THE COMPETITIVE POSITION OF CATTLE FEEDING IN THE NORTHERN CORN BELT

by

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ABSTRACT

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The objectives of this study were to determine (1) the profitability of cattle feeding in the Northern corn belt relative to the Southwest, (2) the profitability of expanding cattle feeding on Northern corn belt farms relative to expanding crop acreage on these same farms and (3) the types of feeding programs and management practices that would make cattle feeding more competitive on Northern corn belt farms.

To accomplish these objectives, the highest profit program solutions obtained under numerous resource, price and alternative opportunity situations in each of three states were compared and analyzed.

Cattle feeding in the Northern corn belt was less profitable than in the Southwest. Because of locational related factors, new feedlot expansion returned at least one dollar less per hundredweight of beef produced on Northern corn belt farms than on Colorado farms. In addition, differences in management practices, such as underutilization of feedlot facilities and the feeding of high forage rations, gave rise to relatively higher nonfeed costs in the Northern corn belt. Also, there are proportionately more large scale lots in the Southwest which enjoy both pecuniary and nonpecuniary economies that are associated with specialization in cattle feeding.

The relative desirability of investing in feedlot facilities as opposed to investing in additional crop acreage depends in part upon the relative efficiency of the cattle feeding and the crop program. With high efficiency levels for both the Colorado farm expands cattle feeding sharply beyond the feed supply produced on the farm whereas in the Northern farm situations cattle feeding tends to expand proportionately with expansion in crop acreage. It appears that specialized feedlots are more likely to develop in areas where (1) crop labor requirements are high due to irrigation and (2) nonagricultural land use demands raise the price of land above its agricultural use value.

Different rations, types of cattle and types of feedlot facilities were studied in an effort to determine the most profitable feeding program for Northern corn belt farms. Rations very high in corn silage gave the highest returns to feedlots in the Northeastern corn belt. This was especially true if only one lot of cattle were fed each year and if corn prices were $1.10 or higher at harvest time. In the Western corn belt, high concentrate rations were found to be more profitable since both cattle and grain prices are lower.

Feeding calves was more profitable than feeding yearlings in the Northern corn belt--especially in Michigan where feeder prices are relatively higher. In the Western corn belt there was little difference and in the Southwest yearlings gave higher returns than calves. As for grade of cattle, in the past lower priced feeders resulted in higher feedlot returns than high grade cattle to those operators who were able to upgrade the cattle and sell them for their true value.

More research work is needed to determine how different feedlot facilities affect requirements for labor and bedding as well as feed. Slotted floors may be justified in cases where labor and bedding costs are high and/or liquid manure has a high value.

In summary, existing feedlots in the Northern corn belt under top management can compete with the larger lots in the Southwest. However, since economic incentives for feedlot expansion are much lower in the Northern corn belt, cattle feeding will not expand nearly as fast in this area as in the Southern Plains area.

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INTRODUCTION

Cattle feeding is the rapid growth industry of agriculture. Fed cattle marketings have almost doubled in the past 10 years, with an annual growth rate of 6.7 percent. Annual growth is expected to average about 5 percent during the next decade--an increase of about one million head per year.[1/] To what extent will the Upper Midwest be able to share in this economic growth? This study approaches this general question by (1) examining recent growth patterns in the beef industry, (2) determining the most profitable cattle feeding system for northern corn belt farms, and (3) examining the competitive position of cattle feeding in the Northern corn belt.

PAST GROWTH PATTERNS

Rapid growth of the beef industry has been sustained by a steady expansion in the total demand for beef in the United States. During the last decade, the United States population increased by three million each year while beef consumption per person climbed at the rapid rate of two pounds per year without materially affecting prices.

[1/] Paul Hasbargen: "Beef Production and Prices", Minnesota Farm Business Notes, No. 475, August 1965.

Total fed cattle marketings in the 39 states for which United States Department of Agriculture estimates are available increased from 11.5 million to 20.6 million during the last cattle cycle. The rate of growth has varied enough among different areas of the country to significantly affect the relative contribution of each area to total beef production. The corn belt's share of fed cattle marketings dropped from 47 percent to 37 percent while the Great Plains increased its share from 22 percent to 31 percent. (See Table 1.1) The Plains enjoyed an annual growth rate of 11 percent compared to only 4.2 percent for the corn belt. Michigan's growth (5 percent) was slightly faster than the average for the corn belt but below the national average rate while Minnesota and Wisconsin showed slower growth rates.

FACTORS AFFECTING GROWTH RATES

There are numerous factors that might be hypothesized as contributing to the differential growth rates among areas. Most such factors can be grouped according to source under the following general headings:

1) Economies associated with geographic location
2) Economies associated with size or specialization
3) Economies associated with more rapid rate of technological adoption
4) The relative profitability of alternative opportunities
5) Institutional barriers (credit availability, small farms).

TABLE 1.1.--MARKETINGS OF FED CATTLE BY AREAS, 1956-58 AVERAGE AND 1966[1/]

Year	39 States	Corn Belt[2/]	Great Plains[3/]	Western States[4/]	Michigan	Minnesota	Wisconsin
			-- Number Marketed in Thousands --				
1956-58	11,478	5,340	2,522	2,800	148	516	156
1966	20,610	7,683	6,444	5,091	230	713	190
			-- Percent of Total Marketings --				
1956-58	100	46.6	22.0	24.4	1.3	4.5	1.3
1966	100	37.3	31.3	24.7	1.1	3.5	.9
			-- Annual Percentage Growth Rate --				
1957-66	6.7	4.2	11.0	6.7	5.0	3.7	4.8

1/ Source: Livestock and Meat Situation, USDA, October 1965 and USDA Cattle and Calves on Feed Reports.

2/ Includes the following states: Ohio, Indiana, Illinois, Minnesota, Iowa, Missouri, Michigan, and Wisconsin.

3/ Includes Kansas, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas.

4/ Includes Arizona, California, Colorado, Idaho, New Mexico, Oregon, and Washington.

The slower expansion of cattle feeding in the corn belt may be due to an inability to compete because of lower profits (1, 2, or 3 above). On the other hand, it may be due to a lack of interest on the part of farmers or credit agencies (4 or 5 above).

If the profitability of cattle feeding is actually lower in corn belt states, an important question to answer is the extent to which this disadvantage is caused by factors associated with location as opposed to factors which are related to differences in average size of feedlots or in management practices. Such an answer would prove valuable to the economy of the corn belt as well as to individual cattle feeders and prospective feeders since the general causal factors of size and management are subject to change whereas location factors are not.

Table 1.2 outlines some advantages and disadvantages that might be associated with each of the three major causal factors affecting feeding profits. The general hypothesis outlined in Table 1.2 led to the formulation of the objectives of this study which are presented in the next section.

OBJECTIVES OF STUDY

The major objectives of this study are:

A. To identify cattle feeding systems (types of cattle, rations, and facilities) which offer the greatest opportunities for profit in the Northern corn belt under different resource and price situations.

B. To compare the potential profitability of cattle feeding on large Northern corn belt farms with the profitability of:

TABLE 1.2.--POSSIBLE ADVANTAGES AND DISADVANTAGES OF CATTLE FEEDING IN THE SOUTHWEST AS OPPOSED TO THE NORTHERN CORN BELT, CROSS CLASSIFIED BY TYPE OF ADVANTAGE AND BY MAJOR CAUSAL FACTORS

Causal Factor	Type of Advantage or Disadvantage for Southwest Feeders		
	Feed Cost	Nonfeed Cost	Price Margin
Location	.Higher feed prices 1/ .Effect of climate on gains .Less in-out shrink	.Effect of climate on: - housing requirements, - concrete requirements, - & bedding requirements .Lower wage rates	.Lower fed cattle prices 1/ .Lower feeder prices
Scale	.Greater bargaining power in feed purchasing	.Greater bargaining power power in nonfeed purchasing .Lower labor requirements .Lower building, lot, feed storage and handling costs	.Greater bargaining power in buying and selling
Management	.More efficient feed conversion due to: -marketing at lighter weights -more rapid gains (Higher concentrate rations) -better health care -more crossbred cattle bought	.Fuller use of facilities	.More "up-grading"

1/ A disadvantage.

1. Expanded cash crop production on these farms

2. Cattle feeding on farms located in the area of recent rapid growth when northern feedlots have:

   a. Excellent feed conversion in contrast with average feed conversion

   b. Larger scale feedlots in contrast with the smaller scale limit imposed by usual credit restrictions.

PREVIOUS INVESTIGATIONS

Previous studies of cattle feeding might be grouped into the following general categories: 1) production cost studies, 2) economies of size studies, 3) farm organizational and supply response studies, and 4) spatial equilibrium models of the beef industry.

Most production cost studies such as animal husbandry research and farm record summaries deal with feed costs only. Other special economic studies usually ignore feed costs and deal only with nonfeed costs. Profitability is affected not only by both feed costs and nonfeed costs but by price margins as well. Little attempt has been made to put all three of these factors together and to identify highest profit feeding systems under various specified resource situations. Also, direct comparison of production costs--whether feed or nonfeed--among states is precluded since different accounting methods are used by different researchers. Also, feed costs are difficult to compare since quality of feeds, especially silage, may not be comparable and there is no standard method for pricing silage and other forages.

Economies of size in feedlot operations have been studied in several states. These studies have established the fact that nonfeed costs per unit of production decline as feedlot size is increased. A Kansas study found that most economies were achieved already at 280 head.[1/] However, Hunter[2/] found that it required a 1500 head capacity lot in Colorado before most of the economies of size were achieved for nonfeed costs. But the question as to how much advantage has been gained by the large lots in the Southwest over the smaller farm feedlots in the North has not been answered.

Farm organizational studies indicate that cattle feeding and hog production are the most profitable livestock enterprises on medium to large corn belt farms.[3/] Which of the two is the more profitable often depends upon the assumptions used in the particular study relative to resource restrictions, price relationships, and feed conversion efficiencies.

[1/] J. H. McCoy and H. D. Wakefield, Economies of Scale in Farm Cattle Feedlots of Kansas--An Analysis of Nonfeed Costs, Technical Bulletin 145, Agricultural Experiment Station, Kansas State University, January 1966.

[2/] Elmer C. Hunter and J. Patrica Madden, Economies of Size for Specialized Beef Feedlots in Colorado, U. S. Department of Agriculture, Economic Research Service and Colorado Experiment Station, Agricultural Economics Report 91, May 1966.

[3/] Dale Colyer and George D. Irwin. "Beef, Pork, and Feed Grains in the Corn Belt; Supply Response and Resource Adjustments," Missouri Agricultural Experiment Station Research Bulletin (forthcoming), and North Central Regional Public 178.

Other studies have developed spatial equilibrium models of regional production based on the costs of major production inputs, market location, and transportation costs. These studies often do not adequately take into account differences in some important production cost variables which may result in differences in cattle feeding profits among areas. Rather, most spatial models estimate optimum cattle feeding locations on the basis of exogenous variables such as the location of population centers, feed supplies and feeder animal supplies. King's ambitious model which was published in 1963[1/] was more complete in that it also considered variations in feed conversion and nonfeed costs. However, regional cost differences had to be based on sketchy information which resulted in what now appears to be inappropriate feed conversion relationships among areas. The results of this study as well as the results of a United States Department of Agriculture study[2/] and of a North Dakota study[3/] all suggested that differences in production costs or alternative opportunities were probably more important factors in feedlot location than were differences in transportation costs.

[1/]G. A. King and L. B. Schrader, "Regional Locations of Cattle Feeding-A Spatial Equilibrium Analysis", Hilgardia, Vol. 34, No. 10, July 1963.

[2/]F. A. Williams and R. A. Dietrick, An Interregional Analysis of Feed Beef Economy, Agricultural Economics Report No. 88, USDA, ERS, Oklahoma and Texas Agricultural Experiment Stations, April 1966.

[3/]Thor A. Hertsgaard and Sylvester D. Phillips, Distribution Patterns for Beef, Department of Agricultural Economics, Agricultural Experiment Station Bulletin No. 435, North Dakota State University, June 1961.

Consequently, despite the numerous studies alluded to above, research of the type outlined in this proposal appears necessary to identify relevant variables which decision makers can manipulate in order to improve their competitive position within the constraints of existing exogenous variables. Also, if production cost differences among areas can be quantified more precisely, they can be utilized to provide additional refinement to spatial models. Finally, a study which compares the potential profitability of large scale feedlots in the Northern corn belt with other areas will be a useful guide to investors who are considering alternative locations for large scale feedlots.

PLAN OF STUDY

In general, this study is concerned with the competitive status of cattle feeding on productive northern corn land. Consequently, it does not consider small scale feeding enterprises which utilize many resources which have little alternative use value. It is generally agreed that such enterprises can be maintained on a supplementary basis so long as corn belt farmers do not have to price all resources used at current acquisition prices. However, if the Northern corn belt is to significantly expand cattle feeding it must come through the development of larger scale competitive feeding enterprises rather than by having a few more farmers utilize old dairy barns to feed a small number of steers.

Therefore, this study considers several relevant planning situations in which farmers or potential investors have enough capital to develop feeding operations of at least a few hundred head if it is profitable to do so. Initial resource situations considered include: 1) a one man cash crop farm, 2) a two man cattle feeding farm, and 3) an investment group which has no physical resources. The extent to which these initial resources are utilized to feed cattle is determined under different labor, capital, and price situations.

Input-output coefficients were developed for a number of steer feeding programs for each state being studied in consultation with economists, nutritionists, engineers, and cattle feeders in these states. Coefficients for crop production were also developed. The types of production activities were selected so as to facilitate achievement of the study objectives.

Linear programming models and budgets were developed and used to:

1. Compare the profitability of utilizing various amounts of corn silage in the ration of corn belt cattle feeding programs under varying resource and price situations.

2. Determine what price relationships would be needed between holstein steers and beef bred steers and between calves and yearlings to give equal returns under the relative efficiency levels assumed in this study.

3. Determine what change in returns would be necessary to compensate for lower or higher investment of beef housing systems.

4. Compare the profitability of cattle feeding with expanded crop production on corn belt farms.

5. Compare the profitability of expanded cattle feeding among selected states given various initial resource situations, feed conversion ratios, and price conditions.

Additional detail on the development of the specific models used to obtain the results called for in 1-5 above will be discussed in succeeding chapters.

CHAPTER II

THE ANALYTICAL MODEL

Linear programming is the basic tool used in this study. However, for those problems where the programming model cannot be constructed so as to give the refinement desired, supplementary partial budgeting is also used.

RESOURCE RESTRICTIONS

The cropland considered in the Northern corn belt is top quality level land capable of producing continuous corn. This assumption is made since expanded corn belt feeding must be based primarily on the utilization of this highest return crop for feed. To require that the cropland have some minimum amount of a legume-grass crop in a "rotation" would only complicate the comparison among different rations without contributing to the objectives of this study. This study <u>will</u> determine the hay yield that is necessary to compete with a given corn yield in the production of cattle feed. If hay yield is less than this but it must be grown on a particular farm, haylage can be substituted for other feeds at known ratios without affecting the performance of the cattle--but total farm income, of course, will drop. On the other hand, if hay yields are greater than the breakeven yield, hay could be profitably produced as needed for cattle feeding.

No government restrictions on crop production are considered in this program. Whether or not to participate in any voluntary feed grain program that may be available in any given year is largely a decision that is independent of the decisions considered in this study. If it pays an individual farmer to participate in such a program, he can, thereby adding income over and above that obtained from the organization suggested by the program results of this study. However, such a situation would probably be very rare given the quality of land and management resources used in this study along with the historical pattern of narrow variances from county average yields which are assigned to individual farms for purposes of computing program payments. As for wheat allotments, they are so small on the type of farms considered in Southern Michigan and Minnesota that this program is ignored and wheat must compete on the basis of its market price plus the value of its straw. Normally most farmers with an allotment would benefit by participating in the wheat program--but this should be determined for individual cases.

Planning Situations

Two general classifications of resource situations are dealt with in this study. One is a classification according to the extent of the physical assets originally under control of the entrepreneur--an "initial resource" classification. The other system used is a classification of the attitudes of the entrepreneur and/or his creditors--a "planning horizon" classification.

Three initial resource situations that are considered are:

1. A one family, 350 acre cash crop farm
2. A two man, 350 acre, 500 head capacity cattle feeding farm
3. No physical assets or family labor.

The initial resources assumed for each of these basic situations are shown in table 2.1.

TABLE 2.1.--THREE INITIAL RESOURCE SITUATIONS CONSIDERED IN THIS STUDY

Item	Unit	Cash Crop Farm	Beef Feeding Farm	No Physical Assets
Crop Acres	Acres	350	350	--
Labor, family	Hours	2,500	4,500	--
Cash	$	10,000	10,000	0
Oper. Credit*	$	15,000	80,000	120,000
Real Estate Credit*	$	30,000	30,000	90,000
Beef Facilities	Hd. cap.	--	500	--

* Credit restrictions were varied to test effect of different assumptions relative to credit availability.

The initial land and labor levels selected for situations 1 and 2 above are based primarily on existing levels as indicated by farm record projects and by the "large farm" categories of the NC-54 farm organizational study conducted in Michigan and

Minnesota.[1/] Initial capital positions in these two situations are also partially based on these sources. However, several levels of short-term credit restrictions are used under the assumption of different levels of internal and/or external credit rationing.

This brings up the second classification of resource situations--the "planning horizon" system. The following planning horizons are considered at certain times in the study.

A. Land and labor are fixed; labor is limiting factor.
B. Land is fixed; short-term credit is limiting factor.
C. Land is fixed; feedlot capacity is limiting factor.
D. No assets are arbitrarily fixed--capital is limiting factor.

In situation A, neither land nor labor can be bought; land cannot be sold; family labor will not be used unless it can earn returns equal to the farm wage rate. This situation represents the planning frame of mind of an operator who does not wish to have hired labor and who either cannot find additional land or does not want to buy any more. He has sufficient capital so that labor is the effectively limiting resource for cattle feeding.

Situation B represents a situation similar to A with respect to land but the operator is willing to hire labor if added returns

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[1/] Curtis F. Lard, Profitable Reorganization of Representative Farms in Lower Michigan and Northeastern Indiana with Special Emphasis on Feed Grains and Livestock, unpublished Ph.D. Thesis, Michigan State University, 1963, and C. O. Nohre and H. R. Jensen, Profitable Farm Adjustments in South-Central Minnesota, Station Bulletin 471, University of Minnesota Agricultural Experiment Station, 1964.

are high enough to pay going industrial wage rates. The effective limit on cattle feeding is that imposed by creditors who will not loan money to buy corn or forage for cattle feeding. Consequently, cattle numbers are limited to those that can be fed with home produced feed supply.

Situation C is similar to B except that in this case operating credit is readily available to a "proven" feeder but the operator is either unwilling or unable to increase the size of his feedlot beyond a given capacity.

In situation D, all resources will be endogenously fixed by the program. This long-term planning horizon will be utilized most extensively in comparing profit maximizing courses of action among states under different price situations. In contrast, situations A, B, and C will be used to determine the profitability of different types of feeding programs in Michigan under these different planning horizons.

Labor equations

The one family farm has 3,500 hours of labor available but 1,000 hours are assumed to be needed for overhead labor. Consequently, only 2,500 hours of family labor are available for use in handling the direct labor required for crop and livestock production. However, if such employment returns less than $1.50 per hour, this labor will be sold for wages rather than being used on the farm. The labor supply is divided into 6 different labor periods as follows:

Pd 1 - December 1 - March 31
Pd 2 - April 1 - May 31
Pd 3 - June 1 - July 31
Pd 4 - August 1 - August 31
Pd 5 - September 1 - October 15
Pd 6 - October 16 - November 30

When the labor hiring activity is allowed to function, it provides labor only on a yearly basis. However, as full time labor is hired, a reserve of overtime labor equal to one fourth the full time help is developed. This can be utilized as needed on a seasonal basis by paying 25 percent more than the normal wages for these services. This feature allows hired men to put in longer days during busy seasons provided they are given a bonus for this overtime work.

Land and crop machinery equations

The initial land resource is 350 crop acres with no rotation or government program crop restrictions. When allowed to vary, this resource can be added to by renting or buying; or it can be disposed of by selling or renting out. It is assumed that acreage and crop machinery are in appropriate balance. Therefore, crop machinery will be acquired or disposed of with the land--so as to maintain this balance as acreage is varied. No economies of size relative to machine cost per acre are assumed.

Capital and credit equations

An initial supply of $10,000 in cash is available for use as either operating capital or as real estate capital. The initial supply of chattel credit is varied to reflect different assumptions about external or internal credit rationing.

Operating capital needs must be met with the initial supply of cash plus borrowings through the chattel credit activity.

Long-term capital needs must be met with real estate mortgage credit or through a "cash transfer" that permits use of the initial cash supply for capital investments instead of for operating expenses.

Other resource equations

There will be no initial supply of feed or feedlot facilities on the cash crop farm. Housing and feed storage must be purchased as needed for this situation as well as for the no physical asset situation. However, the large cattle feeding farm will have an initial supply of feedlot facilities sufficient to house 500 head of feeder cattle.

When comparing rations, equipment necessary for feeding will be determined after the solutions are run and annual ownership costs subtracted. This supplemental use of the partial budget will enable more precise estimation of these overhead costs. However, when comparing land acquisition alternatives with cattle feeding, the livestock equipment costs will be included in the linear model. To minimize errors from this procedure, separate program runs are made with changed coefficients when large scale feeding operations are brought in.

ACTIVITIES

Crop activities

Crops considered on the Michigan farms are corn, corn silage, haylage, wheat and soybeans. Since crop production does not tie up operating costs for a full year, only half of the cash costs of production are required out of the operating capital limit if the crop is sold at harvest. However, if the crop is held for feeding, the production costs are assumed to be tied up for another nine months. Costs of harvesting corn and silage are assumed to be tied up for one year when the crop is fed. These assumptions are used in calculating the "operating capital" requirements of each activity. Table 2.2 shows the resource requirements and contributions of each crop activity.

Standing corn can be harvested as silage or as grain with the operators own machinery or by custom operator. Silage can be stored in an upright silo with a 10 percent loss or in a horizontal silo with a 15 percent loss. If silage is stored in a horizontal silo, $2 per acre more is charged to cover the cost of the extra man who must be hired to pack silage.

Hay is handled as haylage although yield and feed requirements are put into the model on a dry hay basis. Haylage must be stored in an upright silo but storage requirements are cut by about 20 percent since partial refilling is possible.

TABLE 2.2.--CROP ACTIVITIES - MICHIGAN

Item	Unit	Soybeans	Wheat	Hay	Standing Corn	Harvest Corn	Harvest Corn Silage	
							Horizontal	Upright
Revenue[1]	$	-76.40	-66.10	18.65	33.65	2.45	11.35	9.35
Yield	bu. or T.	35	50	4.0	-	110	19	20
Oper. Capital	$	9.93	16.95	18.65	42.06	2.45	11.35	9.35
Annual Labor	hrs.	2.38	2.94	4.16	1.71	.96	2.0	2.0
Pd. 1	-	-	.10	-	.10	-	-	-
Pd. 2		.71	.04	.22	.87	-	-	-
Pd. 3		.95	.71	2.48	.53	-	-	-
Pd. 4		.19	1.22	1.24	.12	-	-	-
Pd. 5		.30	.62	.22	-	.16	2.0	2.0
Pd. 6		.23	.25	-	.09	.80	-	-
Silo Space	Ton							
Horizontal		-	-	-	-	-	22	-
Upright		-	-	9.6	-	3.74	-	22

1/Minus sign denotes income over costs.

Wheat is credited with the production of $30 worth of bedding for each acre grown. Although baling is custom hired, labor for hauling bales is required by the activity.

Purchased feed ties up operating capital for nine months if purchased at harvest. However, a second corn purchase activity with corn priced at the yearly average price is available which requires no storage and ties up capital for only three months.

<u>Credit activities</u>

As shown in Table 2.3, the credit activities are limited to one chattel and one real estate activity based on the assumption that the top farm mangers being considered in this study obtain essentially all their credit from one (or two) institutions. Higher cost "dealer" credit is not used.

The cash transfer activity simply provides the manager with the option of utilizing his beginning supply of cash for real estate purchases rather than for operating expenses. If any part of this beginning supply of cash has an earning power of less than 4.5 percent in available production activities it will go into savings instead.

<u>Labor activities</u>

Some of the labor activities are shown in Table 2.4. For Michigan situations the operator and family have a reservation price on their labor of $1.50 per hour ($15.00 for 10 hours). For Minnesota and Colorado the reservation price was set at $1.40. Hired labor must be paid wages that would compete with

TABLE 2.3.--CREDIT ACTIVITIES

Item	Unit	Savings $100	Real Estate Mortgage $100	Chattel Mortgage $100	Cash Transfer $100
Revenue	$	-4.50 1/	5.50	6.50	-
Operating Capital	$	100		-100 1/	100
Operating Credit	$			100	
Real Estate Capital	$	-100 1/			-100 1/
Real Estate Credit	$	100			
Transfer Limit	$				100

1/ Minus sign denotes income in the revenue row; when it appears in the matrix it means that the quantity prefixed is added into the resource equation specified in that row.

TABLE 2.4.--LABOR ACTIVITIES - MICHIGAN

Item	Unit	Sell Labor 10 hrs.	Buy Labor 10 hrs.	Buy Overtime Labor Pd. 1 1 hr.	Buy Overtime Labor Pd. 6 1 hr.
Revenue[1]	$	-15.00	29.00	3.63	3.63
Operating Capital	$		29.00	3.63	3.63
Annual Labor	hrs.	10	-10	-1	-1
Pd. 1		3.32	-3.32	-1	
Pd. 2		1.68	-1.68		
Pd. 3		1.68	-1.68		
Pd. 4		.85	-.85		
Pd. 5		1.23	-1.23		
Pd. 6		1.24	-1.24		-1
Overtime Labor	hrs.				
Pd. 1			-.83	1	
Pd. 2			-.42		
Pd. 3			-.42		
Pd. 4			-.21		
Pd. 5			-.31		
Pd. 6			-.31		1

[1] Minus sign denotes income in revenue row; when it appears in the matrix it means that the quantity prefixed is added into the resource equation specified in that row.

comparable off-farm opportunities in each area. This was estimated at $2.90 in Michigan compared with $2.70 in Minnesota and Colorado. (Equals wage paid in "non-durable" industries in 1965.) Six "overtime labor" activities will provide additional labor on a seasonal basis on an overtime wage rate. This rate was set at 25 percent over the regular wage. (This practice is often followed on an informal "bonus" basis at present--it may become more formalized in the future.)

<u>Building investments</u>

As shown in Table 2.5, feedlot and silo investment costs must come out of real estate credit. These capital investments are assumed to be only 25 percent self-financing since such investments usually do not add greatly to the value of a farm. Thus, every dollar spent on these investments increases the real estate credit limit by 25 cents. Annual costs are based on a 20 year life plus 2 percent for taxes, insurance and repairs on silos and 3 percent for these items on housing. (Subsequent budgeting considers alternate depreciation rates.)

One housing unit provides 30 square feet of building space. Different feeding programs require varying proportions of this standard unit. Associated livestock equipment costs are tied to the building investments in some of the programs but are determined by hand budgeting in early runs in which several different rations are compared.

TABLE 2.5.--BUILDING ACTIVITIES

Item	Unit	Horizontal Silo	Upright Silo	Beef Housing
		10 tons	10 tons	One unit
Revenue	$	2.80	7.00	4.48
Real Estate Capital	$	40.00	100.00	56.00
Real Estate Credit[1/]	$	-10.00	-25.00	-14.00
Silo Space[1/]	Tons			
Horizontal		-10		
Upright			-10	
Building Space[1/]	Head			-1

[1/]Minus sign denotes that quantity is added to the resource.

Each silo activity provides storage for 10 tons of silage per unit of the activity. Corn grain and haylage must be stored in an upright silo--corn silage may be stored in either type unless otherwise specified in a particular planning situation.

Land activities

A sample of the land acquisition and disposal activities are shown in Table 2.6. In the activities shown land could be purchased for $550 per acre or rented for a cash rent of $30 which gave the owner a 4 percent return plus paying for his land taxes. Additional operating costs are required to own the machinery requited to operate the land. Purchased land is 85 percent self-financing, thus, a $467 credit is added to the real estate credit

TABLE 2.6.--LAND ACTIVITIES - MICHIGAN

Item	Unit	Rent	Buy	Rent Out
Revenue[1/]	$	39	8.65	-42.00
Cropland Acres	acres	-.9	-.9	1
Operating Capital	$	69	56.65	-76
Operating Credit	$	-27	-27.00	30
Real Estate Capital	$		550	
Real Estate Credit	$		-467	
Annual Labor	hrs.	1.0	1.0	-1.0
Pd. 1		.2	.2	.2
Pd. 2		.15	.15	-.15
Pd. 3		.26	.26	-.26
Pd. 4		.17	.17	-.17
Pd. 5		.07	.07	-.07
Pd. 6		.15	.15	-.15
Rent in Limit	acre	1		
Buy Limit	acre		1	
Rent Out Limit	acre			1

[1/] Minus sign denotes income in revenue row; when it appears in the matrix it means that the quantity prefixed is added into the resource equation specified in that row.

limits when $550 land is purchased. In other words, only a 15 percent downpayment is required on a contract for deed land purchase.

A complement of equipment valued at $100 per crop acre must be purchased along with each acre. However, it is assumed that when expanding crop acres this original cost would be spread over two years; thus $50 of operating capital is required for machinery rather than $100. This equipment must be financed out of the chattel limit and is assumed to be 60 percent self-financing.

The added annual cost of owning the extra land includes machinery replacement ($10.00), tile and drainage maintenance ($5.00) and taxes of 1.3 percent. However, land values are expected to rise at an annual rate of 2 percent. So, when the land acquisition alternative is compared with feedlot expansion an annual credit must be given to land purchase. (If the land purchase alternative were to be considered for its own merits, it should be contrasted to opportunities for investment in the stock market.)

The operating capital needed in the year of purchase would be the total extra machinery purchased that year to facilitate operating the extra land plus annual taxes and drainage expenses. Machinery operating expenses are included in the production activities.

Since there is overhead labor associated with the operation of land, one hour is required for each acre added in the first increment of rented or purchased land, one-half hour per acre for the second increment, but none thereafter.

The larger scale machinery purchased along with the land assures that field operations can be performed so long as adequate labor is available. (In fact, direct labor requirements per crop acre should be lowered as farm and machinery size increase--thus, machine capacity should be less of a problem with the larger operation than with the original.)

Costs and returns from renting or selling land are about the converse of those incurred in acquiring land. Since the operator is required to buy machinery when acquiring land--he should be allowed to sell when disposing of land. This would mean a $50 (market value) machine complement sale with each acre of land disposed and an accompanying loss of about $30 in the chattel credit limit.

Beef feeding activities

To facilitate examination of the effects of price changes, feeder buying and beef sale activities are entered separately from feeding activities. (See Table 2.7) Beef is sold as carcass beef. This provides a more reliable basis for comparison of prices between areas and simplifies price comparisons among feeding programs which give rise to slaughter beef animals which have different dressing percentages.

TABLE 2.7.--SAMPLE OF CATTLE ACTIVITIES - MICHIGAN

Item	Unit	Buy Beef Calf cwt.	Feed Calf 1% Ration: Single head	Feed Calf 1% Ration: Capacity head	Sell Beef cwt.
Revenue[1/]	$	32.50	37.57	37.57	-44.30
Corn	cwt.	-	17.88	17.88	-
Corn Silage	ton	-	4.53	4.53	-
Operating Capital	$	-	30.09	30.09	-
Annual Labor	hrs.	-	3.08	3.08	-
Pd. 1		-	1.33	1.13	-
Pd. 2		-	.67	.35	-
Pd. 3		-	.67	.55	-
Pd. 4		-	.34	.14	-
Pd. 5		-	-	.47	-
Pd. 6		-	.07	.44	-
Building Space	unit		1.0	.75	-
Feeder	cwt.	-1	4.3	4.3	-
Carcass Beef	cwt.		-6.3	-6.3	1

[1/] Minus sign denotes income in revenue row; when it appears in the matrix it means that the quantity prefixed is added into the resource equation specified in that row.

There is no direct limit on credit available for purchase of feeder animals. An indirect limit is imposed either by the limitation on chattel credit or by not allowing purchase of corn. Interest costs (6 percent) on cattle are included in the cost component of each feeding activity.

There are two activities for each type of ration--one representing purchases of only one lot each year, the second representing purchases at 2 or 3 times during the year so that feedlot facilities can be used to the maximum. Therefore, the second activity always requires less building space, but it requires some labor in every period of the year. The program is allowed to choose any combination of capacity and single lot activities for each ration. Therefore, when it is more advantageous to save fall labor for crop harvest even at the expense of higher building costs, some units of the single lot activity will enter the solution.

PROJECTED PRICES

Price relationships assumed in long range planning are often the most important determinants of the relative profitability of different programs. Consequently, prices must be selected with care and several alternative price relationships should be considered. Fortunately, the impact of price changes on optimal solutions can be quite readily determined when a linear programming model is solved with a high speed computer. Consequently, although the basic cattle and corn prices used in this study are shown in Table 2.8, the effects of many alternative price relationships are also considered.

The projections in Table 2.8 are based on the following assumptions:

1) Corn prices will average 10¢ higher than the 1958-1967 average during the next cattle cycle.

2) The price ratio between choice steers and corn will remain the same even though it trended up during the past three cycles.

3) The return over feed costs per head will remain approximately the same. (See Table 2.9) This assumes that the average efficiency of fed beef production will increase just enough to offset increases in prices of other factors of production.

TABLE 2.8.--CATTLE AND CORN PRICE PROJECTIONS FOR THE NEXT CATTLE CYCLE COMPARED WITH THE LAST TWO CYCLES

Item	Unit	1949-58	1958-67	Projected 1967-76
Corn Price, Chicago #3	$	1.50	1.20	1.30
Choice steer-corn price ratio		18.00	21.6	21.6
Choice steers-Chicago	$	27.00	25.95 2/	28.00 2/
Gd-Ch. calves-Kansas City 1/	$	25.87	27.14	30.50
500-700# steers Kansas City 1/	$	22.32	24.50	27.00
Beef Carcass Ch 600-700# Chicago	$	-	41.20 2/	44.50 2/
Beef Carcass Gd 600-700#	$	-	39.04	42.50
Beef Carcass Ch 600-700# Denver	$	-	40.20	43.50
Corn-farm Level 3/	$			
Michigan			1.10	1.20
Minnesota			.98	1.08
Colorado			1.12	1.22

1/ Prices of feeder cattle at the farm level are determined by adding transportation and commission costs. Seasonal variations in feeder prices result in below average prices in Winter and above average in Spring.

2/ Average choice liveweight price equals 63 percent of the choice carcass price. The past relationship is projected into the future. This assumes that value of by-products will about cover slaughter costs in the future as it has in the past.

3/ Harvest time prices would be 10¢ lower than this average price in Michigan and Minnesota and 6¢ lower in Nebraska and Colorado. Corn can either be bought and sold at harvest time prices if storage is provided or bought at the season average price if no storage is provided. (In the Southwest, grain sorghum prices are 10¢ below average at harvest time.)

TABLE 2.9.--FEEDER CATTLE PRICE ESTIMATES BASED ON PROJECTIONS OF RETURNS OVER CORN COSTS SIMILAR TO PAST CATTLE CYCLES

Item	Unit	1949-58	1958-67	Projected 1967-76
		Calves (430# - 1030#)		
Ch steer price Chicago	$	27.00	25.95	28.00
Gd-Ch calves-K.C.	$	25.87	27.14	30.55
Gross margin per head	$	166.86	150.59	157.00
Bu. of corn (9/cwt)	bu.	54	54	54
Corn price (Chicago-20¢)	$	1.30	1.00	1.10
Corn cost	$	70.20	54	59.40
Gross margin less corn cost	$	96.66	96.59	96.60
		Yearlings (680# - 1080#)		
500-700# yearlings-Chicago	$	22.32	24.50	27.02
Gross margin	$	139.82	114.27	118.67
Corn cost (11 bu/cwt)	$	57.20	44.00	48.40
Gross margin less corn cost	$	82.62	70.27	70.27

CHAPTER III

COMPARATIVE PROFITABILITY OF DIFFERENT FEEDING PROGRAMS IN THE NORTHERN CORN BELT

There is no one best feeding system that fits all farms in a particular area. There are differences in the profitability of different rations under different price and crop yield situations; there are differences in the profitability of feeding different classes and grades from one year to the next depending on seasonal price movements of feeder and fed cattle; there are differences in the relative desirability of different types of housing and feed storage depending on weather and drainage problems; and there are differences in the profitability of different feeding programs due to initial fixed resources.

Recognizing the above, various feeding systems are examined under several planning situations in this chapter. These comparisons lead to some general guidelines as to when different feeding programs can be expected to be the most profitable.

TYPES OF RATION

The prime question relative to rations is how to utilize the corn plant--the northern corn belt's most profitable crop. Corn silage has long been called "king" of all cattle feeds because it produces the most beef per acre of feed. However, highest production per acre is not necessarily consistent with most profitable production, and the question of just how much corn silage should be included in a ration has not been examined on a total profit basis.

To gain some insight into this problem, three basic rations are considered for calves and 4 rations for yearlings. These rations, shown in Table 3.1, contain varying proportions of corn silage from all silage (plus protein supplement) to no corn silage. The feed requirements for these rations were developed on the basis of the results from many research trials conducted by animal husbandry scientists throughout the midwest.[1/] Research work at Michigan, Illinois, and South Dakota has demonstrated that each of these programs will finish good quality feeders to slaughter steers which will make the U.S.D.A. choice carcass grade. These same experiments showed that cattle fed more silage yield a lower dressing percentage. The dressing percentage shown in Table 3.1 is based on market weights after a uniform 3 percent farm to market shrink has been deducted from feedlot weights. The 3 percent figure is the average of all the farm to market shrinkages reported in Midwest animal husbandry cattle feeders experiments in recent years. It is assumed to represent the shrinkage expected in a 100 mile haul.

The efficiency of feed conversion and rate of gain shown in Table 3.1 are both excellent--approaching the maximum that can be achieved by top cattle feeders who consistently purchase healthy,

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[1/] Dr. Hugh Henderson, Professor, Animal Husbandry, Michigan State University, assisted in the interpretation of animal husbandry research results and in the development of these rations.

TABLE 3.1.--BASIC FEEDING PROGRAMS CONSIDERED FOR BEEF STEERS IN THE NORTHERN CORN BELT

Item	Unit	Type of Ration			
		All Silage	1% Concentrate	Full Feed	Haylage
Calves[1/]					
Days on feed	days	340	280	255	
Ave. daily gain[2/]	lbs.	1.76	2.14	2.35	
Feed requirements[3/]	head				
Corn silage	ton	7.2	4.4	2.0	
Corn	bu.	-	31	55	
Protein suppl.	lbs.	340	280	255	
TDN/cwt. gain	lbs.	520	558	577	
Variable cash costs[4/]	$	44.64	37.57	34.28	
Dressing percent	%	59.9	61.2	62.2	
Yearlings[1/]					
Days on feed	days	200	174	160	160
Ave. daily gain[2/]	lbs.	2.0	2.3	2.5	2.5
Feed requirememts[3/]	head				
Corn silage	ton	5.7	3.5	1.1	-
Hay	lbs.	-	-	-	640
Corn	bu.	-	24	46	50
Protein suppl.	lbs.	200	174	160	80
TDN/cwt. gain	lbs.	605	645	653	654
Variable cash costs[4/]	$	31.38	27.87	25.80	21.64
Dressing percent	%	59.9	61.2	62.2	62.2

[1/] Calves are purchased at 430 pounds and sold at a shrunk weight of 1030 pounds. Yearlings are bought at 680 pounds and sold at 1080 pounds.

[2/] Average daily gain is calculated on basis of market to market weights which assumes a 3 percent outshrink and a 10 to 14 day period to regain in-shrink.

[3/] These feed requirements were increased 3 percent for calves and 2 percent for yearlings before they were used in the model to cover waste and death losses.

[4/] Cash costs are itemized in Appendix Table A.

growthy cattle and experience no difficulties in keeping them eating to capacity. Lower efficiency levels will be considered later in this study. The point of major concern in this section is that the different rations show the appropriate feed requirements relative to one another. In this respect, the item open to most questions is the difference in dressing percentage among the different rations since these relationships are based on limited research data.[1/]

The variation in dressing percent used in this study results in the carcass weights and values per hundred pounds liveweight shown in Table 3.2.

TABLE 3.2.--CARCASS WEIGHTS AND COMPARATIVE LIVEWEIGHT PRICES FOR SLAUGHTER STEERS FROM THE DIFFERENT BEEF FEEDING PROGRAMS COMPARED IN THIS STUDY

Feeding Program	Carcass Weight	Equivalent Liveweight Price: Carcass Price $44.80	Equivalent Liveweight Price: Carcass Price $42.80
	lbs.	$	$
Calves			
Rations			
All silage	617	26.83	25.64
Partial grain	630	27.40	26.18
Full feed of grain	641	27.88	26.63
Yearlings			
Rations			
All silage	647	26.84	25.64
Partial grain	661	27.42	26.19
Full feed of grain	672	27.88	26.63

[1/] Carcass data was furnished on cattle fed various amounts of silage in the following Feeders Day Reports: Illinois, 1960 and 1962; South Dakota, 1962, 1963 and 1964; and Michigan State University, 1965.

The differences in live price shown in Table 3.2 agree quite closely with those suggested by Ohio researchers after extensive research with feeding programs containing different amounts of silage.[1/] The differences in liveweight selling prices shown in Table 3.2 should be kept in mind when considering the results in the succeeding sections of this chapter.

The all silage ration

The comparative profitability of the all silage ration as determined by linear programming and budgeting for numerous resource and planning situations suggests that it may be quite competitive in Michigan feedlots where only one lot of cattle is fed each year but that usually it is not competitive with other rations when a feedlot is used to capacity. The all silage ration was found to give the lowest return to fixed resources in the following situations:

1) When labor was the limiting factor

2) When building space was the limiting factor but it was used to capacity

3) When real estate capital was the limiting factor.

However, the all silage ration (fed from horizontal silo) becomes the highest return ration when:

1) Only one lot of cattle is fed and feedlot size is held constant

2) Acreage is limited and credit is not available to buy corn

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[1/] J. Hubert Warner, Commercial Cattle Feeding in Ohio, Agricultural Extension Service, Ohio State University, Extension Bulletin 355, June 1957, p. 21.

3) The price margin in cattle feeding drops so far that total costs of cattle feeding are not recovered

4) Corn grain prices move over $1.50, farm level average

5) If the ratio of corn grain harvested to silage harvested is less than 4.1 bushel/ton (the usual ratio is about 5.0).

Most small corn belt feeders operate as indicated in (1) above--buying a certain number of cattle each fall. In this situation, if the operator is able to obtain top performance with an all silage ration, this is the lowest cost way of producing beef. The lowest cost production method will also be the highest return method if the silage of fed cattle command a selling price based on a carcass grade of choice. (Although this carcass grade is often achieved experimentally from an all silage ration, some feeders will not be paid for this grade--especially if cattle are sold on the hoof. The live price on these cattle should be about $1.00 per hundredweight under those on the high concentrate ration to compensate for lower dressing percentage.)

However, to maximize profits, cattle feeders should normally attempt to make fuller use of their facilities than to feed only one lot of cattle per year. Feedlot facilities can be utilized much more efficiently if a program is planned in which the facilities are used most intensely in the winter and least in the summer after hot weather arrives. Professor Robert Maddox of Agricultural Engineering and Dr. R. Hugh Henderson of the Animal Science Department at Michigan State University have concluded that 2 square feet of building space per hundredweight of animal is sufficient in the winter, but 3 square feet is necessary in the summer. Using these constraints, the space requirements shown in Table 3.3 were developed. These requirements are based on purchase dates of feeders that would maximize use per unit of building space for each ration. Calves must be bought in the summer as well as in late fall in order to get maximum use out of a given amount of shelter space.

Fortunately for the farmer-feeder these purchase-sale patterns are somewhat supplementary to crop production in terms of labor requirements since heaviest demands for feedlot labor come in the winter. Unfortunately, if too many operators attempt to purchase feeder calves during the summer, the supply at that time will become limiting. In this case cattle of different weights can be bought at different times of the year to keep the lot filled in the winter. Whether these cattle are "calves" or "yearlings" is of less importance than is the fact that a given building should contain more beef in the winter than in the summer in order to realize the significant decrease in overhead facility needs per head shown in Table.3.3.

A decrease in building overhead leads to increased profits in two ways. First, it means that each animal fed will have a lower feedlot facility cost charged against it. Secondly, a given size feedlot will turn out a larger number of finished cattle in a specific time period--thus, if returns over variable costs per head are positive, the larger volume handled through a given fixed plant results in greater profits to the firm. Consequently,

TABLE 3.3.--MINIMUM BUILDING SPACE REQUIREMENTS[1] PER HEAD FOR DIFFERENT RATES OF FEEDLOT GAIN

Program	All Silage Ration		1% Concentrate Ration		Full Feed Ration	
	1 lot/year	Capacity[2]	1 lot/year	Capacity[2]	1 lot/year	Capacity[2]
			square feet per head			
Calves	28	22	30	18	30	16.5
Yearlings	27	18	27	14	23	13
			percent of standard unit of 30 square feet			
Calves	93	73	100	60	100	55
Yearlings	90	60	90	47	77	43

1/ Calculations are based on space requirements by months of:

2 square feet per hundredweight during December, January and February
2.2 " " " " " November and March
2.5 " " " " " September, October, April and May
3.0 " " " " " June, July and August.

2/ Capacity requirements are based on twice a year purchases for calves (fall and summer) and two or three times a year purchases for yearlings with purchases made at such times as will make maximum use of space. In contrast, single lot purchases are made in the fall after corn picking. For example, of purchase-sale patterns which would give maximum utilization of capacity see Appendix Table B.

the high silage ration loses out on two counts in years when cattle feeding is profitable. The first count--higher nonfeed costs--may be more than offset by lower feed costs resulting in higher profits per head for the high silage ration. But the second disadvantage--slower turnover and therefore smaller volume--may be quite difficult to overcome. This was evident in the results of many of the situations programmed as shown in Table 3.4. Note that the higher silage rations (S or P) usually resulted in higher returns on a per head basis but lower returns per building unit or to all fixed resources than did the full feed (F) ration.

All of the programs included in Table 3.4, except the one which limits the number of feeders purchased, allowed cattle to be fed either on the "one lot per year" program or on a program which required 15 percent more space than indicated to be the "capacity" requirements shown in Table 3.3. The most profitable combination of these two activities usually consisted of almost all cattle being fed on the "capacity" program (actually 85 percent of physical capacity), with a limited number of single lot cattle added to help relieve the labor load at harvest. And, as noted in Table 3.4, the rations which result in higher rates of gain and subsequent lower building requirements when "capacity" feeding is allowed, give higher total returns in most resource situations. The main reason is that in moving from the single lot to the capacity program, feeding profits from a fixed size feedlot are increased much more in the faster turnover programs than in the all silage program.

TABLE 3.4.--RANKING OF RATIONS ACCORDING TO DIFFERENT FINANCIAL MEASURES FOR VARIOUS RESOURCE AND PLANNING SITUATIONS IN MICHIGAN[1/]

Planning Situation[2/]	Measures of Financial Success: Return to all Resources	Return on Investment (Per Building Unit)	Return on Operating Capital (Per Head Fed)	Return on Labor
		Highest Return Ration[3/]		
Crop Farm				
Limited Operating Capital				
200 acre farm	S	P,F	F,P	F
350 acre farm	P,F	F,P	F,P	F
Limited Labor	F	P,F,S,	S,P	F,P
Limited Real Estate Capital	F,P	P	P	P,F
Beef Farm				
Single Purchase	S,P	S,P	S,P	F,P
Capacity Use (85%)	F,P	F,P	S,P,F	F

[1/]The results shown in the table are based on calf programs with calves bought at $32.50 and sold at $44.30 per hundredweight of carcass. Dollar returns for some of these situations are shown in Appendix Table C. Comparisons for yearling programs showed relatively less favorable results for high silage programs. Although program solutions always selected horizontal silos, forced use of upright silos resulted in generally the same pattern of results as shown except that again high silage programs were relatively more profitable. When cattle feeding was less profitable, the higher silage rations became more desirable than the full feed ration.

[2/]The limited operating capital situations did not allow purcahse of corn. All situations other than the 200 acre farm had 350 crop acres. All situations other than the limiting labor one allowed labor to be hired. All situations other than the Beef Farm, single purchase allowed facilities to be used to 85 percent of capacity.

[3/]S = all silage, P = 1% concentrate, F = full fed. If more than one ration is shown there is judged to be no significant difference in the return figures. (See Appendix Table C for dollar returns).

However, it is informative to note that when farm acreage is reduced to 200 acres and no corn can be purchased, the all silage ration gives the greatest return to all resources. This illustrates the fact that a high silage ration does give the "highest return per acre". This planning situation has been realistic for many in the past due to attitudes on credit. However, home produced feed should not be considered to be a "fixed" resource if it is profitable to buy (or sell) corn.

As the selling price on carcass beef drops, the returns from cattle fed the full feed ration drop more rapidly than those from higher silage programs since the high concentrate ration of this study produces a heavier carcass as well as more of them in a given period of time. If the sale price is lowered by more than three to four dollars, the total return to all resources becomes greater for the all silage program than from the other rations in a situation where the feedlot capacity is about 500 standard units.

Also, when the price of corn moves higher, the all silage rations become more competitive. As the average price of corn moves over $1.40 ($1.30 harvest price) the all silage and 1 percent rations are equally favored over the full feed ration in returns to all resources. The all silage ration becomes the highest return ration in the harvest price of corn moves over $1.40 per bushel.

Finally, the all silage ration shows up in a more competitive position if the silage yield is increased relative to the corn grain yield. However, the relative profitability of the ration is not as sensitive to this yield relationship as might be expected. The basic relationship assumed in this study was a grain to silage ratio of about 5 bushels per ton of harvested silage, but 5.5 bushels per ton of silage on a "preserved for feed" basis after a 10 percent storage loss of silage in an upright silo. (Losses in the horizontal silo were assumed to be 15 percent, thus, the ratio was 5.8 on a fed basis in this case.)

Decreasing the ratio to 5.0 on a fed basis from the upright silo causes the margin of differences in returns among rations to narrow but does not change the basic relationships shown in Table 3.4. Further reducing the ratio to 5.0 on a fed basis for the horizontal silo puts the 1 percent ration on a par with the full feed ration but still leaves the all silage ration showing a lower total feedlot return. Before the all silage ration catches up in this respect the ratio on a fed basis must drop to about 4.8 or about 4.1 on a harvested yield basis.

The one percent concentrate ration

The Animal Husbandry Department at Michigan State University has records on the results of this ration fed to over 1000 cattle. On the basis of the results of many experiments in which this ration has been compared to others, the 1 percent concentrate ration is now generally recommended to Michigan cattle feeders. It appears to have the advantages of (1) utilizing a large amount of silage; (2) resulting in fairly rapid gains; (3) assuring an adequate finish; and (4) being very simple to maintain. Its simplicity stems from the fact that cattle are kept on a ration containing enough corn added to one pound of a 64 percent supplement so that the total concentrate intake equals 1 percent of their body weight each day throughout the feeding period.

The results of this study tend to support this recommendation as indicated by the frequency with which this ration appears in Table 3.4 as being either highest or close to highest in returns per building unit and per head fed. Additional programming at lower slaughter beef prices or higher costs gave returns to the 1 percent ration which were equal to or superior to returns from the full feed ration. For example, when the carcass price was dropped to $42.80, total returns from the 1 percent ration were usually greater than returns from the full feed ration. Also, when feed requirements were increased by 15 percent (to equal averages shown in farm record summaries) the 1 percent ration usually gave slightly higher returns than the full feed ration.

In looking over the results from many comparisons it appears that the 1 percent ration will probably give near maximum returns to the feeder who feeds a limited number of cattle under most planning and price situations. For maximum profits under the conditions that are near those assumed in this study, cattle feeders who feed only one lot of cattle per year probably should feed less than 1 percent concentrate in the ration. (They may want to feed some corn to insure adequate growth and finish on calves in 12 months.) On the other hand, those who are trying to move as many cattle as possible through their feedlots should increase the corn level above the 1 percent level to obtain a faster turnover--especially when profits are good.

<u>The high concentrate ration</u>

The results of this study indicate that corn belt cattle feeding literature has undersold the high concentrate ration in the corn belt. This short treatment of the high concentrate ration--especially for calves--stems from the fact that almost all research on the profitability of different rations has been limited to comparing <u>returns over feed</u> on a <u>per head</u> basis. In this type of comparison it is difficult for the high concentrate ration to compete with the high silage ration given the price usually inputed to corn silage. And the results of this study support the contention that on a per head return basis the high concentrate ration is less profitable.

However, in all resource situations where capacity feeding and corn purchases were allowed the full feed rations of this study resulted in the highest total feedlot returns. Furthermore, in comparing the results from the <u>yearling rations</u> used in this study, the high concentrate ration also gave higher returns per building and per head than did the higher silage rations.

This favorable showing for high concentrate rations stems from the fact that nonfeed costs are lower and slaughter prices higher for cattle fed these rations. Therefore, the larger scale feeder who is attempting to operate his feedlot at maximum capacity should move toward the high concentrate rations, especially with heavier feeder animals. A ration with somewhat less than a full feed of corn might give maximum average daily gains to many feeders while holding feed and price risks down slightly. (As noted in the previous section returns are higher from the 1 percent ration when price margins are narrower.) Also, as corn prices move above the $1.10 harvest level it will pay to substitute more corn silage for the grain.

If cattle feeders can safely feed cattle an all concentrate ration with the feed conversion efficiencies that have recently been demonstrated at Illinois and Minnesota,[1/] these would be the highest return rations at the price relationship used in this study. Although rations which do not use any roughage have been safely fed to heavier steers, the feasibility of these rations under feedlot conditions is still debatable.

The haylage ration

Given normal yield relationships between corn silage and hay, corn silage is the higher return feed crop. Returns from the yearling high concentrate haylage ration that was shown in Table 3.1 became greater than returns from the corn silage rations when the hay yield was increased to over 4.4 ton compared with the 19 tons of

[1/] Minnesota 1963 and 1964 Cattle Feeders Report, Illinois 1966 Cattle Feeders Report. A ration developed on the basis of these experiments would put 400 pounds of gain on a yearling steer with only 47 bushels of corn and 340 pounds of a specially fortified protein supplement.

corn silage preserved in the horizontal silo. If hay yields are relatively greater than this, hay becomes competitive. Otherwise, hay should be included in the cropping program only to the extent that it is required due to soil limitations or government program participation. Hay or haylage produced on required acres can be substituted for part of the corn silage in the feeding program. According to Dr. Henderson, up to 3 or 4 pounds (air dry hay basis) per day can be used to replace corn silage without adversely affecting animal performance.

However, even at a 4 ton yield, some haylage fed yearlings come into solutions when labor is limiting on larger acreages. This indicates that some hay may be justified on large farms that must diversify crops somewhat to spread labor. Also, haylage fed yearlings start to come in as the price of corn moves below $1.00 per bushel. The haylage high concentrate program becomes more competitive then because it uses relatively more corn grain than any other program considered.

To summarize this section on rations, it was found that higher concentrate rations, (1) give higher returns to labor, (2) give higher returns when price margins are favorable, (3) will increase feedlot returns due to more rapid turnover of cattle and (4) is more desirable in the western corn belt because of lower grain prices. Conversely, high silage rations were found to give higher returns: (1) when grain prices are higher, (2) when a given number of cattle are to be fed, and (3) when no money can be obtained to buy feed on a small farm.

CALVES VS. YEARLINGS

The question of which is more profitable to feed--calves or yearlings--usually hinges on the price pattern for the period in question. But given the same expected sales price, there does exist an appropriate feeder price relationship for each individual cattle feeder who is considering both. It was interesting to discover that when using the average prices projected in Chapter II, returns from the two classes of cattle were about equal when capacity feeding was allowed. That is, the results of this study tend to verify that the projected prices of $30.50 for good to choice calves and $27.00 for 500-700 pound steers at Kansas City are appropriate relative to one another.

Good quality steers near the top of this weight group (680#) could be purchased for about $26.00 per hundredweight. Adding commission and transportation costs would put these steers in Michigan lots at $28.00 compared to $32.50 for the calves. With these purchase prices, yearlings on the full feed ration gave essentially the same total returns as full fed calves. Yearlings fed the higher silage rations did not quite match the calves getting the same rations. Thus, the spread in returns from the full feed ration to the all silage ration was much greater for yearlings than it was for calves.

All yearlings have a much lower return on a <u>per head</u> basis. Thus, if yearlings are to be fed, they should be utilized on more than a single lot per year basis and should be fed a high concentrate ration so that turnover can be as rapid as possible.

TABLE 3.5.--RELATIVE PRICES WHICH WOULD GIVE EQUAL RETURNS TO CALF AND YEARLING PROGRAMS BEING FED A 1% CONCENTRATE RATION

Fed Cattle Price	Equivalent Feeder Prices	
	430 lb. Calves	680 lb. Yearlings
$34	$46.00	$36.75
32	41.50	38.75
30	37.00	30.75
28	32.50	27.75
26	28.00	24.50
24	23.50	21.50
22	19.00	18.50
20	14.50	15.50

Price differentials between calves and yearlings must change with the level of cattle prices. For every increase in the price of fed cattle, feeder calf prices should increase more than yearling prices. For example, if the slaughter price goes up enough to make the finished product worth $8.00 more per head, feeders will bid up the price of 400 lb. calves by $2.00 per hundredweight in contrast to a $1.00 per hundredweight increase for 800 lb. steers. Conversely, as slaughter prices move down, the price differential between the different weights of cattle must narrow, disappear, and finally move in the opposite direction if slaughter prices go low enough. Consequently, feeders must construct and keep in mind a whole set of price relationships similar to those shown in Table 3.5.

Nonfeed costs per hundredweight of gain are usually quite high on cattle that are held for only a small gain. If only one lot of yearlings is fed per year, the nonfeed costs are especially high due to the high overhead costs of facilities that are idle for many months. However, if these yearlings are fed to heavier weights, nonfeed costs per hundredweight decline. This fact may partially explain the tendency of corn belt feeders who traditionally feed only one lot of cattle, to market their cattle at heavier weights. In these instances there may often be economic justification for adding more weight in order to maximize returns <u>per head</u>--but, more profitable alternatives might be to either buy a second lot of cattle or to purchase lighter cattle in the first place. Calf feeding is the alternative followed by most northern corn belt feeders.

On the other hand, the larger commercial feeder prefers the other alternative--more frequent buying of heavier feeders. And, it was interesting to note that the results of the linear programming analysis suggest that the high concentrate ration is relatively more profitable for yearlings than for calves. Apparently the higher nonfeed costs associated with feeding yearlings makes it especially costly to get slow gains on yearling cattle--making the all silage yearling program the least profitable of all due to high nonfeed costs per unit of gain. Another point of interest is that as cattle feeding becomes more profitable through either lower costs or higher beef prices, yearling feeding becomes relatively more desirable. This may partially explain why large commercial feeders often prefer yearlings and put such a premium on rations which result in rapid gains.

In summary, it appears that if feeders are to be purchased only once each year, calves should definitely have preference over yearlings on most farms in the Northern corn belt. But for managers who are seriously in the cattle feeding business the year around there is little reason for avoiding yearlings. As more feedlots in the corn belt shift over to operating near capacity, more yearlings will have to be purchased since the summer calf supply is not large enough to meet a greatly expanded demand.

In a recent survey of Michigan cattle feeders, 16 percent of the respondents indicated they were purchasing some heavier feeders in an attempt to market on a year around basis.[1/] This same survey showed that Michigan feeders bought 65 percent of their feeder cattle in the fall, but the summer was the second highest purchase period with 16 percent bought in June, July, and August. They sold about two-thirds of their cattle in the summer and fall months suggesting that most were single lot, fall purchased calves. (60 percent of the feeders bought were under 550 pounds.) The fact that this uneven supply of slaughter cattle tends to raise average packer costs should be of concern to the area cattle industry. As more cattle feeders shift to year around capacity feeding the seasonal slaughter supply pattern will improve. The results of this study suggest that this shift will come in Michigan since modern crop machinery and equipment make it unnecessary to

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[1/] David L. Cole, "Marketing of Fed Beef Cattle in Michigan, 1966," Agricultural Economics Report No. 63, April 1967.

shut down the feedlot during the crop season. And, as more feeders invest in additional facilities they will want to utilize these facilities more fully.

BEEF VS. DAIRY STEERS

The practice of feeding out dairy steers is one of fairly recent development. The rapid expansion in demand for fed beef during the past decade resulted in the diversion of many otherwise slaughter-bound dairy calves into feedlots. However, there are still a large number of dairy calves produced in the Northern corn belt states that are not going into feedlots in these states. In fact, some of these low quality feeders are bought for the large commercial feedlots from as far away as California.

In Chapter I, Table 1.2, it was suggested that the practice of buying low quality feeders and "upgrading" them in the feedlot might be one way in which commercial feedlots have been getting a profit edge on corn belt feeders. For this reason it was decided to include in this study some comparisons between high and low priced feeders. Although it is difficult to specify consistent differences in input-output coefficients for various grades of feeders, the dairy steer, which has been subjected to many feeding trials can be used to represent a lower priced and therefore, presumably, a lower quality feeder of known performance ability.

Numerous research trials with dairy steers have established the fact that the large dairy breed steers can be expected to gain faster than steers of straight beef breeding. The faster gain is due primarily to the larger daily intake capacity of dairy steers. Hence, feed conversion is usually identical to only slightly better than for the beef animals. Table 3.6 shows the standards that were assumed for the dairy steer programs examined in this study.

Nine studies comparing the dressing percentage of dairy steers with steers of beef breeding showed an average differential of 3 percentage points between the dairy steers and the beef steers fed similar rations to similar weights.[1/] The variation among studies appeared quite small (2.5 to 3.8). Although dairy steers fed a high concentrate ration or fed for longer periods of time can produce carcasses grading choice, the length of feeding period assumed in this study was sufficient to produce only good grade carcasses. The lower carcass grade along with the lower dressing percentage result in a $2.00 lower price for dairy steers--in this study--on the liveweight basis as well as on the carcass basis. (The liveweight equivalent price on the dairy slaughter steers from the 1 percent concentrate calf feeding program being $25.34 in contrast to $27.40 for the beef bred steers fed the same ration.)

For these two programs to result in equal returns, the dairy calves could incur a laid-in cost of $28.45 per hundredweight when good to choice calves cost $32.50. Thus, with a $2.00 lower expected selling price, dairy calves must be bought for about $4.00

[1/] These studies were reported in the cattle feeders reports in Michigan, Minnesota, Wisconsin, Ohio, Iowa, South Dakota, and Tennessee.

TABLE 3.6.--FEEDING PROGRAMS CONSIDERED FOR DAIRY STEERS[1/]

Item	Unit	Calves (430-1088#)	Yearlings (680-1124#)
Days on feed	days	280	174
Average daily gain[2/]	lbs.	2.35	2.55
Feed requirements[3/]			
Corn silage	tons	4.8	3.9
Corn grain	bu.	34	26
Protein suppl.	lbs.	280	174
TDN/cwt. gain	lbs.	558	645
Variable cash costs[4/]	$	38.00	28.48
Dressing percent	%	58.2	58.2

[1/]The rations used for purposes of comparison with beef steers is the one percent concentrate ration. Dairy steers are assumed to be kept the same number of days as the beef steers fed this same ration. This results in a higher liveweight but due to the lower dressing percent the carcass weight is almost the same.

[2/]Average daily gain is calculated on basis of market to market weights which assumes a 3 percent outshrink and a 10 to 14 day period to regain in-shrink.

[3/]These feed requirements were increased 3 percent for calves and 2 percent for yearlings before they were used in the model to cover waste and death losses.

[4/]Cash costs are itemized in Appendix Table C.

less. In contrast, if choice beef steers are expected to sell for $2.00 less in one year than in another--the feeder calves must be bought for $4.50 less if other costs are the same. (See Table 3.5) For yearlings fed a 1 percent ration, equivalent returns would be obtained if dairy steers cost about $24.50 in contrast to $27.75 for beef steers. This is the same differential as indicated to be necessary for beef yearlings in Table 3.5 when faced with a $2.00 difference in selling price.

In the past the price differential between beef bred steers and dairy steers has been <u>greater</u> than necessary to insure similar returns. Thus, higher than average returns have been possible to cattle feeders buying dairy steers. Higher returns were in fact obtained from dairy steers than beef steers in recent research trials at Iowa and Michigan.[1/] Other research at these stations has shown similar profit advantages to other so called "lower quality" cattle when compared to choice quality feeders. Thus, the evidence suggest that corn belt cattle feeders have been bidding the price of choice feeders up too high relative to lower grade feeders.

One reason for this may be that many midwest cattle feeders have had difficulty in getting paid full value for these lower quality cattle when sold on the live cattle market. Some found it necessary to change to selling on the carcass basis in order

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[1/] See 1965 and 1966 Cattle Feeders Reports for these states.

to get a more equitable value for these cattle. Others either discontinued buying low quality feeders or were discouraged from ever trying them.

Thus, it may be that one factor that has discouraged the feeding of lower quality cattle in the corn belt has been the inefficiency of the corn belt market system relative to the market system in the West and Southwest of reflecting true product value back to producers. (This general set of phenomena is often passed over as a "difference in demand" between these areas. A true difference in consumer demand may or may not exist but this author would hypothesize that most of this difference has its origin in cattle buyers rather than in consumers.)

As the corn belt market system improves the sensitivity of its pricing mechanism to true retail value, and as feeders in this area learn more about the profit potential in feeding dairy and other low grade steers, the price differential between feeder grades will narrow. (Or traditional grades will change in definition.) This trend has been under way in recent years and as it continues, and as the number of lower grade steers continue to decline with declining dairy numbers and improved beef breeding, the feeder grade pricing problem--as known in the past--may disappear. In its place will be the question of growing importance--how much more can be paid for feeder cattle from proven performance herds. That is, rather than basing the relative prices among feeder animals on differences in color or conformation, more emphasis will be put on trying to price them according to a more appropriate measure--how efficiently they will convert feed into retail beef of desired quality.

FEEDLOT FACILITIES

Because of the limited amount of research work that has been conducted on the effect which different feedlot facilities have on cattle performance in the Northern corn belt area, an extensive economic comparison of different facilities could not be made in this study. However, on the basis of existing knowledge, limited comparisons are made between different housing, feeding and feed storage facilities. The results of these comparisons are presented in this section.

Feed storage facilities

The lowest cost method for a cattle feeder to harvest and store corn grain is in an upright silo. The model used in this study required that concrete upright silos must be provided for all corn grain that was harvested and kept for feed or that was purchased in the fall. However, no additional storage space was required if corn was purchased at the yearly average price which was set 10¢ higher than the price at harvest time. The silo storage could be purchased for $10.00 per ton capacity. This does not include the silo unloader. In determining space for high moisture corn, a conversion figure of 30 bushels per ton of storage space was used.[1/]

[1/]Based on the experience at Michigan State University cattle research farm.

A simple cost budget will indicate that it is cheaper to buy extra corn needed for feeding at harvest time and build the necessary silos since storage costs would be calculated to be less than 10¢ per bushel. Therefore, it was interesting to note that this alternative was seldom selected in the many profit maximizing solutions that were determined by the computer. This was because, in the situations that were studied, the marginal value product of capital was almost always higher than the interest cost that is used in budgeting.

It was not so surprising that a high value on real estate capital would prevent investment in silos. But, a high marginal value product on short term capital had the same effect. In fact, in situations where operating capital was very limiting, some existing silo space was left unused while some corn was purchased later in the year rather than at harvest. This apparently odd behavior was due to the fact that it requires more operating capital to store the year's corn supply all year than to buy corn as needed. Since this model required that fall stored corn be kept, on the average, six months longer than corn bought as needed, an MVP of 20¢ or more per dollar of operating capital would more than compensate for the 10¢ price differential. (.20 x 1/2 corn price $>$ .10)

If the silo had to be built, its annual cost could be covered if the MVP of operating capital dropped below 11¢ when real estate credit was available at cost (5.5%). Silo purchasing would of course also be precluded with a high MVP on real estate capital.

For corn silage, horizontal silos were always preferred over upright silos under normal price relationships. This preference occurred in spite of the fact that silage losses from spoilage were assumed to be 50 percent higher in the bunker silos (15% vs. 10% of harvested yield) and an extra man was required for harvesting. (Increasing harvest costs by $2.00 per acre.) Even by charging depreciation costs of 10 percent on horizontal silos but only 5 percent on upright silos the latter would not come into solutions. The fact that farmer feeders in Michigan actually construct upright silos rather than horizontal ones is probably because most operations are smaller than the 500 unit size considered in this section of the study. Smaller units would show greater losses in horizontal silos as well as require more labor.

Silo type is not so important when a high concentrate ration is fed since fewer tons of silage are required. For a feedlot with a standard capacity of 500 head utilized to feed only one lot of calves fed the full feed ration, net income would be only $100 to $350 less with upright silos depending on which depreciation rate is used on horizontal silos. If this feedlot is used to capacity, about 900 head requiring a little over 2000 tons of silage would be fed and the net difference would be almost twice as high. For the high silage programs which require several times as much silage for the same number of cattle, net income is decreased proportionately more when the higher initial investment silos are constructed.

Feeding facilities

The cost of different types of feeding facilities was not compared in this study. Rather, since only larger scale feedlots were being considered, fenceline feeding was assumed to be the most practical as well as the most profitable. For feedlots of less than 500 head, auger tubes can be just as economical and may be more desirable for many.[1/] However, if additional expansion is to be considered as a possibility, the fenceline feedbunk offers more flexibility even when smaller scale feedlots are constructed.

The equipment needed for feed processing and handling includes silo unloaders, a roller mill for corn, and an unloading wagon. If size of unit increases much beyond a 500 head feedlot, a truck with silage mix box and scale might well be substituted for the wagon. A used wagon should be kept on hand in case of breakdown. Other equipment items necessary for feeding cattle and the approximate new cost of each are shown in Table 3.7. In estimating annual use costs, an annual replacement cost of 10 percent was assumed for all equipment. When considering the all silage ration, ownership costs of the roller mill and one silo unloader were excluded. However, since the all silage program did not appear too desirable even with this lower investment cost, all feedlots of this scale should have facilities for storing, processing, and handling corn.

[1/] C. R. Hoglund, "Investments and Annual Costs for Alternative Beef Cattle Feeding Systems," Research Report No. 7, Michigan State University Agricultural Station, 1965.

TABLE 3.7.--ESTIMATED EQUIPMENT REQUIREMENTS FOR A 500 HEAD FEEDLOT

Function	Item	Investment Cost
Harvest	Chopper, blower and wagons	$6000
Silage removal	Tractor & scoop or unloader	2000
Corn removal	Silage unloader	2000
Process corn	Roller mill and meter	1000
Protein storage	Bin and auger	500
Feed distribution	Self-unloading wagon or truck	2500
Manure handling	Manure loader and spreader(s)	1500
EXPECTED PER UNIT CAPACITY INVESTMENT		30

Housing facilities

There are many different housing and lot arrangements possible in cattle feeding. The limited available research results on alternative housing and lot arrangements were used to make some comparisons between a few different arrangements in the Northern corn belt. On the basis of investment requirements, three general types of layouts can be differentiated. These are as follows:

1) Low investment - no housing, earthen lot.

2) Typical investment - housing partial concrete.

3) High investment - confinement feeding, slotted floors.

Several years of research at Ohio and Iowa indicate that both gains and feed efficiency are depressed if no shelter is available.[1/] The three years work at Iowa showed an average decrease in daily gains of .34 pounds when going from feeding under a roof in an open building to feeding in an earthen lot with no shelter. (2.86 vs. 2.52) These results were from yearlings on a high concentrate ration. The Ohio research with calves over a 6 year period showed that average daily gain was .2 pound lower in the no shelter--earthen lot situation as compared with either the open shed--concrete lot or the open building--under roof situation. On the basis of these findings, a calf program for the low investment situation was established which gained about .2 of a pound less per day and required about 6 percent more feed than the full feed calf program of this study. However, this program requires no expenditures for shelter or concrete. Investment requirements for a feedlot of this type are compared with the average and high investment situations in Table 3.8.

[1/] For a summary of research findings on beef cattle housing see "Effect of Environment and Housing on Feedlot Performance," AH-BC-25, February 1967 by Mitch Geasler and Hugh Henderson, Department of Animal Husbandry, Michigan State University.

TABLE 3.8.--INVESTMENT REQUIREMENTS PER STANDARD UNIT OF CAPACITY FOR THREE TYPES OF FEEDLOT FACILITIES

Item	No Housing Earthen Lot	Housing Partial Concrete	Confinement Slotted Floor
Housing (or fence)	$3	$36	$180
Feedbunk	4	4	4
Feeding floor	1	2	-
Driveway	2	2	2
Waterers	2	2	2
Water and electric system	2	2	2
Land and grading	6	4	4
Corral, chutes and scale	4	4	4
TOTAL COST PER UNIT	$24	$56	$198

The average or typical feedlot facility in the Northern corn belt usually has some concrete as well as housing. Cattle may be fed either outside or inside the shelter. Likewise they may be confined to the building or allowed to exercise in a lot which is at least partially paved. The combination shelter and lot situation with outdoor feeding is the most common. However, in pricing several alternative layouts which include shelter it appears that the one with lowest investment may be the complete confinement plan which confines cattle in the building thus precluding added investment for concrete, fence, and extra land. Therefore, the standard or typical feeding facility as outlined in Table 3.8, consists of an open building with a fenceline feedbunk along the open end of the building. There is a 10 foot concrete feeding platform inside the building and a similar platform on the outside for driving on. The plan of this building is such that it can be converted to a slotted floor building at a later date if desired.

No available research indicates that there are any economies to be gained from "environmentally controlled" housing. Therefore, the high investment situation is the same as the above outlined confinement feeding facility except that slotted floors are provided rather than a dirt floor. The slotted floor and pit are estimated to cost $6.00 per square foot. This would be $180 for 30 square feet of floor space plus $36.00 for the building to make a total of $216. But, since there is no manure pack to develop heat it is estimated that a standard unit of space on slotted floors would be 25 square feet compared to the 30 square feet required with the manure pack. Thus, the cost per building unit is reduced from $216 to $180.

The increased annual ownership costs associated with this much larger investment must be offset by savings in such items as bedding, labor, feed and manure nutrients. With the quantity of bedding assumed in this study, elimination of the bedding chore would save about one third of the labor required or 52 minutes per head. This could be an important consideration in a labor-tight situation.

Research work at Ohio and Michigan both showed no change in feed efficiency from slotted floors. In the first comparison that

Ohio made the steers on slotted floors graded significantly higher and yielded somewhat more. However, this result was not repeated in the second comparison. Thus, no difference in feed costs or product value is assumed for the high investment system. However, a slight advantage is assumed for preserving more of the nutrients in the animal excrement. Whereas it was assumed that only about one half of the major nutrients were preserved in the confined housing situation, it is estimated that about three fourths are saved in the liquid manure system. For the no building situation only one fourth was assumed to be saved. (These assumptions resulted in calculated per head manure values of $5.67, $3.78 and $1.89 for the three systems.) There is no known research to support or refute these assumptions.

Table 3.9 shows the returns to cattle feeding that were determined for the three housing situations when $40,000 of short term credit and $30,000 of real estate credit were available to the cash crop farm. Although the total labor returns were about twice as high for the typical investment situation as for the high cost one, the latter could be handled by one man whereas the 500 unit operation would require two men. (Labor bought on a $2.90 hourly rate basis would cost only $2,850 but since this represents about one half a man, the amount must be doubled to cover a full time worker's salary.) Thus, if part time labor is not available, there is not much difference in returns per man between the two programs under the assumed planning situation. However, with more capital the two man operation could be expanded to give higher returns whereas a very large amount of capital would be needed to expand the high investment facility into a two man operation.

TABLE 3.9.--RETURNS FROM CATTLE FEEDING UNDER DIFFERENT HOUSING SITUATIONS

Item	No Housing Earthen Lot	Housing Partial Concrete	Confinement Slotted Floor
Number fed	922	909	390
Extra man required	1	1	0
Returns to all labor:			
Total	$13,751	$17,023	$7,946
Per feedlot unit	24.86	34.04	36.96
Per head fed	14.91	18.72	20.37

Another point of interest relative to the slotted floor housing is that it gives higher labor returns per steer even when the building is first purchased and without subtracting out labor costs. After the building investment is paid off, returns over cash costs for the high investment housing would be increased by about $10.00 per head given the bedding and manure values outlined above. Thus, the critical variables affecting the decision on slotted floor housing are bedding costs, labor restrictions, long term credit availability and the relative value placed on liquid manure. Also, of course, the larger the investment per unit of capacity, the more important it is to utilize the facility to capacity.

The variables important to the relative economic position of the low cost facility are about the same, with the added one of feed conversion efficiency. For the comparison shown in Table 3.9, it was assumed that some bedding was used in the winter months, but there was a savings in bedding costs of $4.25 per steer over the typical program. Note that if savings were about $4.00 more the no housing situation would become the highest return program. But, if savings in bedding costs are less than $8.00 per calf fed, feed conversion must be relatively better than assumed in this comparison before the low cost feedlot becomes competitive in situations where ample real estate credit is available.

One possibility for low cost housing is suggested by the results of an experiment conducted at Michigan State University in 1964-65 which showed no significant difference between feed requirements for yearlings fed in facilities which provided only 10 percent coverage of an earthen lot (the feeding area) as opposed to 40 percent coverage of a concrete lot. Average daily gain was significantly depressed (2.57 vs. 2.68) during the feeding period which did not include the summer months. If this relative performance could be expected on year around feeding programs which have investments in facilities limited to the comparative level used in this study, this would be a highly desirable system for expanded cattle feeding on corn belt farms.

There is little doubt that the no housing arrangement is already the least cost production system on some farms which are well suited with respect to drainage and sun and wind protection.

The question is, what are the minimum investments required for competitive performance in those situations where these natural advantages are not present. This question needs investigation.

In summary, present information suggests that the medium investment facility--the typical one at present--is the most desirable on most Northern corn belt farms. In selecting the design of this system it may be more economical to select one designed to feed cattle in confinement rather than one which has outdoor feeding plus shelter. The liquid manure system might be economically justifiable on family operated farms where there is a desire to feed a fair number of cattle (200-500head) but where both bedding and labor are scarce commodities. This system will grow in popularity as both of these commodities become scarcer on corn belt farms. However, since investment capital will remain a limited commodity, before many large scale feedlots (over 1000 head) will develop in this area it may be necessary to develop new feedlot designs which will greatly reduce capital requirements from the traditional level. Some reduction will result from a shift from the upright silo-auger feeding combination so popular in the corn belt to the large horizontal silo and fenceline feeding which is the standard method in commercial feedlots. Additional reductions should be discovered through research and experience with different shelter-lot designs.

SUMMARY OF DIFFERENT FEEDING PROGRAMS

The many variables that were considered in this chapter are the major ones that the feedlot manager has control over. He can decide what type of ration to feed, what class and grade of cattle to feed, and what kind of housing and feed storage investments to make. Investment decisions are made infrequently by any one operator. However, decisions on the number and kind of feed, what to feed, and when to buy and sell must be made over and over again. Before a corn belt feeder can profitably expand his feedlot operation much beyond the sideline supplementary size he should become better than average in these management tasks. And when the expansion is made the type of buildings and facilities selected should be based on a very careful study of investment alternatives.

Relative to ration selection, it was found over a wide range of planning situations on Michigan farms, the high silage ration will give <u>the highest return per head</u> fed as well as <u>the highest return per acre</u>. Consequently, the high silage rations should be used if only one lot of cattle is to be fed each year or if credit and acreage are both limited. However, if cattle feeding is profitable enough to cover variable costs in any one year, and credit is available, cattle numbers should be expanded to the limit of feedlot facilities rather than feeding only one lot of cattle per year. And, when this is done it pays to use a ration which furnishes the animals 1 percent or more of their body weight in concentrates every day.

The 1 percent concentrate ration that was included in this study appears to be a good "compromise" ration which combines some of the advantages of the all silage ration with some of those of the high concentrate rations. A precise ration can't be recommended for each situation since small changes in conditions could result in a change in preferability of rations. However, it can be recommended that with current corn prices ($1.10 - $1.30 farm level) the concentrate level should be increased when operating at capacity and could be decreased below 1 percent if only a single lot of cattle is purchased each year.

The relative desirability of the different rations changes somewhat in moving from Michigan west to Minnesota. The most important factor influencing the changes is the decrease of 12¢ in the corn price. Although cattle prices also change so that overall earnings from feeding are about the same, the high concentrate rations become relatively more profitable. Therefore, the all silage program is a very poor competitor in most planning situations in Minnesota.

Some breakeven purchase prices were determined between classes and grades of cattle. Feedlot managers should think in these terms when buying feeder cattle. Expectations on price differentials between future time periods and between slaughter grades should also be considered. Such price relationships will be the prime determinator of the relative profitability among these programs in any one year. However, it was generally found that calf feeding fits better in situations where (1) only one lot of cattle is fed, (2) high roughage rations are fed and (3) transportation costs on cattle are relatively high.

Yearlings can be expected to give higher feedlot returns in periods when cattle feeding is more profitable than average and the lot is kept operating at capacity. That is, if corn prices are low or price margins relatively favorable, a rapid turnover of high concentrate fed yearlings will give the largest total feedlot returns. Also, yearlings become more desirable as feedlot site is moved closer to feeder cattle source.

It is probable that lower priced feeders will continue to return higher profits to those who are able to "upgrade" them in the feedlot and sell them for their true value until many more feeders are able and willing to do the same.

There is a major unfilled need for information on the economies of different feedlot facilities. How facilities affect bedding needs, labor needs, manure handling costs, and manure value must be determined as well as effects on the rate of gain and feed conversion. Due to the lack of very complete research data on these questions, few definite recommendations can be made on the question of beef housing. The one rather obvious conclusion reached was that the lower the MVP of real estate credit the more one can afford to spend on housing in exchange for savings in feed, labor, bedding or other substitutes of economic importance. It was also determined that slotted floors may be justified in cases where bedding costs are high, labor expensive and/or liquid manure has a high value.

Horizontal silos appear to have a definite advantage over upright silos in large feedlot operations. Along with horizontal silos--although not necessarily tied to them--go fenceline bunks in preference to auger feeders. Finally, it is not always desirable to provide storage for all the corn needed for a whole year. Rather than using limited credit reserves to build more silos so that total yearly corn needs can be filled at harvest time, it may be more profitable to expand the feedlot instead.

For cattle feeders in the Northern corn belt who get only "average" results in feedlot performance or who expect price margins such that total production costs, acquisition basis, will not be covered, the following changes in the aforementioned conclusions apply:

1) no expansion in beef feedlot facilities need be considered,

2) rations should not be higher in concentrates than the 1 percent level,

3) a single fall purchase of lightweight cattle will maximize or nearly maximize returns to existing facilities,

4) upright silos are probably more appropriate for feeding smaller droves of cattle.

CHAPTER IV

COMPETITIVE POSITION OF CATTLE FEEDING RELATIVE TO EXPANDED CROP PRODUCTION ON NORTHERN CORN BELT FARMS

In comparing the many alternative feeding programs in the last chapter, the internal MVP of capital was sometimes held down in order to consider results when factors other than capital were the effectively limiting ones. If the planning horizon is expanded to include a land acquisition alternative, the MVP of capital can be expected to increase in most situations. The extent to which this alternative use of capital competes with cattle feeding in the Northern corn belt is the subject of this chapter.

One of the reasons suggested in Chapter I for the slower than average growth rate of cattle feeding in the Northern corn belt was that alternative use of resources might be more profitable. The two major enterprises that are in competition with cattle feeding for use of agricultural resources in the Northern corn belt are hogs and cash crop (corn and soybean) production. Results of the comprehensive North Central beef-hog-feed grain adjustment study indicated that beef feeding was often preferable to hog production on Northern corn belt farms whereas hogs were almost always preferred in the Central corn belt.[1/] More specifically, the studies in Michigan and Minnesota concluded that as farm size was increased

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[1/] Dale Colyer and George Irwin, op. cit.

beef feeding became relatively more desirable than hog production.[1/] Furthermore, when land could be bought or sold, most farms in these studies bought more land. An exception occurred in some Michigan situations where land was sold to obtain more capital to expand a very efficient cattle feeding operation. Thus, the results of the NC-54 study, as well as observations as to the kinds of enterprises that are selected by managers of the larger Northern corn belt farms, indicate that the major competitive enterprises on these farms are cash crops and cattle feeding.

Farmland is very heterogeneous in quality even in a small geographical area. This makes it difficult to describe or use as an example land with specific characteristics that will exactly fit very many existing acres. The characteristics of the cropland used for most of this study as described in Chapter II (cropland capable of growing continuous corn yielding 110 bushels per acre) are such that few farmers could go out and buy large contiguous tracts of it. On the other hand, with management varying from good to excellent this yield potential is attainable on a wide variety of soils from shallow sandy loams over clay subsoils through loams to clays.[2/] For soil and management combinations

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[1/] Curtis Lard, C. O. Nohre and H. R. Jensen, op. cit.

[2/] Fertilizer Recommendations for Michigan Vegetables and Field Crops, Michigan State University Extension Bulletin E-550, p. 4, November 1966.

that are significantly different from those assumed in this study, appropriate adjustments must be made from the findings presented here.

THE MICHIGAN SITUATION

First, it should be pointed out that the combination of yields, costs, and product prices assumed for Michigan (see Table 4.1) result in corn being a slightly higher income crop than soybeans or wheat. Corn is the only crop selected in the optimal organization of the 350 acre cash crop farm when no cattle are fed. However, substituting an acre of beans for an acre of corn would have cost only 20¢ when the reservation price on family labor was $1.50 per hour. When crop acreage is expanded or when a cattle feeding enterprise is added, some soybeans are almost always included--apparently to spread the labor load. Wheat acreage appeared less frequently even when the wheat straw produced was valued at $40.00 per acre instead of $30.00. (If a fair sized wheat allotment were assumed and participation in the Government wheat program were allowed, a fixed acreage would probably be included in most situations.)

At the standard average price of $1.20 on corn, which means the harvest price is $1.10, no wheat is grown but up to 127 acres of beans are produced, apparently to relieve the labor load in the 6th period. If the price of corn is decreased from the standard price, crops other than corn take over a larger share of the acreage.

TABLE 4.1.--PER ACRE RESOURCE REQUIREMTNS AND CROP YIELDS FOR PRODUCTIVE LAND IN SOUTHERN MICHIGAN AND MINNESOTA

Item	Unit	Growing Corn	Harvesting Corn Grain	Harvesting Corn Silage	Hay	Wheat	Soybeans	Custom Harvest Corn	Custom Harvest Silage
Yield, harvested	bu.or ton	-	112	22.2	5.0	50	35	-	-
Yield preserved for feeding	" "	-	110	20	4.5	-	-	110	20
Fertilizer needs[1/]									
N	lb.	130	-	50	-	50	40	-	50
P_2O_5	lb.	60	-	-	60	75	40	-	-
K_2O	lb.	60	-	-	60	75	25	-	-
Cash Costs	$								
Fertilizer[2/]		18.80	-	4.00	8.40	14.50	8.05	-	4.00
Seed		5.00	-	-	.75	3.60	4.00	-	-
Herbicide		5.00	-	-	.25	.45	5.00	-	-
Insecticide		2.40	-	-	1.45	-	-	-	-
Fuel & repairs[3/]		2.45	2.45	5.35	5.35	2.35	2.80	.75	1.05
Custom hire[4/]		-	-	2.00	-	13.00	-	8.00	20.00
Taxes, R. E.[5/]		7.15	-	-	7.15	7.15	7.15	-	-
Basic machinery Replacement[6/]		10.00	-	-	10.00	10.00	10.00	-	-
Drainage system		5.00	-	-	5.00	5.00	5.00	-	-

[1/] Fertilizer needs are based on recommendations for fine textured soils with medium soil tests.

[2/] Prices used per pound are: N = 8¢, P_2O_5 = 9¢, K_2O = 5¢.

(continued)

TABLE 4.1.--(continued)

3/Based on 6 row machinery as reported by Van Arsdall, Illinois-USDA Report AE-4112.

4/Custom hire for wheat is for baling 1.5 tons of straw and swathing.

5/Taxes are assumed to be 1.3 percent of the value of land.

6/Annual expenditure needed to maintain a basic machinery complement with a depreciated value of $50-$60 per acre.

7/Annual expenditure for keeping tiles and ditches operating effectively.

Situations conducive to buying or selling land

With corn and beef at the standard prices a series of different land prices were considered to determine the prices at which land of the above specified quality would compete with a top feedlot operation in Michigan. The land that could be bought had cropland of the same quality as that already operated. Cropland constituted 90 percent of the acreage available for purchase so $500 land is equivalent to $556 per acre of cropland. At this price and a 15 percent downpayment, the optimum solution on the 350 acre cash crop farm shows a slight preference for using limited real estate capital for buying land rather than feedlot facilities. The $30,000 real estate credit was utilized to buy 219 acres of land and a 298 standard unit capacity feedlot which was used to feed 542 head of calves on the full feed ration. (When land is priced too high to be bought, the MVP of capital is lower and 20 percent of the 800 cattle fed are fed the 1 percent ration.) The land added 197 cropland acres to increase the total to 547 which was used to produce 256 acres of corn for grain, 232 acres of soybeans and 59 acres of corn silage. The soybeans were raised even though it was necessary to buy 2,482 bushels of corn because of the relatively high cost of purchased labor for the one operator cash crop situation.

When the downpayment requirement on the contract for deed land purchase was dropped from 15 to 10 percent, relatively more of the available real estate credit was used to buy land. With the lower downpayment, 400 acres were purchased at a price of $550 ($611 per crop acre) along with a feedlot not much smaller than in the previous situation. When the beef farm (a two man operation with a 500 unit feedlot) situation was considered, more land would be bought at a higher price since labor was available to enable the farm to produce more of the corn needed for its cattle enterprise.

The above examples illustrate the difficulty of pinpointing a land price that would make investment in land more attractive than investment in feedlots _even if perfect knowledge of future conditions is assumed_. The range in which land _bought on contract for deed_ begins to get priced out of the competition under the conditions assumed in this study--which included an annual appreciation in land values of 2 percent--is \$500 to \$600 (\$550 to \$650 per acre of cropland). The midpoint of this range is where expanded cropping and expanded cattle feeding give equal returns to real estate capital as indicated by their respective MVP's when the two alternatives are considered separately for _the cash crop farm_. If the beef farm situation is considered, or if an assumption of economies of size in crop machinery costs is included, the upper end of this range is more appropriate. Conversely, if the assumption of an annual increase of 2 percent in land values is removed, the lower end is more appropriate for the top cattle feeder who has not yet expanded cattle feeding facilities to utilize his corn production. Changed assumptions relative to crop and livestock efficiency levels or price relationships would also change the boundaries of this price range.

For example, as corn prices move up, the land of course becomes worth more relative to feedlots if beef prices do not also increase. If the corn price is increased by 10¢, more than $600 will readily be paid per acre of cropland and, if cattle are fed, they get less corn grain in the ration. If beef prices are decreased, the same changes occur since the MVP of real estate capital devoted to feedlots drops relative to that devoted to land in both cases. But, as indicated above, there is no sudden shift from one investment alternative to the other as price relationships change. Rather, since corn production and cattle feeding are in part complementary to one another, the MVPs of the two investment activities are brought back to equality by an accompanying shift in the amount of capital devoted to each activity.

Competitive land prices were also determined for situations in which only average performance is achieved in the cattle feeding enterprise. The results from these are more indicative of the course of action that should be followed by the operator who is just average as a cattle feeder but perhaps above average as a crop producer. Average daily feedlot gains in this situation were assumed to be a quarter pound lower and corn and silage requirements 15 percent higher than for the high efficiency case. This decrease in performance results in an increase in the amount that would be paid for land relative to feedlot facilities. The alternative investments in this case would give approximately equal returns at about $700 per crop acre in contrast to the $600 determined for the high efficiency cattle feeding situation.

Several land disposal activities were checked under different situations. No land was rented out under the situations that were checked. Whether or not land was sold depended upon the terms of sale. Land was not sold on a contract for deed even if carcass beef prices were increased by $2.00 per hundredweight ($1.25 increase in live price) or corn prices were decreased. But, if land could be sold for cash, a limited number of acres would be sold already at the "breakeven" price of $600 per crop acre. This occurred because the land could be exchanged for a relatively larger investment in feedlot facilities since this investment was 25 percent self-financing. This points out that the method of financing greatly affects the relative profitability of buying as well as selling land. If land can be sold for cash, the efficient feeder who is short of credit may sell some land so as to be able to finance feedlot expansion. On the other hand, if the sale is allowed only on some partial downpayment basis the cattle feeder would prefer to keep the land. Conversely, when looking at land acquisition alternatives, if limited capital must be used to buy land on a conventional mortgage basis it may not be a competitive alternative to the efficient cattle feeder. On the other hand, the efficient feeder who can buy land for a small downpayment will find it profitable to expand both in land and feedlot resources.

Situations conducive to renting land

Land rentals involve the use of large quantities of short term credit in contrast to the relatively greater demands on real estate credit required by land purchase. If a manager is relatively short of one type of capital or credit he will prefer acquiring land in such a manner as to require little of that type. Since the general programming model used in this study was structured so as to keep the two types of credit separate, the above preference could be demonstrated. But if both types of acquisition and disposition of property are considered at the same time in a situation where there is a wide divergence in the MVPs of the two types of capital, the profit maximizing program may select both a land acquisition and disposition activity at the same time in an attempt to equalize the two MVPs. For example, if land is allowed to be sold for cash at the same time that a rent-in activity is available, both activities may be selected thereby generating additional capital for feedlot expansion while maintaining crop acreage.

If the two types of capital are earning about equal returns, the equivalent cash rent can be estimated in the usual manner of calculating a rate of return on investment in the land and then adding on the landlord's cash costs. (Annual appreciation of land should also be considered. In this study the landowner is assumed to obtain a capital appreciation income of 2 percent per year.)

The higher the balanced level of the MVP of capital, the higher will be the equivalent cash rent since the purchase activity uses up about $60 per acre more of the combined credit restraints. Thus, if the MVP of the last dollar of credit is 10 cents, approximately $6.00 is added to the relative value of the rental alternative. Given this situation and a land price of $500, an interest charge of 5.5 percent and a landlord net cost of \$2.00 (\$12.00 cost less an appreciation of \$10.00) gives an equivalent rent of \$35.50 (\$6.00 + \$27.50 + \$2.00). By contrast, if the MVP of capital is about 4 percent rather than 10 percent, a cash rent of \$35.50 per acre would be equivalent to a \$550 land price rather than \$500.

THE MINNESOTA SITUATION

Crop alternatives in Southern Minnesota are essentially the same as those in Southern Michigan except that wheat is rarely produced. Oats is still produced on many farms but since it is not competitive on land capable of growing continuous row crops, no small grain activity was considered in the Minnesota situation. Corn and soybean yields and production costs were estimated to be the same as those for Michigan. However, value of production is less in Minnesota due to lower crop prices. Corn was assigned an average annual price of \$1.08 in contrast to the \$1.20 used for the Michigan situation. The soybean price was set at \$2.60 per bushel.

With the assumed yields, costs and prices, corn and soybeans were about equally profitable in Minnesota--with corn holding only a slight edge. When no cattle were fed, the cash crop farm situation produced 191 acres of corn and 159 acres of beans. When cattle are added to the initial crop farm situation, enough corn silage is produced to fill requirements of the high concentrate ration and the remaining acreage is evenly divided between corn grain and soybeans. However, in the resource situation depicted by the cattle feeding farm (2 men and buildings and silos for 500 head) no soybeans were produced. This was apparently due to the larger initial labor supply which permitted higher peak labor loads since the reservation price on labor was \$1.40 per hour in contrast to the \$2.70 that had to be paid to attract more labor to Minnesota farms.

The capitalized value of land in Minnesota should be somewhat lower than in Michigan due to the lower value of crop production resulting from lower prices. However, this fact says nothing about the relative desirability of investing in feedlot facilities instead of land in Minnesota. The answer to this question again hinges on the relative profitability of these two investments in Minnesota. And, since cattle feeding <u>per se</u> turned out to be about equally profitable in the two states, comparable quality land must be bought for about \$150 less in Minnesota. That is, the cash crop farm situation is indifferent to expanding crop acreage as opposed to investing in feedlot facilities at a \$450 price per acre of cropland. Again, the two man cattle feeding farm would be inclined to pay more (about \$50 per acre) for additional acreage to better balance land with labor and feedlot facilities. And with surplus operating credit available, the beef farm continued to buy land even after the price was increased by another \$200 per acre. (See Table 4.2.) Also, other changes in price or production relationships would affect this "breakeven" land price as discussed in the previous section.

TABLE 4.2.--THE INFLUENCE OF AN INCREASE IN LAND PRICE ON ACREAGE PURCHASED VS. FEEDLOT FACILITIES PURCHASED BY THE MINNESOTA BEEF FARM[1/]

Land Price	Acres Purchased	Units of Feedlot Facilities Purchased
$450	271	276
500	234	291
550	203	303
600	166	314
650	112	336

[1/] Initial resources were 350 crop acres, 4500 hours of labor, a 500 head feedlot, $80,000 of operating credit and $30,000 of real estate credit.

SUMMARY OF COMPETITIVE INVESTMENT OPPORTUNITIES ON NORTHERN CORN BELT FARMS

The "breakeven" land prices determined for the one family cash crop farm in Michigan and Minnesota are surprisingly close to the current land prices in these states. However, overall results of the various land purchase activities considered in this study suggest that land prices will continue to move upward. This conclusion stems from the following findings: (1) that one family can operate more than 350 crop acres, (2) at present land prices, the land purchase alternative is a more attractive investment than feedlot expansion for the cattle feeder getting only average performance in cattle feeding, (3) as efficient cattle feeders expand to two or three man operations they will be willing to pay above current prices to expand land acreage. (See Table 4.2.)

Thus, it appears that a strong demand for land will come from most above average crop producers whether or not they feed cattle. The exception will be the farmer who is doing very well with a small cattle feeding operation and wishes to expand this first to fully utilize his home produced feed. Also, the operator who wishes to limit the total farm labor load to what he and his family can handle may favor feedlot expansion over land expansion. This one family operation should be able to handle a 300 to 500 head feedlot along with 300 to 400 crop acres.

Considering that variations do exist among farm operators in both crop and livestock production efficiencies, additional specialization can be expected to develop in cattle feeding and crop production. As those who are more proficient in crop production continue to bid the price of land up, proficient cattle feeders may find it to their advantage to buy a higher proportion of their feed rather than to compete for the land. To the extent that the efficient expansion-minded cattle feeder does expand in crop production it is more apt to be via renting rather than buying. (or by contracting feed production from neighboring crop farmers.)

At this time there appears to be little difference between Michigan and Minnesota in the relative profitability of investment in land vs. investment in feedlots. If any does exist it favors land purchase in Minnesota slightly more than in Michigan.[1/]

[1/]There are no precise land price series that quote current land prices in such a way that they can be compared with the "break-even" prices determined in this study. Consequently, the above judgment is based on land price estimates made by Extension Specialists, agents and farmers in the two states.

Given that the urban influence on land values will continue to be much greater in Michigan, land prices can be expected to continue to move up more rapidly in Michigan. Given this relative change in land prices and the previously mentioned pressures toward specialization, one might expect that relatively more cattle feeders in Michigan will expand via the intensification route than in Minnesota.

In conclusion, under the price assumptions of this study, investment in cattle feeding facilities can be competitive with investment in additional cropland for the efficient cattle feeder. However, the efficient crop production man who is only an "average" cattle feeder is willing to pay more than current land prices and can be expected to bid land prices up. If land goes up in price relatively faster than the cost of feedlot facilities, specialized feedlots can be expected to develop. This development is more likely to occur in Michigan than in Minnesota where feedlot facilities and farm acreages will tend to grow together on cattle feeding farms since land prices are expected to remain closer to the value of the land for agricultural use.

CHAPTER V

COMPETITIVE POSITION OF THE NORTHERN CORN BELT RELATIVE TO THE SOUTHERN PLAINS IN CATTLE FEEDING

One major objective of this study was to compare the potential profitability of cattle feeding in the Northern corn belt with the profitability of feeding in the area of recent rapid growth. During the last decade the rapid growth area has been in the Southwestern states--Texas, Oklahoma, Kansas, Nebraska, and Colorado. Marketings of fed cattle have more than doubled in these states since 1956, with Nebraska showing the largest absolute increase of 1.6 million head. Texas also had an increase in excess of one million head to show the largest percentage gain from a very small base. Kansas and Colorado each had increases of about 700,000 head. By contrast, Minnesota increased marketings by 224,000 head while Michigan and Wisconsin together had an increase of only 116,000 head between 1956 and 1966. The accompanying map shows the number of fed cattle marketed in all major feeding states in 1966 and the changes in marketings since 1956. Note that Iowa increased marketings by 1.5 million head to retain its first place position.

For purposes of a detailed comparison of cattle feeding profitability with the Northern corn belt, the Platte River Valley of Colorado was selected for study. This area located in Northeastern Colorado accounts for about 75 percent of the cattle

FIGURE 1. FED CATTLE MARKETINGS IN MAJOR FEEDING STATES IN 1966 AND INCREASE SINCE 1956
(1,000 HEAD)

feeding in Colorado and is similar to the North Platte River Valley in Southwestern Nebraska.[1/] A study of cattle feeding in this area for the period 1953-1959 attributed the strong growth of the industry during that period to the following changes in the area: (1) growth of the sugar beet industry, (2) expansion of irrigation, (3) development of corn hybrids suitable to grain production and (4) expanded feed grain production in adjacent dry-land areas.[2/] The last three of these four trends continued into the 1960's and cattle feeding has continued to expand in Eastern Colorado.

It was suggested in Chapter I that factors causing differential growth rates in cattle feeding among areas might be grouped into five categories. To reiterate, these were:

1) Economies associated with location
2) Economies associated with specialization
3) Economies associated with different management practices
4) Differences in available alternative opportunities
5) Differences in institutional constraints.

[1/] Albert G. Madsen, et. al., Colorado Cattle Feeding Industry, Popular Bulletin 528S, Agricultural Experiment Station, Colorado State University, Fort Collins, April 1967.

[2/] Elmer C. Hunter, Changes in the Cattle Feeding Industry Along the North and South Platte River, 1953-1959, ERS-98, U.S.D.A. March 1963, p. 8.

Factors associated with each of the above groups will be identified and examined in this chapter to determine the extent to which they might be expected to give rise to differential growth rates among areas in the future.

LOCATIONAL FACTORS AFFECTING THE COMPETITIVE POSITION OF THE NORTHERN CORN BELT

Economies associated with location might be considered to be the most important long run determinants of industry location since, by definition, these are economies which cannot be affected by managers. On the other hand, if these factors can't be altered, feedlot managers might consider them to be of least importance since they are more interested in data relevant to decisions they can make which will improve their individual competitive position. However, data on locational advantages provide information relevant to decisions regarding feedlot expansion. Such information also establishes some of the constraints within which the feedlot manager must operate. Consequently, this section will identify and quantify the economic importance of those factors which are related to the geographic location of the cattle feeding areas under comparison. Later sections will deal with other factors which appear to have differed in the past between the areas--factors related to scale, management and attitudes--but which need not be different in the future.

Factors affecting cattle feeding profits can be separated into three categories--feed costs, nonfeed costs, and cattle prices.

These components were used in Table 1.2, Chapter I to facilitate specification of the advantages and the disadvantages that were hypothesized to exist for cattle feeding in the Northern corn belt. The hypotheses put forward in Chapter I relative to the causal factor of location will now be examined under each of the three components which determine profits in cattle feeding. The combined effect of all factors will then be determined by comparing the added returns from feeding and the propensity for feedlot expansion under several planning situations in each state.

Feed costs

It was expected that the Northern corn belt would have an advantage over the southern plains in feed prices. This turned out to be only partially true. Moving across the corn belt from its northwest corner, where Minnesota and the Dakotas meet, to the northeast around Detroit, Michigan--grain prices move from the lowest in the nation to a moderately high level. Corn prices in Minnesota are lower than in Colorado by 10 cents to 15 cents a bushel. But corn prices in Southern Michigan are essentially the same as in Northeastern Colorado. Also, Colorado and the Plains states from Nebraska through Texas have ready access to grain sorghum at prices which have been 85 to 90 percent that of corn. Therefore, a ration containing half milo and half corn (milo is commonly substituted for one half of the corn without materially affecting feed conversion) is actually cheaper in that area than is corn in Michigan. Yearly average prices for corn equivalent that were projected for use in this study were: Michigan - $1.20;

Colorado - $1.15; Minnesota - $1.08. The Colorado price is the average of corn at $1.22 per bushel and sorghum at $1.92 per hundredweight (88 percent of corn price).

Grain prices vary among counties in any one state and also relationships among states may change in the future. For these reasons, results of changing assumptions relative to grain prices are considered later.

Climate was suggested as being a factor that would adversely affect gains in the corn belt. This proposition was based on two facts--the higher rainfall and the colder winters in the North. It is generally agreed that if heavy rainfall (or excessive snow thaw) results in muddy lots this will cause depressed gains and feed conversion. However, since this problem can be overcome by investing in concrete or confinement housing it need not directly affect feedlot gains. The other factor--colder weather--was not established to be a definite disadvantage when weighed against the hotter summers in the Southern plains area. Animal scientists have established the fact that additional feed is required when temperatures go above or below a range centering around 35° to 70° F. The extent to which different areas of the country are affected by this temperature factor awaits additional research.

The third locational factor that was suggested as possibly affecting feed requirement differences was the greater shrink taken on feeder cattle shipped to the Northern corn belt. This factor is related as much to buying arrangements as it is to location. But, given the same buying conditions at a point in the feeder cattle surplus area, tissue shrink on feeders shipped a longer distance would be expected to be somewhat greater. This difference though is so small and variable that it was not considered to significantly affect total feed needs.

Thus, after considering several possible reasons for differences, it was assumed that feed requirements and feedlot performance should be about equal under conditions of top management in both areas. The effects of relaxing this assumption on equal management are determined in a later section.

With equal feed conversion, variations in feed costs among the three feeding areas considered (Northeastern Colorado, Southern Michigan, and Southern Minnesota) varies proportionately with feed prices. Using harvest time prices on silage (excludes storage costs), and average yearly prices on grain, estimated feed costs for calves fed the high concentrate ration are $15.00 per hundredweight in Minnesota; $16.06 in Colorado, and $16.33 in Michigan. For calves fed the 1 percent ration, Michigan feed costs would be slightly lower than Colorado ($14.84 vs. $15.02). Silage is relatively more expensive in Colorado ($7.00 vs. $6.50 for harvest delivered silage) because corn must compete with higher return crops. (For the farm feeder in Colorado who does not use any sorghum grain in the ration, feed costs would also be higher on the full feed ration.)

<u>Nonfeed costs</u>

It was expected that climatic differences between the Northern corn belt and the Southern plains would cause higher expenditures for bedding as well as for housing and concrete. It was found that this one single item--bedding--may account for the largest deterrent to feedlot expansion that the Northern corn belt has relative to the Southern plains. Small cattle feeders in the corn belt who utilize straw or corn cobs from their own farms usually don't consider this input to be very costly. However, as small grain acreages continue to decline and corn harvest shifts over to field shelling, these traditional sources of bedding are disappearing. Even now, corn belt livestock producers are paying from $10 to $25 per ton for bedding. Assuming a cost of $15 per ton and a bedding requirement of 3.33 pounds per day, the direct bedding cost for calves ranges from $1.42 per hundredweight of beef produced with an all silage ration to $1.06 for the high concentrate ration. In addition, to acquire, handle, and dispose of this bulky item requires a significant amount of extra labor--about one hour per head for calves.

Cattle feeding in the Platte Valley is done in open feedlots with fenceline feedbunks which usually have a concrete apron along the feedbunk. Total feedlot investment per unit of capacity in Colorado was estimated to be equal to the low investment housing system shown in Table 3.8 of Chapter III ($24). This is less than half the $56 per unit determined for the Northern corn belt where housing is used. Assuming a 20 year depreciation, a six percent interest rate and a three percent annual cost for repairs, taxes and insurance, the difference in annual ownership costs would be $3.52 per unit. If each unit of capacity produces 1000 pounds of beef, the lower cost one has an advantage of 35 cents per hundredweight. If only one calf is fed per unit (600 pounds of gain) the advantage is 59 cents per hundredweight. And, if a shorter depreciation period is allowed the cost difference is even greater.

Horizontal silos are used almost exclusively for storage of silage in the Southwest. These silos are usually pit silos with no concrete or with a concrete floor only. Such construction is feasible even on level land in that area because of the lower annual rainfall. Consequently, silage storage costs are slightly less than in the Northern corn belt where pit silos are not as feasible. A saving of $1.00 per ton construction costs because of the reduced concrete use ($3 per ton vs. $4 per ton) amounts to 10 cents per ton in annual costs or in 20 cents per calf fed the high concentrate ration when horizontal silos are used in both locations. The fact that upright silos are much more frequent in the North means that present storage costs are considerably higher in the Northern states.

Equipment costs were also found to be somewhat lower in the Southwest. Without upright silos for grain storage, no silo unloader--an investment of $4.00 per unit of capacity in the North--is necessary. This represents a savings in annual cost of about $.80 per unit.

It was expected that wage rates would be lower in the Southwest than in the Northern corn belt. They were found to be lower than Michigan but no difference was found to exist between Colorado and Minnesota. Based on wages paid to workers in nondurable industries in the three states in 1965, farm wage rates were set at $2.70 per hour in Minnesota and Colorado and at $2.90 in Michigan. (Also, a slight difference was assumed in the reservation price for farm labor; $1.40 per hour in Minnesota and Colorado in contrast to the $1.50 used in Michigan. That is, in the programming model, labor would not be employed in either crop or livestock production unless it earned this minimum.)

Although wage rates were not found to differ much among the three states, it was found that labor requirements in cattle feeding do differ. As pointed out earlier, this difference stems primarily from the fact that bedding is not needed in the Southwest. Also, less overhead time is necessary to move snow, mud, and manure. Savings in direct labor were estimated to be about 1.1 hours for calves and .7 for yearlings.[1/] Thus, even with no difference in wage rates, the labor cost of feeding a calf is significantly higher in the Northern corn belt unless the confinement slotted floor system is used.

Interest costs on feeder cattle and death losses are both slightly higher in the Northern corn belt due to the higher

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[1/] These estimates are based on unpublished survey data collected in Michigan by C. R. Hoglund in 1962 and on labor data collected in Colorado by E. Hunter in 1964.

laid-in price of the original feeder. These two items amount to 46 cents per calf fed when comparing Colorado to Michigan when similar interest rates and death losses are assumed. The difference between Colorado and Minnesota is slightly less due to the lower cost of the laid-in feeder animal in Minnesota relative to Michigan.

The Northern states do enjoy advantages over Colorado in some nonfeed cost items. The major advantage held by Michigan and Minnesota in nonfeed costs was gained just recently when both states abolished personal property taxes on livestock and machinery. The Colorado personal property tax per calf is about $1.50. Another added cost incurred by Colorado feeders is a charge for their water ($1.30 per calf). And finally, since a value is placed on the nutrients in manure, the absence of straw decreases the manure credit in Colorado by 16 cents per calf.

Adding up the economic advantages and disadvantages in nonfeed costs incurred in the Northern corn belt area results in a total disadvantage of about $12.00 per calf or $2.00 per hundredweight when only one calf is fed per year (See Table 5.1.) Since the difference in the annual cost of the building is the same regardless of how intense the facility is used, the total difference between the two areas would be somewhat less if the feedlot is used to capacity. (Within the Northern corn belt area, Minnesota is estimated to have slightly lower costs than Michigan due to lower wages and the lower initial cost of the feeder animal which leads to slightly lower costs for death loss and interest.)

TABLE 5.1.--ESTIMATED LOCATIONAL ADVANTAGES AND DISADVANTAGES THAT MICHIGAN HAS RELATIVE TO COLORADO IN NONFEED COSTS

Item	Cost Difference - Michigan Relative to Colorado[1/] One Calf Per Year	Two Yearlings Per Year
Advantages		
Tax on feeder	$ 1.44	$ 2.00
Water charge	1.30	1.36
Manure value	.16	.14
Total Advantages	2.90	3.50
Disadvantages		
Bedding	6.38	9.60
Labor	3.73	4.43
Feedlot and equipment[2/]	3.94	3.94
Silo	.22	.24
Other[3/]	.83	1.06
Total Disadvantages	15.10	19.27
NET DISADVANTAGES	12.20	15.77
Disadvantage per cwt. produced:		
Above listed costs	2.03	1.97
Above costs plus feeder transportation	2.93	4.10

1/ All cash costs are itemized in the Appendix.

2/ Annaul use cost of 11 percent on buildings and 17 percent for machinery in Michigan; one percentage point more was charged on machinery in Colorado to cover personal property taxes.

3/ Includes differences in costs of materials handling, death loss and interest on feeder and operating expenses.

Cattle prices

Prices received for fed cattle are higher in Michigan than in Colorado. Minnesota, however, has no advantage over Colorado in this respect. Cattle prices determined for each of the states were based on the price projections shown in Chapter II. ($44.50 for choice carcass beef and $42.50 for good grade carcasses at Chicago.) Carcass beef prices in Northeast Colorado and Southern Minnesota were set at $1.00 below the Chicago market while the Michigan price was set 30 cents over Chicago.[1/] It was assumed that if cattle were sold at desirable weights and finish that 75 percent would grade choice in the carcass. Therefore, the "blend" carcass price determined for Michigan was $44.30 in contrast to $43.00 for the other two states. This gives an advantage to Michigan of $8.33 per carcass from calves fed the high concentrate ration. The advantage would be greater on the heavier carcasses from yearlings but less on the lighter carcasses from the calves fed the higher silage rations.

Feeder cattle prices are lowest in the Southern states. Since feeder cattle originate from many sources and are so variable in quality it is difficult to specify exact laid-in feeder prices for each state unless a common market price quotation source is assumed. Therefore, the Kansas City market was assumed to provide the common quotation on which cattle purchases were

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[1/] The Minnesota price would vary from more than $1.00 below Chicago in Western Minnesota to less than the $1.00 difference in Eastern Minnesota. However, within state location differences such as this are largely offset by compensating differences in feeder prices.

based. Transportation and commission charges were then added to arrive at laid-in purchase prices of comparable cattle in each state. The charges added and the total base prices established for each state are shown in Table 5.2.

TABLE 5.2.--FEEDER CATTLE PRICES AND COSTS PER HEAD DELIVERED TO FEEDLOTS IN THREE STATES

Item	Unit	Michigan	Minnesota	Colorado
Calf (430#, Gd.-Ch.)				
Base price	cwt.	$ 30.50	$ 30.50	$ 30.50
Commission	cwt.	.50	.50	.50
Transportation	cwt.	1.50	1.00	.25
Delivered price	cwt.	32.50	32.00	31.25
Cost	head	139.75	137.60	134.38
Yearling (680#, Gd.)				
Base price	cwt.	26.00	26.00	26.00
Delivered price	cwt.	28.00	27.50	26.75
Cost	head	190.40	187.00	181.90

In total, under the prices determined for this study, the Michigan producer has a net price advantage over Colorado of about $3.00 per head on calves. For yearlings, however, the advantage of the higher finished market is completely wiped out by the larger acquisition cost on the feeder. (These price relationships suggest that economic incentives exist for buying lighter feeders and for carrying cattle to heavier market weights in areas that have high fat cattle prices but are not close to feeder cattle surplus areas.) Relative to the Northwestern part of the corn belt (Western Minnesota), Colorado has an absolute advantage of about $3.00 per calf due to lower cost feeders,

Comparative returns to cattle feeding

Table 5.3 shows a summary of the cost and return differences that were determined in the previous sections. This summary indicates that with the assumptions and price projections of this study, the Platte Valley of Colorado does hold a competitive advantage over the Northern corn belt area based on factors associated with location. The advantage over both Michigan and Minnesota amounts to about $1.50 per hundredweight when one unit of feedlot capacity is being utilized to feed one calf a high concentrate ration and hired labor is being paid competitive wages.

TABLE 5.3.--SUMMARY OF LOCATIONAL ADVANTAGES AND DISADVANTAGES HELD BY THE NORTHERN CORN BELT OVER THE SOUTHWEST

Item	Difference in Costs Per Hundredweight Relative to Colorado[1/]	
	Michigan	Minnesota
Feed costs	$ 0	$ 1.00
Nonfeed costs	-2.00	-2.00
Cattle prices	.50	-.50
TOTAL	-1.50	-1.50

[1/]Rounded results from calculations based on a calf fed the high concentrate ration.

It should be noted at this point that the complete location disadvantage of the corn belt is represented in the bedding and extra labor costs. Consequently, on farms where these two items are readily available and have little alternative use value the locational disadvantage is virtually eliminated. It is also reduced or eliminated if some of the other resources (old buildings, excess hay, etc.) that are used in small farm feeding operations are priced at low alternative use values. But, it appears that locational diseconomies would be encountered if nothern feedlots located in bedding deficient areas expand to the point of paying market prices for all resources.

In order to gain additional insight into the nature and extent of the location connected differences on the profitability of cattle feeding, the added returns from feeding in each of the states were determined by linear programming and compared for several resource situations. The situations considered were a large cash crop farm when (1) no added labor was available and (2) when labor was plentiful but capital was short. Table 5.4 shows the initial resources for the cash crop farm in each state along with the profit maximizing organizations that were determined by the computer. The added returns from cattle feeding were determined by subtracting out the returns that were obtained from the most profitable cash crop organization.

TABLE 5.4.--OPTIMAL ORGANIZATIONS AND RETURNS FROM CATTLE FEEDING ENTERPRISES ADDED TO CASH CROP FARMS IN MICHIGAN, MINNESOTA, AND COLORADO

Item	Unit	MICHIGAN	MINNESOTA	COLORADO
Initial Organizations				
Corn	acre	350	191	27
Soybeans	acre	---	159	--
Pinto beans	acre	---	---	148
Sugar beets	acre	---	---	75
Unused resources:				
Savings	$	4,047	4,772	2,885
Short term credit	$	50,000	50,000	50,000
Real estate credit	$	30,000	30,000	30,000
Year around labor[1/]	hr.	34	1,117	183
Total unused labor[2/]	hr.	1,565	1,612	1,608
Return over direct costs	$	29,897	25,007	28,491

(continued)

TABLE 5.4.--OPTIMAL ORGANIZATIONS AND RETURNS FROM CATTLE FEEDING ENTERPRISES ADDED TO CASH CROP FARMS IN MICHIGAN, MINNESOTA, AND COLORADO--(continued)

Item	Unit	MICHIGAN Limited Labor	MICHIGAN Limited Capital	MINNESOTA Limited Labor	MINNESOTA Limited Capital	COLORADO Limited Labor	COLORADO Limited Capital
Revised Organizations[3/]							
Crop acreage:							
Corn silage	acre	79	83	57	84	78	21
Hay	acre	--	--	--	--	--	75
Corn grain	acre	248	267	156	266	97	--
Wheat	acre	23	--	--	--	--	--
Soybeans	acre	--	--	137	--	--	--
Pinto beans	acre	--	--	--	--	--	78
Sugar beets	acre	--	--	--	--	75	75
Beef production:							
Beef produced	cwt.	3,414	4,596	3,224	4,620	5,268	5,564
Calves fed	head	543	766	458	770	--	--
Yearlings fed	head	39	--	119	--	1,317	1,391
Investments:							
Capital invested in R.E.	$	40,017	46,876	38,490	47,077	24,054	22,497
Feedlot capacity	head	413	528	407	531	743	751
Horizontal silo capacity	ton	1,750	1,830	1,250	1,840	2,070	1,490
Upright silo capacity	ton	990	1,000	1,070	1,000	--	--
Added returns and ratios:							
Total added returns	$	8,434	13,397	10,287	15,410	19,216	20,696
Returns: cwt. of beef	$	2.47	2.91	3.19	3.34	3.65	3.72
Returns: per dollar invested in R. E.	$	.21	.29	.27	.33	.80	.92

(continued)

TABLE 5.4.--OPTIMAL ORGANIZATIONS AND RETURNS FROM CATTLE FEEDING ENTERPRISES ADDED TO CASH CROP FARMS IN MICHIGAN, MINNESOTA, AND COLORADO--(continued).

1/ Labor that is evenly distributed throughout the year and therefore available for regular off-farm employment at farm wage rates.

2/ Total of all available labor that was not used in crop production. This amount was left over from the original supply of 2500 hours on the corn belt farms and 4500 hours on the Colorado farms.

3/ The limited labor situation could use only the existing labor on the crop farms while the limited capital situation assumes that an extra man is available so that capital became the limiting factor. Real estate capital was the factor limiting expansion in the Northern states while operating capital limited expansion in Colorado.

The initial cash crop organization on each of these farms left unused about the same amount of labor--1600 hours. The Minnesota farm, however, was the only one which had a significant supply of labor available in all periods of the year. (The difference between the Northern states in this respect is due to the fact that harvest labor requirements were lower as well as better distributed on the Minnesota farm since 45 percent of the acreage was devoted to soybeans.) This initial advantage in labor availability held by the Minnesota farm accounted for part of its somewhat higher cattle feeding returns relative to the Michigan farm. The keener competition for labor on the Michigan farm showed up in the higher marginal value of labor determined for this farm in the labor limited situation. ($22 per hour in 6th period vs. $19 per hour for the Minnesota 3rd period.) When additional labor was made available the differences between Michigan and Minnesota in returns per hundredweight of beef produced was narrowed.

Labor requirements for crop production under ditch irrigation are considerably higher than for dryland farming.[1/] Consequently, an additional man--either a family member or a hired man--was found on the large irrigated farms of the Platte Valley in Northeastern Colorado. Despite this difference in the initial labor

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[1/] Elmer C. Hunter, Crop Enterprise Costs on Irrigated Lands For South Platte Valley, Colorado, Fort Collins, Colorado, March 1967.

supply, the same amount of labor was left over on the Colorado farm as on the Michigan farm when no cattle were fed. However, since labor requirements for cattle feeding are lower in Colorado, more beef can be produced with the same amount of labor. Also, by shifting completely out of pinto bean production in the limited labor situation, more labor was made available for feeding. This greater flexibility in labor use plus the lower cost of feedlot facilities allowed the Colorado farm to expand feeding up to the limit of its short term credit already with its original labor supply. Thus, very few additional cattle were financed even when extra labor was made available. Rather, changes were made in the cropping program with the shift to hay as the major forage since this program required less short term capital--fewer operating expenses for crop production and lower per head cash outlay for protein supplement--and consequently allowed more cattle to be fed.

Yearlings were selected for feeding in Colorado because, as pointed out in Chapter III, when profits are good yearlings tend to bring in greater returns than calves, However, when yearlings were blocked out of the limited capital solution, added returns dropped by only $1025 as 878 calves were fed in a 606 unit capacity feedlot. Returns per hundredweight produced and per dollar invested remained essentially the same as those received on yearlings. Thus, the labor returns per calf were $21.38 in Colorado compared with $20.00 in Minnesota and $17.50 in Michigan. (This includes a manure credit of $3.62 in Colorado and $3.78 in the Northern states.)

This spread of only 65 cents per hundredweight of gain among the states was below that budgeted because (1) the Colorado farm had to sacrifice more income by changing its cropping program, and (2) labor had a much lower cost than budgeted since most of the labor used in the feeding enterprise was slack time labor.

Although the returns per hundredweight of beef produced were not much higher for the Colorado farm situations than for the corn belt farm situations, the returns per dollar of real estate capital invested were considerably higher. Also, total added returns are much higher since more cattle were handled with equal labor and/or with equal capital investment. With such high returns possible from investments in feedlots, and with the surplus off-season labor on irrigated farms, the incentives for going into cattle feeding appear to be extremely high in the Platte Valley and in other irrigated areas of the Southwest where conditions are similar. (If the tops from sugar beets are salvaged for feeding to yearlings, returns climb even higher.)

In order to compare potential returns between areas when all resources must be paid current market prices to bring them into production, the results from the situations which had nothing to start with except access to capital can be compared. In this planning situation it was assumed that the individuals in control of the available capital would make up to $200,000 available for investing in feedlots if they felt they could get better than 10 percent expectation they have from alternative opportunities.

Since this capital venture would probably be in a fairly large feedlot--if at all--input-output data were developed to reflect costs and returns that could be expected in a feedlot of 2000 head or more. The details of the differences in costs due to increased size of operation will be discussed in a later section. But some of the results of these programs will be used at this point to assess the differences in potential profits between areas from large scale commercial lots which purchase all resources.

Table 5.5 shows the nature, extent, and profitability of the feedlot businesses that were developed in Michigan and Colorado under two planning situations: (1) land was available only for the feedlot, and (2) additional land of up to 1000 acres (900 acres of cropland) was available for purchase on a contract for deed.

The full locational difference in returns to cattle feeding _per se_ can be seen in the results from the feedlots which were not permitted to buy cropland. (There was an option to buy corn silage in the field for $1.25 per ton less than when it was delivered to the feedlot.) A comparison of returns for the no land situations shows that the Colorado lot realized a profit of $2.86 per hundredweight of gain on yearlings in contrast to only 75 cents received per hundredweight of gain on calves fed in Michigan. (Minnesota, with the same organization as Michigan showed a profit of $1.15 per hundredweight.) Thus, the difference in profits between the two areas was twice as great for large scale lots than for the small farm feedlots compared in Table 5.4

TABLE 5.5.--COMPARATIVE RETURNS FROM LARGE SCALE CATTLE FEEDING ENTERPRISES WHICH PURCHASE ALL RESOURCES[1/]

Item	Unit	MICHIGAN Cropland Available	MICHIGAN Cropland Not Available	COLORADO Cropland Available	COLORADO Cropland Not Available
Resources Acquired					
Cropland	acre	900	--	484	--
Labor, full time	hrs.	10,088	14,359	15,172	10,388
Feedlot capacity	head	2,055	4,012	6,964	6,956
Investment in land and feedlots[2/]	$	706,000	266,666	460,452	218,938
Sources of Silage					
Bought delivered	ton	0	8,868	0	14,186
Bought in field	acre	0	234	277	125
Raised	acre	323	--	484	--
Beef Produced					
Calves fed	head	2,978	5,813	--	--
Yearlings fed	head	--	--	12,896	12,881
Beef produced	cwt.	17,868	34,878	51,584	51,524
Net Returns and Ratios					
Total net return	$	41,665	26,157	166,206	147,126
Per cwt. produced	$	2.33	.75	3.22	2.86
Invested[2/]	$	.06	.10	.36	.67

[1/]Long term capital of $200,000 is available if returns of better than 10 percent can be obtained. One half million dollars of short term credit is available at 6.5 percent interest. (The short term credit became the limiting factor in the Colorado, no cropland situation.) When cropland is available (900 acres) it can be used only for producing crops used for feed.

[2/]Investment in real estate exceeds $200,000 because feedlot facilities are 25 percent self-financing and land is 85 percent self-financing. Consequently, returns on the original capital are considerably higher than shown--especially in cases where land is bought. Returns to original dollars can be determined by dividing total returns by $200,000.

For feedlot costs to be reduced by $2.00 per hundredweight so that investments in feedlots without farmland in the Northern corn belt might look competitive with the Southwest does not appear too likely. Following is a list of items which would obtain a decrease of $1.00 per hundredweight in the return differential between the two areas.

1) The grain price differential be changed by 11 cents--from a plus 5 cents in Michigan to a minus 6 cents.

2) The elimination of bedding costs in Michigan without significantly increasing other costs.

3) An increase in the fed cattle price differential between the two states of 94 cents per hundredweight of carcass beef.

4) A decrease in the feeder price differential of $1.40 per hundredweight.

The following changes could save 50 cents per hundredweight for the Northern feeder:

5) Cutting feedlot investment costs in half.

6) Reducing labor costs by 40 percent.

The most likely opportunities for reducing the locational disadvantage appear to be in items 2, 5, and 6 above. These items are subject to the control of management. They present a real challenge to the cattle industry of the Northern corn belt--especially to the combined efforts of agricultural engineers and farm managers of the area.

When cropland is purchased along with the feedlot the margin of difference in profit per hundredweight does not appear quite so insurmountable. But this is somewhat misleading.

The return of $2.33 per hundredweight for the Michigan feedlot is inflated by the imputation of crop returns from 900 acres into relatively few cattle. Not only is corn silage priced at production cost but also 577 acres of corn grain that is picked by custom operators. (The Minnesota farm showed a return of $1.79 per hundredweight after buying 511 acres of cropland to produce the silage needed for 4715 calves.) With higher corn production costs in Colorado some corn silage was still purchased (as standing corn) and the reduction realized in feed costs was less than in the Northern states when land was made available.

The locational disadvantage of Michigan for a large scale feedlot appears even more obvious when the computed returns to all real estate capital for each state are compared. When returns to the original $200,000 are computed, Michigan showed returns of 13 and 21 percent; Minnesota 19 to 25 percent and Colorado 83 to 90 percent. ($36,000 of the available $200,000 was not used in one Colorado situation since the short term credit allowance became limiting.) Therefore, from the standpoint of returns to investor capital, the Northern corn belt is in a relatively weak competitive position. Investment capital for large scale feedlots probably will not be attracted to this area unless major changes in technology and/or prices materially shift present cost and return relationships.

In summary, budgeted cost and return differences indicate a disadvantage to the Northern corn belt of $1.50 per hundredweight of beef produced in a calf feeding program; this difference grows to about $2.00 when all resources are purchased and the Southern lot is allowed to feed yearlings; the difference drops to about $1.00 per hundredweight when farm feedlot situations are compared but sugar beet tops are not fed. These results suggest that large scale commercial feedlots in the Northern corn belt would not be competitive with the Southwest but that existing farm feedlots should prove competitive under good management. That is, cattle feeding farms which already have the facilities and labor required for feeding cattle can be competitive with the Southern feeders in the bidding for feeder cattle. This proposition is examined in the next section.

Comparative propensity for feedlot expansion or abandonment

It appears that a difference in the profitability of cattle feeding does exist, favoring the Southern plains area over the Northern corn belt. However, to examine the question of future expansion or future abandonment closely, the propensity to expand feedlot facilities or to contract feeding operations was considered under more adverse conditions.

The profit comparisons made in the previous section should be considered to be the potential under top management. If there are, in fact, many operators who are getting average returns that are this favorable over a period of years, excessive feedlot expansion will tend to bid up the price of feeder cattle over the level which was projected and used in this study. At any rate, price margins will be considerably lower in some years and will be expected to average lower by many planners. Consequently, the relative effects of lower price margins or lower planning price margins should be examined. The influence of progressively higher feeder cattle prices on feedlot activity by farm type by state is shown in Table 5.6.

The farm organizations developed under different cattle price assumptions reveal some interesting facets about the Northern corn belt's competitive position in cattle feeding. First, the results suggest that under most probable cattle price expectations expansion will be much slower by Northern corn belt farm feeders than by Colorado farm feeders. Second, the results suggest that investments in large scale lots independent of a land base are unlikely to occur in the Northern corn belt. Concerning the ability of existing feedlots to compete, the results indicate that top level farm feeders in the corn belt can withstand as much or more of a price squeeze than can their competitors farther south before leaving a feedlot stand empty because of failure to cover variable cash costs. The Michigan beef feeding farm was the only one that could cover all operating costs when calves moved upt to $38.50 at Kansas City. When feeder prices were at $36.50, the Northern beef feeding farmers were getting a higher return to existing buildings and labor than was the Colorado feedlot. (In contrast to having the 500 head capacity feedlots stand empty, the Michigan beef farm added $2806, the Minnesota farm added $3115, while the Colorado one added only $1582.)

TABLE 5.6.--COMPARATIVE FEEDLOT ACTIVITY UNDER PROGRESSIVELY HIGHER FEEDER CATTLE PRICES BY FARM TYPE BY STATE

Planning Situation	Kansas City Base Feeder Calf Price	Michigan	Minnesota	Colorado
		Number of cattle fed		
Limited Labor Crop Farm	$30.50	569	537	1,317[1]
	32.50	417	455	891
	34.50	156	325	875
	36.50	1.05[2]	2.38[2]	.55[2]
Beef Feeding Farm-500 head capacity	$30.50	1,380	1,397	2,425[1]
	32.50	1,128	1,167	1,614
	34.50	667[3]	725[3]	1,614
	36.50	354	574	506
	38.50	213[4]	.02[2]	1.45[2]
No Physical Resources	$30.50	2,978	4,715	12,896[1]
	32.50	1,702[5]	1,508[5]	8,061
Old Lot - 2500 Head capacity	$30.50	6,709	7,588	13,474[1]
	32.50	3,333[3]	3,623[3]	8,454
	34.50	1,702[5]	1,702[5]	3,623[3]

[1] Yearlings, all other figures are calves.

[2] Reduction in earnings if one calf is fed.

[3] The existing lot is used to capacity. The one percent ration is fed in Michigan, the high concentrate ration in Minnesota and Colorado.

[4] A total of $271 is added over not feeding.

[5] Cattle feeding is expanded only to the limit of the feed that was raised on 900 acres. The one percent ration is selected.

The above observations confirm the suggestion made in the last section that pressures for expanding feedlot capacity will continue to be very strong in areas which enjoy the locational advantages found in the Platte River Valley--low cost feedlot facilities, low cost feeders and limited rainfall. This description fits all of the central and southern high plains areas of Eastern Colorado, Western Kansas and Nebraska, and Northwest Texas. In fact, these other areas are somewhat closer to surplus feed and feeder cattle than is the Platte River Valley. Perhaps one reason that they were slower to develop was lack of irrigation for local production of bulky forages. If so, the rapid current expansion of well irrigation in these areas can be expected to stimulate the expansion of cattle feeding in the Southern plains states at a rate much faster than that in the Northern corn belt. (The Platte River Valley itself may not keep pace with the growth rates in the new irrigation areas. This is because traditional land use patterns on old irrigated land must shift in order to produce more forage for cattle. But, a fairly rapid change should not be ruled out since labor shortages, insect problems and high machine costs may result in a substantial shift out of sugar beet production.)

Cattle feeding in the future may be less dependent upon the use of bulky forages such as silage or hay in the ration. Already many feedlots in Texas and Arizona use cottonseed hulls to provide the bulk in the ration. Seashells are also used. Feedlots using these rations can expand rapidly without waiting for expansion in irrigation. Consequently, although irrigation has been a contributing factor in past feedlot growth trends, it is not necessary in the future.

SIZE FACTORS AFFECTING THE COMPETITIVE POSITION OF THE NORTHERN CORN BELT

The growth in cattle feeding in recent years has been closely associated with the growth in feedlots with over 1000 head capacity. The data in Table 5.7 indicates the importance of this shift during the period from January 1, 1963 to January 1, 1967. The larger lots accounted for 80 percent of the growth in cattle feeding in these 16 states. In terms of national growth, these 1520 feedlots accounted for 58 percent of the total 32 state increase.

TABLE 5.7.--NUMBER OF LOTS AND CATTLE ON FEED FOR TWO SIZE CATEGORIES, JANUARY 1, 1963 AND 1967 FOR 16 STATES[1/]

Item	Lot Capacity			
	Under 1000 Head		Over 1000 Head	
	No. of lots	No. on feed	No. of lots	No. on feed
		(1000)		(1000)
1963	59,510	1,730	1,304	3,042
1967	52,830	1,951	1,520	3,951
Change, No.	-6,680	221	216	909
Change, %	-11	+13	+17	+30

1/ Source: U.S.D.A. Cattle on Feed Reports. States included are the 11 Western states and all the Plains states except North Dakota.

Since virtually all large scale feedlots have developed in the Western states, the question arises as to the extent to which larger size *per se* adds to the competitive position of that area. A related question is--would large scale feedlots in the Northern corn belt be better able to compete with the Southwest than can the medium sized farm feeders? The answers to these questions were already suggested in the data shown in Table 5.6 of the previous section. Before analyzing those results a more detailed examination will be made of cost and return differences that are related to scale. The factors related to size will be grouped in the same categories as those that were related to location--according to whether they influence feed costs, nonfeed costs, or cattle prices.

Feed costs

It was suggested in Chapter I that greater bargaining power might give large scale producers an advantage in feed prices. This hypothesis is rejected. It is possible that buyers for a firm of very large scale may gain some advantages by developing some special contacts or by actually integrating into other segments of the feed handling industry. (For example, one large feedlot in Colorado owns grain elevators and leases railway cars.) However, there is little reason to believe that a 5000 head feedlot can purchase feed any cheaper than a 500 head lot. In fact, one might argue that if home produced feed is any cheaper, the "blend" price of purchased and raised feed will increase as the mix becomes more predominantly purchased. Also, the smaller feeder has more opportunity to buy directly from neighbors thereby holding transportation costs to a minimum.

As for feed conversion, there are reasons to expect that higher efficiencies exist in the larger operations. First, it should be recognized that large feedlots are in a better position to adopt new cost reducing technologies that require relatively large initial outlays of capital. One such new technology being adopted by large scale feedlots is the "thin" flaking of grain. (Grain is rolled into very thin flakes after being steam processed.) Research work and feedlot experience suggests that feed conversion can be improved by 5 to 15 percent with proper flaking of corn and milo. Since the installation of flaking equipment is relatively more costly per unit of beef produced for a small feedlot, this feed conversion advantage might be considered as partially related to size of operation. Also, since milo appears to be improved more than corn by this process, this advantage is partially associated with location.[1/] But it is also related to management since it is a technology available to any operator. And, since it is a new technology not yet in general use by southwest feedlots, discussion of its effects will be considered in the section on management.

[1/] Experimental work reported by California, Colorado and Arizona indicates a feed conversion improvement of 10 percent or more for milo compared to 5 percent for corn.

Even before the discovery of the effects of "thin" flaking, some larger lots were getting improved feed conversions due to regular flaking. Also, most operators of large lots can exercise better control over cattle ration formulations because feed mill complexes facilitate such control better than do the simple grinding centers found on most farm feedlots.

Finally, feed conversions may be better in larger lots because of better selection for this trait when feeder cattle are purchased. Large scale feedlots can amass a tremendous amount of data on feeder cattle performance under their specific programs. As these data are accumulated and correlated with such known variables as original cattle producers, (ranch brands), area of origin, breed type, and previous history of cattle, cattle buyers can be given very specific requests as to what to buy or how much to pay for specific variations from the desired type of feeder. No doubt this backlog of experience is what influenced larger feedlots to shy away from the "typey" beef feeders of uniform markings in favor of crossbred beef of nondescript coloring that gave equal or better feedlot performance and could be bought for considerably less.

Although there probably exists a real difference in feed conversions between large scale and farm feedlots, these are going to be assumed to be due primarily to factors under the control of the feedlot manager and will be discussed in a later section. The assumption at this point will be that no differences in feed costs are related to size _per se_. This assumption is supported by a recent study in Nebraska which found no significant differences in feed costs for similar type feeding programs in operations from 50 to 2000 head.[1/]

Nonfeed costs

Beside the improved bargaining power position of the large lots in buying supplies and investment goods it was expected that labor costs and costs associated with building and equipment ownership would decrease with increases in size of operation. The bargaining power question cannot be answered because of lack of data, but sufficient information on labor and feedlot facility costs is available to allow reliable estimates of differences in these nonfeed costs.

Labor requirements per head decline with increased feedlot size. Building and equipment costs also decline. These facts have been established by numerous studies. The labor and investment requirements per head as determined by some of these studies are shown in Table 5.8 along with the requirements used in this study.

The indicated Michigan and Kansas labor requirements as determined by field surveys illustrate size economies that exist between 100 and 500 head lots. (They also illustrate the difference in labor requirements between the Northern corn belt and the Colorado area. No doubt this difference is primarily due to

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[1/] Ralph Johnson, Unpublished research results in Nebraska.

TABLE 5.8.--LABOR AND INVESTMENT REQUIREMENTS AS ESTIMATED BY VARIOUS STUDIES ON ECONOMIES TO SIZE

Study	Feedlot Capacity 0	100	200	400	800	1,600	3,200	6,400	12,800
	Labor hours per head fed								
Michigan 1/		5.5	3.5	2.4					
Kansas 2/	3.1		1.4						
Colorado 3/			3.4	1.9		1.3	1.1		
Western 4/					1.2		1.0		
This study: 5/									
Northern corn belt				2.6		2.0			
Colorado				1.4		1.1			
	Investment per head capacity								
Michigan 6/		193	143	121					
South Dakota 7/		196	145	115	96	90			
Colorado 3/		192		80	50	42	33		26
Oklahoma 8/			75	74	60	52	49	31	29
Kansas 9/		74	58	49	46				
Michigan 1/		96	96	99					
This study:									
Northern corn belt				96-115*		73			
Colorado				57- 64*		41			

(continued)

TABLE 5.8.--LABOR AND INVESTMENT REQUIREMENTS AS ESTIMATED BY VARIOUS STUDIES ON ECONOMIES TO SIZE--(continued)

1/George W. Arnold, An Economic Comparison of Different Sizes of Beef Feeder Cattle Operations on Selected Michigan Farms, unpublished Masters Thesis, Michigan State University, 1963.

2/Dale A. Knight and C. F. Bortfeld, Labor and Power Requirements by Size of Enterprise for Beef Cattle Systems in Eastern Kansas, Agric. Exp. Sta. Kansas State College, Tech. Bull. No. 98, September 1958.

3/E. Hunter and J. Madden, Economies of Size for Specialized Beef Feedlots in Colorado, Ag. Econ. Report No. 91, May 1966.

4/Tarvin F. Webb, Improved Methods and Facilities for Commercial Feedlots, Mkg. Research Report No. 517, USDA, May 1962.

5/Labor requirements shown are for the high concentrate calf feeding program.

6/C. R. Hoglund, Investments and Annual Costs for Alternative Beef Cattle Feeding Systems, Michigan State University Research Report No. 7, April 1965.

7/Rex Helfinstine, Equipment Costs for Different Size Feedlots, F.S. 59, Cooperative Extension Service, South Dakota State College, Brookings, 1961.

8/Willard F. Williams and J. I. McDowell, Costs and Efficiency in Commercial Drylot Cattle Feeding, Processed Series p. 509, Oklahoma State University, 1965.

9/J. H. McCoy and H. D. Wakefield, Economies of Scale in Farm Cattle Feedlots of Kansas--An Analysis of Nonfeed Costs, Tech. Bull. 145, Agric. Exp. Sta., Kansas State University, January 1966.

*/Range shows investment with and without grain storage. All silage is in bunker silos in contrast to upright used in Michigan and South Dakota budgets. See Tables 3.7 and 3.8 for details of investment requirements used in this study.

differences in time required to handle bedding and to move snow.) The studies by Hunter (Colorado) and Webb (Western feedlots) indicate the additional savings in labor that can be expected when moving from farm feedlots of 500 head or less to larger scale lots.

The investment estimates made by Hoglund (Michigan) and Helfinstine (South Dakota) indicate the economies available when increasing the size of farm feedlots in northern states where housing and feed storage are both provided. The studies by Hunter (Colorado) and Williams (Oklahoma) indicate the economies available as feedlot size is increased in southern states. All four of these investment estimates by size were made using the synthetic approach. However, investments determined by McCoy of Kansas and by Arnold in Michigan were determined from actual farm surveys. The Michigan figures were based on values at the time of the survey whereas the Kansas figures represent original investment costs. Original costs were also obtained in that Michigan study and these gave rise to equal annual use costs for all three lot sizes from 112 to 435 head capacity. Thus, this study as well as the Kansas study suggest that, in practice, there is less difference in investment and annual use cost between farm feedlots of different size than is ordinarily determined by the synthetic firm approach. This is because equipment costs are held down by smaller firms by buying second-hand equipment--or keeping it much longer before replacing, and by having less specialized equipment. These factors, being difficult to estimate realistically, are usually ignored in the synthetic approach.

Consequently, almost every economies of size cost curve constructed with the synthetic approach will have an unrealistically sharp slope initially. However, once the size is reached which requires full commitment of all basic equipment, the synthesized results should portray differences due solely to scale more accurately than survey results. The differences determined by these studies as feedlot size grows beyond the 400 to 800 head size groups is consistent with the estimates made for this study.

A third major component of the costs that are grouped under nonfeed costs are the cash operating expenses. There is not only lack of information as to differences due to scale in the bargaining position over prices of these inputs, there is also a paucity of data on the relative quantities of these inputs that are required per unit of output as size increases. Following is a brief discussion of the probable effects of size on the major items of cash cost.

Bedding, a major cost factor in the Northern area, cannot be expected to decline in cost as size is increased. More likely this item would become costlier as expansion required a greater and greater supply of this high transportation cost item.

Veterinary and medical expenses can vary greatly among feedlots and from one year to the next. However, there is no real evidence that these expenses should vary according to size of operation. Hopkin[1/] reported a drop from .85 cents to .41 cents

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[1/]John A. Hopkin and Robert C. Kramer, Cattle Feeding in California, Economic Research Department, Bank of America, February 1965.

per head fed per day between the less than 4000 head group and the 4000 to 10,000 head group. However, almost invariably smaller feedlots tend to feed more calves which incur larger veterinary expenses than yearlings. (The next sized group showed a 50 percent increase back to .64 cents per head.) Williams[1/] assumed that veterinary costs would be $1.50 per head for 700 head or less in contrast to $1.00 for lots of 5000 head or more. (This assumption accounted for 27 percent of his estimated variable cash cost decline per head between the 600 head lot and the 5000 head lot.) McCoy[2/] got a very small "a" value ($25) in the regression equation on veterninary costs by size of operation in Kansas. The regression coefficient was 71.4 cents for each head fed. Hunter[3/] found similar costs in Colorado and used a flat 72 cents per head for all sized lots in his study. This study also assumes no change in veterinary costs from the original 75 cents for yearlings and $1.50 for calves when considering larger scale operations.

[1/] Willard F. Williams and J. I. McDowell, Costs and Efficiency in Commercial Dry-Lot Cattle Feeding, Processed Series, Oklahoma State University, 1965.

[2/] J. H. McCoy and H. D. Wakefield, Economies of Scale in Farm Cattle Feedlots of Kansas--An Analysis of Nonfeed Costs, Technical Bulletin 145, January 1966.

[3/] Elmer C. Hunter and J. Patrick Madden, Economies of Size For Specialized Beef Feedlots in Colorado, Agricultural Economic Report No. 91, May 1966.

Death loss is another factor that can vary considerably but can hardly be claimed to be related to size *per se*. Hunter's survey data obtained in 1962-63 showed that average death losses decreased from .91 percent in lots with about 500 head. However, he points out that--"the inclusion of calves in the data creates an upward bias on the percentage of death loss", and goes on to use a flat .6 percent death loss for all size lots. Other studies agree that this item should remain the same for larger lots.

Fuel and electricity costs would be expected to vary more with ration fed and type of feeding than with scale when fence-line bunks are used. These items, in fact, varied only slightly with size in both the Colorado and the Kansas surveys. Electricity costs were essentially constant in the Colorado study and found to increase slightly with size in the Kansas farm feedlots due to heavier reliance on electrically powered equipment. For fuel costs the estimating equation derived in the Kansas study was $100 plus .82x and in Hunter's study it was $225 plus .95x. (With x being the number of cattle fed in both cases.) Considering that the Kansas study dealt with a range of feedlot size less than 10 percent of that involved in the Colorado survey (1000 head vs. over 10,000) the two studies indicate very little differences in fuel costs between the farm feedlot and the large scale feedlot. Also, the correlation coefficient given for the

Kansas equation was only .4[1]--lower than for any of the other equations.

Repair costs can be expected to decline slightly with increased size to the extent that size reduces investment in feedlot facilities. However, equipment repair costs will vary closely with intensity of use. Therefore the assumption in this study is that repairs on the feedlot, and feed storage structures are reduced in proportion to their per head investment costs--this amounts to about 60 cents per head for calves.

Interest costs in cattle feeding are probably the largest single cash cost item for most producers. A survey of Colorado feedlots made in 1964 showed that two thirds of the feeders with lot capacities between 1000 and 5000 head borrowed over half their operating capital.[2] Twelve percent of all respondents reported that they borrowed fully 100 percent of their capital. Thus, it is not unusual for a feeder to be paying interest on operating capital for cattle and feed of over $200 per head for up to a 12 month period. This gives rise to a larger cost item than does labor at $3.00 an hour. Consequently, a small difference in interest rate charged on capital could make a bigger difference than all of the previously discussed variables. The Colorado survey indicated that larger feeders tended to pay lower interest rates. Only 4 percent of the feedlots under 500 head

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1/ McCoy, op. cit., p. 25.

2/ Albert G. Madsen, op. cit., p. 38.

capacity paid less than 6 percent on money borrowed in 1964 in contrast to 89 percent of the over 5000 capacity group. The total range reported in interest rates paid was from 4.5 to 8 percent. This allows room for a full $1.00 per hundredweight difference in nonfeed costs.

Again the question must be raised as to the true case of these observed relationships. Is this truly an example of a pecuniary advantage of size or are both size and interest rate paid related to one or more other causal factors. For example, one might argue that this relationship might be due to a weaker financial position among small feeders. However, if one considers the percent of operating funds borrowed to be indicative of financial strength there would be no basis of support for this proposition. In fact, the distribution of this factor by size group was found to be skewed in the opposite direction--large feeders tended to borrow a larger proportion of their total operating cash needs. Although there are other measures such as net worth and past performance in cattle feeding that the lender appraises in establishing a risk rating on individuals, there apparently is sufficient economic incentive for lenders to do business with the larger accounts that premium interest rates are given to a higher proportion of the large operators. Consequently, this advantage must be considered to be related to size although specification of its magnitude may be difficult.

Other miscellaneous cash costs such as telephone and insurance on cattle are quite minor and were assumed to remain the same on a per head basis with the different sized lots in this study. Buying and selling costs will be considered in the section on cattle prices.

A summary of all of the nonfeed costs that were estimated for this study are shown in Table 5.9. With no change in interest rate or in other cash cost items except repairs, total savings per calf fed are $5.10 in Michigan and $3.56 in Colorado when moving from a 500 head feedlot to a 2000 head feedlot. For each one half of one percent difference in interest rate granted to large scale operators they gain an additional advantage of about 70 cents per head or 12 cents per hundredweight of gain.

Cattle prices

Larger operators probably pay less for feeder cattle because they tend to purchase lower grade feeders. Hopkin indicated that Okies and Mexican cattle often provided California feeders with more favorable margins than did English breeds.[1/] However, this is a buying practice that can be followed by any operator.

A second possible advantage to scale is that more frequent purchasing of cattle--as well as the large volume demanded--may contribute to better buys through commission buyers than is obtained by irregular customers. On the other hand, the smaller feeder can do more of his own buying locally, thereby saving on purchase costs. This factor showed up in the Kansas survey where

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[1/] John Hopkin, op. cit., p. 23.

TABLE 5.9.--DIFFERENCES IN NONFEED COSTS BETWEEN A 500 HEAD CAPACITY LOT AND A 2000 HEAD CAPACITY LOT IN MICHIGAN AND COLORADO

Item	Costs per Calf Fed High Concentrate Ration			
	MICHIGAN		COLORADO	
	Lot Capacity		Lot Capacity	
	500	2000	500	2000
Labor[1/]	$ 7.40	$ 5.92	$ 3.67	$ 2.92
Feedlot[2/]	6.16	6.16	2.64	2.86
Equipment[3/]	5.10	1.70	4.68	1.80
Silo[4/]	.83	.61	.61	.46
Cash costs[5/]	18.04	18.04	13.66	13.66
Total per head	37.53	32.43	25.26	21.70
Decrease due to scale		5.10		3.56
Total per cwt/gain	6.26	5.41	4.21	3.62
Decrease due to scale		.85		.59

[1/]Based on labor cost of $2.90 in Michigan and $2.70 in Colorado. (If salvage value labor prices are used the labor cost is about one half as much.) Labor requirements are reduced by 20 percent in the large scale operations.

[2/]Annual use cost of 11 percent for depreciation, interest, repairs, taxes, and insurance on feedlot investments of $56 and $56 in Michigan and $24 and $26 in Colorado. The large scale lot investment includes a complete 15 ton feedmill.

[3/]Annual use cost of 17 percent in Michigan and 18 percent in Colorado for depreciation, interest, taxes, and insurance on investment in machinery and equipment of $30 and $10 for Michigan and $26 and $10 for Colorado. However, small feedlots include silage making equipment which is not included in large lots.

[4/]Base on investments in horizontal silos per ton of $4 and $3 in Michigan, $3 and $2.25 in Colorado. The small farm in Michigan would normally have some upright silo storage but this is not included above since the average yearly price was used on feed cost calculations in a previous section.

[5/]Excludes interest on feed and cash costs, and marketing and buying costs on cattle. All other nonfeed costs as itemized in the Appendix are included.

the 115 head feedlots reported only 44 cents buying costs per head compared with the $1.21 for the 450 head lots and $1.34 for the 925 capacity lots.[1/] On the basis of these findings, no quantitative advantage was assigned to larger lots in the matter of feeder prices in this study.

The net selling price obtained for finished cattle is also subject to some degree of bargaining under given market conditions. Here again there is evidence that lower selling costs are incurred by the large scale operator. The Kansas study showed a savings of 22 cents per head for the 925 unit lot over the 115 head lot. Some savings in marketing costs stem from the higher propensity of larger lots to sell direct. The Colorado survey of 1964 revealed that operators of feedlots over 5000 head capacity sold 72 percent of their cattle direct to packers in contrast to 45 percent sold in this manner by lots of 500 to 1000 head capacity. This correlation was explained as follows:

> "Packers are in need of a relatively constant supply of uniform quality cattle for slaughter. The large feeders are able to meet this demand since they sell slaughter stock regularly. They usually have a large enough selection of cattle in their feedlots so that they can sell uniform lots on a regular basis. Sellers and buyers become relatively well acquainted and thus they are able to compliment each other's needs.
>
> It is more difficult for the small feedlots to establish such a working relationship with any given packer. They may only sell cattle once or twice during the year and usually only a small number of head at one time. It

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[1/] McCoy, op. cit., p. 36.

> is frequently to their advantage to sell on an organized market where small packers as well as large packers purchase livestock, or through a commission firm that has contact with several packers on a regular basis".[1]

A related factor discovered in the above quoted study is that large feedlot operators sold 63 percent of their own cattle while the operators of the smallest size handled only 15 percent of their own sales. These comparisons simply indicate that the larger firms tend to take on this additional management function whereas the smaller ones find it more advantageous to have this job "custom hired". Since this study does not include any added cost for the large firm to pay the salary of a marketing specialist, marketing costs are assumed to remain unchanged as size increases.

If individual managers can net more by selling their own cattle (or having one of their employees do the selling) than by utilizing the services of some organized market place they can do this no matter what the size of operation. Michigan cattle feeders marketed about 18 percent of their fed cattle direct to packers in 1966 in contrast to 10 percent ten years ago.[2] (Marketings through terminals also increased--from 45 to 56 percent--while auctions declined from 37 to 18 percent.) Michigan cattle feeders who marketed over 700 head sold 28 percent of their supply direct to packers, dealers and local lockers which was only slightly above the direct sales of the other size categories.

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[1] Albert G. Madsen, <u>et</u> <u>al</u>., <u>op</u>. <u>cit</u>., p. 31.

[2] David Cole, <u>op</u>. <u>cit</u>.

Transportation costs are a function of nearness to markets, size of load sold, and who pays the bill. The Colorado study found a slight indication of bargaining power in that transportation costs to market were paid for by the buyer on 9.6 percent of the cattle sold from lots over 5000 in contrast to 2.5 percent for lots of less than 500 capacity. This is not a great difference. If large scale lots are directly integrated with a packing plant, transportation costs of course will be less. Both in buying and selling, cattle movements which require less than a full semi-load usually will be more costly to the feeder. However, this requirement is met satisfactorily by the 500 head feedlot.

In summary, although advantages do exist for larger feedlots in buying and selling cattle the differences are probably not significantly related to size alone when starting from a 500 head capacity lot.

Comparative returns

Net return differences attributable to scale can now be estimated under different sets of assumptions for both the Northern corn belt and Colorado. The first set of conditions to consider are those developed in the preceding sections. With no changes in cattle prices or feed costs, total cost differences due to scale would be the differences in nonfeed costs that were shown in Table 5.9. However, since investments used for the large feedlot did not include silage equipment, some adjustment should be made in either the machinery item cost for large scale feedlots or in the feed cost comparison since purchased corn silage is more costly than that produced by the farmer feeder. Adjustment for this item would raise the cost per head 70 cents for the large scale operation. However, if an interest rate differential of one half of one percent is conceded to the larger operation, this 70 cents differential is regained. Moreover, if the large scale feedlot is expanded to a 5000 head capacity or more, additional savings would be effected. Consequently, the cost advantages due to scale that were shown in Table 5.9 should be considered to be the minimum expected.

But, the cost reductions budgeted for labor and feedlot facilities do not tell the whole story on differences in profitability between a farm feedlot and a commercial feedlot. What are the true costs of labor in the farm situation as compared to the commercial lot? What happens to the value of the manure as feedlot size increases way beyond the needs of any cropland acreage that might be directly associated with the feedlot?

In the programming model set up for this study, the value of the manure was removed as a direct credit against cattle costs in the large scale feedlots. However, if land were purchased, a $4 fertility credit was allowed for each acre devoted to corn silage. Thus, for the large scale Michigan feedlot that was shown in Table 5.5 in which 323 acres were devoted to corn silage, the manure credit amounted to 43 cents per calf fed. However, where no cropland was available no manure credit was earned.

It is quite significant that this assumption relative to the value of manure about completely wipes out all the economies of size obtained from reductions in labor and equipment costs. (The manure credit for the Northern farms was calculated to be $3.78 per calf and for Colorado $3.62.) The assumption of zero value manure does not always hold since there are some large feedlots who manage to sell manure for about $1.00 per steer fed. However, there are others who are simply stockpiling it or who actually pay to have it hauled away.

If the cost and return comparisons developed in this section are basically sound, they can only lead to the conclusion that the so-called economies of size in cattle feeding are more myth than reality. It was noted in the review of the literature on this topic that smooth downward sloping curves were often a function of how the study was made as much as a reconstruction of reality. But, as indicated earlier, attempts to capture reality via the survey approach can be even more difficult because of the problem of trying to sort variables. For example, the studies by Hopkin,[1/] and Moran[2/] did not take into account variations in intensity of use and/or type of cattle fed. It appears that if the data in the Hopkin study were adjusted for varying intensity of use among the size groups the large cost differences shown would be almost wiped out. (The turnover ratio varied from 1.08 to 1.70 indicating

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[1/] John Hopkin, _op_. _cit_.

[2/] Moran, _op_. _cit_.

that different types of feeding programs were being compared.) The study by Moran in Arizona also came up with some sharply sloping curves when relating nonfeed costs to size of lot as measured by tons of feed fed. However, this study did continue on to make a comparison among size groups with similar intensity of use factors. When this comparison was made it was discovered that labor and investment expense per ton of feed fed actually increased slightly with increased sizes of feedlot. (This comparison is still subject to some question because type of feeding programs varied among size groups.)

Studies which developed regression equations on specific cash cost items (King,[1/] Hunter,[2/] McCoy[3/]) on the basis of survey data probably could not avoid confounding the effects of intensity of use and type of ration fed with the effects of size since these variables are always found to exist in association with one another. Some economic reasons for this intercorrelation that are suggested by the results of this study are that the smaller lots are almost always farm feedlots where:

1) Labor demand for crop production preclude full utilization of feedlot facilities.

2) Since only one lot of cattle is fed per year,

   (a) calves will return more than yearlings and

[1/] Gordon A. King, Economies of Scale in Large Commercial Feedlots, Ginannini Foundation Research Report No. 251, California Agricultural Experiment Station, March 1962.

[2/] Hunter, op. cit.

[3/] McCoy, op. cit.

(b) high roughage fed calves will return more than high concentrate fed calves (See Table 3.4)
(c) heavier market weights will give higher returns over feed.

3) More severe credit rationing (internal or external) dictates that a high roughage ration be utilized to give higher per acre returns rather than higher returns per unit of capacity. (See Table 3.4.).

4) Lower returns over feed costs due to lower feed conversion efficiencies dictate

   (a) feeding calves rather than yearlings and
   (b) high roughage rather than high concentrate rations.

5) The higher roughage rations fed necessitate the feeding to heavier weights in order to obtain equal market prices.

When calves rather than yearlings are fed, both rate of turnover and daily gains decline, therefore increasing all costs related to ownership of buildings and equipment per unit of output whether measured in number of head or in pounds of beef produced. Perhaps the more subtle intercorrelation to guard against is the increase in cash costs associated with higher roughage rations. The coefficients developed for this study show a 20 percent increase in cash costs per calf associated with moving from the high concentrate ration to the all silage ration when bedding and labor costs are excluded. If labor is priced at $2.00 per hour the increase climbs to 33 percent since the increase in labor requirements per head alone was estimated to be 60 percent (4.08 hours vs. 2.55).

Consequently, it appears that the economies of size found to exist in the cattle feeding business might be more appropriately called <u>economies of specialization</u>. Most of the probable existing advantages held by the larger scale lots are due to different management practices which stem partially from improved knowledge about the business--whether hired or inherent in the manager--and partially from economic factors which dictate different practices. The effects of some of the different practices used by low cost operators will be considered in the next section of this chapter.

To conclude this section on the influence of size factors on the competitive position of the Northern corn belt the information that was shown in Table 5.6 will be analyzed. First it should be noted that the efficient farm feedlot will find it profitable to expand under more adverse price conditions than will the large scale feedlot. This is indicated by the fact that it is still profitable to add feedlot facilities to the limited labor crop farms when prices of feeder calves rise to $34.50, Kansas City base, whereas no new large scale feedlots are built at this price. (However, it should be noted that changed assumptions on interest rates and manure value would change this.) Secondly, existing farm feedlot beef feeding operations can still cover added variable costs when feeder prices rise to $36.50 whereas the large scale lots are closed down at this price. Thus, under the assumption of a limited manure credit and no advantage in interest rates for large scale lots, the small scale lots are more tolerant of adverse price conditions even when farm labor has a reservation price of $1.40 or $1.50 per hour.

For specific comparisons of the relative profitability of the small and large scale lots the financial ratios previously shown in Table 5.4 and 5.5 are reproduced in Table 5.10.

TABLE 5.10.--COMPARISONS OF SELECTED FINANCIAL RETURN RATIOS FOR SMALL AND LARGE FEEDLOTS, MICHIGAN AND COLORADO

	Michigan		Colorado	
	Lot Size		Lot Size	
Item	500	2000	500	2000
Returns per cwt of beef produced	$2.47 1/	$.75 2/	$3.65 1/	$2.86 2/
Returns per dollar invested in feedlot	.21	.10	.80	.67

1/ If manure credit is removed returns are reduced about 65 cents per hundredweight. If the operator's labor is charged, returns are reduced almost $1.00 per hundredweight.

2/ If an interest cost advantage of .5 percent is granted to large feedlots, returns increase by 70 cents.

From the measures of profitability compared in this study, it appears that the internal economies generated by the larger feedlots in the Southwest do not significantly add to the locational advantages which that area holds over the Northern corn belt. Rather, the results of this analysis suggest that the development of large scale feedlots in the Platte Valley of Colorado and adjacent states has been the result of the higher profits attainable there--not the cause of them.

MANAGEMENT FACTORS AFFECTING THE COMPETITIVE POSITION OF THE NORTHERN CORN BELT

When considering the effects of location and size related factors on production costs it was often observed that some differences which appeared to be associated with those two characteristics were, in reality, due to different management practices. There are far too many cost saving or income increasing techniques in the cattle feeding business to be reviewed in this section. Therefore, attention will be focused only on those which appear to be associated with the stronger competitive position of the feedlots in the Southwest.

Feed costs

In the earlier sections no advantage was credited to the Southwest feeders for better feed conversions. However, there is strong evidence that the large feeders of that area have been getting better feed conversions than have the average feeders in the corn belt. Some of this evidence is shown in Table 5.11. Factors contributing to the conversion differences observed in these studies might be:

1) Inaccuracies in the estimates.
2) Differences in feed quality.
3) Differences due to locational factors.
4) Differences in management practices.

TABLE 5.11.--FEEDLOT PERFORMANCE OF SHORT-FED YEARLING STEERS, 1960-1961

Item	Unit	Colorado[1/]	Arizona[2/]	Minnesota[3/]	Michigan[4/]
Weight per head					
When bought	lbs.	610	614	731	665
When sold	lbs.	1045	1015	1114	1060
Average daily gain	lbs.	2.57	2.56	1.92	1.60
Feed per pound of gain					
Air-dry weight	lbs.	8.8	8.6	12.0	11.7
Pounds of TDN	lbs.	5.9	6.1	8.2	8.0

[1/] Elmer C. Hunter, *op. cit.*

[2/] Walter W. Pawson, *Emerging Patterns of Feedlot Management in the Southwest and Interregional Competition in the Locations of Cattle Feeds*, U.S.D.A., March, 1964.

[3/] A. R. Wells and T. R. Nodland, *Feeder Cattle Costs and Returns, 1960-1961*, University of Minnesota, Department of Agricultural Economics, Report No. 266, June 1962.

[4/] K. T. Wright, *Cattle Feeding Economics*, Reprinted from the Quarterly Bulletin, *Michigan State University*, Vol. 45, No. 4, May 1963.

Crop yields tend to be overestimated by farmers. Therefore, feed records that are based primarily on farm feed production tend to be overestimated. Secondly, the problem is somewhat greater in the Northern corn belt where the moisture level of corn is higher at harvest time. This quality factor is usually not adequately adjusted for when estimating yields. This is apparent when feed conversions appear to drop after a "soft" corn harvest. Also, feed conversions on Minnesota record keeping farms tend to be somewhat less efficient than those on Illinois record keeping farms which suggests incomplete adjustment of crop yields for the lower dry matter content in Minnesota.

No specific research has been done to determine the effects of different locations on feed conversion. Regional cooperation could shed some light on this important question if it is deemed worthwhile to aid the national industry in this manner. Until such effort is undertaken, the influence of this factor will remain open for speculation.

The comparisons shown in Table 5.11 indicate a 25 percent reduction in total digestible nutrients required in the Southwest. (Or a 33 percent increase in the North.) Even if one half of this difference is discounted due to possible errors in the data, a sizeable difference still exists. Some of the variations in management practices that account for the wide observed differences in feedlot performance between large feedlots of the Southwest and typical corn belt feeders are as follows:

1) The higher concentrate rations fed in the Southwest.

2) More crossbred cattle fed in the Southwest.

3) Better animal health in the Southwest.

4) Better balanced rations and more complete rations in the Southwest.

5) Better processing of feed in the Southwest.

6) Less "topping out" of cattle in the Southwest.

7) Lighter marketing weights in the Southwest.

Higher concentrate rations usually result in faster gains and improved feed conversion. Michigan and Purdue have both demonstrated that TDN requirements do not increase with higher levels of corn silage. However, increased levels of hay in a ration tend to decrease rates of gain, feed conversion and dressing percent. Also, the common practice of utilizing the corn cobs by grinding ear corn tends to decrease feed conversion efficiencies.

An example of the effects of a popular corn belt custom of wintering calves on hay as opposed to using corn silage, a much higher energy feed, was demonstrated by a 1964 Purdue experiment. Some of the findings of this experiment are shown in Table 5.12.

TABLE 5.12.--RESULTS OF WINTERING CALVES ON HAY INSTEAD OF ON CORN SILAGE[1]

Treatment[2]	Slaughter Weight	Average Daily Gain	Dressing Percent
	Lbs.	Lbs.	%
CS-CS-X	901	1.85	59.3
Hay-CS-X	899	1.11	54.4
Decrease from hay		.74	4.9
CS-EC-X	903	1.93	60.3
Hay-EC-X	901	1.15	57.3
Decrease from hay		.78	3.0
CS-EC-EC	1000	1.75	63.2
Hay-EC-EC	1002	1.32	58.6
Decrease from hay		.43	4.6
CS-CS-EC	1000	1.74	61.1
Hay-CS-EC	1003	1.25	60.3
Decrease from hay		.49	.8

[1] Annual Indiana Cattle Feeders Day, 1965, Purdue University, Lafayette, Indiana.

[2] Calves were started on experiment at 475 pounds and changes in some of the rations were made at 750 pounds and again at 900 pounds. Corn silage = CS; Ground ear corn = EC.

Although no feed conversion data were obtained in this experiment the dramatic and consistent reduction in average daily gain resulting from a higher roughage ration is quite obvious and is usually highly correlated with feed conversion. And for more specific evidence of the effect of high hay rations on feed conversion, a series of three trials at South Dakota showed decreased TDN conversion efficiencies of 8 to 20 percent when hay was added to ear corn rations and 6 to 8 percent when the amount of hay fed with shelled corn was increased from 4 to 8 pounds per head per day.[1/] In considering these large reductions it should be remembered that low feed cost rather than low feed conversion ratio is the more desirable objective. However, in the South Dakota results, feed costs also increased despite savings in protein from higher hay rations. Thus, it appears that the common corn belt practice of wintering calves on a "low cost" hay ration, or of substituting hay for corn and protein in a finishing ration, may in fact be very "high cost" practices.

It is estimated from these and other research trials that increasing daily hay intake from two pounds to four or more pounds will decrease feed conversion rates between 5 and 10 percent and dressing percentage at least 1 percent. Therefore, the practice of feeding more hay and ground ear corn in the Northern corn belt may be a major reason for the lower feedlot performance in this area.

If the practice of heavy hay feeding stems from the fact that surplus, low alternative value hay must be produced on the farm, it may be economically justifiable. However, many corn belt feeders continue to produce more hay than dictated by soil and topography characteristics thereby decreasing farm returns on two counts--by decreasing feedlot performance as well as by growing a lower return crop. (These practices have been perpetuated

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[1/] South Dakota Ninth Annual Beef Cattle Field Day, April 21, 1965.

on some farms due to participation in the government feed grain program.)

Also, lower feedlot performances and higher nonfeed costs often stem from the corn belt practice of feeding ground ear corn rather than shelled corn, the earlier discussed research trials at South Dakota also demonstrated that corn cobs were worthless as a substitute for corn grain and resulted in depressed feedlot performances. Cobs can be used as a roughage to replace hay if hay is worth about $30 a ton--an unlikely probability in the Northern corn belt. Thus, it appears that the long encouraged practice of trying to "cheapen" costs of gain in the corn belt by feeding larger quantities of roughages (hay, corn cobs or straw) may have greatly retarded improvements in feedlot performance by the average corn belt feeder. Now that a lower cost protein source (urea) has come into use perhaps less research effort will go into the high roughage ration.

That "hybrid vigor" results from crossbreeding has long been an established fact of genetics. But, for some reason, extensive work on the beneficial economic results that might be attained from crossbreeding in beef production has been delayed until recent years. Studies of the past few years indicate that a feed conversion improvement of about 5 percent is attainable from crossbreeds. The Oakies that have long been popular in large scale lots are crosses of various kinds and qualities. These Oakies are commonly grouped into three or more quality classes and, according to California feeders, the number one

Oakies are considered equal to the English crossbreed in feedlot performance.[1/] Although Oakies are not as prevalent in southwest feedlots as in California, cattle with high gainability are obtained more readily by larger feeders than by smaller ones. This is due not only because crossbred cattle are purchased but also because operators of larger feedlots usually have more experience as to what performance levels can be attained from different kinds of cattle.

Better animal health may be maintained from the outset by the large commercial feeder in the Southwest for two reasons (1) most of his cattle come directly from their previous feeding area and (2) they are not in transit so long. As is pointed out by Williams relative to the fact that many small cattle feeders obtain their feeder supply at auction sales--"...sickness in feeder cattle will be more common in purchases at auctions and relatively high shrinkage will be experienced. The shrink encountered at many auctions is notoriously high."[2/]

In terms of rations, the large scale producers in the Southwest keep close control over rations formulated in their own feed mills. In contrast, most farm feeders of the Midwest utilize their farm produced corn, hay and silage along with a fixed daily amount of some commercially prepared protein supplement. Since

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[1/] John Hopkin, op. cit., p. 22.

[2/] Willard F. Williams, Structure and Conduct of the Commercial Cattle Feeding Industry, Supplement No. 1 to Tech. Study No. 1, National Committee on Food Marketing, June 1966, p. 72.

these standard corn belt feeds can vary considerably in nutrient contents from year to year and field to field there is a real problem in maintaining a balanced ration in farm feedlots. This problem can be overcome in part by providing adequate supplies of all nutrient ingredients that might be in short supply. To fully overcome the problem would require periodic feed testing. It is difficult to estimate the probable magnitude of the influence of differences in this management practice but it should be recognized as causing differences in feed costs between typical corn belt feeders and most large scale operators.

A related difference in feed rations is due to differences in the processing method. Whereas most corn belt concentrate rations are prepared from grinding or rolling the ear corn or shelled corn component of the ration, some of the modern large scale lots have been flaking grain after subjecting it to a steam treatment. This has been especially beneficial for milo but has also improved the value of corn and barley. And recently it was discovered that if more pressure were applied in the rolling process, increased efficiencies in feed conversions could be effected. For example, a 1966 Colorado trial showed an improvement in feed conversion of 3.3 percent of regularly flaked corn over ground corn and an additional gain of 8 percent of thin flakes over regular flakes.[1/]

[1/] J. K. Matsushima and R. L. Montgomery, "The Thick and Thin of Flaked Corn", Colorado Farm and Home Research, Vol. 17, No. 2, Winter 1967, p. 4.

Although the earlier advantage shown for regular flaking was probably not a significant one when compared to rolled high moisture corn in the corn belt, the added advantage from thin flaking cannot be ignored.[1/] This process will put additional competitive pressure on small feedlots which do not adopt it since it will increase returns by almost $1.00 per hundredweight of beef produced for those who do adopt it. (Based on an investment of $5.00 per head of lot capacity, added operating costs of 20 cents per ton, and a saving in feed of 7 percent.) It should be feasible for large farm feedlots to adopt this technology--but the added cost for them will be relatively larger thereby giving a slight advantage to larger lots.

Another management practice difference observed between farm feedlots and some larger scale lots is that of "topping out". Managers of larger lots have learned that it is too costly to keep feeding the slow gainers in a lot. If necessary, some "topping out" may be done to remove cattle showing too much finish before the average of the group reaches low choice--but otherwise they all go to slaughter at once. This results in higher average feedlot gains as well as better feed conversions than will be attained if the genetically poorer animals are actually kept in the feedlot considerably longer than the best gainers. The average difference in gains between the top 20 percent and bottom 20 percent of 7000

[1/] See the June 1967 issue of the Feedlot magazine for a review of experiences of cattle feeders as well as experiment station results from using thin flakes.

cattle involved in an on-the-farm beef feedlot performance evaluation project in Iowa was 0.8 of a pound per day.[1/] (2.54 vs. 1.74.) Using the mean reported gains of 2.14 would, on the average, bring 430 pound calves to 1061 pounds in 295 days. However, if the 20 percent slow gainers were to be held until they reached 1061 pounds it would take 363 days--assuming they maintain the same average daily rate, which is unlikely. These animals would tie up the lot space for the remainder of the year incurring additional interest, labor and overhead expenses as well as reducing the overall performance rate of the whole group of cattle. Thus, the free advise so often given to feeders to "keep lots topped out" probably is worth even less than feeders are paying for it.

The last suggested reason for the often observed differences in performance between the two areas was the difference in typical marketing weights. Heavier cattle are less efficient in feed conversion because their maintenance requirements are higher. Also, considerable evidence has been gathered in the past few years to demonstrate that feed requirements increase significantly as more outside fat is put on cattle. For example, Illinois results showed an increase of 26 percent in feed requirements per unit of gain between yearlings sold at 1114 pounds and those sold at 1442. (7.67 to 9.67 pounds of air dry feed.)[2/] And, although dressing percentage increased by three percentage points, percent of retailable carcass dropped sharply--by 12 percentage points. The

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[1/] Robert C. deBaca, "Iowa's Programs of Feedlot Performance Evaluation," presented to Purdue Cattle Feeder's Day, April 21, 1967.

[2/] Illinois Cattle Feeder Day, April 14, 1966.

Illinois work with calves showed that increasing weight about 200 pounds on calves--from 1057 to 1246 required an average increase of 18 percent in unit feed requirements. But most of the increase in costs came after the first hundred pound increase. Michigan showed an increase of 2.4 percent in feed requirements per unit of gain in going from 1037 pounds to 1133 pounds with a similar increase when adding the next one hundred pounds.[1/] South Dakota reported an increase of 4.4 percent in going from 1019 to 1138 with a 50 percent roughage ration (haylage).[2/] Therefore, it appears from these and other studies that to add another one hundred pounds to the market weight of steers which already grade mostly low choice would result in an increased overall feed conversion rate of 4 to 5 percent.

In order to more closely explore the economics of carrying cattle to heavier weights, the option was made available in the programming model for the Michigan farm to add an extra 100 to 200 pounds over the standard feedlot marketing weight of 1060 pounds (1030 pounds shrunk weight) for calves fed either the one percent ration or the high concentrate ration. The requirements for corn and silage for the first one hundred pounds were set 30 percent higher than the average per hundredweight requirements had been in the full feed ration. (This increased the overall average ratio by 4.4 percent.) The second one hundred pound increment was

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[1/] Michigan Beef Cattle Day Report, 1966.

[2/] South Dakota Tenth Annual Beef Cattle Field Day, April 20, 1966.

estimated to be one third higher than the first, thus, increasing the overall feed conversion ratio by about 12 percent (12.89 more corn and 9.7 percent more silage per hundredweight of gain than required by the original full feed program.) Average daily gain was established at 1.9 pounds for the first one hundred pound increment and 1.6 for the second one hundred, thus, requiring 53 and 63 days, respectively, to make these gains. Additional costs for protein supplement, interest, bedding and materials handling were estimated on the basis of these added time requirements. The estimates for each of these resource requirements are shown in Table 5.13.

TABLE 5.13.--ADDITIONAL RESOURCES REQUIRED TO ADD ONE HUNDRED POUNDS OF LIVEWEIGHT TO STEERS WEIGHING 1060 POUNDS IN THE FEEDLOT

Item	Unit	First 100 Pounds 1060 to 1160#	Second 100 Pounds 1160 to 1260#
Corn	bu.	13.68	16.32
Silage	ton	.45	.5
Cash costs	$	$7.66	$9.42
Short term capital[1/]	$	1.07	1.63
Labor, hours	hr.	.58	.76
Building unit	30 sq.ft.	.18[2/]	.24[2/]

[1/]Additional interest charge on animals held.

[2/]No added building space is required when weight is added to animals being fed on the once a year program.

In estimating increased value, consideration had to be given to probable changes in dressing percentage, in grade, and in price due to decreased retail cutability of carcass. It was assumed that the dressing percentage would increase one percentage point (from 62.2 to 63.2 for the full fed calf) for the first increment and an additional 0.8 of a percent for the next increment. The following three different price assumptions were considered:

1) No increase in carcass grade but a discount of 1.1 percent and 2.1 percent, respectively, for the first and second 100 pound increments for decreased cutability of carcasses.[1/]

2) Carcass grade was increased from 75 percent choice and 25 percent good to 100 percent choice, but the discount was still applied.

3) Carcass grade was increased to all choice and no discount was applied.

The three sets of prices are shown in Table 5.14 in both carcass and liveweight terms. The first set represents prices most likely to prevail if buying is done on a grade and yield basis with some discount for the reduced cutability of the heavier cattle because of excess fat. The second set represents what could happen if cattle actually were still a little short of their potential carcass grade at the 1030 pounds shrunk market weight. The third set of prices represents those likely to exist on a live market where buyers are not attempting to buy on the basis of true retail value.

[1/] Percentages decreases that were found to exist in Michigan State University Exp. AH-RC-649 Beef Cattle Day Report, 1966.

TABLE 5.14.--CARCASS AND LIVEWEIGHT MARKET PRICES FOR CATTLE OF DIFFERENT WEIGHTS UNDER DIFFERENT SELLING CONDITIONS

Marketing Situation		Carcass Prices*		Liveweight Prices*	
Carcass Grade Ratio Ch. to Gd.	Discount For Excess Fat	1130# steers	1230# steers	1130# steers	1230# steers
75:25	yes	$43.80	$43.37	$27.68	$27.76
100:0	yes	44.30	43.86	28.00	28.07
100:0	no	44.80	44.80	28.31	28.67

* Base Price for 1030 pound steer was: Carcass = $44.30; liveweight = $27.55.

It was determined that under the first price situation in combination with the planning situation where a fixed capacity building was allowed to be used to capacity no cattle were carried to heavier weights.

Each of the three prices were used under several different planning situations. Likewise, in the planning situations where feedlots were allowed to expand only to the limit of farm produced feed, this scarce feed was not used to feed any cattle to heavy weights. (Neither on the 200 or the 350 acre farm.) In the situations where labor was limiting a few cattle were carried to heavier weights, but income was not significantly increased.

However, the profit maximizing solution for the fixed capacity, single lot, planning situation added slightly to feedlot profits by adding an extra one hundred pounds to over half the cattle fed. As speculated earlier, this is not so surprising when it is remembered that under this situation the most limiting resource is number of head--so, if returns per head can be increased at all by selling at heavier weights this will be done. The most profitable feeding program shifted from almost all silage fed calves to about 60 percent calves on the partial grain feed so that there would be enough time to carry them to 1130 pounds. This shift added $205--a gain of less than $1.00 per head fed to the heavier weight--to total feedlot returns.

With the two sets of higher prices, some cattle were carried to heavier weights in most planning situations considered. With the second set of price assumptions all cattle fed in the single lot housing situations were carried to the 1130 market weight. Furthermore, when prices were slightly higher the single lot situation was encouraged to carry 40 percent of its cattle up to the 1230 pound weight to maximize returns per head fed when labor and feedlot space were readily available. Average per head returns were increased about $2.00 per head with the second price situation and about $6.00 per head in the third price situation over the original returns when cattle were all marketed to 1030 pounds.

On the other hand, it did not pay to add weight to cattle if the feedlot could be used to capacity until the third price situation when returns were increased by $1500 by adding the first increment to all cattle fed.

Limited real estate credit availability on large crop farms is a factor which can encourage feeding to heavy weights. If real estate credit is limiting, the feedlot cannot be expanded, so improved profits from feeding encouraged feeding to heavier weights.

However, increased earnings were not large--only $785 in the second price situation.

On the other hand, prohibiting the use of operating credit for buying corn or silage tended to discourage feeding to heavy weights on small farms where feed supply was quite limited relative to family labor. But on the 350 acre farm where feed supplies were considerably more ample relative to family labor this limitation did not deter the feeding of cattle to heavier weights.

An analysis of all the situations in which there was a tendency to feed cattle to heavier weights suggests the following economic causes of the practice:

1) The practice of buying only one group of cattle each year.

2) The economically inefficient buying practice of paying equally high prices for carcasses which have lower retail values.

3) External or internal credit restrictions which prohibit expansion of cattle feeding to the number best suited to feed and labor resources on large farms.

4) A poor feed conversion rate.

Since these factors are, in fact, more prevalent in the corn belt than in the Southwest, it is not too surprising that market weights tend to be somewhat higher in the corn belt. Another factor contributing to the heavier weights in the corn belt is the earlier discussed ration composition factor which delays attainment of finish. (Heavier market weights due to this factor may be less costly in terms of added feed since the composition of the added weight is lower in fat content.) In addition, higher marketing weights are encouraged in the Eastern corn belt than in the Southwest because of the higher fed cattle prices which prevail in the East. (The increasing marginal costs of adding weight run into the marginal return curve at a lighter weight when the product price is lower.)

The estimated differences in feed conversion rates due to the different management practices commonly followed between Northern corn belt feeders and large Southwest feeders are summarized in Table 5.15. The total is disconcertingly large. This total may be overstating the case since some of the individual factors are partially interrelated and therefore not totally additive. The intercorrelation between level of concentrates in a ration and marketing weights has been pointed out. Thus, the observed heavier market weight of steers out of corn belt feedlots is partially due to the fact that these steers were finished after a longer growing period and the added cost of such finish may be less than estimated.

TABLE 5.15.--ESTIMATED FEED CONVERSION EFFICIENCY ADVANTAGE HELD BY LARGE SCALE SOUTHWEST FEEDLOTS DUE TO SELECTED MANAGEMENT PRACTICES

Management Practice	Advantages in Feed Efficiency Held by Large Scale Feeders
	- percent -
Less hay and/or corn cobs in ration	5 - 10
Higher inherent gainability of cattle	4 - 7
Better animal health	1 - 3
Improved composition of ration	2 - 4
Improved processing of feed	2 - 4
Less "topping out"	1 - 2
Lighter marketing weights	3 - 5
TOTAL	18 35

The lower end of the range of the estimated advantages probably represents the difference that has existed in the past between larger corn belt feeders and large scale Southwest operators. The effects of these estimated differences on feedlot profitability was compared by adjusting the feed conversion levels used in one of the programming models. Since both the type of ration and the level of market weight was internally selected in the model, the estimated effects of these two variables was subtracted from the 18 percent figure shown in Table 5.15 leaving a 10 percent disadvantage in feed conversion for the typical corn belt feeder. It can be immediately estimated that the result of such a reduction in feed efficiency would be to increase feed costs about $1.50 per hundredweight of gain. More detailed estimates of the impact of changing from top efficiency to average feeding efficiency on farm feedlot earnings in Michigan will be examined later.

Nonfeed costs

In the analysis of factor associated with scale it was determined that much of the difference in nonfeed costs often found to exist among feedlots is related to intensity of use variations rather than to size differences. In the Kansas study it was found that the extent of the influence of this factor on costs per pound of gain was greater than was the influence of increased feedlot size.[1/]

[1/] McCoy, *op. cit.*, p. 18.

To observe the influence of the intensity of use factor on feedlot profitability, the results of the profit maximizing solutions obtained when only one lot a year was fed should be compared to results when capacity feeding was permitted. One such comparison is shown in Table 5.16 along with a comparison of costs and returns for two different rations.

TABLE 5.16.--NONFEED COSTS AND RETURNS PER HUNDREDWEIGHT OF BEEF PRODUCED AND RETURNS TO TOTAL FEEDLOT FOR SELECTED CALF FEEDING PROGRAMS

Item	Unit	One lot per year		Two lots per year
		All silage ration	Full feed ration	Full feed ration
Nonfeed costs[1/]	$/cwt.	6.24	5.01	4.44
Net return[2/]	$/cwt.	3.94	3.31	3.79
Total added return	$	11,598	9,928	16,467

[1/]Excludes labor costs which are higher for the all silage program.

[2/]Calculated from computer results.

The comparison between the two full feed rations indicates what happens to nonfeed costs and to net returns when moving to capacity utilization of a feedlot. The 57 cents drop ($5.01 - $4.44) in nonfeed costs is, however, only part of the total profit story--the rest of it lies in the multiplication of the new net return per hundredweight produced by the larger production out of the same feedlot. Even if the new net return figures were no larger than the previous one--total returns would still go up by 45 percent--the proportionate increase in the number of cattle fed.

To further illustrate the mistake of putting undo emphasis on any particular cost or return ratio--the results from the two single lot programs should be studied. The full feed ration has a large edge over the all silage ration in nonfeed costs per hundredweight of gain. However, the silage program shows a higher return per unit of gain and a subsequent higher total return in this situation where only one lot of cattle is purchased each year. This is because feed costs per hundredweight of gain are less for the silage ration in Michigan. And finally, it should be noted that the net return ratio can also be misleading since it is not a reliable indicator of total feedlot returns to a given set of resources. (The differences in results would be even greater if 100 percent capacity feeding were allowed--however 85 percent of total computed capacity is all that is allowed in the multiple feeder purchase activities.)

The point is that efforts should be made to control nonfeed costs just as they should be made to control feed costs. However, neither of these should be looked upon as an end in itself. As was illustrated in Chapter III (Table 3.4) the most profitable program will vary considerably depending upon the mix of resources that are available. Management must decide what the best program is in terms of overall goals and available resources. They should, however, keep in mind two general means for decreasing nonfeed costs--(1) by purchasing feeders more than once during the year and (2) by utilizing a higher concentrate ration so as to speed up feedlot turnover rate.

Cattle prices

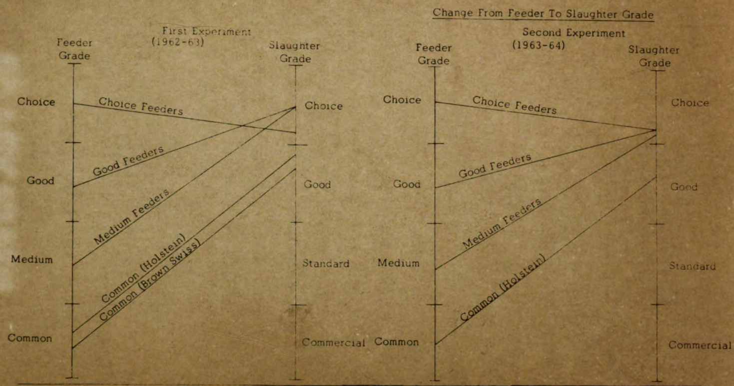
It was suggested in Table 1.2 that one disadvantage of the typical corn belt feeder with respect to management practices affecting cattle prices was the greater tendency to "upgrade" cattle in some of the large feedlots. Although there is evidence that this difference exists from observation on cattle movements[1/] the extent of such differences is difficult to quantify.

First, it should be noted that the term "upgrade" has been set in quotation marks in this report because under the latest federal feeder grade system it is supposed to be impossible to "upgrade" cattle in the feedlot. (Feeders are to be graded according to their finished grade potential.) But the federal feeder grades are almost universally ignored in the trade since they are completely inadequate as guides to potential feedlot performance. Also, their past inability to forecast final slaughter grade is quite evident by the results of Iowa research shown in the accompanying graph. In an attempt to correct these deficiencies in federal grades and to facilitate more precise sight-unseen buying of feeders, some of the larger feeder cattle supply firms in the South use more than 20 or 30 separate classifications of feeder cattle.[2/]

[1/] Harold Abel and William Capener, Shifts in the Production and Marketing of Western Feeder Cattle, Washington Agricultural Experiment Station Bulletin No. 667, November 1965.

[2/] Williams, op. cit., p. 46.

FIGURE 2. CHANGE FROM FEEDER TO SLAUGHTER GRADES OF YEARLING STEERS FED HIGH ENERGY RATIONS FOR SIX MONTHS



SOURCE: IOWA STATE A.S. LEAFLET R60

In Chapter III when the feeding of dairy animals was compared with the feeding of beef animals the beef carcasses were assumed to grade one full grade higher than those resulting from the dairy animals. That this was a conservative estimate is graphically illustrated by the Iowa work. The added profit available from taking advantage of the lower purchase price on holstein steers averaged $24 per head when sold on the grade and yield basis in the three years of Iowa work (1963-65). The Iowa researchers went on to point out the differences in returns that would have resulted from alternative marketing methods as follows:

> "The $24 advantage would have been largely wiped out if the Holsteins were sold on a live-bid basis since the average live-bid was $19 per steer lower than the grade and yield price received. Also the $24 advantage could have been increased to $50 advantage per Holstein steer if there were an established market based upon retail cutability which did not assume Holstein beef was inferior. Our data indicated that the eating quality of beef from a Holstein steer grading high good was equal to that of a beef-bred steer grading choice."[1/]

Greater profit gains have also been demonstrated for steers of mixed breeding which are commonly priced lower than well bred Hereford or Angus steers. Iowa showed net return advantages of $16 and $41 in 1964 and 1966, respectively, from "medium grade steers costing 3 to 4 cents less per pound liveweight" over "higher priced Hereford and Angus steers".[2/] Again the market

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[1/] Burroughs, et. al., <u>Feedlot Performance Marketing Considerations and Carcass Characteristics of Holstein vs. Beef-bred Feeder Steers</u>, A. S. Leaflet R 70, Iowa State University, June 1965, p.2.

[2/] Burroughs, et. al., <u>Performance of Choice Hereford and Angus Steers in the Feedlot Versus Medium Grade Steers Costing 3 to 4 Cents Less Per Pound Liveweight</u>, A. S. Leaflet R81, Iowa State University, September 1966.

price was based on grade and yield which gave a 43 cents average liveweight price advantage to the Hereford and Angus steers. But, had payment been based on liveweight, bids indicated a difference of $1.00 per hundredweight, and if payment had been on a retail cutout basis, the advantage would have shifted over to the lower priced feeder.

The suggestion that large scale feeders are essentially on a grade and yield market already even if sales are made mostly on a liveweight basis has been made previously in this thesis. In addition, it is here hypothesized that where large scale packers are competing in a national beef carcass market the retail cutability of their product is an important variable affecting their competitive position. To the extent that large scale retailers are buying beef according to cutability, packers can in turn pay more for carcasses of higher cutability. And finally, to the extent that this premium is actually paid to the producers, the feeding of lower quality feeders becomes even more profitable. (The above relationships suggest that one major source of pressure for integrating--either formally or contractually--from the retailer--through the packer--to the feedlot--to the rancher--is to insure that no "outside" firm reaps unearned gains from the production and marketing of beef that has relatively high final retail value.)

Corn belt cattle feeders can take advantage of the increased potential returns from lower priced feeders to the extent that they can obtain grade and yield prices--either through that method of selling or through establishment of a "reputation" for consistency of product. Of course, as a greater demand develops for the lower priced feeders, prices on these cattle will be brought more nearly into line with their value. However, complete adjustment of either slaughter cattle or feeder cattle prices to their true relative values based on final consumer values may be very difficult under the existing production--marketing system. And, the adjustment can be expected to be delayed longer in areas of small feeders, small packers and small retail outlets. Consequently, corn belt feeders may not be able to completely bid away the current advantage in feeder-fed price margins held by the larger feeders located in intensive feeding areas.

<u>Comparative returns</u>

The previous three sections have developed the following probable disadvantages held by the average or typical Northern corn belt feedlot relative to the larger Southwest feedlot:

1) Feed requirements might be at least 10 percent higher with the same ration and selling weight; and over 15 percent higher if these factors are also allowed to vary.

2) Nonfeed costs are higher in the Northern corn belt not only because of higher initial investments per unit of feedlot, but also because of differences in types of rations and feedlot use intensity. However, such differences may, in part, be economically desirable in that feed costs may be lowered or labor requirements better meshed with crop production needs.

3) Cattle price disadvantages stem from the propensity of corn belt feeders to purchase top quality feeders, thus, bidding prices for these animals too high relative to those for lower quality feeders.

The combined effects of all of the factors considered under management practices relating to the feed and nonfeed cost items can be observed in the comparatively lower returns shown in the profit maximizing solutions developed for Michigan farms under average feed conversion levels. Feed requirements for the average feed conversion situation were set at 10 percent more corn and corn silage than in the high efficiency conversion situation. Protein costs were not increased. However, extra protein as well as another increase in corn and silage was required if cattle were to be carried to heavier weights. Thus, compared to the previously used high efficiency levels, the TDN requirements per hundredweight of beef produced increased 9.5 percent if market weight remained unchanged; and by 13.2 percent if calves were sold at 1130 pounds. The heavy steers were sold at $27.68 per hundredweight on a liveweight basis compared to $26.54, $27.11, and $27.55 for the all silage, one percent, and full fed steers of lighter weight. The profit maximizing program developed for three different situations is shown in Table 5.17.

The crop farm, limited labor situation is included for comparison with results previously shown for this situation under more efficient feed conversion. (Table 5.4.) Such a comparison shows a drop in returns per hundredweight of beef produced from $2.47 to $1.70 on the Michigan crop farm and a decline in returns per dollar of real estate capital invested from 21 cents to 14 cents. Only 443 head of calves were fed in a 346 head capacity

TABLE 5.17.--RETURNS FROM CATTLE FEEDING IN MICHIGAN UNDER AVERAGE FEED EFFICIENCY FOR SELECTED PLANNING SITUATIONS

Item	Unit	Crop Farm	Beef Feeding Farm	
		Limited Labor	Single Purchase	Capacity Use
Cattle Fed				
to 1030 lbs.	Number	331	154	654
to 1130 lbs.	Number	112	357	5
Returns and Ratios				
with 10 yr. bldg. life:				
Total return	$	3,035	4,709	5,938
return per head	$	6.85	9.22	9.01
with 20 yr. bldg. life:				
Total return	$	4,700	8,109	9,338
return per head	$	10.60	15.87	14.17
return per cwt. gain	$	1.70	2.37	2.36
return per dollar real estate capital	$	.14	.12	.14

feedlot under average conversion in contrast to the 543 calves and 39 yearlings fed in the 412 capacity feedlot under the improved feed conversion.

The results in the two beef feeding farm situations indicates that there may not be much advantage in fully utilizing feedlot capacity when profits from feeding are depressed by higher feed costs. It is interesting to note that returns <u>per head</u> and <u>per hundredweight produced</u> were slightly higher in the single lot situation where most animals were carried to a heavier weight. This was achieved despite higher nonfeed costs per head because feed costs were held down by shifting to higher silage rations and gross sales value was increased because of the heavier market weights. Thus, the once a year purchase habit which encourage both heavier slaughter weights and higher silage rations, does not depress income very much in a poor feed conversion feeding situation.

Finally, it is quite obvious that there will not be very much incentive for expanding a feeding operation which is only average in feeding efficiency. If competition increases feeder cattle prices by $2.00 a hundredweight or decreases slaughter prices by $1.00 per hundredweight, all returns to labor are wiped out in the crop farm case. The beef feeding farm situations appear to be more profitable only because an additional man is available on these farms. If he is paid $7000 there isn't much left for the manager. (Building and equipment costs have already been deducted.)

In conclusion, it appears that superior management practices add a minimum of 75 cents per hundredweight of gain to the cost advantage held by large commercial feeders over average Northern corn belt feeders. If a price margin advantage is also credited to the large feeders, management becomes the most important general causal factor affecting the difference in cattle feeding profitability between the two geographic areas considered in this study. Thus, the conclusion is that the average feeder in the Northern corn belt will not be competitive in the future and certainly will have little incentive for expansion. However, those Northern feeders who become top managers will probably be able to profitably expand feeding operations since they will be competitive with average feeders in other locations.

OTHER FACTORS AFFECTING THE RELATIVE RATE OF FEEDLOT EXPANSION IN THE NORTHERN CORN BELT

Expansion of feedlots in the corn belt area has no doubt also been delayed by the two other possible reasons listed in Chapter I for the past differential rate growth between areas. (The relative availability of alternative opportunities and institutional barriers.) As shown in Chapter III, feedlot returns must be above average if cattle feeding is to compete with expanded crop production. Also, hog production will probably continue to be the more attractive enterprise on most corn belt farms. In contrast, it was determined that in all situations examined in the Platte Valley of Colorado, it was more profitable to expand cattle feeding than to expand cropland. Thus, the relative propensity for expansion of feedlots in the irrigated areas of the Southwest is considerably greater than in the Northern corn belt where added crop acreages can be handled with very little extra labor.

As for the final factor--institutional constraints--the financing of large scale lots is already a firmly established banking practice in the Southwest. And, the attitudes of farmers in that area is that they will not even consider livestock enterprises other than cattle feeding. Thus, attitudes and traditions in the Southwest are conducive to continued expansion in cattle feeding.

In contrast, many institutional barriers have limited cattle feeding growth in the corn belt in the past and probably will continue to impede growth in the future. Many of the institutional factors which have tended to retard expansion are tied to the strong "family farm" tradition in the corn belt. The strength of this value is reflected in the attitudes and actions of (1) farmers, (2) bankers, (3) researchers, and (4) extension workers. Some examples of actions stemming from this value which have had a retarding affect upon growth of larger feedlots in the corn belt are as follows:

1) Farmers - continued abhorence of large credit use--resistance to expansion of livestock enterprise beyond feed supply--general distrust and dislike of bigness.

2) Bankers - inadequate credit limits imposed on many aspiring feeders--general unwillingness to expand credit for purchase of feed as well as cattle.

3) Researchers - continual programming of family farm type operations with fixed labor, credit, land, and even buildings--often at "average" levels already existing. As for animal science research--much of it in the corn belt is tied, albeit unwittingly, to the small farm income maximizing motto of "highest return per acre" or highest returns per head fed.

4) Extension workers - here again much management and production work is carried out with the implicit assumption that labor and land (feed supply) are fixed factors of production.

The attitudes of all these groups appear to be changing. But change comes slowly and, in cattle feeding time may be running out if cattle feeding in the Northern corn belt is to avoid what happened to the family farm chicken flock. If this area expects to stay in the race at all, concerted effort must go into expanded and imaginative research on many subjects other than what is the cheapest feed (corncobs or straw?) or at what size of feedlot are most of the size economies achieved (at 150 head--as McCoy found; at 1500 as Hunter found--or at 15,000 as Hopkin found?). Extension programs must be geared up to give in-depth instruction to cattle feeders who are desirous of improving and expanding this enterprise on their farms. And credit agencies and other agriculturally related industries must get geared up to give more competitively priced services to Northern cattle feeders, if they desire to see this industry grow.

SUMMARY

The many factors considered in this chapter lead to the conclusion that the cattle feeding enterprise is less competitive on Northern corn belt farms than it is in the Southwest. The major reason for the slower expansion of cattle feeding in the North has been the lower profits in feeding relative to those achieved by the large scale operators of the Southwest. It was expected that factors causing lower profits would be found that were related to location, to scale, and to technological lag. The findings of this study indicate that: (1) factors associated with location gave rise to the major disadvantages, (2) factors related to management practices have been important contributors to past disadvantages, and (3) factors related to scale differences between the two areas are probably the least important in their direct effect upon the relative profitability of cattle feeding.

Table 5.18 shows the extent of the lower profits from cattle feeding that were determined to be associated with each of the general causal categories considered in this study. The total disadvantage to the Northern cattle feeder appears to be $10 to $15 per head fed when contrasted with a well managed large commercial lot. This is a very significant difference and suggests that the Northern feedlot under average management probably has not been receiving full payment for all resources used in cattle feeding in recent years. As low cost operations expand and account for a larger proportion of the total cattle fed, these average producers will have increasing difficulty in covering feedlot costs.

TABLE 5.18.--SUMMARY OF THE DISADVANTAGES OF CATTLE FEEDING IN MICHIGAN AS OPPOSED TO COLORADO CLASSIFIED BY CASUAL FACTORS

Causal Factor	Michigan	Colorado	Disadvantages to Michigan Added	Disadvantages to Michigan Cumulative
	Profit per Hundredweight of Beef Produced[1]			
Location, small scale	$1.24[2]	$2.93[2]	$1.69	$1.69
Scale	-	3.22[3]	.29	1.98
Management	.47[2]	-	.77[4]	2.75

[1]The profit calculations are based on optimum programs determined by linear programming.

[2]Profits per hundredweight were determined by subtracting out a labor cost from the labor returns to the cash crop farm situation with limited labor. (See Table 5.4 and 5.17) The difference in returns to labor per hundredweight produced in these situations was $1.18. ($3.65 - $2.47)

[3]Based on returns to the Colorado large scale farm which produces most of its own silage. (See Table 5.5) Returns would be increased by 61¢ per hundredweight if adjusted to allow an advantage of .5 percent in interest rate on operating capital and a total manure credit of $1.00 per head. Also, the same increase would result if no change is made in interest rate but the manure credit is left the same in both Colorado lots.

[4]This is a difference in costs alone based on a 10 percent poorer feed conversion. If a price margin disadvantage were also charged this figure would be considerably larger.

Increasing size of lot in Michigan may not help to improve its competitive position. Although opportunities exist for decreasing nonfeed costs by increasing size of operation, these savings might be largely wiped out by decreasing manure value. And, as a higher proportion of the feed and labor is purhcased, average returns per unit of production decline. Since the competitive disadvantage of the large scale lots is even greater than that of farm feedlots, large scale lots are unlikely to develop in Michigan other than in conjunction with large crop farms.

Therefore, cattle feeding can be competitive with the Southwest only if the enterprise is well managed and if conducted in conjunction with a cropping program. The efficient feeder will find it profitable to increase feedlot size beyond the feed supply of his own farm at least to the point of being able to fully utilize his feedlot capacity and fully employ extra men that are required for the seasonal labor of crop production. The feeding operation should not be shut down during the cropping season if it is possible to organize the work so as to pay overtime wages to keep it going. Added returns from the extra head fed in a capacity operation will normally go quite far in paying for overtime labor.

The most important variables affecting an individual's ability to compete if he is located in the Northern corn belt are:

1) Feed costs - with feed conversion rates and storage and handling being the important factors for management to exercise control over.

2) Bedding costs - management must find a cheap source or a way to do without before expanding lot size. (Home produced straw is not cheap.)

3) Buying and selling - there is much to be learned about recognizing gainability in feeder cattle as well as knowing carcass and retail values of slaughter cattle.

To the extent that individuals in the Northern corn belt can be successful in the above, cattle feeding should prove profitable. However, if feed and bedding costs are average and marketing skills mediocre, feedlot expansion would probably add nothing to income, and, alternative employment opportunities--within or outside of agriculture--should be explored unless feedlot management practices are improved.

Looking to the future, it can be expected that the corn belt will continue to lag far behind the Southwest in feedlot expansion and may even be below the national average. Smaller scale lots will close down as some small farms pass out of existence and other operators realize they are not much more than recovering their feed costs. Operators who are able to put together the management practices required to show positive returns over all costs will tend to expand feedlot capacity--usually in conjunction with expanded crop acreages. This is simply a continuation of past trends. But with the large commercial lots having a greater and greater influence on the average industry cost of producing beef--it is expected that the rate of change will be accelerated.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose, method, and findings of this study will be reviewed in this chapter. Also, some implications of these findings will be translated into specific recommendations for various industry and university groups.

PURPOSE OF STUDY

This study was prompted by the fact that expansion in cattle feeding has been much more rapid in the Southwestern United States than in the Northern corn belt. From 1956 to 1966 marketings of fed cattle increased by 113 percent or 3,700,000 head in the states included in the Southwest grouping[1/] as opposed to a 38 percent or 340,000 increase in the three Lake States (Michigan, Wisconsin, and Minnesota).

The general questions to which this study was addressed were:

1) Is cattle feeding relatively more profitable in the Southwest?

2) If so, to what extent is the disadvantageous position of the Northern states due to factors which are amenable to change as opposed to factors which are of a longer run nature?

3) What are the feeding programs and practices required to maximize returns from cattle feeding in the Northern corn belt?

[1/] The Northern corn belt is defined to include the states of Michigan, Wisconsin, and Minnesota, plus the Northern parts of Ohio, Indiana, Illinois, and Iowa. The Southwest is defined to include Colorado and the Southern plains states--Nebraska, Kansas, Oklahoma, and Texas.

METHOD OF STUDY

To answer the above questions, a survey of selected feedlots in different areas was first considered. However, after due consideration it appeared that such an approach would be almost impossible because of the great number of variables involved and the fact that almost no two feedlots follow similar feeding programs. Thus, time, cost, and reliability considerations all suggested use of synthetically developed firms and feeding programs which could be subjected to a computer program designed to determine highest profit organizations. The linear programming solutions obtained under numerous resource, price, and alternative opportunity situations were compared and analyzed in an effort to achieve the objectives of the study.

The major components of the programming model were developed as follows:

Prices of cattle and feed - Projections were made of average prices through the next cattle cycle. Results of these estimates were:

Chicago No. 3 corn $1.30; Chicago choice steers $28.00; Kansas City gd-ch 430 lb. calves $30.50; Kansas City 680 lb. yearlings $26.00.

Feed conversions - These were developed for different rations and types of cattle on the basis of the research findings of numerous animal husbandry feeding experiments.

Nonfeed costs - These were based primarily on the findings of studies of actual feedlot operations.

FINDINGS RELATIVE TO THE COMPETITIVE POSITION OF THE NORTHERN CORN BELT

All the evidence turned up in the course of this study indicates that cattle feeding is more profitable in the Southwest than it is in the Northern corn belt. The reasons for this are many but may be grouped according to source under three headings when comparing the farm feedlot of the North with the larger scale lots of the Southwest. These three groupings are:

1. Reasons related to geographic location.
2. Reasons related to differences in average size of feedlot between the two areas.
3. Reasons related to differences in management practices followed by the typical feeder in each area.

The Locational Disadvantage of the Northern Corn Belt

The major locational disadvantages of cattle feeding in the Northern corn belt are the higher nonfeed costs due to the bedding and housing requirements necessitated because of the higher precipitation and greater annual temperature variations in the Northern corn belt. Neither bedding or shelter are required in the drier high plains region located in the Southwestern part of the United States. These climate related differences in inputs result in increased nonfeed costs for the Northern area. These were estimated to total about $1.50 per hundredweight of beef produced.

Limited research suggests that to do without these inputs results in lower feedlot performance. However, more research is necessary to determine the most economical combination of shelter and bedding for the Northern area.

Feed costs differ among areas due to differences in either feed prices or feed conversion efficiency. Feed prices are somewhat higher in Michigan than in the Southwest, but are lower in the Northwestern corn belt. Consequently, if feed conversion is assumed to be unaffected by differences in climate, average feed costs would not be too different between the two areas. Michigan feeders can partially offset the higher grain cost they have by feeding more corn silage which is somewhat cheaper in Michigan than in the Southwest.

Cattle prices as affected by an area's location with respect to feeder cattle supplies and to population centers is the third major factor affecting the profitability of feeding. The Northeast corn belt has an advantage in slaughter cattle prices, but a disadvantage in feeder cattle prices. The net gain over Colorado on these two price items amounts to about $3.00 per calf fed but there is no net advantage on yearlings. Conversely, the Northwest corn belt (Minnesota) has a net disadvantage of $3.00 per head on calves and almost twice as much on yearlings. Thus, the Northeastern corn belt gains in cattle price advantage about what it loses in feed price disadvantage to the Northwestern corn belt. This leaves both areas of the Northern corn belt with a total disadvantage equal to that estimated for nonfeed costs, that is, $1.50

per hundredweight of gain or $9.00 per calf fed. The disadvantage for yearlings is slightly larger on a per hundredweight of gain basis.

Since yearlings are usually selected for feeding in the larger feedlots of the Southwest, the total difference in returns over all costs between the two areas was about $2.00 per hundredweight produced rather than the $1.50 estimated when both fed calves. A large scale feedlot buying all inputs in Michigan showed a profit of only 75 cents per hundredweight of beef produced in contrast to a profit of $2.85 in the large scale Colorado feedlot.

However, when excess farm labor was utilized to feed cattle, the expected returns to that labor under the projected price relationships and superior management was $2.47 per hundredweight of beef produced in Michigan and $3.65 in Colorado. The main reason that the margin was narrower in this situation was because the labor that was not charged for would have amounted to $1.23 per hundredweight produced in Michigan but only half that much in Colorado if it were purchased in both cases.

In summary, the results of the various resource situations compared in this study indicated a locational disadvantage for the Northern corn belt of from $1.00 to $2.00 per hundredweight of beef produced. If capital investments are to be recovered in less than 20 years the locational disadvantage is even greater because investments per unit of capacity are at least twice as much in the North.

The findings relative to costs and returns in the two areas led to the conclusion that feedlot expansion in the Northern states will continue to be small relative to expansion in the Southwest.

The Size Disadvantages of the Northern Corn Belt

Numerous studies on economies of size in cattle feeding have established that both labor and overhead facility costs per unit of output decline with increased size of operation. Therefore, the fact that most feedlots are larger in the Southwest suggests that additional cost disadvantages accrue to the typical farm feeder in the corn belt.

In developing budgets for feedlots of 2000 head capacity as opposted to lots of 500 head capacity it was determined that non-feed costs would decrease about 60 cents per hundredweight of gain in Colorado and 85 cents in Michigan as lot size was expanded. However, these savings in nonfeed costs are quickly dissipated by increases in average feed and labor costs when comparing a large feedlot which purchases all inputs with a farm feedlot that uses some home produced feed and surplus farm family labor which has a relatively low salvage value. And, expansion in Michigan incurs the most in the way of additional costs since both feed and labor costs increase relatively more when expansion goes beyond initial feed and labor supplies. Also, if manure changes from an asset to a liability as feedlot size is increased, a value equivalent to about 60 cents per hundredweight of gain is wiped out.

Consequently, it was concluded that large scale feedlots operated independently of crop production appear unlikely to develop in the Northern corn belt since returns to such investment ventures would probably be quite low. On the other hand, large scale lots in Colorado can be developed without suffering any diseconomies of size. Because of lower labor requirements and lower wage rates in Colorado, moving from farm labor to hired labor only increases costs 30 cents per hundredweight compared to 60 cents in Michigan. And, feed costs change very little as size increases since the production costs of silage are closer to the market value of silage in irrigated areas and little if any of the grain needs are home produced for any size of feedlot. Thus, the farm feeder in the Southwest who becomes proficient in the management of a feedlot has a strong profit incentive for increasing the size of his lot. And, as he expands he will find that the larger operation facilitates the attainment of pecuniary advantages--lower interest rates, lower feeder and feed prices, and relatively higher product prices.

In conclusion, the medium sized Northern corn belt feedlot is not put at much of a disadvantage because of its smaller size. In fact, if it were to change into a large scale operation it might be in an even less competitive position, Nevertheless, the farm feedlot probably does have additional disadvantages relative to the larger feedlots in the Southwest as opposed to the farm feedlots of the Southwest. These are partially related to the lower building and equipment costs associated with size. In addition, advantages of buying and selling are achieved by specialized feedlots. Such advantages may be the most significant advantage held by large feedlots over farmer feeders in any area. For example, if these lots obtain operating credit at a rate one percentage point lower than the farm feeder, they gain an advantage of up to $2.00 per head on long fed calves. Also, small gains in the average sale price or small savings in the purchase price due to superior knowledge of supply and demand ~~conditions as well~~ as to bargaining position may be attained by large scale feeders. Although pecuniary advantages of this type are probably more important than the savings in other costs which accrue as size increases, the extent of such advantages have not been estimated in any study to date.

The Management Disadvantages of the Northern Corn Belt

This study found that the stronger competitive position of the specialized feedlots of the Southwest also appears to be associated with differences in a number of management practices. These differences give rise to relatively lower feed costs, lower nonfeed costs, and more favorable cattle price margins. To the extent that Northern cattle feeders allow these differences to persist, in the future they will continue to obtain lower return from cattle feeding than could be attained despite locational and size disadvantages. Since many of these management factors will be reviewed in a later section, only a brief listing will be made here.

First, it was estimated that feed conversion rates average more than 15 percent poorer in the Northern corn belt due to such factors as higher roughage rations, heavier marketing weights, poorer inherent gainability of cattle, and less desirable ration palatability and composition. However, the well managed feedlot in the Northern corn belt need not embrace practices which result in poor feed conversions.

Secondly, it is known that average daily gains and rate of cattle turnover in lots are both lower in the corn belt than in the large feedlots of the Southwest. Both of these factors give rise to higher nonfeed costs. Fixed overhead costs per unit of output are decreased when a given feedlot turns out more pounds of beef in the given time period. Variable cash costs per unit of output decrease when average daily gains are increased. Again, the corn belt feeder need not confine himself to the customary practice of feeding only one lot of cattle a low energy ration, thereby incurring high nonfeed costs. However, pressure of crop labor requirements and availability of ample supplies of low energy feed will encourage many Northern feeders to continue this custom.

Finally, it has been established that the "typey" well-marked Western beef calves normally purchased by corn belt feeders have been returning less than lower grade feeders because of the wide price spread between these animals. As more corn belt feeders turn to Southern crossbreds and other lower grade animals most of the past price advantage held by these feeder cattle should disappear. However, if the marketing system in the North lags behind that in the Southwest in the extent to which it reflects retail beef values back to the cattle feeder, Northern cattlemen will not be able to bid the price of the lower grade feeders up enough to completely squeeze out the excess profits now available to those who can get true retail value for the final product from these animals.

In summary, there is no question but that specialized feedlots enjoy numerous economic advantages over the average farm feeder because of improved management practices. Many of these advantages are due to lack of knowledge on the part of the smaller feeder. However, some of them are due to economic forces which, although they result in apparent disadvantages in cattle feeding costs and returns, may actually bring higher returns to the overall crop-livestock business. Also, other advantages may net less additional income to the small feeder than he feels is the cost of acquiring the knowledge and/or taking the action necessary to obtain the advantage. Thus, many of the observed differences in management practices are no more than what should be expected when the efficiency with which a hobby or sideline enterprise is managed is contrasted with how a large business is managed. But, if farmer feeders in the corn belt want to put their cattle feeding enterprise on a paying basis, they will have to devote more time to improving their feedlot management practices. Some suggestions for improvement are found in a later section.

Future Growth Rate Differences

The findings of this study leave no doubt that feedlot expansion will continue to be very rapid in the Southwest relative to the Northern corn belt. This will be due to the long-term locational advantage held by that area with respect to climate and feeder cattle availability. These advantages give rise to profits which encourage size expansion of individual lots and the development of specialized feeding operations. The larger size in turn leads to decreases in per unit labor and facility costs whereas the specialization factor generates improved management practices as well as giving rise to pecuniary advantages. As for total feedlot capacity expansion, it is the more rapid growth in average lot size that is the prime factor affecting this, rather than increases in the number of feedlots.

Some people wonder what has changed to put the corn belt area in the weaker competitive position since its historic dominations of the cattle feeding business. The main reason is that the specialized beef feeding industry of today that furnishes about two-thirds of all beef eaten in the United States is of fairly recent origin. Prior to World War II only one-third of a much smaller beef supply was fed beef. As this shift in type of beef was being made, it was discovered that feedlots could be developed on a large scale at a low cost in arid areas. Further, it was no doubt discovered that cattle performance was better in areas of high elevation where summer temperatures were lower. Finally, if irrigation was possible so that necessary forages could be locally produced, the situation became almost ideal for the establishment and subsequent growth of feedlots. These conditions led to rapid expansion of feedlots in Colorado, California, and Arizona during the 1950's. Colorado had the advantage of being closer to supplies of feeder cattle and feed grains whereas the other two states were closer to the highly concentrated, rapidly expanding affluent beef eating population centers of the West Coast.

In the 1960's other changes have been taking place which have shifted the growth point of feedlot expansion to the high plains of Texas and the three plains states that border Colorado. Two changes of major importance have been the rapid development of well irrigation and the huge expansion in grain sorghum production. With these two developments taking place right in the heart of the largest feeder cattle production in the country--in an area that already possessed the locational advantages of dry weather and high altitude--the results should have been predictable. The rapid expansion seen in this area in the past few years can be expected to continue through the next cattle cycle. There appears to be no other area in the nation with as favorable a combination of location advantages as this one has. Consequently, any area concerned with its competitive position in cattle feeding might best measure itself against these Southern plains states.

Some additional factors may tend to enhance the position of the Southwest relative to the corn belt are (1) the recent relative improvement in the feeding value of milo by the thin flaking process, (2) the more rapid beef demand growth expected in the South, Southeast, and West relative to the rest of the country, and (3) future research findings on ration improvements that are more likely to be adopted by large scale feedlots.

On the other hand, there are some trends now under way which should tend to improve the competitive position of corn belt cattle feeders. These are:

1) Shifts away from the production and feeding of hay (due to higher returns from corn and beans and labor shortages on larger farms).

2) A general shift in the industry from yearling to calf feeding (expected because improved breeding will produce heavier calves, forage supplies will not be adequate to carry calves an extra year, and more calves will be available throughout the year as the South expands beef cow herds and some calf production moves to drylot in the corn belt).

3) A relaxation of attitudes concerning credit use.

4) Research on housing and lot facilities that may lead to savings in production costs.

The relative importance of the different factors to the profitability of cattle feeding as indicated by this study suggest the following hypotheses concerning firm growth: Feedlots which exhibit growth over a period of years will, upon study, be found to possess one or more of the following advantages relative to other cattle feeders in the same location:

1) Better feed conversion efficiency.

2) Buying advantages on credit, cattle, and/or feed.

3) Selling advantages due to a higher quality product (cattle have higher retail value) and/or to superior knowledge.

FINDINGS AND RECOMMENDATIONS RELATIVE TO TECHNOLOGIES NECESSARY TO MAXIMIZE FEEDLOT RETURNS IN THE NORTHERN CORN BELT

The findings reviewed in the previous section have very significant implications for cattle feeding in the Northern corn belt. One important conclusion is that profit margins in cattle feeding will tend to narrow rather than widen in the future. This conclusion follows if one accepts the finding that large scale lots will continue to develop in the Southwest. As these lots account for more and more of the total beef production they will also have more of an influence on the average cost curve of the industry--bringing it relatively lower. Therefore, farmer feeders who wish to maintain feedlots which are adding monetary returns to the farm business will have to sharpen their management practices. The findings reviewed in this section may help in this risk.

The comparison of different technologies, practices, or programs with an eye toward determining "the best one" is a very complex matter. The problem inherent in depending on a single measure of superiority have been demonstrated several times in this study. Even the broad measures of feed costs, nonfeed costs, and cattle price margins do not tell much about comparative profitability when examined alone. Even the term "profitability" is a vague one unless agreement can be reached as to which financial ratios are the most appropriate ones to use. (The investor is interested in net returns on investment; the small farmer feeder in labor returns per head; the farmer's wife in residual returns after debt repayment and taxes; the animal husbandryman in returns over feed cost per head; the economist in returns to all resources; etc.) Consequently, any broad recommendations found in this section will usually be couched in general terms and the more specific recommendations will be tied to specific planning situations or encumbered with qualifying statements.

<u>Types of Cattle to Feed</u>

One of the most advantageous management practices that has been followed by the sharper profit oriented cattle feeders in the past has been the feeding of lower priced feeder cattle. Lower quality feeders have quite consistently given higher feedlot returns because of their more favorable price margins and their satisfactory gainability. Five separate experiments at Iowa all showed higher returns over feed from lower priced feeders--averaging a $25.00 advantage over choice feeders. Work at Michigan and Minnesota also indicated that such an advantage is possible. Therefore, more corn belt feeders should shift over to these lower grade cattle to take advantage of this price margin characteristic and help to bring the prices on these feeders more in line with their value. Holstein cattle, so plentiful in the Lake States, offer a very good potential supply of lower grade feeders to Northern corn belt feeders.

In feeding lower grade feeders the evidence suggests that a high concentrate ration may be used as well as a high roughage one. Thus, the traditional advise given in the corn belt to "feed low quality feed to low quality feeders" is no longer applicable, and has no doubt materially delayed the shift to this type of cattle by corn belt producers with high concentrate feeding programs.

Lightweight feeder cattle should continue to be the major weight category fed by Northern feeders because of the lower transportation costs on these feeders as well as the reduced level of direct competition from the large feedlots who are bidding more actively on heavier feeders. But, differences in average returns between calves and yearlings are so small that the change in slaughter price between the two different marketing dates is apt to be the factor which determines whether the yearling program or the calf program is more profitable in a given year. Consequently, a more important consideration is how to spread the risk of both slaughter price and feeder price variability. One technique for doing this is to feed both calves and yearlings.

Another way to spread price risk is to feed some heifers since they finish out sooner than steers. However, since heifers are sold at lighter weights after smaller weight gains they are not as competitive in the Northeastern corn belt where high feeder transportation costs coupled with high slaughter cattle prices give the advantage of feeder cattle which can put on more gain and be sold at heavier weights.

Finally, the need for more complete information on the feedlot performance potential of feeders from different geographic areas as well as from different breeding is very acute. Thus, corn belt feeders should encourage the development of as many techniques as possible to obtain such information. For example, production testing by ranchers must be encouraged. Also, research aimed at determining performance differences related to locational source of cattle, breed background, and visual appearances could be stepped up. A final possibility is that Northern cattle feeders pool their experience through some organization--possibly a computer record keeping service--so that a backlog of relevant feedlot performance data can be accumulated for use as a guide in establishing relative bid prices among different types of feeders.

Types of Rations to Feed

High roughage rations were found to be one of the factors responsible for the poorer feedlot performance observed in the Northern corn belt. Excess hay or corn cobs in a ration cause slower gains, increase feed requirements, require feeding to heavier weights for similar finish, and reduce dressing percent. These disadvantages began to accrue when daily hay intake is increased over 3 or 4 pounds per head. (In addition to decreasing feedlot returns, hay production over and above the amount dictated by soil management needs, usually decreases crop income on corn belt farms.)

Ground ear corn is another expensive feed when sufficient hay is raised on the farm to already provide the minimum roughage requirements for the cattle. When adequate hay is already available, the addition of cobs to the ration simply decreases average gains and may actually increase corn grain requirements since cobs will substitute for hay and the cobs in a full feed of ground ear corn can furnish the total roughage requirement of a finishing ration. Thus, one or the other--hay or cobs--might best be eliminated from a finishing ration.

Some combination of corn grain and corn silage is the most practical ration for most large corn belt feeders. What proportion of these two ingredients to use depends upon the price of corn, the farm resource situation, the number of lots purchased in one year, and the relative profitability of the operation.

As the price of corn moves up it becomes more profitable to use higher silage rations. Thus, higher silage rations should be used in the Northeastern corn belt than in the Northwestern corn belt. Under the price projections of this study and efficient feed conversion, a daily concentrate feed equal to one percent of the body weight of the cattle was the concentrate level that was most generally selected in the profit maximizing solutions in Michigan whereas a full feed (almost 2 percent of body weight) concentrate level was always selected in Minnesota. And, if corn prices drop below the yearly average projected for this study ($1.20 in Michigan and $1.08 in Minnesota) the higher grain ration becomes relatively more profitable in Michigan also.

The farm resource situation which calls for heavier use of corn silage in the ration is when limited availability of operating capital prohibits purchase of added feed grains. This limitation could force the small farm operator to a 100 percent corn silage ration in order to get maximum returns per acre. However, when credit is available to expand the feeding enterprise beyond the farm feed supply additional grain should be purchased and the farm feedlot used to capacity by buying more than one group of cattle each year.

When only one lot of cattle is fed each year, the corn silage portion of the ration can be increased up to a full ration unless otherwise dictated by crop labor needs. That is, if facilities and labor availability permits feeding all summer, a 100 percent silage ration can be utilized if this permits marketing of finished cattle within 11 - 12 months. However, if spring labor requirements, mud problems or hot summer weather make it desirable to get the cattle to market finish earlier, a higher concentrate ration will be required. However, the most profitable organizations on the many farm situations programmed in this study usually used feedlots to near capacity levels--which entails buying feeder cattle more than once during the year.

Finally, if returns from feeding are low, higher silage rations will give greater returns to existing feedlot facilities than will the higher concentrate rations since feed costs tend to decrease as the proportion of silage is increased so long as corn costs more than $1.10 per bushel. Feeding returns may be low due to low fed cattle prices, high feeder cattle prices, high grain prices, or poor feed conversion rates. When any of these changes were incorporated into the programming model, higher silage rations were selected. Also, it was informative to note that when feed requirements were increased 10 percent, there was not only a tendency to feed higher silage rations but to feed only one group of cattle a year and to carry the cattle to heavier weights. Conversely, when feeding profits were improved from the normal relationships used in this study, yearling feeding programs came into the solution. This suggests that the most efficient lots might better use their facilities to the maximum with rapid turnover yearling programs while the least efficient ones can maximize returns by feeding only one lot of calves a higher roughage ration and carrying them to heavier weights. Since this is, in fact, the general pattern that is observed, not only between areas but within areas as well, it appears that there exists some economic logic for these differences in program selection. Nevertheless, more research is needed to determine the relative merits of different high concentrate rations for the large efficient corn belt feeder.

Type of Feedlot Facilities to Invest in

A corn belt cattle feeder should carefully consider all alternatives before deciding on long-term investments in feedlot facilities. Special attention should be given to all questions relative to materials handling (bedding, manure, and feed). Will there be a dependable supply of low cost bedding in the forseeable future? How can manure be best handled? Will there be adequate labor for handling bedding and manure as desired? How will feed be stored, removed from storage, and be distributed to cattle? How might the organization and cost of all these tasks be changed if the feedlot is expanded more in the future?

The decision on what type of building to construct will hinge on how the questions relative to bedding and manure handling are answered. The decision on feedlot design will also depend on these answers but also on decisions relative to feed storage and handling, and on the capital position of the potential feeder.

If the feedlot is expected to grow to over 500 head capacity, the feeding system should probably be a fenceline bunk system. Also, if expansion is expected to utilize one or more hired men, the confined, slotted floor system will probably be ruled out on the basis of its high initial cost which may preclude continued growth on the basis of feedlot earnings.

Rather, the slotted floor system should be considered where labor is limited, real estate capital is plentiful, and bedding is expensive. Such a situation might exist where an older, established farmer with no children at home, would like to feed a few hundred cattle a year. If the savings in bedding and labor are worth about $8.00 per head fed, returns per head will be just as great as with traditional housing and outside feeding or in a confinement feeding, manure pack building. This situation may well prevail in areas where bedding materials are scarce. If research demonstrates that a saving in feed can be realized from confinement housing which has some environmental control features, this type of housing may also be recognized as being economically desirable under certain conditions.

However, the younger feeder with a smaller equity position who is just beginning a long period of expected business growth should search for other solutions even if bedding is scarce. One possibility is to design a feedlot without any shelter except perhaps a roof over the feed bunk. If topography and soil type are such that muddy lots can be avoided, the concrete area might also be limited to an apron along the fenceline bunk. If muddy lots cannot be avoided either large portions of the lots must be concreted, or the cattle might be moved into a building with a concrete floor designed in such a way as to facilitate manure removal without the use of any straw. Insufficient research evidence is available on these programs at this time to completely assess their impact on feedlot performance. Existing evidence suggests that daily gains would be 5 to 10 percent less in the shelterless lots and feed requirements would be higher by about 5 percent. (Almost $1.00 per hundredweight.)

Therefore, if straw is not too expensive, a confinement building might be used which has a concrete apron along the feed bunk and a manure pack is built up on either a dirt or a concrete floor. (It might be necessary to periodically move dirt fill into the building if no concrete floor is laid.) The straw requirements in such a confined feeding setup are quite high, averaging at least 3 to 4 pounds per head per day. Using a price of $15 per ton on straw (home produced straw costs almost this much to harvest and handle) this totals up to a bedding cost of about $1.00 per hundredweight of beef produced. (Straw requirements are about the same when an outside lot is provided and cattle are allowed to move in and out at will.)

Thus, each of three different systems--confinement--slotted floor; conventional-manure pack (indoor or outdoor feeding) and the no housing system--has disadvantages as well as advantages. To summarize these:

1) The slotted floor system has a high initial cost but saves on annual costs of labor, bedding, and probably manure nutrients.

2) The conventional manure pack requires much straw and labor to handle the straw and the manure. It has a lower investment cost than the slotted floor system. Although it has a higher investment cost than the no housing system it also results in better feedlot performance than that system.

3) The no housing system requires less initial investment than the slotted floor system, less bedding and initial cost than the conventional system but gives rise to higher feed and operating interest costs than the other two systems.

Feed storage facilities need not be as extensive as often found on corn belt farms. The findings of this study indicated that if a farm feedlot is expected to grow beyond a few hundred head capacity the horizontal silo should be used for storage of corn silage. This is especially true if a high silage ration is to be fed. Total farm business income is reduced if capital is tied up in expensive upright silos. However, if feedlot size is to be limited, an auger feeding system and upright silo may be the least cost system. Again though, younger feeders should keep in mind that a healthy farm business must continually expand if it is to stay competitive.

Finally, if the overhead costs for buildings, equipment, and labor are to be held down on a per unit of production basis some important management techniques are as follows:

1) If feedlot is to be mechanized, it should be expanded enough to fully utilize specialized equipment and available labor.

2) Use feedlot facilities to capacity the year around. This will require buying cattle more than once a year and probably will entail buying some yearlings as well as calves.

3) Obtain high daily rates of gain.

All of these techniques are employed by feedlots in the Southwest. Efficient corn belt feeders interested in expanding the feedlot enterprise will find it profitable to employ these same management practices. Crop labor requirements are no longer so demanding as to preclude feeding cattle in a mechanized feedlot during the summer months. Also, once these lots have been mechanized it is simply too costly to leave them under-utilized for very much of the year. Thus, the extent of one's commitment to feeding should be decided before major investments are made in a specialized cattle feeding enterprise.

RECOMMENDATIONS

The major implications of the findings of this research study are contained in the following recommendations which are aimed at strengthening the competitive position of the Northern corn belt in cattle feeding:

For Cattle Feeders

1. Must acquire more knowledge concerning the economics of cattle feeding, including the effects of differences in rations, feed processing methods, building and lot setups, and weight-production cost relationships.

2. Must better learn the arts of buying and selling or get commission firms to do a better job of buying on basis of gainability and selling on basis of retail value for them.

3. Encourage the market agencies in the North to more accurately reflect retail carcass values back to the producers.

For Credit Agencies

1. Feedlot expansion should not be encouraged unless the operator has exhibited above average ability in cattle feeding.

2. Do not limit financing expansion only to the limit of home produced grain after feeder has established superior feeding ability.

3. Adequate intermediate and long-term credit must be provided in the Northern corn belt to assure that climatic disadvantages are overcome.

For Potential Investors

1. Best climate for feedlot location is when summers are cool, winters are mild, and precipitation is low.

2. Best location from standpoint of feed and feeder supplies and product market is one which minimizes costs of inputs--transportation costs on beef are less important.

3. Strong financing arrangements for operating capital must be assured at prime interest rates.

For Researchers

1. A greater proportion of research efforts must be aimed at solving problems relevant to larger scale feedlots in the corn belt.

2. Additional research is required on the economic efforts of:

   a. Different building-lot arrangements.

   b. Different bedding and manure systems.

   c. Visual differences, breed differences, and locational differences in feeder cattle. This information might be used to develop new feeder cattle grades which describe feedlot potential of cattle.

   d. Differences in the pricing efficiency of alternative marketing systems.

<u>For Extension Workers</u>

1. More intensive educational work with the industry is required to teach knowledge already available.

2. A computer record keeping and planning service might be developed to aid farmer feeders in acquiring additional knowledge about the feeding business.

APPENDIX A

APPENDIX TABLE A.--VARIABLE CASH COSTS FOR CATTLE FEEDING IN MICHIGAN AND MINNESOTA

Item	Beef Calves			Beef Yearlings			Haylage	Dairy Calves	Dairy Yearlings
	All Silage	1% Conc.	2% Conc.	All Silage	1% Conc.	2% Conc.			
Selling cost[1/]	$ 5.78	$ 5.78	$ 5.78	$ 5.90	$ 5.90	$ 5.90	$ 5.92	$ 5.92	$ 6.01
Protein[2/]	19.21	15.40	13.65	11.30	9.57	8.56	4.60	15.40	9.57
Salt & mineral mix	.80	.67	.60	.80	.67	.60	.60	.70	.70
Vet. & med.[3/]	1.50	1.50	1.50	.75	.75	.75	.75	1.50	.75
Bedding (.75¢/lb.)[4/]	8.50	7.00	6.38	6.00	5.22	4.80	4.80	7.35	5.48
Manure handling ($1.10/hr.)[5/]	.75	.62	.56	.53	.45	.42	.42	.65	.47
Process grain ($.23/100 bu.)[3/]	-	.07	.12	-	.06	.11	.12	.07	.06
Unloading silos ($.09/ton)[3/]	.65	.47	.34	.51	.39	.25	.19	.51	.43
Distributing feed ($.19/ton)[3/]	1.37	.99	.72	1.12	.84	.55	.40	1.03	.92
Death loss[6/]	2.33	2.29	2.27	1.39	1.38	1.38	1.38	1.74	1.19
Other[3/]	.30	.30	.30	.25	.25	.25	.25	.30	.25
Interest on cattle (6%)	7.81	6.43	5.85	6.25	5.44	5.00	5.00	5.34	4.86
Manure credit[7/]	4.36	3.95	3.78	3.31	3.04	2.69	2.69	4.35	3.34
TOTAL	44.64	37.57	34.28	31.38	27.87	25.80	21.64	36.25	27.35

1/ Selling costs include yardage $1.35, commission $1.60, insurance 19¢, meat board and LIAM 6¢ plus transportation of 25¢ per hundredweight for a 100 mile haul.

2/ Protein cost based on mixtures that contain 72, 64, and 55 percent protein for the high to low corn silage rations. These supplements vary in price from $5.65 to $5.50 to $5.35 for the corn silage program and to $5.75 for the haylage ration.

(continued)

APPENDIX TABLE A.--(continued)

3/Source: Roy N. Van Arsdall, "Resource Requirements, Investment Costs, and Expected Returns from Selected Beef-Feeding and Beef-Raising Enterprises," AE-4075, Illinois Agricultural Experiment Station, University of Illinois and E.R.S., U.S.D.A., 1965.

4/Bedding is all purchased. Use is limited to 3-1/3 pounds per day for calves and 4 pounds for yearlings.

5/Hours of manure handling are estimated at .002 hours per day per calf based on unpublished data obtained in a survey of Michigan cattle feeders by R. Hoglund in 1962. It is assumed to be 20 percent more for yearlings.

6/Death loss is estimated at 1.5 percent for calves and .7 percent for yearlings and is calculated from laid-in purchase cost plus protein and bedding costs. Other feed loss is covered in feed allowance.

7/Estimated value of nutrients that are returned to the field.

APPENDIX B

APPENDIX TABLE B.--EXAMPLE OF PURCHASE-SALE PATTERNS CALCULATED TO GET MAXIMUM CAPACITY UTILIZATION OF BUILDING SPACE WHEN FEEDING CALVES

Average Daily Feedlot Gain	MONTH											
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.
	average feedlot weight from 430 to 1062											
2.35	Bot	501	573	644	716	787	859	930	1001	sold	--	--
	644	716	787	859	930	1001	sold	--	--	Bot	501	573
	Limiting period - - - - - - - - - - - - Feb. (18 square feet per head)											
2.60	--	--	Bot	509	588	667	746	825	904	983	sold	--
	588	667	746	825	904	983	sold	--	--	--	Bot	509
	Limiting period - - - - - - - - - - - - Feb. (16.5 square feet per head)											

APPENDIX C

APPENDIX TABLE C.--RETURNS TO FIXED RESOURCE AND RETURNS PER HEAD FROM THREE DIFFERENT RATIONS UNDER DIFFERENT PLANNING SITUATIONS1/

Planning Situation	Type of Ration			Type of Ration		
	All silage	Part. Conc.	Full Feed	All silage	Part. Conc.	Full Feed
	return to fixed resources			return per head fed		
200 acre crop farm can't buy corn	$7992	$7000	$5950	$15.60	$18.51	$18.53
350 acre crop farm can't buy corn	6259	9256	8659	11.56	14.39	15.40
350 acre crop farm can't hire labor	4632	7182	8373	17.95	17.55	14.61
350 acre crop farm limited real estate credit	5521	7352	7787	14.30	17.38	11.65
Beef feeding farm single lot per year	18570	17472	15953	37.89	34.94	31.91
Beef feeding farm capacity	18570	22060	22678	37.89	33.47	31.32

1/ Calves are bought in Michigan for $32.50 per hundredweight and sold for $44.30 per hundredweight of carcass beef.

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