Competitive Position of Cattle Feeding in the Northern Corn Belt
Michigan State University Agricultural Experiment Station and Cooperative Extension Service
Research Report
Paul R. Hasbargen, University of Minnesota; Leonard R. Kyle Michigan, Agricultural Economics State University
Issued September 1968
12 pages

RESEARCH REPORT 77

FARM SCIENCE

FROM THE MICHIGAN STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION AND COOPERATIVE EXTENSION SERVICE, EAST LANSING

Competitive Position of Cattle Feeding in the Northern Corn Belt

Competitive Position of Cattle Feeding in the Northern Corn Belt

By Paul R. Hasbargen and Leonard R. Kyle [1]

This research report is a summary of a joint research project by the University of Minnesota and Michigan State University. The research was conducted as Project 662 of the Michigan Agricultural Experiment Station and Project 1430H of the Minnesota Agricultural Experiment Station.

Special acknowledgement should be expressed to Dr. Glenn L. Johnson, who served as major professor for this research project, and these staff members of Michigan State University who assisted on the thesis committee: Dr. Hugh Henderson, Department of Animal Husbandry, Dr. John Brake, Dr. John Ferris, Dr. Leonard Kyle, Dr. Karl Wright, and Professor Raymond Hoglund, Department of Agricultural Economics.

PURPOSE OF STUDY

Expansion in cattle feeding has been much more rapid in the Southwestern United States than in the Northern Corn Belt.[2] 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 as opposed to a 38 percent or 340,000 head in the three Lake States (Michigan, Wisconsin, and Minnesota).

This study was addressed to the following questions:

1) Is cattle feeding relatively more profitable in Southwest?
2) If so, to what extent are the disadvantages of the Northern states due to factors which can be changed?
3) What feeding programs and practices will maximize returns from cattle feeding in the Northern corn belt?

METHOD OF STUDY

A survey of selected feedlots in the differerent areas would be desirable but almost impossible because of the number of variables involved and the dissimilarity of feeding programs. Time, cost and reliability considerations suggested the 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 in each of three states—Michigan, Minnesota, Colorado — were compared and analyzed.

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. See Table 1 for comparisons with previous cattle cycles and for farm level prices in the three states specifically analyzed in this study.

---

[1] Professor, Dept. of Agr. Econ., University of Minnesota; and Professor, Dept. of Agr. Econ., Michigan State University, respectively.

[2] 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.

TABLE 1—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 steers— corn price ratio		18.00	21.6	21.6
Choice steers—Chicago	$	27.00	25.95 (b)	28.00 (b)
Gd-Ch calves— Kansas City (a)	$	25.87	27.14	30.50
500-700# steers— Kansas City (a)	$	22.32	24.50	27.00
Beef Carcass Ch 600-700# Chicago	$	—	41.20 (b)	44.50 (b)
Beef Carcass Gd 600-700# Chicago	$	—	39.04	42.50
Beef Carcass Ch 600-700# Denver	$	—	40.20	43.50
Corn-farm Level (c)	$			
Michigan			1.10	1.20
Minnesota			.98	1.08
Colorado			1.12	1.22
Feeder Cattle— farm level (a)				
Michigan—calves				$32.50
Minnesota—calves				32.00
Colorado—calves				31.25
Michigan—yearlings				28.00
Minnesota—yearlings				27.50
Colorado—yearlings				26.75

(a) 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.

(b) 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.

(c) 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).

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. Table 2 describes the different feeding programs used in this study. Since each feeding program gives rise to a different dressing percent, the equivalent liveweight price for each program at each location is shown in Table 3.

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

COMPETITIVE POSITION OF THE NORTHERN CORN BELT

The results of this study indicate that cattle feeding is more profitable in the feedlots of the Southwest than in the farm feedlots of the Northern Corn Belt. There are numerous reasons for this, but they can be grouped according to source under three headings:

TABLE 2—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 (a)					
Days on feed	days	340	280	255	—
Aver. daily gain (b)	lbs.	1.76	2.14	2.35	—
Feed requirements (c)	per 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 (d)	$	44.64	37.57	34.28	—
Dressing percent	%	59.9	61.2	62.2	—
Yearlings (a)					
Days on feed	days	200	174	160	160
Aver. daily gain (b)	lbs.	2.0	2.3	2.5	2.5
Feed requirements (c)	per 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 (d)	$	31.38	27.87	25.80	21.64
Dressing percent	%	59.9	61.2	62.2	62.2

(a) 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.

(b) 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.

(c) 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.

(d) Cash costs are itemized in Table 11.

TABLE 3—Carcass weights and comparative liveweight prices by location for slaughter steers from beef feeding programs

Feeding Program	Carcass Weight lbs.	Equivalent Liveweight Price (a): Michigan $	Minnesota and Colorado $
Calves			
Rations			
All silage	617	26.54	25.73
Partial grain	630	27.10	26.30
Full feed of grain	641	27.57	26.76
Yearlings			
Rations			
All silage	647	26.54	25.73
Partial grain	661	27.10	26.30
Full feed of grain	672	27.57	26.76

(a) Equivalent liveweight prices are based on average carcass prices of $44.30 per cwt. in Michigan and $43.00 in Minnesota and Colorado. These averages are based on the assumption that 75 percent of the carcasses grade choice and 25 percent grade good with all rations shown.

1. Reasons related to geographic location (those which *cannot* be affected by management).
2. Reasons related to differences in average feedlot size.
3. Reason related to the different management practices followed by the typical feeder in each area.

Locational Disadvantage of the Northern Corn Belt

Nonfeed cost differences give rise to the major locational disadvantages of cattle feeding in the Northern Corn Belt. The higher nonfeed costs are due primarily to the bedding and housing expenditures associated with the higher precipitation and greater annual temperature variations in the Northern Corn Belt. Neither bedding nor shelter are required in the drier high plains region located in the Southwestern part of the United States. Labor requirements are also lower in the South. These climate related differences in inputs result in increased nonfeed costs for the Northern area (Table 4) which

TABLE 4 — Differences in nonfeed costs between the Northern Corn Belt and Colorado in a 500 head capacity lot

Item	Costs per Calf Fed High Concentrate Ration	
	Northern Corn Belt	Colorado
Labor (a)	$ 7.40	$ 3.67
Feedlot (b)	6.16	2.64
Equipment (c)	5.10	4.68
Silo (d)	.83	.61
Cash costs (e)	18.04	13.66
Total per head	$37.53	$25.26
Total per cwt./gain	6.26	4.21

(a) Based on labor cost of $2.90 per hr. in Northern states and $2.70 in Colorado (if salvage value labor prices $1.50 and $1.40 are used, labor cost is about one half as much).

(b) Annual use cost of 11 percent for depreciation, interest, repairs, taxes and insurance on feedlot investments of $56 in Michigan and $24 in Colorado.

(c) Annual use cost of 17 percent in the Northern states and 18 percent in Colorado for depreciation, interest, taxes and insurance on investment in machinery and equipment of $30 for Northern states and $26 for Colorado.

(d) Based on investments in horizontal silos of $4 per ton in Northern states and $3 in Colorado. The farm in the North would normally have some upright silo storage for corn grain but this is not included above since the average yearly price on corn is used on feed cost calculations in the next section (if corn storage costs are charged, harvest time corn prices should be used).

(e) Excludes interest on feed and cash costs, and marketing and buying costs on cattle. All other nonfeed costs as itemized in Table 11 are included.

total about $2.00 per hundredweight of beef produced. Limited research suggests that to do without buildings and bedding results in lower feedlot performance. However, more research is necessary to determine the most economical combination of shelter, labor and bedding for the Northern area.

Feed costs could differ among areas due to differences in either feed prices or feed conversion efficiency. Feed prices are lower in the Northwestern Corn Belt than in Michigan or Colorado. Consequently, if feed conversion is assumed to be unaffected by differences in climate, average feed costs would be the lowest in the Western Corn Belt. Michigan feeders can partially offset their higher grain cost by feeding more corn silage, which is somewhat cheaper in Michigan than in the Southwest.

The price of cattle, as affected by location with respect to feeder cattle supplies and to population centers, is the third geographic 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 Northwestern 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 what it loses in feed price disadvantage to the Northwestern Corn Belt.

Both areas of the Northern corn belt have a total locational disadvantage of about $1.50 per hundredweight of gain or $9.00 per calf fed a high concentrate ration (Table 5). The disadvantage for yearlings is slightly larger per hundredweight of gain.

TABLE 5—Summary of locational advantages and disadvantages of the Northern Corn Belt over the Southwest

Item	Difference in Cost Per Hundredweight Relative to Colorado (a)	
	Michigan	Minnesota
Feed costs	$ 0	$ 1.00
Nonfeed costs	–2.00	–2.00
Cattle prices	.50	– .50
TOTAL	–1.50	–1.50

(a) Rounded results from calculations based on a calf fed the high concentrate ration.

Since yearlings are usually fed in the larger Southwestern feedlots, 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. For example, at a high efficiency level, 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 a 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 (only $1.18) in this situation was because the unpaid operator's labor would have amounted to $1.23 per hundredweight produced if purchased in Michigan but only half that much if purchased in Colorado.

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.

Feedlot 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 Southwestern feedlots are larger suggests that the typical farm feeder in the Corn Belt may have an even greater cost disadvantage than that due to location alone.

In developing budgets for feedlots of 2000 head capacity as opposed to lots of 500 head capacity it was determined that nonfeed costs would decrease about 60 cents per hundred weight of gain in Colorado and 85 cents in the Northern states as lot size was expanded. However, these savings in nonfeed costs are balanced out by increases in average feed and labor costs when comparing a large feedlot which purchases all inputs to a farm feedlot that uses some home produced feed and surplus family labor which has a relatively low salvage value. Expansion in the North also incurs more additional costs since both feed and labor costs increase relatively faster when expansion goes beyond initial feed and labor supplies. Also, if manure changes from an asset to a liability as feedlot size increases, a value equivalent to about 60 cents per hundredweight of gain is wiped out. The programming results shown in Table 6 indicate

TABLE 6—Comparisons of selected financial return ratios for small and large feedlots, Michigan and Colorado

	Michigan Lot Size		Colorado Lot Size	
Item	500	2000	500	2000
Returns per cwt. of beef produced	$2.47 (a)	$ .75 (b)	$3.65 (a)	$2.86 (b)
Returns per dollar invested in feedlot	.21	.10	.80	.67

(a) If manure credit is removed returns are reduced about $.65 per hundredweight. If the operator's labor is charged, returns are reduced by $1.23 per hundredweight in Michigan and by $.72 in Colorado.

(b) If an interest cost advantage is granted to large feedlots, manure retains some value, or buying and selling costs are reduced, returns will increase.

how these various factors total up to a net advantage to scale in the Southwest as opposed to the disadvantage that is incurred by operating a large lot independent of land ownership in the North.

These results indicate that large scale feedlots operated independently of crop production are 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 hundred-weight compared to 60 cents in the Northern states. Feed costs also 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 net product prices.

In conclusion, the medium sized Northern Corn Belt feedlot of 500 to 1,000 head 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 become less competitive. However, advantages of buying and selling are often achieved by specialized feedlots. Such advantages may be the most significant ones held by large feedlots over farmer feeders in any area. For example, if large 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 advantages of this type may be more important than the savings in other costs which accrue as size increases, the extent of such advantages have not been determined in any study to date.

Management Disadvantages of the Northern Corn Belt

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. 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. Table 7 shows the performance of cattle in Northern feedlots in contrast to Southern feedlots in the same feeding year. The

TABLE 7—Feedlot performance of short-fed yearling steers 1960-61

Item	Unit	Colo (a)	Ariz (b)	Minn (c)	Mich (d)
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 T.D.N.	lbs.	5.9	6.1	8.2	8.0

(a) Source: Hunter, Elmer C. and J. Patrick Madden (1966). Economies of size for specialized beef feedlots in Colorado. USDA Agr. Econ. Rep. No. 91.

(b) Source: Pawson, Walter W. (1964). Emerging patterns of feedlot management in the Southwest and interregional competition in the locations of cattle feeds. U.S.D.A.

(c) Source: Wells, A.R., and T. R. Nodland (1962). Feeder cattle costs and returns, 1960-1961. Univ. of Minn. Dept. of Agr. Econ. Rep. No. 266.

(d) Source: Wright K. T. (1963). Cattle feeding economics II, Causes and variations in costs and returns in Michigan, 1961-1962. Mich. Agr. Expt. Sta. Quart. Bul. 45:560.

Northern lots averaged one-third more feed nutrients per unit of gain. Part of this was probably due to an overestimation of feed by Northern feeders, but over half the difference was probably due to the factors just listed. However, the well managed feedlot in the Northern Corn Belt need not embrace practices which result in such poor feed conversion.

Secondly, it is known that **average daily gains and rate of cattle turnover 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 a 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 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, specialized feedlots have economic advantages over the average farm feeder because of improved management practices, and the Corn Belt feeders who want to put their cattle feeding enterprise on a paying basis will have to improve their management efficiency.

Many of the small feeder's disadvantages stem from a lack of knowledge. Others are due to economic forces which, although they result in apparent disadvantages in cattle feeding costs and returns, may actually bring higher returns to an overall crop-livestock business. The small feeder must decide if the actual or aesthetic value of a particular advantage is worth the cost of acquiring the knowledge and/or taking the action necessary to gain the advantage. Many of the differences in management efficiency between the small and large feeders are what should be expected when a sideline enterprise is contrasted with a large commercial enterprise.

MANAGEMENT PRACTICES FOR MAXIMUM RETURNS

The findings reviewed have 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 large scale lots continue to develop in the Southwest. As these lots account for more and more of the total beef production they will also tend to lower the average beef production costs. Therefore, farmer feeders who wish to add monetary returns to their farm business from feedlots will have to sharpen their management practices.

The comparison of different technologies, practices, or programs in order to determine "the best one" is very complex. 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 vague unless agreement can be reached as to which financial ratios are the most appropriate. 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 be made in general terms, and more specific recommendations will be qualified with regard to their respective planning situations.

Types of Cattle to Feed

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 had the potential for 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 has also indicated that such an advantage is possible. Therefore, more Corn Belt feeders should shift to these lower grade cattle to take advantage of this price margin and to help to bring the prices of these feeders more in line with their value. Holstein cattle, so plentiful in the Lake States, offer a good potential supply of lower grade feeders to Northern Corn Belt feeders.

In feeding lower grade cattle, evidence suggests that a high concentrate ration may be used as well as a high roughage one. Thus, the traditional advice 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—especially those in the Northeastern Corn Belt—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 yearling 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 to 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 should 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 revelant 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 begin 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 not substitute for corn grain. However, cobs will substitute for hay as the roughage part of the ration, so when hay is not available the cobs in a full feed of ground ear corn can furnish the total roughage requirements 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 feeding operation.

As the price of corn moves up it becomes more profitable to use higher silage rations. Thus, higher silage rations should be used more 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 1 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 occurs 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 labor is the important factor limiting expansion in cattle feeding, a high concentrate ration will allow more cattle to be fed.

The importance of the resource situation and planning restriction in determining which ration is the most profitable can be seen in the comparisons shown in Table 8.

TABLE 8—Returns to fixed resources and returns per head from three different rations under different planning situations (a)

	Return to Fixed Resources			Return per Head Fed		
	Type of Ration			Type of Ration		
Planning Situation	All Silage	Part. Conc.	Full Feed	All Silage	Part. Conc.	Full Feed
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

(a) Calves are bought in Michigan for $32.50 per hundredweight and sold for $44.30 per hundredweight of carcass beef.

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 (see returns to different rations in the single lot per year situation in Table 8.) That is, if facilities and labor availability permit 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. It makes little difference whether feeding returns are 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. When feed requirements were increased 10 percent, there was not only a tendency to feed higher silage rations but also to feed only one group of cattle a year and to carry the cattle to heavier weights. Conversely, when feeding profits were improved over the normal relationships used in this study, more yearling feeding programs came into the solutions. 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.

Type of Facilities

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 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 distributed to cattle? How might the organization and cost of all these tasks be changed if the feedlot is expanded 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 bedding and manure handling plus decisions relative to feed storage and handling, and the capital position of the potential feeder.

If the feedlot is expected to grow to over 500 head capacity, strong consideration should be given to the fenceline bunk system. Also, unless feed savings are

realized, the confined, slotted floor system should probably be ruled out on the basis of its high initial cost which may preclude continued growth on the basis of feedlot earnings.

The open shed-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 would like to feed a few hundred cattle a year without any additional help. **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. However, until research demonstrates that a saving in feed can be realized from confinement housing which has some *environmental control features*, this type of housing will not be recognized as being economically desirable if slotted floor systems can function in a building with an open side.

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 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 when little or no bedding is used. 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 unsheltered lots and feed requirements would be higher by about 5 percent (almost $1 per hundredweight).

If straw is inexpensive, 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 it has no concrete floor). 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 when labor costs are included) this totals up to a bedding cost of about $1 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 on 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 the labor to handle straw and manure. It has a lower investment cost than the slotted floor system. It has a higher investment cost than the no housing system but 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 indicate 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 continually expands 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.
4) Feed high concentrate rations.

The impact of type of ration fed and of feeding to capacity of unit instead of only one group a year is shown in Table 9. It should be noted that nonfeed costs per unit of gain are decreased by shifting to a higher concentrate ration and also by feeding more than one lot of cattle per year. However, it should

TABLE 9—Effects of capacity use and type of ration on costs and returns

Item	Unit	One Lot Per Year		Capacity Use
		All Silage Ration	Full Feed Ration	Full Feed Ration
Nonfeed costs (a)	$/cwt.	6.24	5.01	4.44
Net return (b)	$/cwt.	3.94	3.31	3.79
Total added return	$	11,598	9,928	16,467

(a) Excludes labor costs which are higher for the all silage program.
(b) Calculated from computer results.

also be noted that *if only one lot is to be fed* each year, the lower feed costs of the high forage ration may more than compensate for the higher nonfeed costs associated with such a ration, thus resulting in higher total feedlot returns.

FUTURE GROWTH

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.

The comparative propensity for feedlot expansion or abandonment is evident in the profit maximizing solutions shown in Table 10 for various resource and price situations in the three states. As efficient feedlot operators continue to expand, feeder cattle prices will be bid upward relative to slaughter prices. The influence of such narrowing margins can be studied in this table.

TABLE 10—Comparative feedlot activity under progressively higher feeder cattle prices by farm type by state

Planning Situation	Kansas City Base Feeder Calf Price	Mich.	Minn.	Colo.
Limited Labor Crop Farm	$30.50	569	537	1,317 (a)
	32.50	417	455	891
	34.50	156	325	875
	36.50	1.05 (b)	2.38 (b)	.55 (b)
Beef Feeding Farm—500 head capacity	$30.50	1,380	1,397	2,425 (a)
	32.50	1,128	1,167	1,614
	34.50	667 (c)	725 (c)	1,614
	36.50	354	574	506
	38.50	213 (d)	.02 (b)	1.45 (b)
No Physical Resources	$30.50	2,978	4,715	12,896 (a)
	32.50	1,702 (e)	1,508 (e)	8,061
Old Lot—2500 Head capacity	$30.50	6,709	7,588	13,474 (a)
	32.50	3,333 (c)	3,623 (c)	8,454
	34.50	1,702 (e)	1,702 (e)	3,623 (c)

(a) Yearlings, all other figures are calves.
(b) Reduction in earnings if one calf is fed.
(c) The existing lot is used to capacity. The 1 percent ration is fed in Michigan, the high concentrate ration in Minnesota and Colorado.
(d) A total of $271 is added over not feeding.
(e) Cattle feeding is expanded only to the limit of the feed that was raised on 900 acres. The 1 percent ration is selected.

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 up 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).

Some people wonder what has changed to put the Corn Belt area in the weaker competitive position since its historic domination 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 were 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 major changes have been the rapid development of irrigation wells 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. Consequently, any area concerned with its competitive position in cattle feeding might best measure itself against the Southern Plains States.

To better appreciate the magnitude of the long term changes that would have to occur to improve the locational position of the Northern Corn Belt the following list contains items which would obtain a decrease of $1.00 per hundred weight in the return differential between the two areas.

1. An $.11 change in the grain price differential.
2. The elimination of bedding costs in Northern feedlots without significantly increasing other costs.
3. An increase in the fed cattle price differential between the two areas of $.94 per hundredweight of carcass beef.
4. A decrease in the feeder price differential of $1.40 per hundredweight.

The following changes could save $.50 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 at least partially 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.

Some factors that may tend to further 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, Southwest, 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 suggests that feedlots which exhibit firm 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.

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. 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 (Table 11).
2. Learn the arts of buying and selling or get commission firms to do a better job of buying for them on basis of gainability and selling on basis of retail value.

TABLE 11—Variable Cash Costs for Cattle Feeding in Michigan and Minnesota

Item	Beef Calves			Beef Yearlings				Dairy	Dairy
	All Silage	1% Conc.	2% Conc.	All Silage	1% Conc.	2% Conc.	Haylage	Calves	Yearlings
Selling cost (a)	$ 5.78	$ 5.78	$ 5.78	$ 5.90	$ 5.90	$ 5.90	$ 5.92	$ 5.92	$ 6.01
Protein (b)	19.21	15.40	13.65	11.30	9.57	8.56	4.60	15.40	9.57
Salt and mineral mix	.80	.67	.60	.80	.67	.60	.60	.70	.70
Vet. and med. (c)	1.50	1.50	1.50	.75	.75	.75	.75	1.50	.75
Bedding (.75¢/lb.) (d)	8.50	7.00	6.38	6.00	5.22	4.80	4.80	7.35	5.48
Manure handling ($1.10/hr.) (e)	.75	.62	.56	.53	.45	.42	.42	.65	.47
Process grain ($.23/100 bu.) (c)	—	.07	.12	—	.06	.11	.12	.07	.06
Unloading silos ($.09/ton) (c)	.65	.47	.34	.51	.39	.25	.19	.51	.43
Distributing feed ($.19/ton) (c)	1.37	.99	.72	1.12	.84	.55	.40	1.03	.92
Death loss (f)	2.33	2.29	2.27	1.39	1.38	1.38	1.38	1.74	1.19
Other (c)	.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 (g)	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

(a) 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.

(b) 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.

(c) Source: Van Arsdall, Roy N. (1965). Resource requirements, investment costs, and expected returns from selected beef-feeding and beef-raising enterprises. Ill. Agr. Expt. Sta. AE-4075.

(d) Bedding is all purchased. Use is limited to 3⅓ pounds per day for calves and 4 pounds for yearlings.

(e) 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.

(f) 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.

(g) Estimated value of nutrients that are returned to the field.

For Market Agencies

1. 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 expansion financing 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 where summers are cool, winters are mild, and precipitation is low.
2. Best location from standpoints of feed, feeder supplies and product market is one which minimizes input costs—transportation costs 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 effects 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.

For Extension Workers

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.

9-68—11M