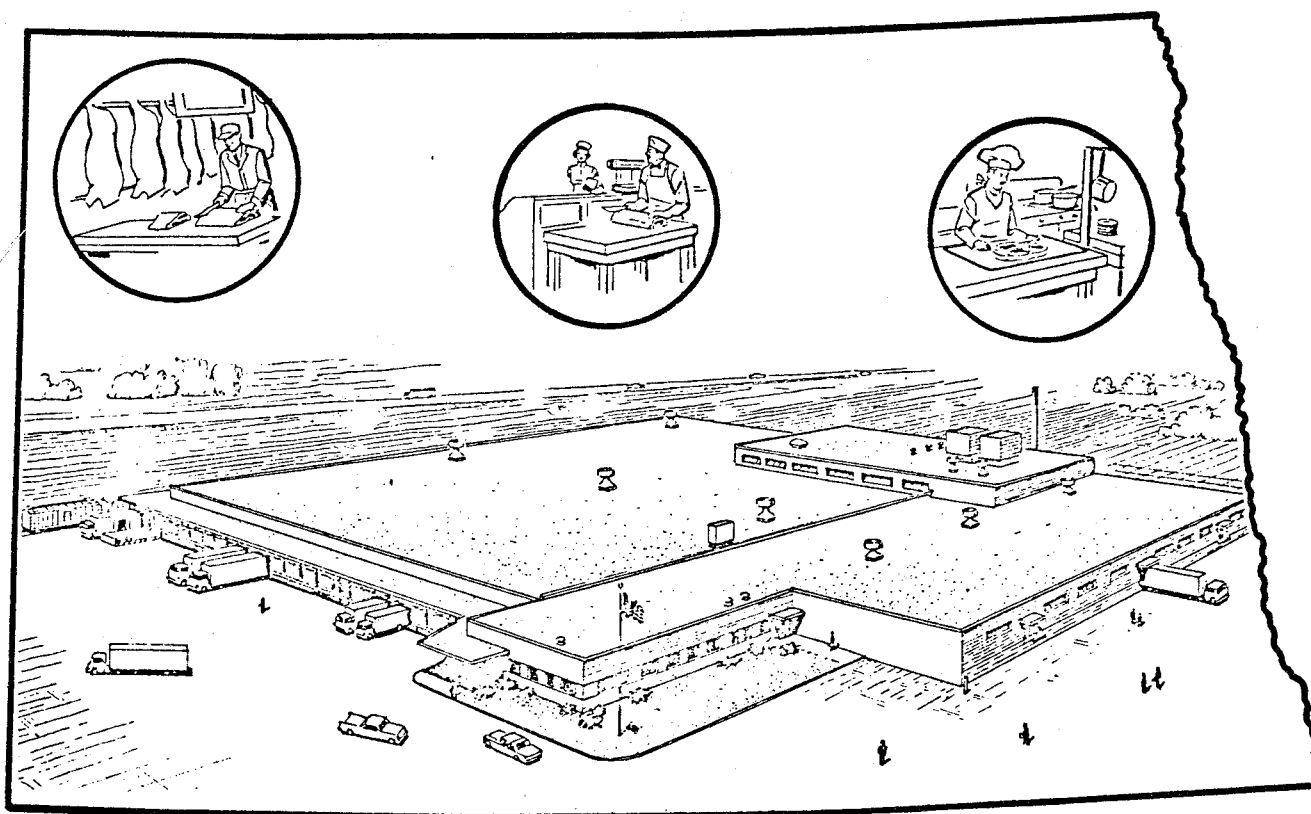
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Economic Feasibility Of A Hog Slaughtering And Processing Facility In North Dakota



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RESEARCH-EXTENSION RURAL DEVELOPMENT PROJECT REPORT

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and
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FOREWORD

This report is one of a series being conducted under a special Research and Extension Rural Development Project at North Dakota State University as authorized by Title V of the Rural Development Act of 1972. The study was initiated and partial funding was provided through a grant from the North Dakota Business and Industrial Development Department.

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ECONOMIC FEASIBILITY OF A HOG SLAUGHTERING AND PROCESSING FACILITY IN NORTH DAKOTA

by
Arlyn R. Staroba and Eddie V. Dunn*

Hogs play an important role in the economy of North Dakota. In 1974 hogs returned \$72,875,000 in cash farm income to North Dakota farmers, which was an increase of 52 percent from the 1973 average. Hogs marketed in 1974 accounted for 14.9 percent of the total receipts of livestock and livestock products and 2.8 percent of the total crops and livestock income of the state (1:61).**

Although hogs are important to the state's economy, there are no large-scale hog slaughter plants in North Dakota. Present plants in the state slaughter only a few head per day, leaving the majority of the hogs to be slaughtered by out-of-state plants. Individual out-of-state plants slaughter up to one or two million hogs annually, with the minimum size of 600,000 head per year considered economically feasible by industry sources.

This study examines the feasibility of a large-scale hog slaughtering and processing plant in North Dakota. The research was initiated in response to interest expressed by various community development groups, hog producers, and retail interests in the state. The general need for this type of information has been expressed by community development groups and hog producers through the North Dakota Business and Industrial Development Department, while additional producer and retailer interests were identified in surveys conducted by Bergstrom (2) in 1971 and Huber (3:35) in 1973.

Data for the study were obtained from industry sources, slaughter equipment suppliers, meat wholesalers, and similar studies conducted in other states. The data were updated or adjusted, where necessary, to apply to the North Dakota livestock economy for the year 1975.

The report is divided into eight sections:

1. Demand for Pork.
2. Supply and Concentration of Hogs in North Dakota.
3. Plant Location and Size Factors.

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**Underscored numbers in parentheses refer to literature cited; numbers following colon refer to specific pages in the reference cited.

4. Plant Types.
5. Plant Investment and Operating Costs.
6. Gross Operating Margin.
7. Other Factors Affecting Slaughter Plant Feasibility.
8. Summary and Conclusions.

Demand for Pork

The per capita pork consumption in the United States has remained relatively constant over the last one and one-half decades (Figure 1). Average consumption has ranged between 54.1 and 67.9 pounds per person (retail weight basis) and is expected to remain relatively constant through 1985, based on projections made by the USDA Economic and Statistical Analysis Division (4).

lbs./capita

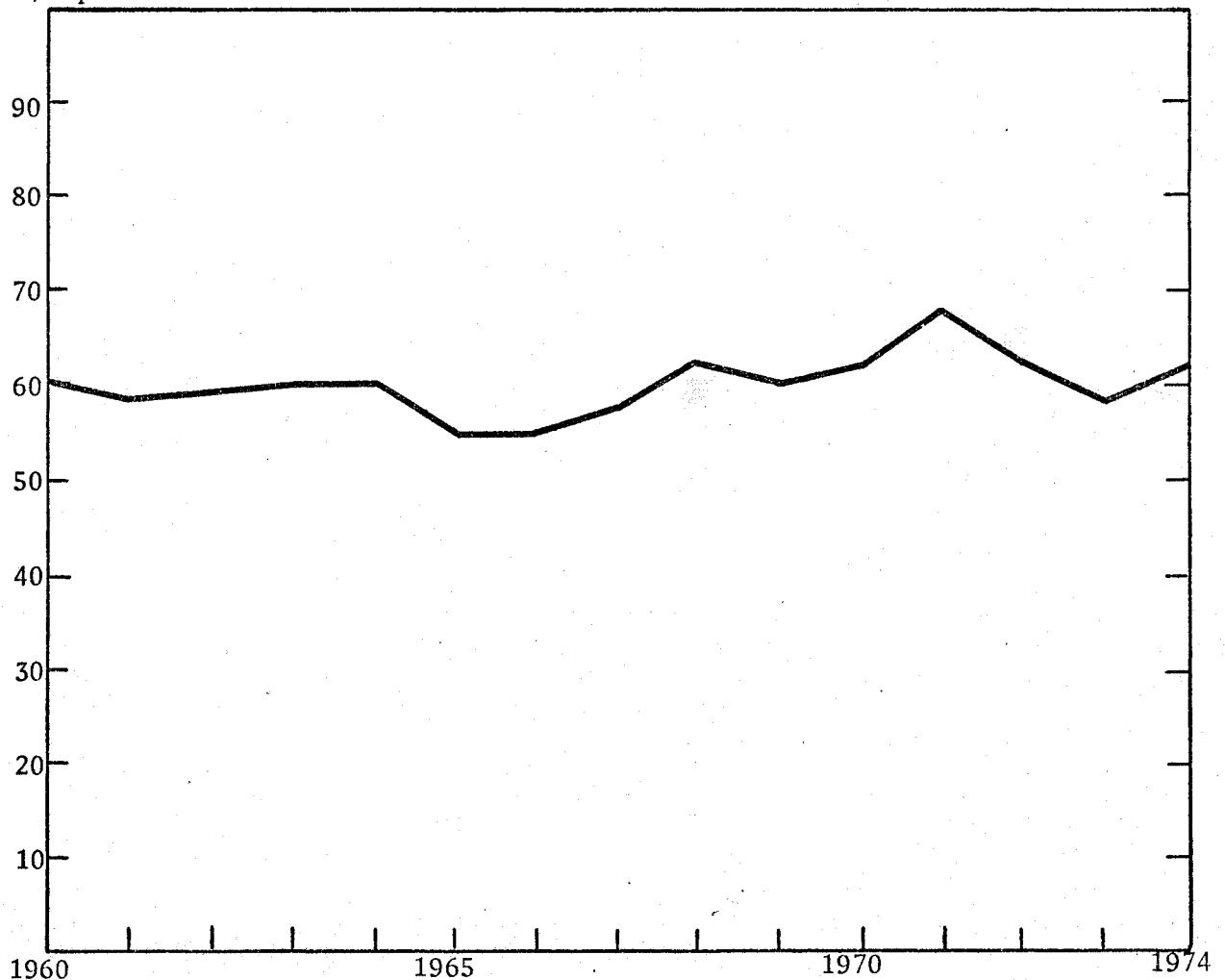


Figure 1. U.S. Per Capita Pork Consumption, Retail Weight Basis

Source: USDA, ERS, Livestock and Meat Statistics, Statistical Bulletin Nos. 522 and 543, Washington, D.C.

North Dakota does not publish per capita consumption figures for the state. Consumption figures used herein were derived from either U.S. or North Central Region data.

The USDA Agricultural Research Service completed a study in 1972 that utilized 1965 data to show consumption figures for various regions of the U.S. (5). The North Central Region population was stratified into three classes of urban, rural nonfarm, and rural farm, and a regional average was calculated. Results indicated that the North Central Region average per capita pork consumption was 4.2 percent higher and the urban classification was 8.7 percent higher than the U.S. average (Table 1). The per capita consumption was 0.9 percent and 2.9 percent lower than the U.S. average in the rural nonfarm and rural farm classes, respectively.

TABLE 1. ANNUAL PER CAPITA PORK CONSUMPTION IN THE U.S. AND THE NORTH CENTRAL REGION, 1965

Class	U.S.	North Central Region
	-----pounds-----	
Urban	49.87	54.22
Rural Nonfarm	51.85	51.37
Rural Farm	58.60	56.93
Average	51.05	53.72

Source: 1965 Household Survey (5).

Bergstrom (2) estimated North Dakota pork consumption to be 43 million pounds per year using 1971 unpublished survey data.

Bedker (6) utilized data from the USDA Consumption Surveys as a basis for estimating North Dakota meat consumption in 1974. He estimated the total pork consumption for the state to be 40.4 million pounds on a retail weight basis, which is equivalent to an annual state consumption of approximately 300,000 hogs.* The 1974 North Dakota per capita consumption was estimated by Bedker to be 63.4 pounds, which is slightly above the 61.9 pound U.S. average (see Figure 1).

North Dakota's commercial and farm hog slaughter averages 55,600 head annually. With consumption demand estimated at approximately 300,000 hogs

*Based on the average weight of 230 pounds per hog.

annually, North Dakota slaughter plants furnish only 18 percent of the pork consumed in the state. In comparison, 192 percent of the beef consumed in North Dakota is slaughtered in the state (92 percent more is slaughtered than is consumed) (6).

Supply and Concentration of Hogs in North Dakota

The number of hogs marketed annually in North Dakota is sufficient to fill the demand for pork in the state. Annual marketing figures vary somewhat, depending on the source of information used--but average about 486,000 head annually. Table 2 presents North Dakota and U.S. hog marketings for 1964-75, including three four-year hog cycles. Data for Table 2 were taken from USDA Crop and Livestock Reporting Service information. Data from the USDA Statistical Reporting Service and the U.S. Census of Agriculture differ because of different methods and time of collection, summarizing methods, etc. But data from both sources indicate that there is an annual surplus of hogs marketed in the state over its consumption needs.

TABLE 2. NUMBER OF HOGS MARKETED IN NORTH DAKOTA AND THE U.S., 1964-75

Year	North Dakota ^a	U.S. ^b
	-----number of head-----	
1964	508,000	86,086,000
1965	448,000	78,127,000
1966	468,000	75,761,000
1967	501,000	85,256,000
1968	452,000	87,726,000
1969	431,000	88,074,000
1970	417,000	87,422,000
1971	576,000	99,586,000
1972	530,000	90,486,000
1973	486,000	82,329,000
1974	547,000	85,962,000
1975	469,000	73,966,000
Average	486,083	85,065,083

Sources: a. Taylor, Fred R., and J. R. Price (1).

b. USDA, ERS, Livestock and Meat Statistics, Statistical Bulletin Nos. 522 and 543, Washington, D.C.

The number of hogs marketed and existing state slaughter for three time periods are summarized in Table 3. The 12-year average (1964-75) indicates that 433,283 hogs were annually sold to out-of-state buyers. This figure includes all classes of hogs, not only slaughter hogs. The potential for the feeder pigs to be fed to slaughter weight within the state and made available to a slaughter plant exists, given the necessary price incentives for producers.

TABLE 3. NUMBER OF HOGS MARKETED AND SLAUGHTERED IN NORTH DAKOTA DURING THREE TIME PERIODS

Item	1975	1 Hog Cycle Annual Average 1973-75	3 Hog Cycles Annual Average 1964-75
-----number of head-----			
Hogs Marketed ^a	469,000	500,666	486,083
N.D. Commercial Slaughter ^b	-21,900	-27,500	-27,050
N.D. Farm Slaughter ^b	-19,000	-20,666	-25,750
Total Out-Shipments of Hogs	428,100	452,500	433,283

Sources: a. Taylor, Fred R., and J. R. Price (1), Agricultural Statistical Report Nos. 13, 15, 17, 18, 19, 21, 23, 26, 29, 32, 35, 38.

b. USDA, SRS, Livestock Slaughter, 1964-75 Annual Summaries.

Presently, hogs raised in North Dakota are shipped throughout the U.S. Nichols (7:115) reported in 1971 that 37 percent of the hogs exported from the state were shipped west, 37 percent east, and 26 percent south. States receiving hogs from North Dakota included Minnesota, South Dakota, Washington, Montana, Iowa, and Georgia, with a small number of hogs marketed in Canada.

The consumption estimated by Bedker and Bergstrom, along with the out-shipments reported by Nichols, confirms that North Dakota is in effect shipping a major portion of live hogs out of state for slaughter and, in turn, transporting almost as much pork back into the state for consumption.

Production of hogs and pigs in North Dakota, according to U.S. Census of Agriculture data, is concentrated mainly in the southeast corner of the state (Figure 2). Erlandson (8) used census data to observe that the counties of Richland, Cass, Traill, Ransom, Sargent, Dickey, LaMoure,

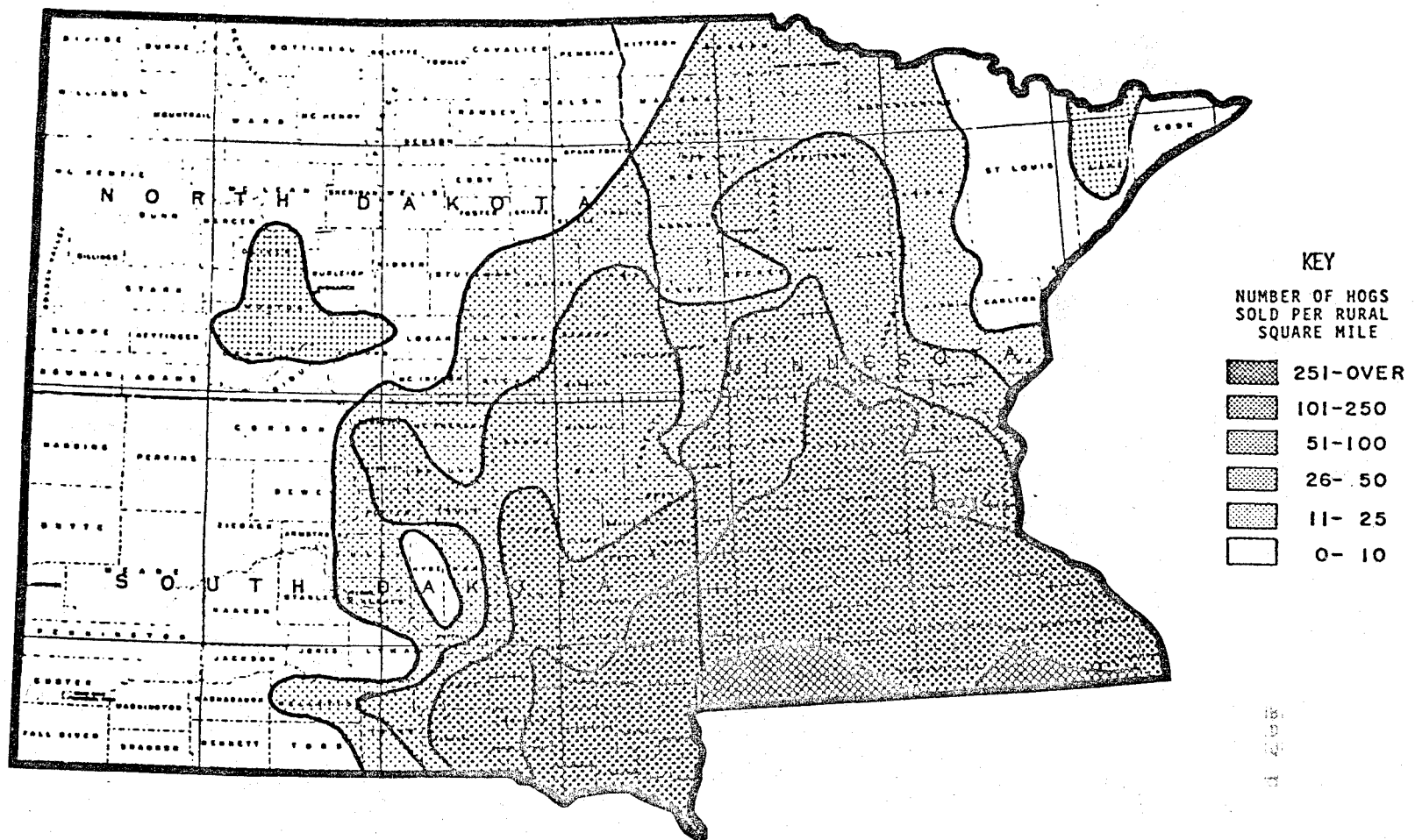


Figure 2. Hog and Pig Marketings Per Rural Square Mile, North Dakota, Minnesota, and South Dakota, 1969

Source: Erlandson (8).

Barnes, and Stutsman have ranked in the top 14 counties in hog sales, without exception, in each of the last five Census of Agriculture periods. These nine counties in 1969 marketed 233,981 hogs or 47 percent of the state's total sales. In 1964 this area marketed 53 percent of the hogs in North Dakota. Table 4 lists the number of hogs marketed in the nine counties and their rank for the 1949-69 census periods.

TABLE 4. SALES OF HOGS AND PIGS IN SOUTHEASTERN NORTH DAKOTA DURING 1949-69 CENSUS PERIODS

County	Census Year									
	1949		1954		1959		1964		1969	
	-----number of head-----									
Richland	48,947	(1)*	37,545	(1)	43,847	(2)	58,008	(2)	52,499	(1)
Cass	44,588	(2)	31,381	(2)	55,025	(1)	58,255	(1)	50,435	(2)
Sargent	24,415	(5)	20,452	(3)	33,488	(4)	29,147	(4)	25,293	(3)
Dickey	29,983	(3)	17,573	(4)	35,087	(3)	39,864	(3)	22,394	(5)
Barnes	17,841	(11)	12,616	(11)	23,029	(10)	17,424	(8)	20,026	(7)
Ransom	24,695	(4)	16,204	(6)	24,454	(8)	23,718	(5)	19,390	(8)
Stutsman	18,202	(9)	12,906	(10)	20,291	(12)	16,921	(9)	18,879	(9)
LaMoure	19,960	(7)	12,048	(12)	24,706	(7)	18,756	(6)	13,016	(11)
Traill	12,097	(13)	8,465	(14)	12,857	(14)	14,928	(13)	12,049	(13)
TOTAL	240,728		169,190		271,884		277,021		233,981	

* () indicate county rank for each census period.

Source: U.S. Censuses of Agriculture, 1949-69.

The percentage change in the concentration of hog and pig sales in 1969 as compared to 1949 for North Dakota, Minnesota, and South Dakota is graphically portrayed in Figure 3. Although percentage changes must be viewed with caution,* it should be noted that there has been no decline in the North Dakota area of major concentration in the 20-year time period, with the exception of Dickey and LaMoure counties. Dickey and LaMoure counties experienced a slight decline in hog concentration.

*The same increase or decrease in the number of hogs produced will result in a substantially higher percent change for a county with a low production density compared to a high-density county. For example, a change of only two in the number of hogs per square mile from 1 hog to 3 hogs is a 200 percent increase, while a change of 100 hogs (from 500-600 hogs) is only a 20 percent increase.

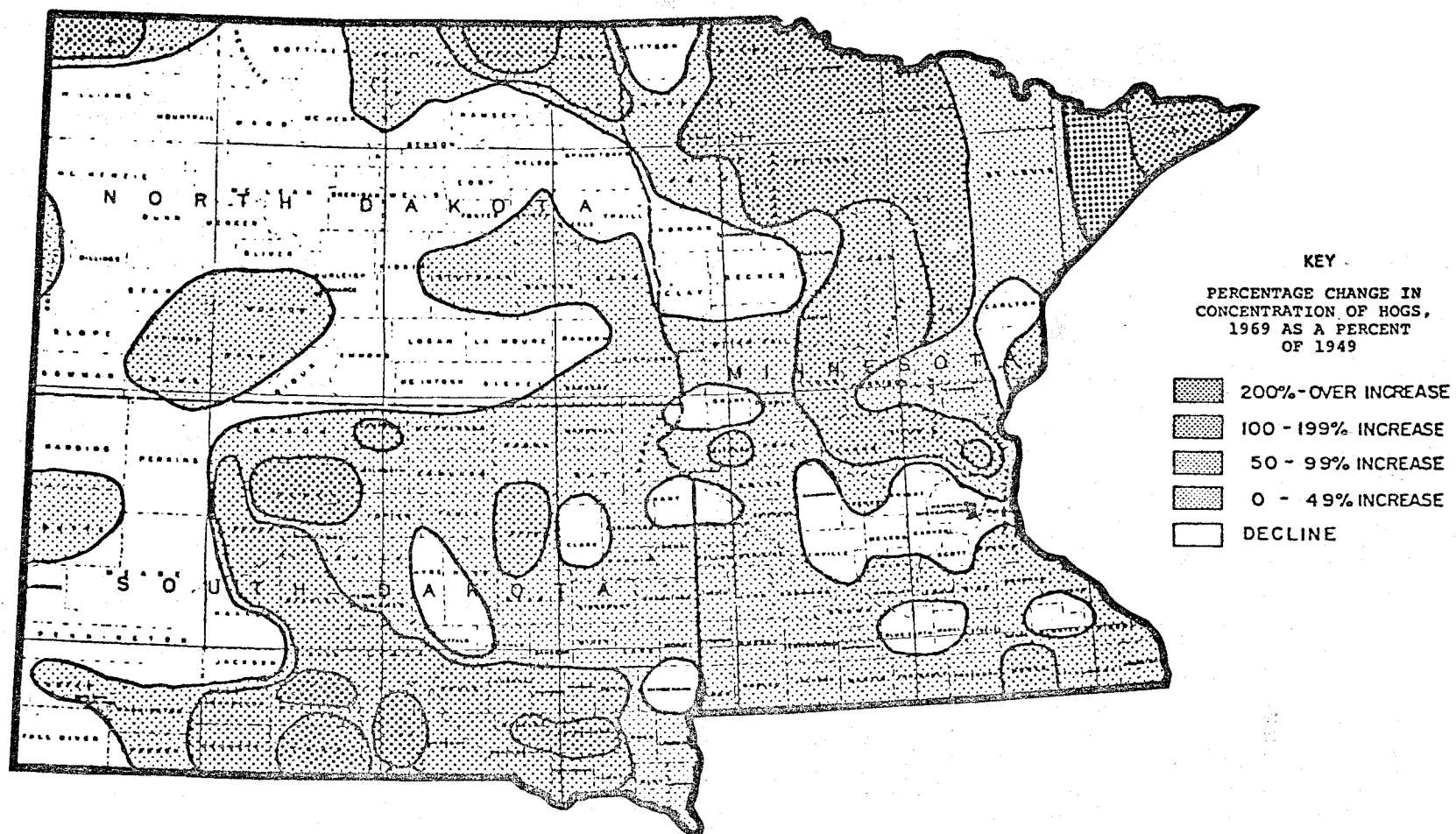


Figure 3. Percentage Change in the Concentration of Hog and Pig Sales, North Dakota, Minnesota, and South Dakota, 1969 as a Percentage of 1949

Source: Erlandson (8).

Figures 2 and 3 indicate that hog concentration per square mile increases toward the south and southeast in the tri-state region of North Dakota, Minnesota, and South Dakota. The meat packing industry has trended in recent years to construct new slaughter plants in areas of high hog concentrations rather than near large demand areas. The trend is evident in Figure 4 which shows where existing large-scale hog slaughtering plants are operating in the tri-state region. Six of the nine operating hog plants individually slaughter in excess of 900,000 hogs per year or almost double the total number of hogs that were marketed in North Dakota in 1975. The hog supply area of each plant is quite wide and includes buyers and buying stations throughout the tri-state area.

Hogs marketed in Minnesota and South Dakota tend to move south and southeast toward the existing large slaughtering facilities and in response to the more favorable price levels at livestock markets in these areas compared to the price levels at the major hog market in North Dakota. Appendix Table 1 lists the monthly prices per hundredweight for U.S. 1-2, 200-240 pound barrows and gilts for 1964-75 at the West Fargo, North Dakota; St. Paul, Minnesota; and Sioux Falls, South Dakota, livestock markets. The West Fargo market price consistently averaged lower than the other two markets in this time period. During the three-cycle time period, the West Fargo hog price averaged \$.72 per hundredweight lower than the St. Paul price and \$.52 per hundredweight lower than the Sioux Falls price. This pricing surface provides a strong incentive for hogs in these two states to move away from North Dakota.

The number of hogs a North Dakota plant can draw from South Dakota and Minnesota is directly affected by the market supply area of existing plants and the pricing difference at the hog markets in the tri-state area. Another factor that could affect the potential supply of hogs available to a hog slaughter plant in North Dakota is the hog facility in Fergus Falls, Minnesota, which was closed in mid-1974 for environmental reasons. The supply of hogs available to a North Dakota plant from that area would be severely infringed upon if the equipment in the plant was updated to meet Environmental Protection Agency (EPA) standards and the plant resumed operation.

The supply area for a potential North Dakota hog slaughter facility was assumed to include the nine highest hog production counties of Richland, Cass, Barnes, Traill, Stutsman, Sargent, Ransom, Dickey, and LaMoure in

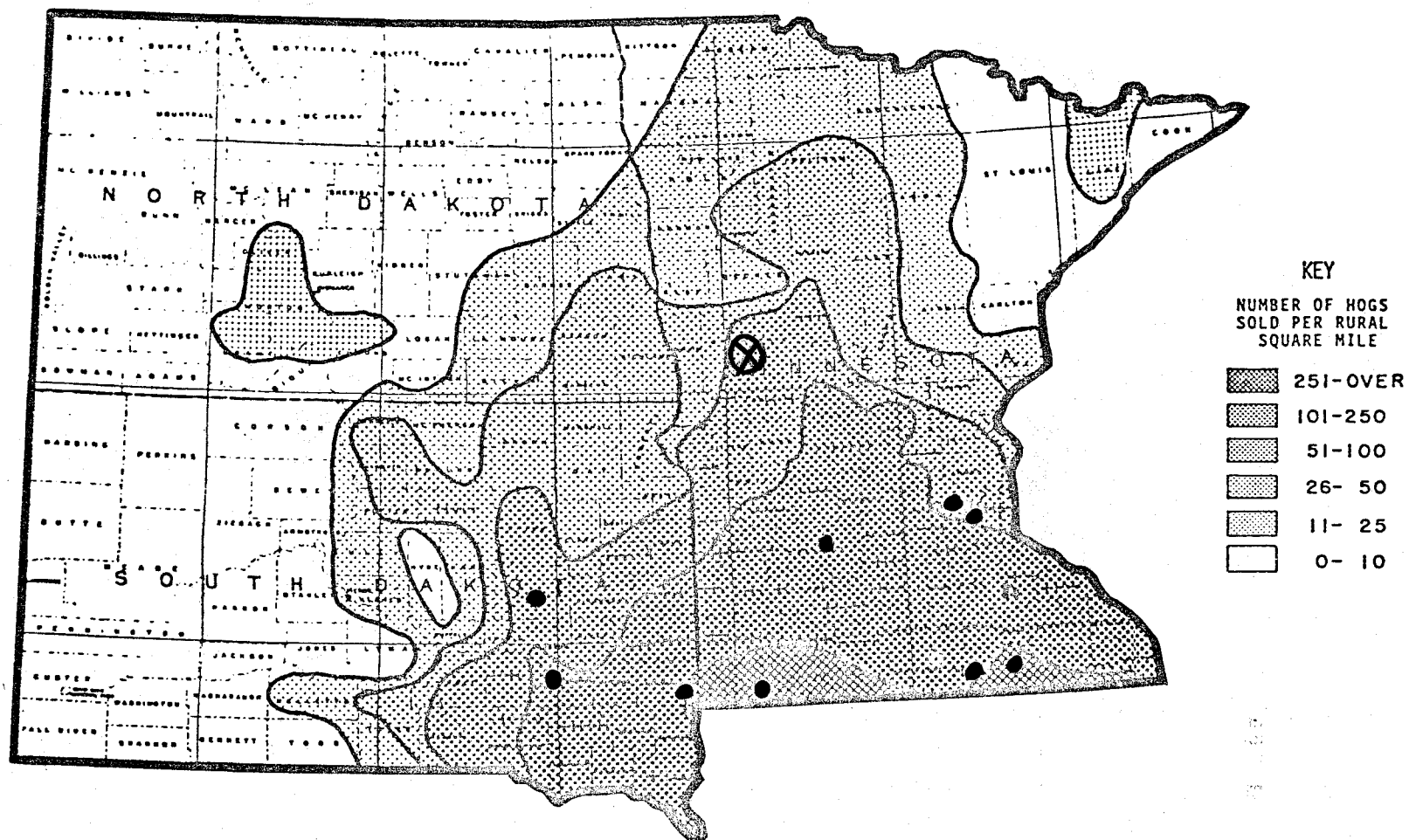


Figure 4. Location of Hog Marketing Concentrations and Large-Scale Hog Slaughtering Operations in North Dakota, Minnesota, and South Dakota (Hog Marketing Concentration, 1969--Plant Location, 1975)

⊗ Indicates closed Fergus Falls, Minnesota, plant.

southeastern North Dakota. In addition, it was assumed that a North Dakota plant could compete for South Dakota and Minnesota hogs within a 50-mile radius of the center of Richland County--North Dakota's highest hog concentration county. Figure 5 illustrates the area included in the supply area for the proposed plant.

No county hog marketing data are available for the supply area since 1969. Therefore, inventory data for hogs and pigs on farms published by the Crop and Livestock Statistical Reporting Service (SRS) for individual states were used to estimate 1975 hog marketings. This estimate was calculated by adjusting individual SRS county inventory figures upward in the same ratio as the state's total of hogs and pigs marketed, to the state hog and pig inventory total, i.e.:

$$\text{1975 County Hog Marketing Estimate} = \text{County Inventory Figure} \times \frac{\text{State Total of Hogs and Pigs Marketed}}{\text{State Hogs and Pigs Inventory}}$$

The North Dakota SRS inventory of hogs and pigs on farms for December 1, 1975, was 350,000 head, which is 9 percent above the 1974 inventory figure. In comparison, the SRS inventory figure for the U.S. for December 1, 1975, was 49.6 million--or 10 percent below the 1974 figure. Total hog marketings for North Dakota in 1975 were 469,000 head. Estimated 1975 county marketings and county rank in state total hog marketings are listed in Table 5 for the North Dakota counties in the proposed supply area. Similar calculations for the Minnesota and South Dakota supply areas add 120,495 hogs to the estimated hog supply--totaling 350,975 head for the entire hog supply area in 1975.

The concentration and numbers of hogs in southeastern North Dakota, along with the potential supply of animals from Minnesota and South Dakota, indicate that the southeastern corner of the state has the highest potential of supporting a large-scale hog slaughtering plant. The exact location of the plant can only be pinpointed after several other factors are taken into consideration.

The total annual hog production in the proposed supply area appears to be large enough to support a large-scale slaughtering facility, but problems may arise in providing a uniform supply of hogs throughout the year. Figure 6 presents the actual monthly receipts of hogs for 1964-75 at the West Fargo Terminal Livestock Market, which is the largest hog market

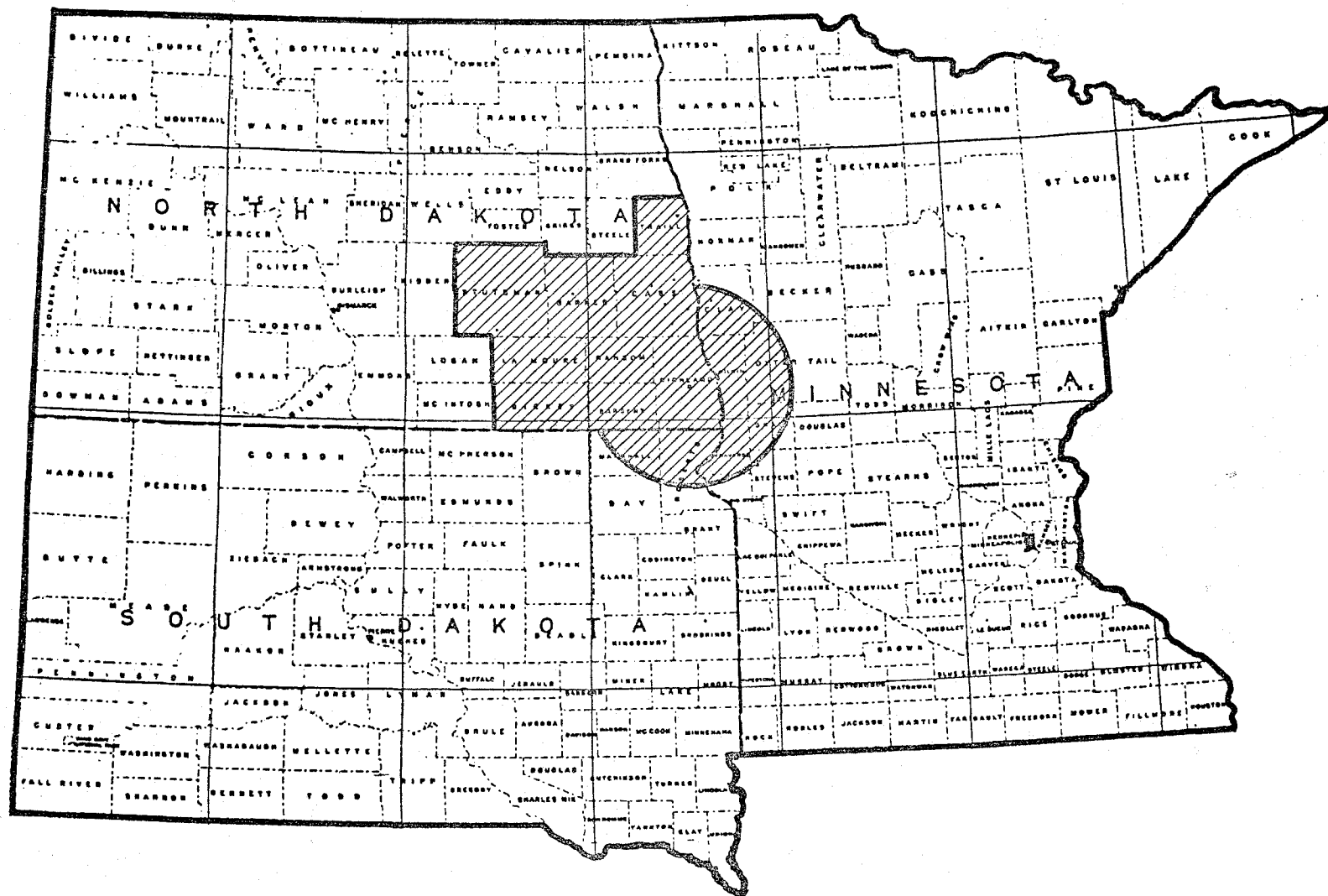


Figure 5. Estimated Supply Area for North Dakota Hog Slaughtering Plant

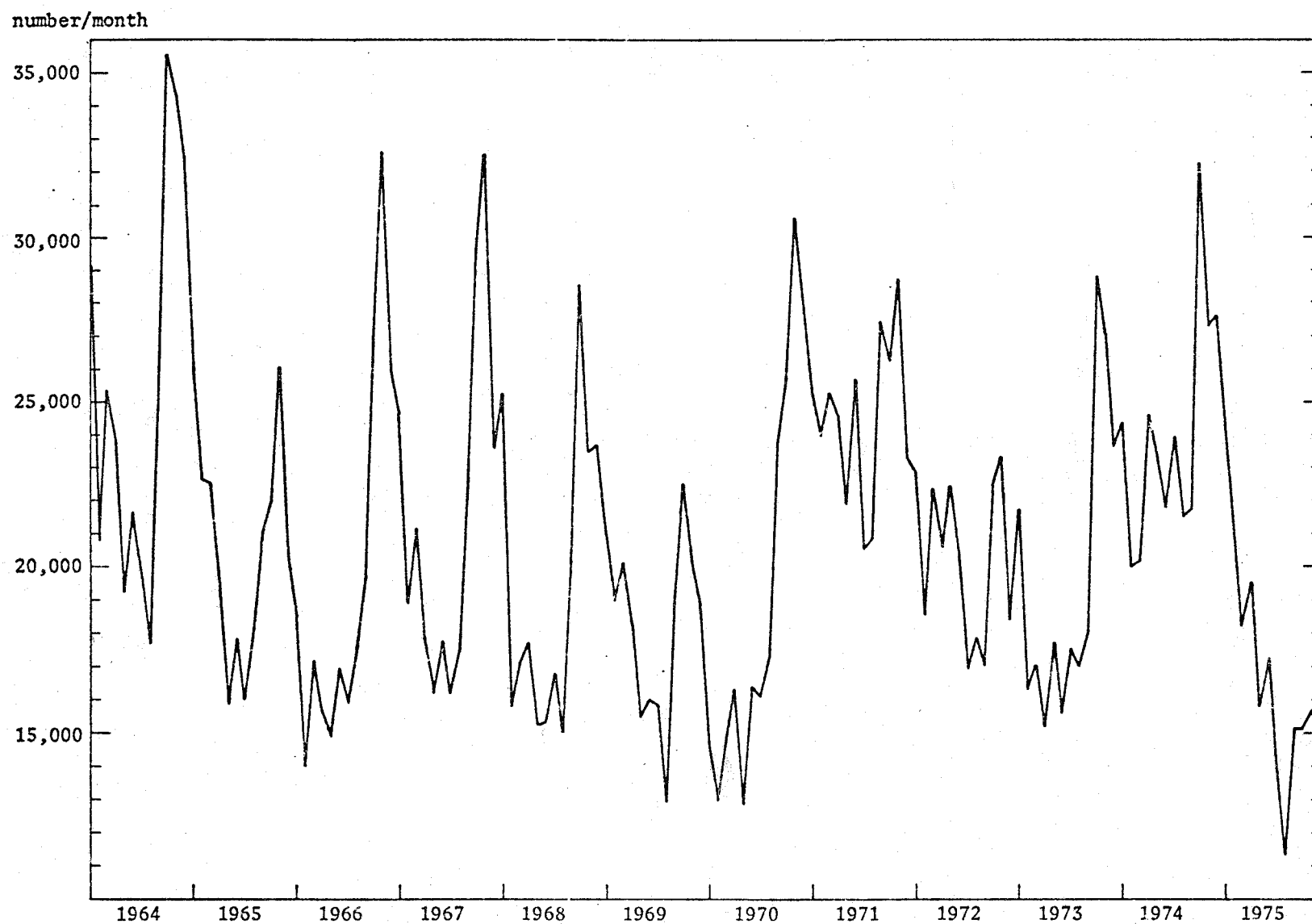


Figure 6. Monthly Marketings of U.S. 1-2, 200-240 Pound Barrows and Gilts, West Fargo Livestock Market, West Fargo, North Dakota, 1964-75

Source: USDA Livestock Market News Service.

TABLE 5. ESTIMATED 1975 COUNTY HOG MARKETINGS WITHIN THE NORTH DAKOTA STUDY SUPPLY AREA

County	State Hog Marketing Rank	Hogs Marketed
	-----rank-----	
Richland	1*	52,260
Cass	1*	52,260
Sargent	3	25,728
Barnes	4	22,512
Dickey	5	21,976
Ransom	7	17,420
Stutsman	9	16,214
LaMoure	11	12,596
Traill	14	9,514
TOTAL		<u>230,980</u>

*Indicates a tie.

in the area and state. Although not all slaughter hogs sold in the supply area are marketed through the West Fargo market, it is apparent that definite historical seasonal patterns in the number of hogs sold per month exist. High market volumes usually occur in October or November of each year, with lows occurring most often in the summer months.

The average monthly marketings at West Fargo for the 12-year time period were 20,829 hogs with a high of 35,541 in October, 1964, and a low in September, 1975, of 11,389 hogs. The spread between the high- and low-volume months during a given year also varied in the time period analyzed. The spread averaged 13,074 hogs a year for the 12-year time period, with the widest spread of 18,589 hogs occurring in 1966. The narrowest spread occurred in 1972 when the total difference between the high- and low-volume months was 6,352 hogs.

Seasonal patterns in hog marketings at West Fargo were similar to the St. Paul and Sioux Falls markets (Appendix Figures 1 and 2) during the 1964-75 time period. Table 6 lists the month that the high and low hog volumes occurred at the three markets in each year of the 12-year study period. Only once in the 12 years did the high- or low-volume point occur during a different month of the year at each market (high, 1967), during all other years the high or low points occurred during the same month for at least two of the markets.

TABLE 6. HIGH AND LOW HOG MARKETING MONTHS AT THE WEST FARGO, ST. PAUL, AND SIOUX FALLS LIVESTOCK MARKETS, 1964-75

Year	High-Volume Month*			Low-Volume Month*		
	West Fargo	St. Paul	Sioux Falls	West Fargo	St. Paul	Sioux Falls
	-----month-----					
1964	OCT.	OCT.	OCT.	AUG.	AUG.	AUG.
1965	Nov.	JAN.	JAN.	MAY	Apr.	MAY
1966	NOV.	Dec.	NOV.	FEB.	FEB.	July
1967	Nov.	Jan.	Oct.	JULY	JULY	JULY
1968	OCT.	OCT.	OCT.	Aug.	JUNE	JUNE
1969	OCT.	Jan.	OCT.	AUG.	AUG.	AUG.
1970	NOV.	Dec.	NOV.	May	FEB.	FEB.
1971	NOV.	Jan.	NOV.	JULY	Dec.	JULY
1972	NOV.	NOV.	NOV.	JULY	Jan.	JULY
1973	OCT.	Nov.	OCT.	APR.	APR.	Feb.
1974	OCT.	OCT.	OCT.	FEB.	FEB.	FEB.
1975	JAN.	JAN.	Apr.	AUG.	AUG.	AUG.

*Upper case letters indicate months in which the high or low occurred at the same time at the various markets.

Source: USDA Livestock Market News Service.

The definite seasonal patterns at the three markets are a strong indication of the supply of hogs potentially available to a new slaughtering facility. In addition, it is highly unlikely that a new plant would be able to purchase the entire supply of hogs from any one market or area because of established buyers. Therefore, there may be a sufficient supply of hogs available to operate a plant on a yearly basis, but the supply of hogs may fall short at low-volume months during the year because of competition from established buyers.

Plant Location and Size Factors

Selecting the exact location for a livestock slaughtering plant involves many factors that must be taken into consideration. Cox and Taylor (9:25-26) compiled the following list of locational factors to consider when selecting a plant site.

1. Supply of hogs in desired numbers and quality. Will competing firms outbid the plant hog buyer for the available supply? Will

the supply be sufficiently uniform throughout the year so that unused capacity will be at a minimum at all times?

2. Labor. Is there an adequate supply of labor with proper skills available at a satisfactory cost? Can an experienced manager be obtained who possesses the skills, experience, and other qualifications needed for successful operation?
3. Water. Are quantity, quality, and cost of water required satisfactory?
4. Sewage disposal. Are present facilities adequate to properly dispose of wastes and sewage from the plant or will additional sewage facilities have to be constructed?
5. Power. Is sufficient electric power available at satisfactory rates?
6. Transportation. Are facilities adequate and rates reasonable for shipping hogs to the plant from the primary hog supply areas and for shipping pork from the plant to the markets where it will be sold?
7. Industrial fuel. Are coal, oil, and/or gas available at reasonable rates?
8. Construction costs. How do these compare with costs at alternative locations?
9. Plant site. Is the suggested site adequate in size for buildings, storage, and desired expansion at reasonable cost? Are drainage, groundwater level, and soil-bearing capacity satisfactory? Are utilities and transportation facilities available at the site?
10. Livestock markets. Are nearby markets available which provide for concentration of selling and buying activities?
11. Others. Have the other factors related to the selection of an appropriate location of a slaughtering plant, such as technical services, repair services, fire protection, local taxes and laws, community characteristics, weather, and the like, been considered?

The most important of the above location criteria is the hog supply. Industry personnel continually stress the importance of an adequate hog supply to assure a viable enterprise. Without an adequate and uniform supply of hogs during the year, the firm would not be able to operate at a capacity which would allow the production costs to be competitive with other firms in the industry.

The supply of hogs is also the limiting factor when considering the size of the slaughter facility to construct in North Dakota. An annual slaughter capacity of 120,000 hogs per year was chosen for consideration in this study. The criteria utilized to select the plant size was based upon the largest sized plant that could feasibly be operated within the supply area given the limited supply and concentration of hogs. The availability of cost data for various sized plants was also a factor in selecting the specific plant size for consideration.

A plant with an annual kill capacity of 120,000 and located within the proposed supply area would utilize 35 percent of the estimated number of hogs marketed from the area in 1975. The plant would require 26 percent of the total 1975 hog sales on a statewide basis.

A plant operating at full capacity slaughtering 120,000 hogs per year, or 480 hogs per day, is a relatively small plant by industry standards. Economies of size studies indicate definite cost advantages as plant size and volume of hogs slaughtered per year increase. Cassell (10:47) in 1967 indicated an approximate \$.40 saving per head for every hog slaughtered as plant size was increased from 34,650 to 519,750 annual slaughter capacity (Appendix Figure 3). No recent studies have been completed to examine more current economies of size, but the general consensus of specialists within the hog slaughtering industry is that the more optimum-sized plants are those with capacities of from one to two million head per year. Hog slaughter plants that have recently been or are being constructed are generally in the one to two million head per year range.

Plant Types

There are a number of different types of slaughter facilities possible for a plant with an annual slaughter capacity of 120,000 hogs. The three main types of hog processing facilities are:

1. Carcass plant. In this type of operation the hog is slaughtered and the carcass is sold on the "green pork market." This type of plant is very specialized and must have an established outlet for the carcasses.

The potential for a carcass plant is not considered in this study due to a lack of demand for pork carcasses within North Dakota. Virtually all pork entering the state through wholesalers is "boxed pork" processed by plants that break pork carcasses into

retail cuts (retail-cut plant). Because meat retail outlets are showing a definite preference and trend toward receiving pork in retail cuts and for discontinuing the cutting of pork in the individual stores, a North Dakota plant which produces carcasses would have to transport the carcasses out of the state for processing and then transport the pork back for consumption, therefore, entailing two shipping charges. This situation would likely result in the North Dakota plant providing carcass pork to another meat packing plant for further processing. The carcasses from the North Dakota plant would represent a supplemental source of hogs to the processing plant. The general unfavorable result of this situation is that when the demand for pork is high relative to the supply of hog carcasses, the carcass price tends to be favorable for the processing plant. But whenever the hog supply increases, the processing plant may have sufficient hogs from its own slaughter plants for processing and could cause a price squeeze on independent supplying plants or could discontinue receiving carcass supplies entirely from the independent carcass producing plant.

2. Retail-cut plant. Hogs are slaughtered and processed into a variety of retail cuts in this type of plant. Many different cuts and combinations of cuts are possible. The plant will vary the combination of cuts in response to changing demand and supply factors.

A retail-cut plant appears to closely meet the present demand for pork in the state. A survey of meat wholesalers indicated that very few retail outlets have facilities for cutting pork carcasses and are purchasing "boxed pork." Virtually all pork handled by the wholesalers interviewed was boxed pork from a retail-cut type of processing operation.

3. Whole-hog sausage plant. A whole-hog sausage operation utilizes almost all pork cuts and edible by-products in the manufacture of sausage products. A sausage operation is designed to meet a specific demand for a pork product and is more limited in its operation than a retail-cut facility. This type of operation, because of its specialized product, may take a longer period of time to establish markets than a retail-cut plant. A sausage

plant will also experience more direct competition from name-brand, nationally advertised sausage products compared to a retail plant which sells its products as a store-brand or unbranded product.

This study will examine the feasibility of two alternative slaughter-processing combinations. The first is designated as a retail-cut plant with an annual slaughter capacity of 120,000 hogs per year with the meat processed into retail cuts. The second is a whole-hog sausage plant with an annual slaughter capacity of 120,000 hogs per year with almost all pork and pork by-products processed into sausage. The feasibility of a carcass plant is not considered in this study.

Plant Investment and Operating Costs

The estimated investment and operating costs for the two plant alternatives considered in this study were based on budgets developed with the assistance of the KOCH-NEEDHAM supply companies. The prefab, pre-engineered facility was designed and equipped to meet all USDA inspection standards and covers an area of 15,264 square feet for the retail-cut plant and 17,280 square feet for the whole-hog sausage facility. The plants were assumed to slaughter 60 hogs per hour, eight hours per day, 250 days per year, and operate with separate slaughtering and processing crews. A janitorial and maintenance crew was also budgeted for each type of plant.

Thirty acres of land were included to provide adequate space for the slaughter facility, waste treatment, future expansion, and control of the immediately adjacent area. An allowance for pens and alleyways of six square feet per hog with a 1½-day holding capacity of animals was budgeted.

Investment in the delivery department consisted of five trucks to deliver the pork products within a 200-mile radius of the slaughtering facility. Trucks with a 22,000-pound capacity were budgeted.

A fee of 5 percent of total investment was included for engineering design and construction supervision.

Estimated Investment Costs

Total investment costs (Table 7) for the retail-cut plant and the whole-hog sausage facility were estimated at \$1,839,038 and \$2,049,743, respectively. The investment costs were broken down into three general areas for each of the two types of plants: 1) land and improvements, 2) buildings and general equipment, and 3) operations equipment. The most

TABLE 7. ESTIMATED INVESTMENT COST FOR PROPOSED NORTH DAKOTA HOG SLAUGHTERING PLANTS, 1975

Item	Retail-Cut Plant	Whole-Hog Sausage Plant
<u>Land and Improvements</u>		
Land	\$ 12,000	\$ 12,000
Site Work, Paving, and Lagoon	192,544	192,544
Pens and Alleyways	51,840	51,840
<u>Buildings and General Equipment</u>		
Building	169,158	191,334
Coolers and Freezers	374,411	374,411
Plumbing	104,167	104,167
Electrical	140,851	140,851
Heating, Ventilating, Air Condi- tioning, and Refrigeration	116,533	116,533
Cleaning and Sanitizing System	41,114	41,114
Office Equipment	16,000	16,000
<u>Operations Equipment</u>		
Kill Floor	118,005	118,005
Edible Rendering	46,369	56,369
Inedible Rendering	125,667	125,667
Cutting and Processing	92,806	271,301
Delivery Department	<u>150,000</u>	<u>150,000</u>
Subtotal	\$1,751,465	\$1,952,136
Engineering and Design Fee	<u>87,573</u>	<u>97,607</u>
TOTAL INVESTMENT	\$1,839,038	\$2,049,743
TOTAL INVESTMENT PER HOG AT 100 PERCENT CAPACITY	\$15.33	\$17.08

expensive area for each plant was buildings and general equipment, requiring 52 percent of the investment for the retail-cut facility and 48 percent of the investment in the whole-hog sausage plant. Refrigeration equipment was the single most expensive item, accounting for 20 percent of the total investment costs for each plant.

Investment averaged \$15.33 per hog for the retail-cut operation and \$17.08 for the sausage plant at full capacity.

Estimated Annual Operating Expenses

Estimated annual operating expenses at 100 percent capacity ranged from \$1,673,405 for the retail-cut plant to \$2,009,355 for the whole-hog sausage operation (Table 8). Costs were developed from North Dakota data when available or adjusted for state conditions using studies conducted in other states. The basis for estimation of each expense item is listed below.

Item:

1. Depreciation. Depreciation was estimated by assigning a life expectancy to each item of equipment and depreciating it by the straight line method (Appendix Table 2). Zero salvage value was assumed for all items.
2. Insurance. Insurance costs were budgeted at 1 percent of total investment, excluding land or trucks. All truck operating expenses were included in delivery department expenses.
3. Repairs and maintenance. Maintenance and repair costs were budgeted at 3 percent of total investment.
4. Interest on average investment. Interest on average investment was calculated at an 8 percent interest rate on 100 percent of the land value and 50 percent of the remainder of total investment items. Only one-half of nonland investment was included to take into account depreciable items.
5. Interest on operating capital. Interest on operating capital was budgeted at a 9½ percent interest rate on 1½ months live animal capacity and 1½ months operating expenses. It was assumed the plant would carry operating capital sufficient to cover the costs of 1½ months' hog purchases and 1½ months of the total operating expenses.

TABLE 8. ESTIMATED ANNUAL OPERATING EXPENSES FOR PROPOSED NORTH DAKOTA HOG SLAUGHTERING PLANTS, 1975

Item	Retail-Cut Plant	Whole-Hog Sausage Plant
1. Depreciation	\$ 112,416	\$ 138,194
2. Insurance	16,770	18,877
3. Repairs and Maintenance	50,311	56,632
4. Interest on Average Investment	68,042	76,470
5. Interest on Operating Capital	134,742	138,585
6. Salaries	642,884	684,380
7. Buying and Selling Expense	56,000	63,000
8. General Travel	4,600	4,600
9. General Office Expense	15,000	15,000
10. Advertising	12,000	60,000
11. Property Taxes	18,390	20,497
12. Electricity, Water, Natural Gas	48,000	48,000
13. Live Hog Shipment	21,250	21,250
14. Delivery Expenses	292,890	287,190
15. By-Products Delivery Expense	138,000	138,000
16. Packaging, Spices, and Supplies	33,770	230,400
17. Miscellaneous Expenses	<u>8,340</u>	<u>8,280</u>
TOTAL OPERATING EXPENSES	\$1,673,405	\$2,009,355
OPERATING COST/HEAD:		
a. 100 Percent Capacity	\$13.95	\$16.74
b. 80 Percent Capacity*	\$15.66	\$18.72

*At 80 percent operating capacity, total operating costs were reduced to \$1,503,004 and \$1,797,955 for the retail-cut plant and the whole-hog sausage plant, respectively. The following items were reduced in cost at 80 percent capacity: interest on operating capital, slaughter and processing salaries, utilities, live hog transportation, delivery expense, by-product delivery expense, packaging, spices, supplies, and miscellaneous expenses.

6. Salaries. The number of management and office personnel was estimated from existing studies. The number required and the skill levels of slaughter and processing employees were based on established union scales. Fringe benefits were set at 18 percent above base salary for management, buyers, and sellers and 14 percent for other employees (Appendix Tables 3 and 4).
7. Buying and selling expense. Annual costs of buying and selling were estimated at \$8,000 per man in the retail-cut plant and \$9,000 per man in the whole-hog sausage processing facility. The sausage facility would market its products over a larger area and, therefore, was budgeted at a higher expense level per man. Buyers may incur more expenses than sellers if a significant number of hogs were purchased direct from farmers due to the amount of travel involved, but the difference between the buying and selling expense was assumed to average out to the budgeted cost.
8. General travel. \$4,600 was included for management travel to trade meetings and for general business requirements.
9. General office expense. General office expenses include the cost of telephone, supplies, and other related office expenditures.
10. Advertising. Advertising expenses are difficult to estimate due to the many advertising methods and media available. An estimate of \$12,000 per year was assumed for the retail-cut plant and \$60,000 for the whole-hog sausage processing facility. Advertising outlays for successfully promoting a branded whole-hog sausage product, especially during the early years of operation while markets are being established, could be significantly higher.
11. Property taxes. Property taxes were estimated at 1 percent of total investment.
12. Utilities. Electricity, water, and natural gas were budgeted at \$.40 per hog.
13. Live hog shipments. A transportation charge of \$21,250 was included to haul 50 percent of the slaughter hogs an average of 50 miles to the plant. It was assumed that one-half of the hogs would be delivered directly to the plant by producers.
14. Delivery expenses. Costs for delivery of pork products were assumed to be the same as the expense incurred (minus profit)

by local meat wholesalers. Transportation costs reported by local wholesalers average $2\frac{1}{2}\text{¢}$ per pound for delivery within a 200-mile radius. A 10 percent allowance for profit was subtracted from the $2\frac{1}{2}\text{¢}$ delivery expense, lowering the transportation charge to $2\frac{1}{4}\text{¢}$ to obtain the delivery cost for the proposed plant. The $2\frac{1}{4}\text{¢}$ per pound rate was multiplied by the total meat output of the plant to calculate the transportation charge (139 and 138 pounds per hog for the retail-cut plant and whole-hog sausage facility, respectively, Appendix Tables 5 and 6). The total transportation charge was also adjusted downward to exclude sales salaries and sales expenses that were already included in the operating expenses.

15. By-product delivery expense. Costs of delivery of by-products to Chicago, Illinois, were budgeted by using the I.C.C. rate of \$1.26 per hundredweight. Chicago was used to put the by-product quote on the same basis as the U.S. meat price quotes explained in Appendix B.
16. Packaging, spices, and supplies. For the retail-cut plant-- packaging, spices, and killing supplies were estimated at \$14,010 + 14.8¢ per hog. An allowance of $1\frac{1}{2}\text{¢}$ per pound of sausage output, assuming 127 pounds per hog, was made for packaging, spices, and other supplies for the whole-hog sausage plant (11).
17. Miscellaneous expense. Miscellaneous expenses were estimated at \$.05 per 100 pounds of pork output.

Operating costs averaged \$13.95 per head at 100 percent capacity for the retail-cut plant and \$16.74 for the sausage processing facility. However, many hog slaughter plants operate seasonally or perhaps continuously at less than design capacity due to the seasonality of hog supplies, price margins, and other economic factors. This fact was pointed out by Baker (12:58) who reported the United States' federally inspected hog slaughtering plants of up to 143,436 annual capacity were utilizing only 52.9 percent of their engineered slaughter capacity in 1973. Eighty percent of engineered capacity was used as a realistic estimate of actual annual slaughter for this study. This capacity estimate is in line with the estimate used by Schupp and Roy in 1973 (13:52). At 80 percent of capacity the estimated operating cost per hog was \$15.66 in the retail-cut plant and \$18.72 in the whole-hog sausage processing operation.

Gross Operating Margin

Hog and pork prices are very volatile. The prices are dependent upon a number of interrelated factors, some of which are illustrated in Figure 7. The heavy lined arrows in the diagram indicate that the factors which directly affect the retail price of pork are disposable consumer income, pork consumption (which is strongly affected by pork production), and the supply of other meats and poultry. The farm price of hogs is primarily affected by the retail price of pork. Hog prices are also directly affected by the price of lard, the fats and oils economy, and a variety of other factors. As is illustrated in the diagram, all the various factors are interrelated and a change in any one can trigger a chain reaction eventually affecting hog and pork prices.

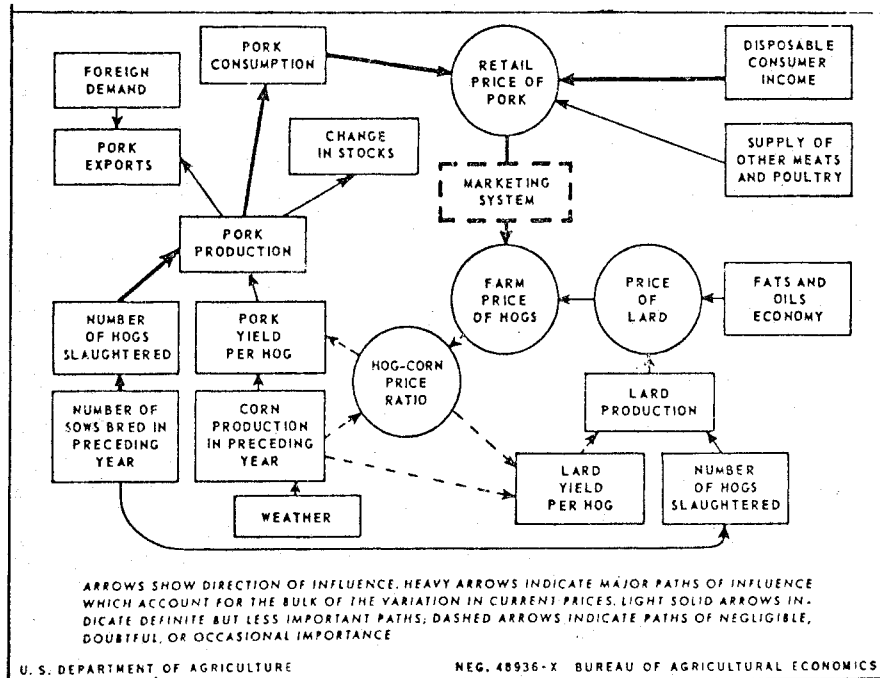


Figure 7. The Demand and Supply Structure for Pork

Source: Williams (14:535).

The U.S. average price of hogs and the wholesale pork price reflect the high degree of variability caused by changes in the interrelated factors (Figure 8 and Appendix Tables 7 and 8). Hog prices during the last three hog cycles (1964-75) have ranged from a low in January, 1964, of \$14.10 per hundredweight to a high in September, 1975, of \$61.23. The pork wholesale

dollars/cwt.

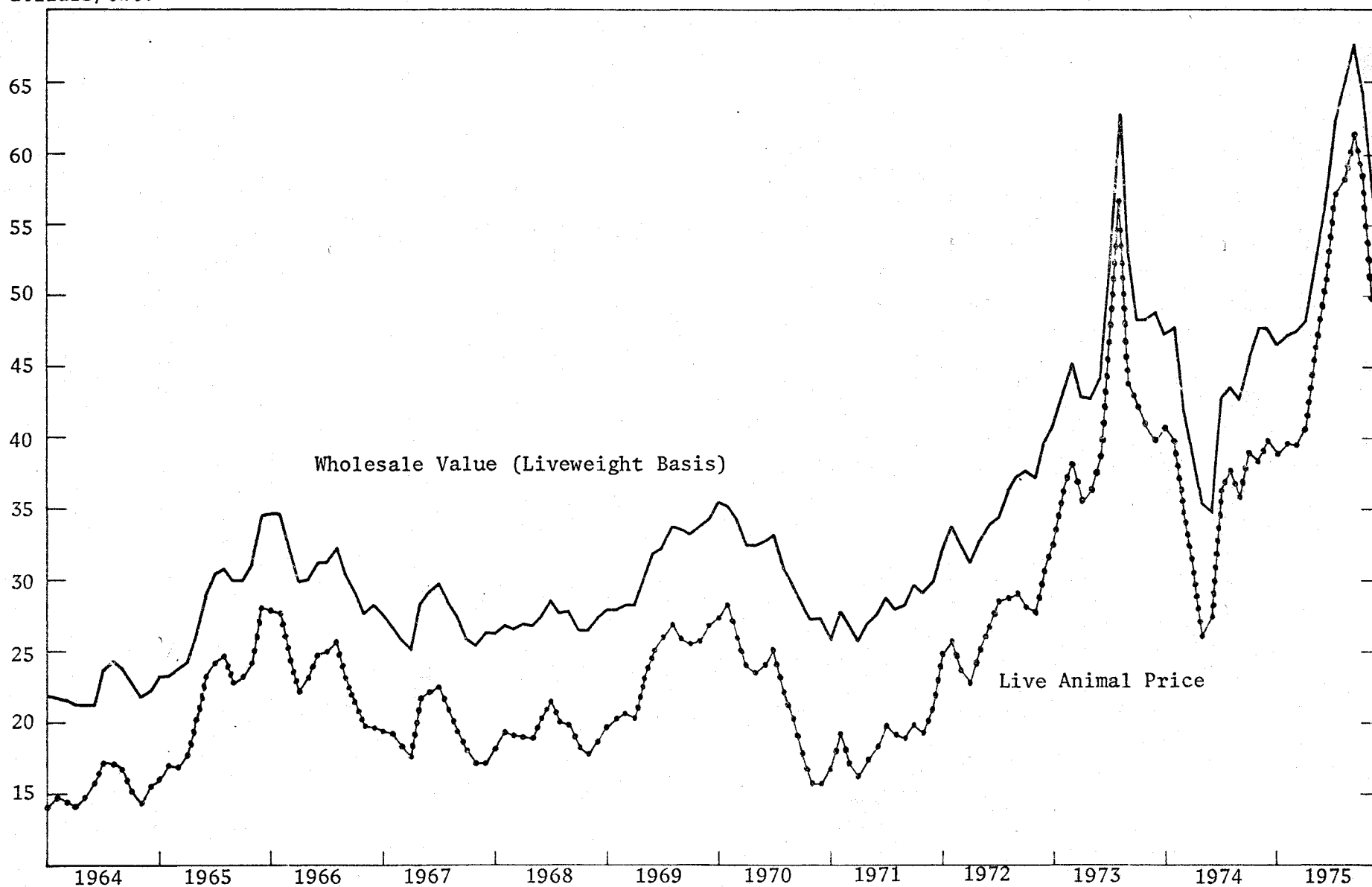


Figure 8. U.S. Average Hog Live Animal Price and Pork Wholesale Value (Liveweight Basis), 1964-75.

Source: USDA, ERS, Livestock and Meat Statistics, Statistical Bulletin Nos. 522 and 543, Washington, D.C.

value on a liveweight basis has varied to an equal extent from a low of \$21.22 per hundredweight in May, 1964, to a high of \$67.69 in September, 1975. The high for both the live hog price and the wholesale meat price occurred at the same time in this 12-year period (September, 1975) and, as is seen in Figure 8, the two price lines move closely together. The area between the live animal price and the wholesale pork price (liveweight basis) is the gross operating margin, which is used as a basis for determining the revenue and profitability of the retail-cut plant.

In simple terms, the gross operating margin is the difference between what the plant manager receives for all salable products of a hog and the cost of originally purchasing the hog. From this margin he must pay all slaughtering costs, labor, supplies, transportation, etc., that were incurred in converting that hog to a finished product and shipping it to its place of sale. What is left over when per hog costs are subtracted from the gross operating margin is the profit or loss before taxes that the operation realizes.

A gross operating margin analysis was used for the retail-cut plant in this study because of the high variability of hog and pork prices. The margin does not vary to as large an extent as hog and pork prices (see Figure 9 and Table 9). In the 12-year time period under consideration (1964-75), the U.S. gross operating margin varied from the narrowest margin of \$5.20 in July, 1975, to its widest spread of \$11.71 in December, 1970, or a range of \$6.51. During the same time period, hog prices had a maximum range of \$47.13 and the wholesale pork price varied by \$46.47.

It is difficult to develop a gross operating margin for a plant in North Dakota. Wholesale pork prices are not published for the state and constructing the information from available pork cut prices is complicated because of the many different cuts of pork and pork products which can be processed from a hog. Shifts in demand for the various pork products change the combination of pork cuts, with most changes affecting the total value received from a hog. In lieu of forming such a North Dakota wholesale pork basis, the standardized U.S. live hog and wholesale pork values were used to calculate a national gross operating margin which was adjusted to be comparable to the market that existing North Dakota wholesalers operate within.

Adjustment procedures and an explanation of the methodology used is outlined in Appendix B.

dollars/cwt.

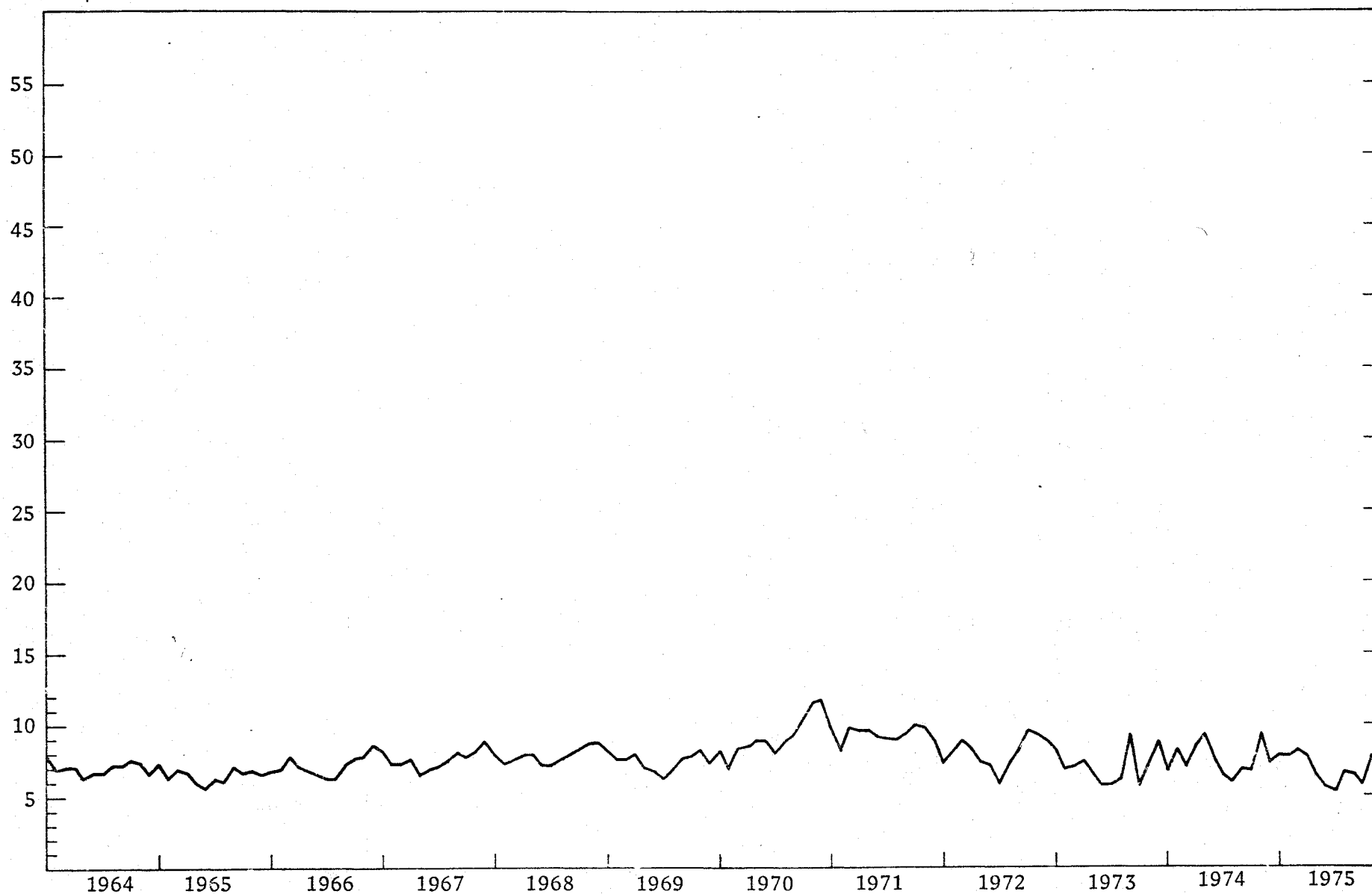


Figure 9. U.S. Gross Operating Margin, 1964-75

Source: USDA, ERS, Livestock and Meat Statistics, Statistical Bulletin Nos. 522 and 543, Washington, D.C.

TABLE 9. U.S. PORK GROSS OPERATING MARGINS, 1964-75

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1964	7.81	6.93	7.08	7.13	6.38	6.60	6.59	7.17	7.11	7.51	7.44	6.59
1965	7.22	6.38	6.92	6.68	5.95	5.60	6.23	6.07	7.09	6.64	6.82	6.52
1966	6.73	6.86	7.78	7.01	6.89	6.48	6.30	6.39	7.31	7.62	7.79	8.57
1967	8.23	7.34	7.41	7.55	6.52	6.97	7.14	7.50	8.10	7.72	8.10	8.91
1968	7.90	7.29	7.51	7.94	7.97	7.15	7.11	7.54	7.96	8.28	8.60	8.64
1969	8.21	7.56	7.52	7.92	6.99	6.74	6.24	6.89	7.56	6.73	8.12	7.39
1970	8.06	6.94	8.30	8.44	8.92	8.82	8.01	8.78	9.38	10.41	11.54	11.71
1971	9.71	8.38	9.74	9.55	9.58	9.20	8.99	8.94	9.33	9.98	9.71	8.86
1972	7.25	8.14	8.84	8.32	7.36	7.17	5.77	7.26	8.11	9.58	9.39	8.87
1973	8.21	6.93	6.99	7.42	6.53	5.65	5.67	6.07	9.28	6.22	7.38	8.84
1974	6.64	8.16	6.96	8.41	9.31	7.56	6.46	5.86	6.86	6.73	9.26	7.69
1975	7.72	7.61	8.07	7.66	6.31	5.49	5.20	6.59	6.46	5.76	7.83	5.53

Retail-Cut Plant

Two average U.S. gross operating margins (GOM) were adjusted for comparison to the North Dakota estimated operating expenses. The U.S. gross operating margin and the resulting North Dakota margin are outlined in Table 10. The 1975 estimated North Dakota gross operating margin of \$16.85 would have generated \$1,617,600 of revenue for the proposed plant, while the latest hog cycle average of \$18.10 would raise the total revenue to \$1,737,600, assuming the plant operated at 80 percent capacity in both cases.

TABLE 10. U.S. AND ESTIMATED NORTH DAKOTA GROSS OPERATING MARGINS FOR VARIOUS TIME PERIODS

Time Period	U.S. Gross Operating Margin Average	Estimated North Dakota Gross Operating Margin
	<i>per hundredweight</i>	<i>per hog</i>
1975	\$6.69	\$16.85
1972-75	\$7.32	\$18.10

Table 11 presents a financial analysis of the two gross operating margins. The 1975 average resulted in a profit of \$1.19 per hog before taxes, while the four-year average realized an additional \$1.25 profit--bringing the total profit per hog to \$2.44. After taxes, a \$.76 profit per hog was realized assuming 1975 gross operating margin and \$1.41 profit per

TABLE 11. FINANCIAL ANALYSIS OF THE PROPOSED RETAIL-CUT PLANT USING 1975 AND 1972-75 ESTIMATED NORTH DAKOTA GROSS OPERATING MARGINS^a

Item	1975	1972-75
1. Gross Operating Margin ^b	\$1,617,600	\$1,737,600
2. Less Operating Expense	<u>1,503,004</u>	<u>1,503,004</u>
3. Net Operating Margin	114,596	234,596
4. Net Operating Margin Before Taxes, Dollar Per Hog	\$1.19	\$2.44
5. Rate of Return on Investment Before Taxes	6.23%	12.76%
6. Less Total Tax ^c	<u>42,006</u>	<u>99,606</u>
7. Net Margin	72,590	134,990
8. Net Operating Margin After Taxes, Dollar Per Hog	\$.76	\$1.41
9. Rate of Return on Investment After Taxes ^d	3.95%	7.34%

^aAn interest charge of 8.0 percent on average capital investment was included as a fixed cost.

^bNorth Dakota Gross Operating Margins of \$16.85 and \$18.10 X 96,000 hogs, respectively.

^cTwenty-two percent on first \$50,000, 48 percent on remainder of net operating margin.

^dRefers to total estimated investment.

hog using the last hog cycle average. Rate of return on investment after taxes was 3.95 percent and 7.34 percent for the 1975 gross operating margin and the 1972-75 average, respectively. With such a small rate of return on investment, a North Dakota hog plant would have difficulty in attracting investment capital, especially by national meat packers. If a plant were established, it would likely be the result of local private investments.

A projected cash flow was developed for each gross operating margin to illustrate the number of years the slaughter facility would operate before realizing a profit (Tables 12 and 13). The cash flow was based upon the basic assumptions that the facility would be constructed in the first one-half of year one and in the seventh month would begin operating at an 80 percent

TABLE 12. PROJECTED CASH FLOW FOR RETAIL-CUT PLANT ASSUMING \$16.85 PER HOG AS THE NORTH DAKOTA GROSS OPERATING MARGIN (\$6.69 PER HUNDREDWEIGHT U.S. 1975 MARGIN)

Item	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9
Profit or Loss from Previous Year	\$ _____	\$ -333,757	\$ -349,737	\$ -333,757	\$ -307,465	\$ -269,682	\$ -219,317	\$ -155,173	\$ -75,942
<u>Expenditures:</u>									
Principal Payment	56,208	112,416	112,416	112,416	112,416	112,416	112,416	112,416	112,416
Insurance	16,770	16,770	16,770	16,770	16,770	16,770	16,770	16,770	16,770
Repairs and Maintenance	25,155	50,311	50,311	50,311	50,311	50,311	50,311	50,311	50,311
Interest on Investment	116,472	142,626	133,633	124,639	115,646	106,653	97,659	88,666	79,673
Salaries	423,804	621,794	621,794	621,794	621,794	621,794	621,794	621,794	621,794
Buying and Selling Expenditures	56,000	56,000	56,000	56,000	56,000	56,000	56,000	56,000	56,000
General Travel Expense	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600	4,600
General Office Expense	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Advertising	60,000	36,000	12,000	12,000	12,000	12,000	12,000	12,000	12,000
Property Tax	18,390	18,390	18,390	18,390	18,390	18,390	18,390	18,390	18,390
Utilities	19,200	38,400	38,400	38,400	38,400	38,400	38,400	38,400	38,400
Live Hog Shipment	8,500	17,000	17,000	17,000	17,000	17,000	17,000	17,000	17,000
Delivery Expense	108,915	217,830	217,830	217,830	217,830	217,830	217,830	217,830	217,830
By-Product Delivery	55,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000	110,000
Packaging, Spices, Supply	14,109	28,218	28,218	28,218	28,218	28,218	28,218	28,218	28,218
Miscellaneous Expense	3,336	6,672	6,672	6,672	6,672	6,672	6,672	6,672	6,672
Interest on Operating Capital	141,098	109,846	109,561	109,561	109,561	109,561	109,561	109,561	109,561
Interest on Previous Year's Loss	--	31,707	33,025	31,707	29,209	25,620	20,835	14,741	7,214
Total Expenditures + Previous Year's Profit or Loss	\$1,142,557	\$1,967,337	\$1,951,357	\$1,925,065	\$1,887,282	\$1,836,917	\$1,772,773	\$1,693,542	\$1,597,791
Less Gross Operating Margin	808,800	1,617,600	1,617,600	1,617,600	1,617,600	1,617,600	1,617,600	1,617,600	1,617,600
Profit/Loss	-333,757	-349,737	-333,757	-307,465	-269,682	-219,317	-155,173	-75,942	+19,809

TABLE 13. PROJECTED CASH FLOW FOR RETAIL-CUT PLANT ASSUMING \$18.10 PER HOG AS THE NORTH DAKOTA GROSS OPERATING MARGIN
(\$7.32 PER HUNDREDWEIGHT U.S. 1972-75 AVERAGE)

Item	Year 1	Year 2	Year 3	Year 4
Profit or Loss from Previous Year	\$ _____	\$ -273,757	\$ -164,037	\$ -10,616
<u>Expenditures:</u>				
Principal Payment	56,208	112,416	112,416	112,416
Insurance	16,770	16,770	16,770	16,770
Repairs and Maintenance	25,155	50,311	50,311	50,311
Interest and Investment	116,472	142,626	133,633	124,639
Salaries	423,804	621,794	621,794	621,794
Buying and Selling Expenditures	56,000	56,000	56,000	56,000
General Travel Expense	4,600	4,600	4,600	4,600
General Office Expense	15,000	15,000	15,000	15,000
Advertising	60,000	36,000	12,000	12,000
Property Tax	18,390	18,390	18,390	18,390
Utilities	19,200	38,400	38,400	38,400
Live Hog Shipment	8,500	17,000	17,000	17,000
Delivery Expense	108,915	217,830	217,830	217,830
By-Product Delivery	55,000	110,000	110,000	110,000
Packaging, Spices, Supply	14,109	28,218	28,218	28,218
Miscellaneous Expense	3,336	6,672	6,672	6,672
Interest on Operating Capital	141,098	109,846	109,561	109,561
Interest on Previous Year's Loss	--	26,007	15,584	1,009
Total Expenditures + Previous Year's Profit or Loss	\$1,141,557	\$1,901,637	\$1,748,216	\$1,571,226
Less Gross Operating Margin	868,800	1,737,600	1,737,600	1,737,600
Profit/Loss	-273,757	-164,037	-10,616	+166,374

slaughter capacity. Also, it was assumed that principal payments would be equal to the annual depreciation expense and that various cost items would vary during the construction and establishment of the plant. Tables 12 and 13 itemize the projected costs and returns until the facility realizes a profit.

With the stated assumptions, the retail-cut plant would have to operate nine years before it would net a profit under a 1975 gross operating margin. If the gross operating margin reached the 1972-75 average, the facility would realize a profit in the fourth year.

Whole-Hog Sausage Plant

The marginal approach cannot be used for the pork sausage operation price analysis due to lack of wholesale price data for sausage. Instead, North Dakota sausage prices and live animal prices were used for the time period of January, 1975, to calculate return on investment. The steps used and an explanation for each step is as follows:

Procedure:

1. Sausage value per hog	\$99.06
2. Value of nonsausage products	+8.10
3. Live animal cost	<u>-91.49</u>
4. Gross operating margin	\$15.67

Explanation:

1. Sausage value per hog. The value of the sausage from each hog was estimated to be \$99.06. A local wholesale sausage quote of \$.78 per pound for January, 1975, was the basis of the sausage price for a plant located in eastern North Dakota. This price was then multiplied by the estimated yield of sausage per hog of 127 pounds (Appendix Table 6).

The January, 1975, sausage price was considered typical in that period of time for North Dakota. Comparative prices include a range of \$.59-\$.65 per pound reported by the National Provisioner in mid-1973 and a January, 1976, price of \$.85 per pound in eastern North Dakota.

2. Value of nonsausage products. The value of \$8.10 was used for nonsausage products of the hog, such as neck bones, feet, spare-ribs, and by-products. The value applied was updated from a study conducted in Arizona (11:V-24).

3. Live animal cost. The West Fargo (January, 1975) monthly average price of \$39.78 per hundredweight was used as the cost of purchasing live hogs for the plant.
4. Gross operating. A margin of \$15.67 is what the North Dakota plant must operate within in order to compete in the whole-hog sausage market, assuming given sausage and hog prices.

A North Dakota whole-hog sausage facility would not be able to incur operating costs greater than \$15.67 per head to be competitive with existing sausage prices in the state. The estimated operating costs for the whole-hog sausage operation (Table 8) is \$18.72 per head at 80 percent capacity. The loss for the plant, using the prices stated above, is estimated at \$3.05 per head.

Other Factors Affecting Slaughter Plant's Feasibility

There are many factors that affect the feasibility of a hog-slaughtering plant in addition to those included in the price and cost analysis. These items are also important to the success of the operation and need to be thoroughly studied along with the investment and operating cost.

The most limiting factor influencing the potential success of a plant is the hog supply. Although the yearly supply of hogs in North Dakota appears to be sufficient to support a plant of the capacity budgeted, the week-to-week competition from existing buyers and the monthly seasonal patterns may force the facility to operate at less than full capacity. Slaughtering facilities cannot be expected to operate at full capacity the year around. An accepted standard in the industry is 80 percent capacity. Continuous shortages in the supply of hogs during several months of the year could seriously affect the profitability and potential success of a new operation.

One way to adjust to the shortages in supply is to temporarily cut back on the labor force when such shortages occur. It may be possible to reduce costs by this method in the initial phases of operation, but eventual unionization of the labor force could strictly curtail this effort.

The size of the facility is a second point to examine when considering factors affecting a slaughter plant's feasibility. A plant with

a slaughter capacity of 120,000 head per year is small by industry standards and will not be as efficient as the more modern, larger plants. Industry research indicates that the major economies of size are realized as a hog slaughter plant achieves a capacity of 500,000 to 600,000 head per year; anything below this capacity will have a higher slaughter cost per head. Size inefficiencies in smaller plants are mainly due to the underutilization of various pieces of equipment. Such equipment items are necessary in the slaughter process, but often cannot be purchased at a size to match a small plant's slaughter capacity. New hog plants being built today range in a slaughter capacity range of 600,000 to 2,000,000 head per year.

The labor force may be also underutilized in a small slaughter plant. There are certain work stations which require a man; but often he will be underutilized and it will be very difficult to shift that man to additional positions to better utilize his labor due to labor union contracts.

It may be difficult to obtain good management personnel with a small plant. Management is extremely important in the initial phases of development. Markets have to be developed for both buying hogs and selling pork; labor must be located and trained; construction of the plant supervised; and financing, advertising, and numerous other duties guided. A good manager probably will have to be hired away from an existing slaughter plant.

A third nonmonetary area that may affect the feasibility of a new slaughtering facility is in the marketing of its products. All pork products from a new plant will be competing with nationally known brands and packers who have established markets and product identities. Often pork products are purchased on the basis of reputation. It will take time for a new slaughter plant to establish both consumer and retailer confidence in its pork products and may, at least in the initial phases, be forced to accept a lower price for its output. There may be little difficulty with the established cuts--loins, hams, etc.--but markets for miscellaneous cuts and sausage will have to be established.

The sausage plant might have the most difficulty in marketing its product. At 80 percent capacity, over 12 million pounds of sausage will be placed on the market. The sausage market is a national market with well-known brand name products. A facility of the size under consideration will not be able to compete on the national level without substantial advertising expenditures. An extensive survey of the local sausage demand should be undertaken before investing in a sausage facility.

Summary and Conclusions

Summary

North Dakota has no large-scale hog slaughtering facilities. Most pork consumed in the state is imported from other states, while the majority of the state's hogs are exported. In effect, North Dakota is exporting its hogs, having them slaughtered, and importing most of the pork for consumption.

It is estimated that a meat equivalent of approximately 300,000 hogs is consumed in North Dakota annually--or 63.4 pounds per person on a retail weight basis. The U.S. average is 61.9 pounds. Commercial and farm slaughter in the state annually averages 55,600 hogs or only 18 percent of the pork consumed in the state.

The annual number of hogs marketed in North Dakota averaged 486,000, with a range from 417,000 to 576,000 for the 12-year time period (1964-75) studied. After existing state slaughter was subtracted, there was an average in excess of 433,000 hogs annually shipped out of the state for slaughter.

Southeastern North Dakota has the highest density of hogs per square mile in the state. Densities range from 11 to 50 hogs per square mile according to the 1969 Census of Agriculture. The nine-county area in southeastern North Dakota marketed 233,981 hogs in 1969 or 47 percent of the state's total sales. Seasonal trends of hog sales at the largest market in the area (West Fargo) indicate a large degree of variation with an average range between the highest sales month and lowest sales month of 13,074 hogs for the 12-year period. An exact location of a plant within this area can be determined only after the remainder of the locational factors outlined in the text have been taken into consideration.

The supply of hogs was the limiting factor when considering the size of the slaughter facility to construct in North Dakota. An annual slaughter capacity of 120,000 hogs per year was chosen for consideration in this study. The criteria utilized to select the plant size was based upon the largest sized plant that could feasibly be operated within the supply area, given the limited supply and concentration of hogs. The availability of cost data for various sized plants was also a factor in selecting the specific plant size for consideration. Two alternative processing types were

examined for the slaughter plant: (1) a retail-cut plant and (2) a whole-hog sausage facility.

Estimated investment costs for the retail-cut plant were \$1,839,038 and \$2,049,743 for the whole-hog sausage plant. Investment per hog at 100 percent capacity was \$15.33 for the retail plant and \$17.08 for the sausage operation.

Estimated annual operating costs totaled \$1,673,405 for the retail-cut facility and \$2,009,355 for the whole-hog sausage plant. At 80 percent capacity, the operating costs were \$15.66 per hog and \$18.72 per hog, respectively, for the retail-cut and sausage operation.

A gross operating margin analysis using USDA data adjusted to compare to the North Dakota wholesale pricing base was used for the financial analysis of the retail-cut plant. This analysis method eliminated a large amount of the price variability and can be easily updated when market conditions change. Two USDA gross operating margin averages were adjusted to be applicable to North Dakota. The 1975 average of \$6.69 per hundredweight yielded an estimated \$16.85 per hog margin in the state, while the 1972-75 average of \$7.32 per hundredweight produced a margin of \$18.10 per hog. Rate of return on investment was 3.95 percent and 7.34 percent for the 1975 average and 1972-75 average, respectively. It is projected that the retail-cut facility would have to operate nine years before experiencing a profit under the 1975 gross operating margin or four years if the 1972-75 average could be realized.

North Dakota prices for hogs and sausage for January, 1975, were applied instead of the marginal approach in analyzing the whole-hog sausage plant. The marginal analysis could not be used for the whole-hog sausage breakdown due to a lack of national wholesale sausage price quotations. The whole-hog sausage plant, using stated assumptions, showed a loss of \$3.05 per hog at 80 percent capacity.

The success of a hog slaughtering plant also depends on several nonmonetary considerations. Items, such as hog supply, seasonality of hog supply, labor restrictions, inefficiencies of facility size, management, and marketing outlets, must be evaluated before the feasibility of a plant can be established.

Conclusions

The construction of a hog slaughtering plant in North Dakota designed to process 120,000 hogs annually does not appear feasible given the present gross operating margins for hogs and plant operating costs compiled and analyzed for this size plant. Several factors would have to change to create conditions more favorable for such a facility, including:

1. A larger and more stable hog supply.
2. A larger plant size to take advantage of economies of size.
3. A larger gross operating margin.

If any or all of these factors change significantly, the feasibility of a large-scale hog slaughtering facility should be re-examined.

Appendix A

APPENDIX TABLE 1. AVERAGE MONTHLY PRICES OF U.S. 1-2, 200-240 POUND BARROWS AND GILTS AT THE WEST FARGO, ST. PAUL, AND SIOUX FALLS LIVESTOCK MARKETS, 1964-75

1964				1965				1966				1967			
Month	West Fargo	St. Paul	Sioux Falls	Month	West Fargo	St. Paul	Sioux Falls	Month	West Fargo	St. Paul	Sioux Falls	Month	West Fargo	St. Paul	Sioux Falls
-----dollars per hundredweight-----															
Jan.	14.47	15.11	15.20	Jan.	15.97	16.64	16.48	Jan.	28.06	28.57	28.77	Jan.	19.69	20.42	20.42
Feb.	14.61	15.08	15.18	Feb.	16.80	17.51	17.40	Feb.	28.12	28.52	28.55	Feb.	19.47	20.22	20.09
Mar.	14.46	14.96	14.88	Mar.	16.69	17.26	17.24	Mar.	24.29	24.77	24.81	Mar.	18.38	19.05	18.90
Apr.	13.97	14.63	14.48	Apr.	17.20	none	17.99	Apr.	22.40	22.84	22.87	Apr.	17.76	18.42	18.18
May	14.86	15.45	15.40	May	20.19	20.79	20.66	May	23.39	24.00	24.04	May	21.82	22.75	22.58
June	15.29	16.02	16.03	June	23.08	23.91	23.77	June	25.30	25.92	25.55	June	22.20	23.07	22.89
July	17.02	15.47	17.51	July	24.04	24.76	24.67	July	24.97	25.57	25.54	July	22.28	23.07	22.80
Aug.	16.74	17.28	17.34	Aug.	24.39	25.08	24.95	Aug.	25.24	25.98	25.82	Aug.	20.70	21.54	21.13
Sep.	16.28	16.95	16.64	Sep.	22.26	23.10	22.88	Sep.	22.41	23.26	23.01	Sep.	18.72	19.76	19.41
Oct.	14.85	15.58	15.46	Oct.	22.91	23.59	23.34	Oct.	21.09	21.90	21.58	Oct.	17.77	18.60	18.30
Nov.	14.07	14.72	14.61	Nov.	23.39	24.56	24.36	Nov.	19.58	20.31	20.13	Nov.	17.60	17.82	17.51
Dec.	15.35	16.13	15.92	Dec.	27.62	28.33	28.50	Dec.	19.89	20.58	20.59	Dec.	18.25	18.00	17.75
1968				1969				1970				1971			
Jan.	18.61	19.23	18.80	Jan.	19.76	20.44	20.18	Jan.	27.63	28.30	28.48	Jan.	16.49	16.94	16.76
Feb.	19.74	20.33	19.72	Feb.	20.26	21.06	20.65	Feb.	28.42	29.01	28.94	Feb.	19.39	19.75	19.80
Mar.	19.11	19.97	19.10	Mar.	20.58	21.43	20.88	Mar.	26.30	26.89	26.70	Mar.	17.01	17.57	17.53
Apr.	19.36	20.10	19.42	Apr.	20.45	21.25	20.72	Apr.	24.31	24.90	24.77	Apr.	16.15	16.78	16.78
May	19.34	20.07	19.44	May	23.32	24.21	23.82	May	24.20	24.85	24.74	May	17.70	18.22	18.12
June	20.94	21.54	20.96	June	24.98	26.04	25.56	June	24.91	25.45	25.14	June	18.70	19.33	19.10
July	21.20	22.01	21.48	July	25.77	26.80	26.39	July	25.64	25.96	25.68	July	19.83	20.45	20.35
Aug.	19.80	20.67	19.88	Aug.	26.67	27.62	27.11	Aug.	22.20	22.42	22.22	Aug.	19.12	19.49	19.27
Sep.	19.82	20.58	19.84	Sep.	25.59	26.56	26.02	Sep.	20.25	20.65	20.44	Sep.	18.51	19.22	18.94
Oct.	18.03	18.84	18.24	Oct.	25.11	26.18	25.60	Oct.	17.78	18.25	18.07	Oct.	19.64	20.19	19.86
Nov.	17.62	18.57	18.07	Nov.	25.32	26.56	26.30	Nov.	15.58	16.30	16.18	Nov.	19.03	19.87	19.66
Dec.	18.77	19.55	19.14	Dec.	26.78	27.93	27.74	Dec.	15.80	16.40	16.39	Dec.	21.02	21.67	21.64
1972				1973				1974				1975			
Jan.	24.58	25.40	25.51	Jan.	32.37	33.37	33.16	Jan.	41.03	41.92	41.65	Jan.	38.78	39.74	39.42
Feb.	25.70	26.18	26.24	Feb.	36.33	37.14	37.06	Feb.	39.77	41.00	40.48	Feb.	39.10	39.88	40.04
Mar.	23.33	24.02	23.94	Mar.	37.57	38.41	38.14	Mar.	34.82	35.63	35.36	Mar.	39.17	39.85	39.96
Apr.	22.82	23.41	23.40	Apr.	35.44	36.27	35.94	Apr.	31.01	31.83	31.77	Apr.	40.60	41.52	41.38
May	25.38	26.07	26.02	May	36.60	37.31	37.14	May	27.24	27.94	27.81	May	46.79	47.60	47.18
June	26.98	27.68	27.62	June	38.87	39.58	39.29	June	28.23	29.53	29.40	June	50.87	52.13	51.85
July	28.50	29.10	29.00	July	44.67	46.09	45.76	July	37.09	37.93	37.68	July	57.06	57.68	57.47
Aug.	28.53	29.23	28.92	Aug.	56.30	56.93	56.34	Aug.	38.12	38.84	38.73	Aug.	58.02	58.57	58.78
Sep.	28.78	29.42	29.14	Sep.	43.46	44.38	43.56	Sep.	35.68	36.40	36.02	Sep.	60.31	61.23	61.30
Oct.	27.72	28.51	28.07	Oct.	41.99	42.80	42.22	Oct.	38.53	39.37	39.10	Oct.	59.05	59.83	59.72
Nov.	27.62	28.49	28.15	Nov.	41.22	42.29	41.69	Nov.	37.87	38.94	38.34	Nov.	49.91	51.12	51.44
Dec.	30.76	31.57	31.42	Dec.	40.15	41.28	40.86	Dec.	39.93	40.82	40.50	Dec.	48.80	49.74	50.05

Source: USDA Livestock Market News Service.

APPENDIX TABLE 2. ESTIMATED ANNUAL DEPRECIATION FOR PROPOSED NORTH DAKOTA HOG SLAUGHTERING PLANTS

Item	Estimated Life <i>years</i>	Retail-Cut Plant <i>-----dollars-----</i>	Whole-Hog Sausage Plant
<u>Land and Improvements</u>			
Land	--	--	--
Site Work, Paving, and Lagoon	15	\$ 12,843	\$ 12,843
<u>Buildings and General Equipment</u>			
Building	25	6,766	7,653
Coolers and Freezers	25	14,976	14,976
Pens and Alleyways	15	3,458	3,458
Plumbing	25	4,167	4,167
Electrical	25	5,634	5,634
H.V., A.C., and Refrigeration	10	11,653	11,653
Cleaning and Sanitizing System	10	4,111	4,111
Office Equipment	10	1,600	1,600
<u>Operations Equipment</u>			
Kill Floor	5	2,220	2,220
	10	9,288	9,288
	15	362	362
	25	344	344
Edible Rendering	5	260	260
	10	4,507	4,507
Inedible Rendering	5	5,786	5,786
	10	9,674	9,674
Processing	5	10,972	27,057
	10	<u>3,795</u>	<u>13,601</u>
TOTAL ANNUAL DEPRECIATION		\$112,416	\$138,194

APPENDIX TABLE 3. KILL-FLOOR LABOR REQUIREMENTS FOR PLANTS SLAUGHTERING
120,000 HOGS PER YEAR

Operation	Number of Workers
1. Drive Hogs	1
2. Stun	1
3. Stick	1
4. Scald and Feed Dehairer	1
5. Work Gambrel Table/Shake1	1
6. Shave Ham	1
7. Shave Side/Belly	1
8. Shave Heads--Trim	1
9. Drop Heads/Split Briskets	1
10. Open, Drop Bungs, Eviscerate	1
11. Remove Passed Viscera from Table	1
12. Split Carcass, Trim Bruises and Heads, Enucleate Kidneys, Face Hams	1
13. Remove Kidneys, Face Hams, Pull Leaf Fat, Scrape Loose Fat, Wash Necks	1
14. Head Work Up	3
15. Spot Livers, Open, Flush Stomachs	1
16. Scale/Brand	1
17. Push into Cooler	1
18. Supervisor	<u>1</u>
TOTAL	20

APPENDIX TABLE 4. BUDGETED SALARIES FOR PROPOSED NORTH DAKOTA HOG SLAUGHTERING PLANTS

Job	Number of Workers	Base Salary	Base + Fringe ^a	Total for All Workers
	<i>number</i>		<i>dollars</i>	
<u>Office</u>				
1. General Manager	(1)	\$ 40,000	\$47,200	\$ 47,200
2. Assistant Manager	(1)	25,000	29,500	29,500
3. Buyer	(4)	15,000	17,700	70,800
4. Sellers	(3)	16,500	19,470	58,410
5. Bookkeeper	(1)	6,900	7,866	7,866
6. Clerk-Typist	(2)	5,280	6,019	12,038
<u>Kill-Floor</u>				
1. Personnel (See Appendix Table 3) \$4.70 Per Hour	(19)	9,400	10,716	203,640
2. Supervisor \$4.90 Per Hour	(1)	9,800	11,172	11,172
<u>Edible Rendering</u>				
1. Personnel \$4.68 Per Hour	(1)	9,360	10,670	10,670
<u>Inedible Rendering</u>				
1. Personnel \$4.68 Per Hour	(1)	9,360	10,670	10,670
<u>Processing--Retail-Cut Plant Only</u>				
1. Personnel	(14)	9,100	10,374	145,236
2. Supervisor \$4.90 Per Hour	(1)	9,800	11,172	11,172
<u>Processing--Whole-Hog Sausage Plant Only</u>				
1. Personnel \$4.55 Per Hour	(18)	9,100	10,374	186,732
2. Supervisor \$4.90 Per Hour	(1)	9,800	11,172	11,172
<u>Maintenance and Clean-Up</u>				
1. Maintenance \$4.75 Per Hour	(1)	9,500	10,830	10,830
2. Clean-Up \$3.00 Per Hour	(2)	6,000	6,840	13,680
TOTAL CUTTING AND BONING PLANT		\$642,884		
TOTAL PROCESSING PLANT		\$684,380		

^aFringe benefits estimated at 18 percent for management, buyers, and sellers, and 14 percent for labor.

APPENDIX TABLE 5. ESTIMATED PRODUCT BREAKDOWN AND STANDARD YIELD OF A 230-
POUND HOG, RETAIL-CUT PLANT

Product	Standard Yield	
	Percent of Liveweight	Pounds Per Hog
Loins	11.3	25.99
Hams, Smoked	14.4	33.12
Sliced Bacon	11.4	26.22
Picnics	6.8	15.64
Butts	4.8	11.04
Spareribs	2.2	5.06
Jowl Squares	2.6	5.98
Neck Bones	1.0	2.30
Feet	1.8	4.14
Regular Trim	2.8	6.44
Lean Trim	<u>1.5</u>	<u>3.45</u>
TOTAL	60.6	139.38

Source: Development Planning and Research Associates, Inc., (11:V-23).

APPENDIX TABLE 6. ESTIMATED PRODUCT BREAKDOWN AND STANDARD YIELD OF A 230-POUND HOG, WHOLE-HOG SAUSAGE PLANT

Product	Standard Yield		Sausage	
	Percent of Liveweight	Pounds Per Hog	Percent of Cut	Pounds Per Hog
<u>Sausage Input</u>				
Loins	11.3	25.99	82.0	21.31
Hams	14.4	33.12	39.0	29.48
Picnics	6.8	15.64	87.5	13.69
Butts	4.8	11.04	94.5	10.43
Jowls	2.6	5.98	100.0	5.98
Regular Trim	2.8	6.44	100.0	6.44
Lean Trim	1.5	3.45	100.0	3.45
Fat	--	--	--	9.90
Bellies	11.4	26.22	100.0	26.22
<u>Other Products</u>				
Neck Bones	1.0	2.30	--	--
Feet	1.8	4.14	--	--
Spareribs	<u>2.2</u>	<u>5.06</u>	--	<u>--</u>
TOTAL	60.6	139.38		126.90

Source: Development Planning and Research Associates, Inc., (11:V-24).

APPENDIX TABLE 7. U.S. HOG LIVE ANIMAL PRICES, 1964-75, BY MONTHS^a

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
-----dollars-----													
1964	14.10	14.70	14.48	14.16	14.84	15.83	17.11	17.05	16.76	15.39	14.43	15.55	15.37
1965	16.06	17.01	16.98	17.63	20.29	23.38	24.27	24.67	22.92	23.36	24.33	28.07	21.51
1966	27.93	27.80	24.41	22.26	23.16	24.72	25.09	25.75	23.16	21.57	19.87	19.67	23.78
1967	19.46	19.38	18.43	17.62	21.83	22.29	22.58	21.04	19.46	18.16	17.36	17.29	19.58
1968	18.31	19.41	19.07	19.00	18.88	20.43	21.48	20.08	19.93	18.29	17.92	18.76	19.19
1969	19.77	20.41	20.69	20.38	23.14	25.16	26.05	26.91	25.94	25.53	25.77	26.93	23.71
1970	27.40	28.23	25.94	24.02	23.53	24.04	25.13	22.12	20.35	17.91	15.69	15.67	21.95
1971	16.25	19.43	17.13	16.19	17.43	18.38	19.84	19.05	18.91	19.80	19.39	20.98	18.45
1972	24.84	25.61	23.56	22.89	25.32	26.78	28.57	28.86	29.10	28.09	27.79	30.78	26.67
1973	32.54	36.23	38.13	35.56	36.35	38.55	46.64	56.68	43.79	42.12	40.97	39.79	40.27
1974	40.59	39.73	34.88	30.52	26.09	27.40	36.31	37.67	35.79	38.90	38.34	39.93	35.12
1975	38.93	39.61	39.52	40.69	46.44	51.19	57.17	58.10	61.23	58.52	49.74	48.33	48.32

^a Average price per 100 pounds of barrows and gilts at seven leading public stockyards (eight stockyards before 1970).

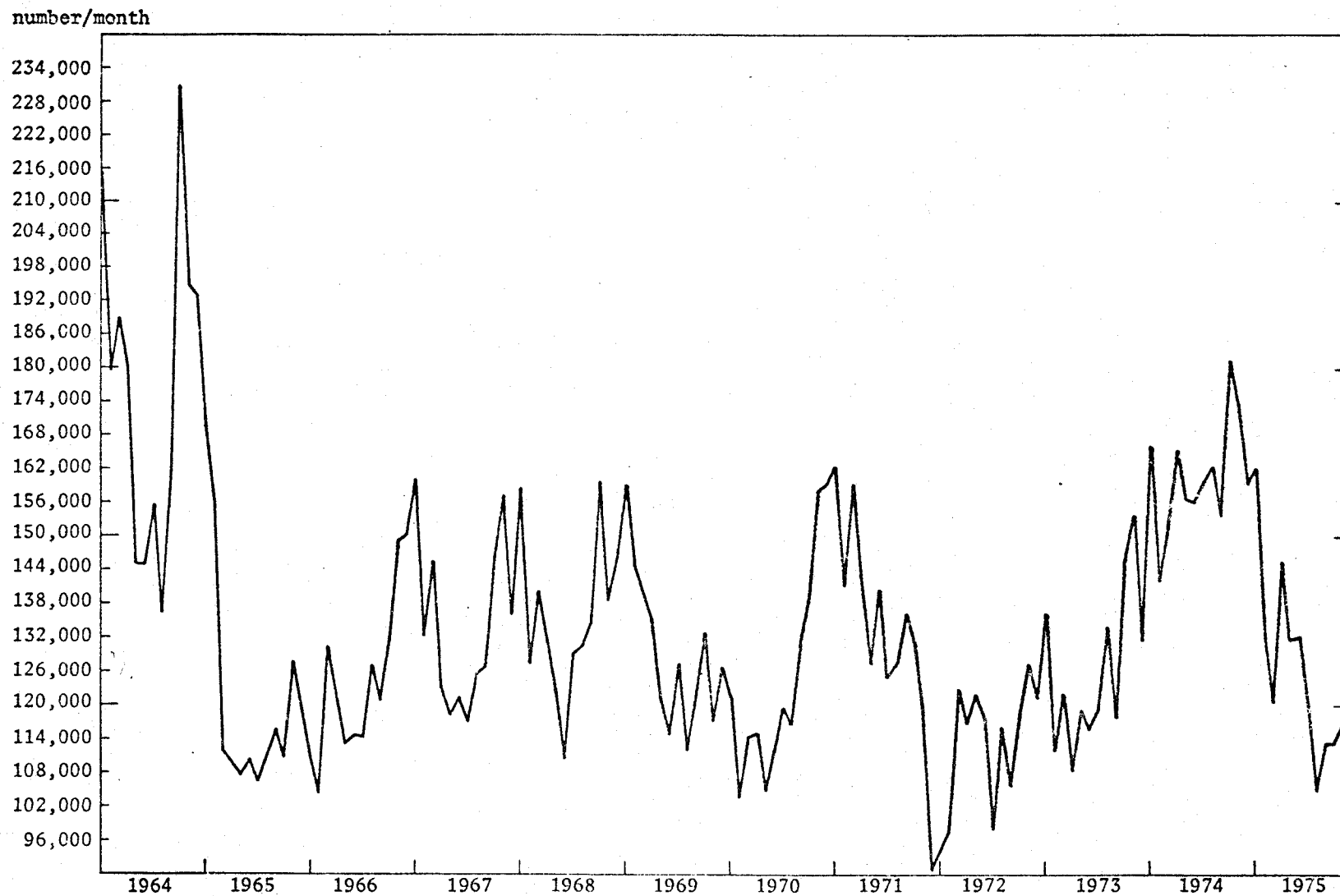
Source: USDA, ERS, Livestock and Meat Statistics, Statistical Bulletin Nos. 522 and 543, Washington, D.C.

APPENDIX TABLE 8. U.S. PORK WHOLESALE VALUE (LIVEWEIGHT BASIS), 1964-75, BY MONTHS^a

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
<i>-----dollars-----</i>													
1964	21.91	21.63	21.56	21.29	21.22	22.43	23.70	24.22	23.87	22.90	21.87	22.14	22.40
1965	23.28	23.39	23.90	24.31	26.24	28.98	30.50	30.74	30.01	30.00	31.15	34.59	28.09
1966	34.66	34.66	32.19	29.97	30.05	31.20	31.39	32.14	30.47	29.19	27.66	28.24	30.98
1967	27.69	26.72	25.84	25.17	28.35	29.26	29.72	28.54	27.56	25.88	25.46	26.20	27.20
1968	26.21	26.70	26.58	26.94	26.85	27.58	28.59	27.62	27.89	26.57	26.52	27.40	27.12
1969	27.98	27.97	28.21	28.30	30.13	31.90	32.29	33.80	33.53	33.26	33.89	34.32	31.30
1970	35.46	35.17	34.24	32.46	32.45	32.86	33.14	30.90	29.73	28.32	27.23	27.38	31.61
1971	25.96	27.81	26.87	25.74	27.01	27.58	28.83	27.99	28.24	29.78	29.10	29.84	27.90
1972	32.09	33.75	32.40	31.21	32.68	33.91	34.34	36.12	37.21	37.67	37.18	39.65	34.85
1973	40.75	43.16	45.12	42.98	42.88	44.20	52.31	62.75	53.07	48.34	48.35	48.63	47.71
1974	47.23	47.89	41.84	38.93	35.40	34.96	42.77	43.53	42.65	45.63	47.60	47.62	43.00
1975	46.65	47.22	47.59	48.35	52.75	56.68	62.37	64.69	67.69	64.28	57.57	53.86	

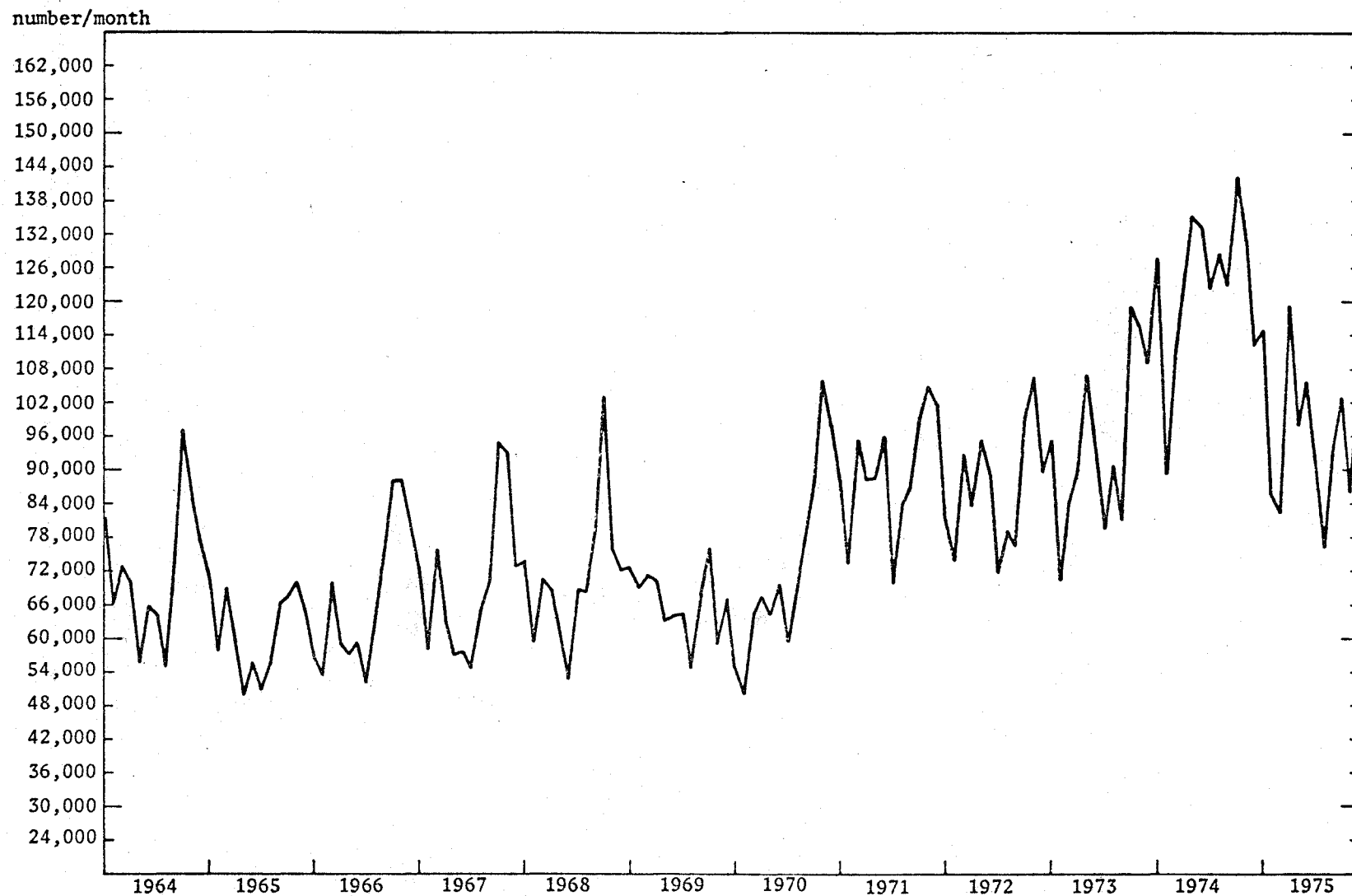
^aWholesale value of fresh and cured wholesale cuts and by-products per 100 pounds liveweight.

Source: USDA, ERS, Livestock and Meat Statistics, Statistical Bulletin Nos. 522 and 543, Washington, D.C.



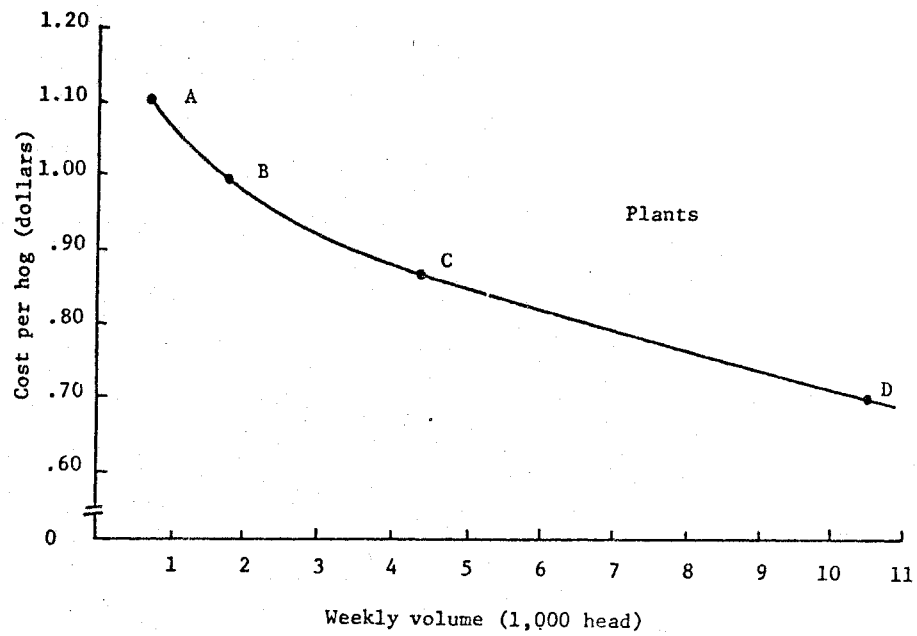
Appendix Figure 1. Monthly Marketings of U.S. 1-2, 200-240 Pound Barrows and Gilts, St. Paul Livestock Market, St. Paul, Minnesota, 1964-75

Source: USDA Livestock Market News Service.



Appendix Figure 2. Monthly Marketings of U.S. 1-2, 200-240 Pound Barrows and Gilts, Sioux Falls Livestock Market, Sioux Falls, South Dakota, 1964-75

Source: USDA Livestock Market News Service.



Appendix Figure 3. Long-Run Average Slaughter Cost as a Function of Volume Per Week, 1967

Source: Cassell (10:47).

Appendix B

Gross Operating Margin Adjustment

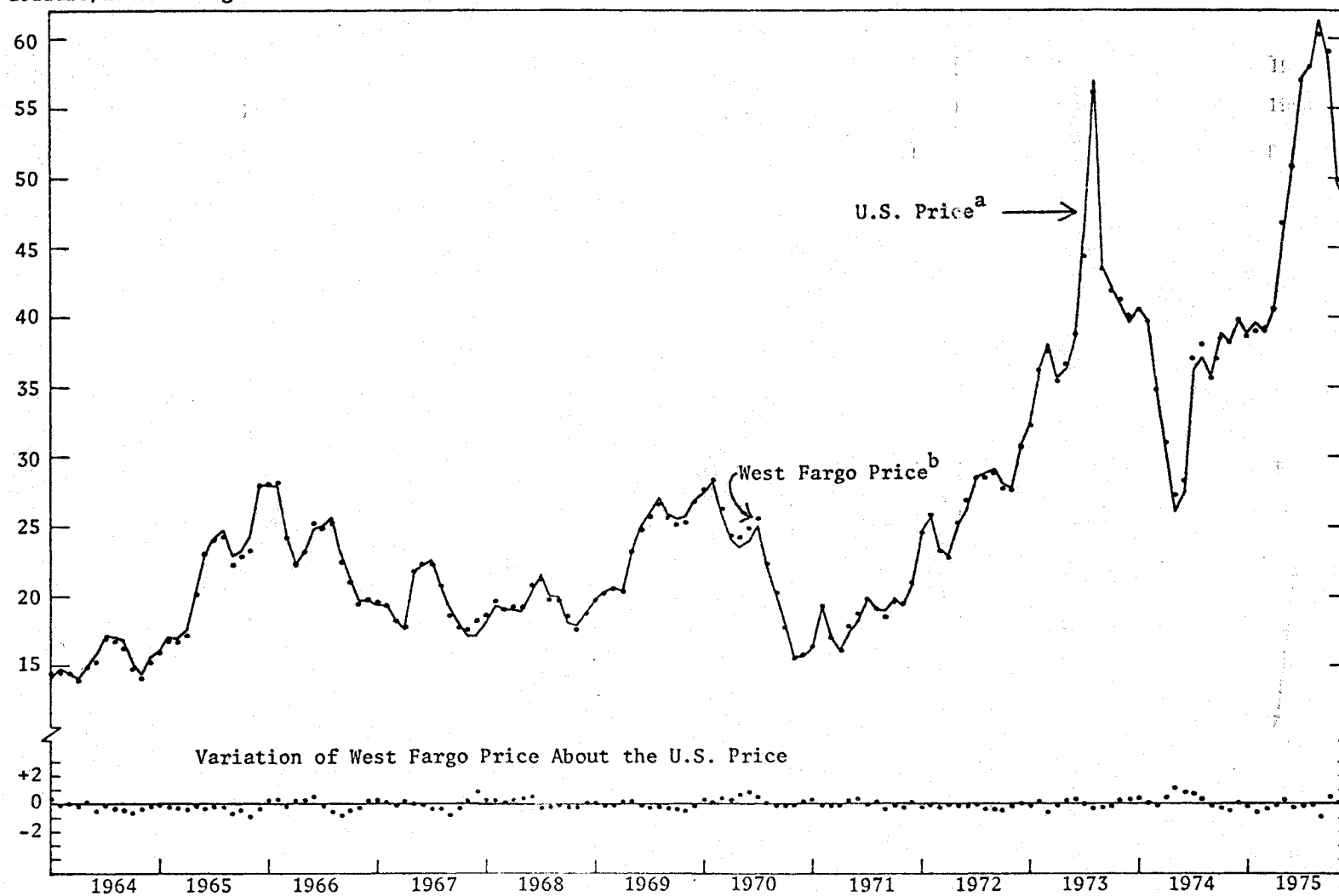
A gross operating margin is difficult to develop for a hog slaughtering plant in North Dakota. Wholesale prices for pork are not published for the state; and, because of the many combinations of pork products that may be processed from a hog, the construction of such an index is impractical. Changes in demand for pork affect the combination of cuts processed from a hog which, in turn, affects the total value received for pork. Wholesale pork pricing in the state is based on the National Provisioner Midwest River Area Yellow Sheet. The price wholesalers pay for pork shipped into the state is basically the Yellow Sheet pork price plus a transportation charge.

The USDA also uses the National Provisioner Yellow Sheet as the basis for establishing Wholesale Price Quotes. Scott (15:77) reported that the USDA average wholesale price for pork is calculated by weighting the wholesale price of each product by the yield of that product per 100 pounds of live hog. The products that are weighted to establish the wholesale price are the same as those used to calculate retail price quotes. Chicago carlot prices, compiled from the National Provisioner Yellow Sheet, are used in determining the wholesale price quotes. A transportation differential of \$.88 per hundredweight is then added to the average wholesale price. This differential is estimated from transportation rates and regional per capita consumption and population data.

The National Provisioner Yellow Sheet is the common link for adjusting the USDA wholesale price to match the North Dakota wholesale pricing structure. But instead of adjusting 12 years of USDA values to a North Dakota location and establishing monthly North Dakota gross operating margins, the USDA Hog Live Animal Price was used along with the USDA Wholesale Price to determine the U.S. gross operating margin (Table 9 in the text portion of this report). Selected values from the U.S. gross operating margin were then adjusted to match the North Dakota wholesale pricing basis.

The USDA Hog Live Animal Price was used instead of a North Dakota based price because of the nearness of the two averages. The West Fargo Livestock Market is the state's largest hog market and is located in the study supply area. Hog prices at West Fargo and the U.S. Live Animal Price correspond closely (Appendix B, Figure 1), with the spread per hundredweight exceeding a dollar only once in the 12-year time period under consideration (1964-75). Because of the close correlation of the

dollars/hundredweight



Appendix Figure 1. U.S. and West Fargo Monthly Average Prices, U.S. 1-2, 200-240 Pound Barrows and Gilts, 1964-75

Sources: a. USDA, ERS, Livestock and Meat Statistics, Statistical Bulletin Nos. 522 and 543, Washington, D.C.

b. Petry (16:25).

two sets of live animal prices, the USDA price was used instead of a North Dakota price for purposes of this study.

In general terms, the adjustment procedure involves converting the USDA-based gross operating margin to the National Provisioner Midwest River Area Yellow Sheet and then adding a transportation charge for shipment into North Dakota. The adjustment procedure for the two gross operating margins and an explanation for each step are as follows:

<u>Procedure</u>	<u>1975 Avg.</u>	<u>1972-75 Avg.</u>
1. USDA Gross Operating Margin	\$ 6.69	\$ 7.32
2. Hundredweight Conversion Factor	<u>x2.3</u>	<u>x2.3</u>
3. USDA Gross Operating Margin Per Hog	15.39	16.84
4. Transportation Differential	<u>-2.02</u>	<u>-2.02</u>
5. Gross Operating Margin, Chicago Yellow Sheet Basis	13.37	14.62
6. Yellow Sheet Conversion Factor	<u>-1.74</u>	<u>-1.74</u>
7. Gross Operating Margin, Midwest River Area Yellow Sheet Basis	11.63	12.88
8. Transportation Adjustment	<u>+1.74</u>	<u>+1.74</u>
9. Gross Operating Margin at Eastern North Dakota Point	13.37	14.62
10. In-State Transportation Adjustment	<u>+3.48</u>	<u>+3.48</u>
11. North Dakota Gross Operating Margin	\$16.85	\$18.10

Explanation:

The first seven steps of the procedure adjust the USDA gross operating margin to the same basis that North Dakota wholesalers use in pricing pork products. The procedure is explained below:

1. USDA gross operating margin. The gross operating margin is found by subtracting the USDA Hog Live Animal Price from the USDA Pork Wholesale Value (Liveweight Basis). The values listed are per hundredweight of live hog (Table 9).
2. Hundredweight conversion factor. The conversion factor changes the gross operating margin to a per hog basis assuming a 230-pound animal.
3. USDA gross operating margin per hog. U.S. gross operating margin on a per hog basis.

4. Transportation differential. The transportation differential of \$.88 per hundredweight is subtracted from the gross operating margin to convert the margin from a USDA to a National Provisioner Chicago Yellow Sheet basis.
5. Gross operating margin, Chicago Yellow Sheet basis. The margin adjusted to compare to the Chicago Yellow Sheet.
6. Yellow Sheet conversion factor. The yellow sheet conversion factor shifts the Chicago Yellow Sheet to the Midwest River Area Yellow Sheet. To convert the Chicago price to the Midwest River Area Price, \$1.25 per hundredweight is subtracted. To establish the new Yellow Sheet basis, 139 pounds of pork is transported. Source: Mr. Lester I. Norton, president of the National Provisioner, Inc.
7. Gross operating margin, Midwest River Yellow Sheet basis. The USDA gross operating margin is now on the same base that is used by North Dakota wholesalers for pricing pork at the state wholesale level.

The last four steps of the procedure adjust the Midwest River Area based gross operating margin to a basis where it may be compared to the retail-cut plant's estimated operating costs.

8. Transportation adjustment. This step is an adjustment for transporting the 139 pounds of pork per hog from the Midwest River Area to North Dakota. The I.C.C. rate of 1½ cents per pound (which is only coincidentally the same as the Yellow Sheet Conversion Factor) for a 40,000 pound load, based on fresh meat rates, was used.
9. Gross operating margin at eastern North Dakota point. The USDA gross operating margin adjusted into eastern North Dakota.
10. In-state transportation adjustment. To make the adjusted gross operating margin comparable to the proposed plant's estimated operating costs, a transportation charge for delivery of the pork to retailers was included to coincide with the charge budgeted in the operating costs. An identical rate of 2½¢ per pound as quoted in interviews with local meat wholesalers was used in the adjustment procedure and in the delivery cost section of the operating costs.

11. North Dakota gross operating margin The USDA gross operating margin is now adjusted so it may be fairly compared to the estimated operating costs of the proposed retail-cut plant.

Literature Cited

1. Taylor, Fred R., and J. R. Price, North Dakota Crop and Livestock Statistics, Agricultural Statistics Report No. 38, Department of Agricultural Economics, North Dakota State University, Fargo, May, 1976.
2. Bergstrom, Gary, Unpublished Data, Department of Agricultural Economics, North Dakota State University, Fargo, 1972.
3. Huber, Bernard, Costs and Returns of Hog Production in North Dakota, Unpublished M.S. Thesis, Department of Agricultural Economics, North Dakota State University, Fargo, March, 1973.
4. Culver, D. W., CRIS Report No. GY-15023-5, Project Title: "Long Run Projections of Agricultural Supplies, Utilization, Prices and Income," Economic and Statistical Division, USDA, Washington, D.C., September, 1972.
5. U.S. Department of Agriculture, Food Consumption of Households in North Central Region, Seasons and Year, Consumer and Food Economics Research Division, Agricultural Research Service, USDA, Washington, D.C., September, 1972.
6. Bedker, Gary M., Unpublished Data, Department of Agricultural Economics, North Dakota State University, Fargo, September, 1975.
7. Nichols, Ronald Q., Motor Carrier Transportation of Agricultural Products in North Dakota, Unpublished M.S. Thesis, Department of Agricultural Economics, North Dakota State University, Fargo, May, 1971.
8. Erlandson, Gordon W., Unpublished Data, Department of Agricultural Economics, North Dakota State University, Fargo, September, 1975.
9. Cox, Rex W., and Fred R. Taylor, Feasibility of Cooperatively Owned Slaughter Plants, Agricultural Economics Report No. 39, Department of Agricultural Economics, North Dakota State University, Fargo, January, 1965.
10. Cassell, Guy R., and Donald A. West, Assembly and Slaughtering Costs for Hogs in North Carolina, Economic Research Report No. 3, Department of Economics, North Carolina State University, Raleigh, June, 1967.

11. Development Planning and Research Associates, Inc., Feasibility of Establishing a Meat Packinghouse at Safford, Arizona, P.O. Box 727, Manhattan, Kansas, April, 1973.
12. Baker, Allen J., Federally Inspected Livestock Slaughter by Size and Type of Plant, Statistical Bulletin No. 549, Commodity Economics Division, ERS, USDA, Washington, D.C., May, 1976.
13. Schupp, Alvin R., and Ewell P. Roy, Economic Feasibility of Hog Slaughtering and Processing Facilities in Central Louisiana, D.A.E. Research Report No. 455, Department of Agricultural Economics and Agribusiness, Louisiana State University, Baton Rouge, August, 1973.
14. Williams, Willard F., and Thomas T. Stout, Economics of the Livestock-Meat Industry, The Macmillan Company, New York, New York, 1969.
15. Scott, Forest E., and Henry T. Badger, Farm Retail Spreads for Food Productions, ERS Misc. Publication No. 741, USDA, Washington, D.C., January, 1972.
16. Petry, Timothy A., North Dakota Livestock Price Statistics, Agricultural Economics Statistical Series 21-75, Department of Agricultural Economics, North Dakota State University, Fargo, May, 1975.

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