Economic Study Report S–70–1 March 1970

Slotted Floor Beef Housing vs. Other Housing Systems an economic analysis

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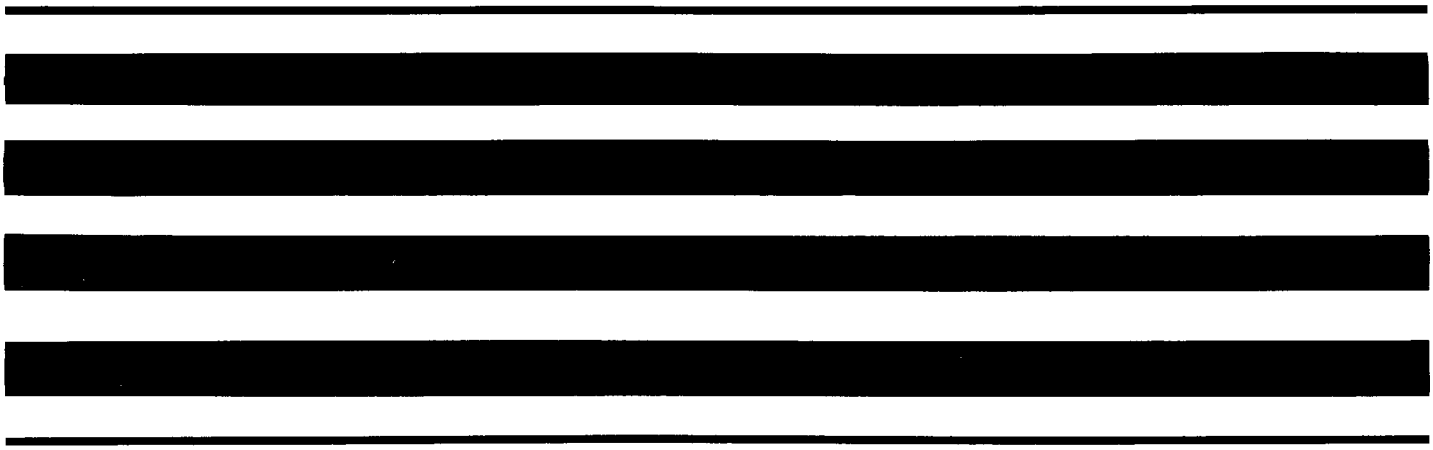

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ALTERNATIVE BEEF HOUSING SYSTEMS: AN ECONOMIC ANALYSIS

by

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Confinement slotted floor beef housing systems have been built by a number of midwestern cattle feeders in recent years. Others have gone to systems with no housing facilities. Many other feeders, potential feeders, and creditors are asking questions about the economic advantages or disadvantages of these systems compared with the more traditional housing systems.

Purpose of Study

This study was initiated to determine the resource requirements of various beef housing systems and to make a comparative economic evaluation of the different systems under different resource price situations. A previous study by one of the authors indicated that cold confinement, slotted floor systems should be considered when labor was limited and bedding expensive (5). This more detailed study was aimed at determining the economic advantages and disadvantages of slotted floor systems under different resource situations.

Method of Study

An attempt was made to visit all the slotted floor beef feeding facilities in the state in the summer of 1968. Twelve Minnesota cattle feeders were personally interviewed to obtain information on investments and operating costs associated with their cold and warm confinement slotted floor facilities. Costs associated with other types of housing systems were obtained through a review of research publications from several agricultural experiment stations.

Major factors determining the most desirable housing system include investment and annual use costs, bedding costs, manure values, and rate of gain and feed efficiency considerations under the various systems. Information concerning these items was obtained from the survey for systems that are now producing beef in confinement. Costs of these systems are then compared with costs of other systems under various resource price assumptions. Comparisons are made at the 200 and 500 head level of capacity, with calf and yearling feeding programs. No attempt is made to compare the various feed storage facilities which might be selected.

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Description of Systems

There are many different housing and feeding systems in use. They might be classified into three general types. These are:

1) Drylot systems - housing, concrete lots.

2) Open lot systems - no housing, earthen lot.

3) Confinement systems - solid or slotted floors.

The drylot system is the conventional system, but there is a growing interest in both confinement and open lot systems.

All systems need a corral. The corral would include a loading chute, a squeeze chute, and a sorting area. The corral arrangement should include a scale also.

For this study it is assumed that each system has the same feed storage and processing facilities. These facilities include storage for shelled corn and corn silage in concrete stave silos, mechanical silo unloaders, a hoppered bulk bin for supplement, a mechanical feed metering device, and an electrically driven conveyor feeder to deliver feed to the cattle. With the open lot system a self-unloading wagon would be used to deliver feed from the silos to fenceline bunks.

With the liquid manure systems, a centrifugal chopper pump empties the pit into a manure tank wagon. With the other systems a front end loader and spreader are used to remove manure.

Drylot Systems

This study considers two conventional drylot systems -- the drylot, paved and the drylot, partially paved. These systems consist of an open-front loafing shed and a completely paved lot. The floor of the loafing shed may be paved. There is a feed bunk with one foot of feed space per head capacity. A roof over the bunk protects the feed and the conveyor from the weather. The feed processing and storage facilities are located at the end of the bunk outside of the lot.

The drylot, paved system has 35 square feet of lot space per head of capacity. A waterer is provided for every 100 head of capacity. There is 25 square feet of space per head capacity in the loafing shed. This includes storage room for bedding. A wooden plank fence encloses three sides of the lot with the loafing shed on the fourth. Open front sheds should face south or east.

The drylot, partially paved system is used by feeders who prefer larger lots and/or less concrete. In this case, additional lot space can be provided on sloping land or in the form of clay or corncob mounds. The floor of the loafing shed may be dirt or concrete, but pavement should cover a 10-foot area in front of the loafing shed, and a 10-foot area on either side of the feed bunks and the waterers. One hundred and fifty square feet of lot space is recommended per head capacity in the lot, including the paved and the unpaved portions.

Open Lot Systems

The open lot system consists of a large dirt lot with no buildings. The lot is not paved except for 10 feet along the inside of the fenceline bunk. There is a 10-foot-high fence on the north side of the lot to protect the cattle from the north winds in the winter and wooden plank fence on the other two sides. Snowfence may be used for shade in the summer. One foot of feeding space per head capacity is provided in the fenceline bunk. A waterer is provided for every 100 head of capacity. Because the lot has no concrete, 200 square feet per head of capacity is allowed. A 16-foot-wide gravel lane, for feed wagons and moving the cattle, runs the length of the fenceline bunk. The feed processing and storage facilities are located a short distance from the lots.

Confinement Systems

The two cold confinement systems have a pole-type or rigid frame barn with the south side left open. A plank or cable fence runs along the open side. During the summer the north side is opened to allow more ventilation. The feed bunk runs through the building with 6 to 9 inches of feeding space per head capacity.

In the cold confinement, solid floor system the floor of the barn is solid concrete sloping to the outside. Thirty square feet per head of capacity is provided in the barn. This includes storage space for bedding.

For the cold confinement, slotted floor facility, 16-20 square feet of floor space per head of capacity is provided. Under the slotted floor are liquid manure storage pits. For easy cleaning, the pits are designed so that the farthest point from the pumping area is not more than 35 feet away (9). A waterer is provided for every 100 head of capacity.

In the warm confinement facility, the building must be totally enclosed and insulated. The building must be fan-ventilated to provide at least 100 cubic feet of air per minute per 1000 pounds capacity in the winter and two to six times this amount in the summer (1). The building should have lighting both day and night. A liquid manure system is also used in this facility.

Resource Requirements of Different Housing Systems

This section will itemize the resources which are required for each of the above described systems. Only those inputs which vary with type of facility will be considered in detail.

Investment and Annual Costs of Various Systems

The investment and annual costs for the different systems are presented in table 1. The investment figures are representative of costs for the year 1968.

The investment costs vary from $19 to $143 per head of capacity for the total system. These costs vary by type of system and by size of the lot. Some of the different elements in the feedlot system are nondivisible; therefore, with small numbers of cattle the cost per head is high. The investment costs in table 1 include housing, fencing, and concrete areas; feeding augers, conveyors, motors, electric service and controls, and bunks; water equipment; and feed handling equipment.

Table 1. Investment and annual costs of actual lot facilities [1/]

System	200 Head			500 Head		
	Total investment	Investment per head	Annual cost per head	Total investment	Investment per head	Annual cost per head
Drylot, paved	11,000	55	6.41	27,160	54	6.29
Drylot, partially paved	9,660	48	5.69	23,087	46	5.36
Open lot	4,745	24	3.12	9,692	19	2.47
Cold confinement, solid floor	9,825	50	6.00	24,825	50	6.00
Cold confinement, slotted floor	23,100	116	13.08	45,300	91	10.26
Warm confinement, slotted floor	28,500	143	16.32	49,500	99	11.30

[1/] Appendix table A gives a breakdown of investment costs of actual lot facilities.

The investment per head of capacity for the warm confinement facility is $88 more than the drylot, paved system at the 200 head level and $45 more at the 500 head level. The cold confinement, slotted floor system is $61 more than the drylot, paved at the 200 head level and $37 more at the 500 head level.

The annual costs shown in table 1 were computed as a percentage of investment costs allocated for depreciation, interest, taxes, and insurance. Table 2 shows the rates that were used for computing annual costs.

Table 2. Rates used to calculate the annual use costs shown in table 1

Item	Feed storage, barns, and lots	Equipment
	Percent of original investment	
Depreciation	5.0%	8.0%
Interest	3.0	4.0
Repairs	1.5	2.5
Taxes	1.0	1.2
Insurance	.3	.3
Total	10.8%	16.0%

The increased annual ownership associated with the larger investments in the slotted floor facilities must be offset by savings in items such as bedding, labor, manure nutrients, or feed efficiency.

Investments in feed storage and manure handling equipment are not included in table 1 since they do not affect the economic comparison of housing systems. Feed storage and unloading equipment investments for all systems amount to about $17,000 at the 200 head level and $32,000 at the 500 head level. Manure disposal equipment costs about $3,000 for either the liquid or solid manure system.

Variable Costs

The electricity for running the fans must be included in the cost of the warm confinement facility. Survey results indicate that this cost is about 1/3¢ per head per day. This cost is not incurred in any of the other systems.

Rate of Gain and Feed Efficiency

The drylot, paved facility will be used as a standard from which to compare other systems for rates of gain and feed efficiency. The rations fed to the cattle in this facility are assumed to produce an average daily gain of 2.5 pounds for yearlings and 2.1 pounds for calves.

A study in Iowa comparing drylot, paved with drylot, part paved and with open lot found that yearlings during the winter gain .43 to .54 pounds less per day in an open lot and .1 pound less per day in a drylot, part paved. During the summer the advantage for the drylot, paved over the open lot was only .2 pound average daily gain while with open lot, partially paved it was .1 pound (14). Similarly, feed efficiency was reduced 6 percent in open lot and 2 percent in drylot, partially paved as compared to drylot, paved (13). Research at Ohio produced similar results when comparing open lot to drylot, paved (2).

In research conducted at Ohio (11) and Michigan (6), little consistent difference in the rate of gain or feed efficiency was observed between drylot, paved, cold confinement, solid floor, or cold confinement, slotted floor. Although research with warm confinement is limited, the results to date do not show a significant increase in feed efficiency with environmental controls. Thus, no difference in feed costs is assumed for the warm confinement systems over the traditional drylot, paved facility.

When feed efficiency is depressed in open lot and drylot, part paved, feed costs will be increased. On the basis of the research findings related above, the assumptions used in this study are that when cattle are fed to the same weight, feed cost for each animal fed will be increased by 6 percent in the open lot and 2 percent in the drylot, part paved over the drylot, paved system.

When average daily gain is depressed, a longer feeding period is necessary to reach a given weight. This will raise the interest and cash costs on each feeder animal 5 percent for calves and 4.4 percent for yearlings in drylot, part paved, and 17 percent for calves and 14 percent for yearlings in the open lot. These are the costs that will be increased when the feedlot is not used at 100 percent capacity. When the feedlots are used to capacity, not only will interest costs be higher but also per head fixed costs will be higher for drylot, part paved and open lot. In addition fewer finished cattle would be produced per year in these two types of systems, thereby depressing profits per unit of capacity. Table 3 shows the combined effect of rate of gain and feed efficiency on costs among the various systems.

Table 3. Effect of differences in rate of gain and feed efficiency on production costs for the different systems as compared to to the drylot, paved system

System	Unit	Calves[1/]	Yearlings A[2/]	Yearlings B[3/]
Drylot, part paved	$/head	+1.99	+1.57	+2.35
Open lot	$/head	+6.10	+4.78	+6.84
Confinement systems	$/head		No change	

1/ One lot of calves per year is fed to gain 2.1 pounds/day for 280 days in the drylot, paved.

2/ Two lots of yearlings per year are fed to gain 2.5 pounds/day for 160 days in the drylot, paved.

3/ Lot is kept filled to capacity with yearlings.

Bedding Requirements

The two drylot facilities and the confinement, solid floor facility require bedding. About 3 pounds of bedding per day are required in a calf feeding program. If bedded for the total feeding period, the bedding requirement per head would be .42 tons. Assuming 3.4 pounds of bedding per day for yearlings, they will need .27 tons for the feeding period. These amounts would be required for the confinement, solid floor facility since the cattle are housed throughout the feeding period.

In the two drylot facilities it is assumed that cattle are bedded only one-half of the year. This will cut the bedding requirements per head by one-half. Therefore, the requirements for calves in these facilities will be .21 tons per head and the requirement for yearlings will be .14 tons per head.

In both slotted floor systems and in the open lot system no bedding is required. Some open lot systems use mounds of corncobs but others use dirt mounds or natural drainage to keep cattle out of the mud. Bedding requirements by systems are summarized in table 4.

Labor Requirements

The nine labor requirements in feeding cattle are feeding; maintenance and care of feeding equipment; bedding; watering; observation, care, and treatment of sick animals; feed grinding; manure disposal; buying and selling; and miscellaneous (3). Feed grinding tasks include all time spent preparing feed for cattle, and miscellaneous tasks are those that are irregular in nature. Not all categories are required for the different systems. For instance, there is no bedding chore when slotted floor facilities are used.

Larger lots require less labor per head than smaller lots. A certain amount of time is required for each task regardless of the number of cattle in the lot. With larger lots, this fixed time is spread over a larger number of cattle.

Labor requirements for feeding cattle depend upon the degree of mechanization in addition to the size of the lot. Labor requirements decrease as the system changes from low mechanization to complete mechanization with all electrically powered in-place equipment (3).

The amount of labor required per head also varies with the length of feeding period. The longer the feeding period, the higher the labor requirement will be.

The labor requirements for the different housing systems have been estimated and are presented in table 4.

Table 4. Estimated bedding requirements and labor requirements for two size categories for the different facilities

Description	Bedding requirements	Labor required per head in hours [1]	
	Tons/Head	200 Head	350-700 Head
Calves [2]			
Drylot, paved	.21	4.2	2.1
Drylot, partially paved	.21	4.2	2.1
Open lot	--	4.8	2.5
Cold confinement, solid floor	.42	4.2	2.1
Cold confinement, slotted floor	--	3.5	1.7
Warm confinement, slotted floor	--	3.5	1.7
Yearlings [3]			
Drylot, paved	.14	2.4	1.6
Drylot, partially paved	.14	2.4	1.6
Open lot	--	2.7	1.8
Cold confinement, solid floor	.27	2.4	1.6
Cold confinement, slotted floor	--	2.0	1.3
Warm confinement, slotted floor	--	2.0	1.3

[1] Feeding is completely mechanized.

[2] Calves are fed 280 days and gain 2.1 pounds per day in the drylot systems.

[3] Yearlings are fed 160 days and gain 2.5 pounds per day in the drylot systems.

PRODUCT VALUE DIFFERENCES

Different housing systems may result in differences in the value of the products produced -- differences in the value of beef, of by-products, or of manure. Research to date has shown no consistent change in the cut-out value of the beef from the different systems. The value of one of the major by-products, hides, might be expected to be different but no research results were found on this question. However, an estimate was made on the possible differences in the value of manure products under the different housing systems.

Manure Value

Manure can be a potential source of income by an indirect process of reducing the fertilizer cost of the crops produced. But not all of the nutrients excreted are delivered to the crops. After the manure has been excreted, losses accrue from storage, handling, leaching, volatilization, or loss of the liquid portion. The facilities differ in the amount of nutrients which are preserved.

A laboratory analysis of manure retained under one slotted floor facility indicated a nutrient content of 1/2 percent N, 1/2 percent P_2O_5, and 1/2 percent K_2O.* This manure was from yearlings which were full fed for a gain of 2.5 pounds per day. On a 160-day feeding period this resulted in a calculated per-head manure value of $5.02. Similarly calves fed 280 days for a gain of 2.1 pounds per day would have an estimated per-head manure value of $6.50 (12). Table 5 shows the estimates of the value of manure that might be salvaged under the different systems.

Table 5. Approximate manure value with different systems

System	Units	Calves 1/	Yearlings 2/
Drylot, paved	$/head	4.88	3.75
Drylot, partially paved	$/head	3.90	3.00
Open lot	$/head	3.25	2.50
Confinement systems	$/head	6.50	5.00

1/ Calves are fed a ration so that they will gain 2.1 pounds per day for 280 days.

2/ Yearlings are fed a ration so they will gain 2.5 pounds per day for 160 days.

COMPARATIVE NET HOUSING COSTS

Given the resource requirements shown in tables 2, 3, and 4, costs of these resources can be calculated using resource prices appropriate to a given situation. And, if the manure is to be utilized in a cropping program, a manure credit such as shown in table 5 can be subtracted from the other costs to arrive at a net cost of housing for each system relative to the other systems. If a system increases feed costs, this is charged against it. And if it preserves more manure nutrients, the net cost is lowered whenever a manure credit is used.

Examples of comparative housing costs under different resource price combinations are shown in table 6.

* Personal interview with a cattle feeder.

Table 6. Comparative costs per head [1/] for selected housing systems for different feeding programs under various resource price situations

Housing system	Resource price situations [2/] A	B	C
	200 head lot, one lot of calves per year		
Warm confinement, slotted floors	$18.32	$23.57	$30.84
Cold confinement, slotted floors	15.08	20.33*	26.79
Drylot, paved	13.18*	21.58	23.91
Open lot	16.42	24.14	22.75*
	200 head lot, two groups of yearlings		
Warm confinement, slotted floor	$ 7.61	$ 8.86	$15.40
Cold confinement, slotted floor	5.99	7.24*	13.37
Drylot, paved	5.76*	8.76	12.53*
Open lot	9.04	10.84	12.78
	500 head lot, two groups of yearlings		
Warm confinement, slotted floor	$ 5.10	$ 7.05	$12.60
Cold confinement, slotted floor	4.58*	6.53*	11.70*
Drylot, paved	5.70	9.78	12.45
Open lot	8.72	11.54	13.33

* Lowest cost system.

1/ Comparative costs include annual building and lot ownership costs (depreciation, interest, repairs, taxes), labor costs, bedding costs, and the added feed costs associated with feeding in an open lot, less credit for the extra manure nutrients saved in the systems with housing.

2/ Resource prices used for each situation are as follows:

Situation A: Capital, labor, and bedding are all plentiful and manure is used. Interest rate = 6%; labor = $1.50/hour; bedding = $10.00/ton.

Situation B: All resources have increased in price with labor and bedding showing the largest increases, manure is used. Interest rate = 8%; labor = $3.00/hour; bedding = $20.00/ton.

Situation C: Capital and bedding are short, labor available, manure not used. Interest rate = 12%; labor = $2.00/hour; bedding = $20.00/ton.

The analysis made in this study indicates that the conventional drylot systems have been the lowest in cost under the low prices on labor and bedding that most farm feeders in the northern cornbelt had in the past (situation A). But, as labor and bedding become more costly and as farm feedlots expand in size beyond 200 head, the open lot or slotted floor systems are becoming more competitive. Also, as facilities are used to capacity with continuous feeding of yearlings, the slotted floor, cold confinement system becomes strongly competetive. Some advantages and disadvantages of each of the systems are described below.

The Drylot System

The drylot systems, which provide shelter and a lot with varying amounts of concrete, are medium-investment facilities that have been popular with cornbelt feeders in the past. A large amount of research and experience has been gained in their operation. Favorable rates of gain and feed efficiency have been experienced. Labor requirements have been reduced by mechanized feeding and manure disposal.

Many feeders have reduced investment costs by using a larger lot with partial concrete or no concrete rather than a smaller, completely concrete, lot. But the results of this study indicate that unless the partly paved drylot is well located with respect to climate and topography it may be a higher-cost production system than the fully paved drylot, since, if feedlot gains are depressed, the slightly lower investment costs may be more than offset by the higher costs associated with lower feed efficiency and slower rate of gain. Therefore, if a drylot system of feeding cattle is chosen it may prove economically advantageous to pave the entire lot.

The Open Lot

Open lot systems with no housing facilities are the standard with the larger scale commercial feeders in the drier western areas. The open lot system is undoubtedly the lowest investment production system. This makes the system attractive to those who wish to feed a large number of cattle. It is also attractive to those who wish to feed cattle but are unable to make a large investment in facilities. The open lot also offers more flexibility with respect to expansion or contraction in the number of cattle on feed. It is not so necessary to keep the lot full to capacity since there are lower fixed costs to be recovered.

If, however, feed efficiency is cut by more than a few percentage points, the saving in investment cost will be more than offset by increases in the costs associated with lower feed efficiency and slower rates of gain. Lower feed efficiency raises feed costs. Slower rates of gain increase per-head fixed costs, interest charges on the feeder animal, and labor costs. Sun, rain, and subsequent runoff also considerably reduce the fertilizer value of the manure in open lots.

Additional problems may be encountered with flies and odors. And, if surface runoff threatens to pollute streams and wells, additional costs may be required for control of such runoff. Also, cattle are often harder to sort, handle, treat, and observe especially during extreme weather conditions.

The open lot system does not compare favorably with drylots when 200-500 head capacity lots are considered unless one or both of the following conditions exist: (1) in such cases where topography and climate conditions allow similar rates of gain and feed efficiency as in drylots, or (2) if the manure has no value to the feedlot owner.

Cold Confinement, Solid Floor

Cold confinement, solid floor systems may require less investment than the drylot, paved because less concrete and fencing are used. Another advantage is that manure value will be increased because of less exposure to sun and rain.

These advantages, though, appear to be offset by the increased cost of bedding and labor used in spreading this bedding. If the cattle feeder is in a bedding deficient area, the confinement, solid floor facility will actually be a higher cost production system. Also, manure accumulation and disposal may present physical problems at certain times of the year when this facility is in use.

Cold Confinement, Slotted Floor

Using the resource requirements determined in this study, the cold confinement, slotted floor facility has the greatest relative advantage of the systems studied in the 200-500 head capacity level. Although the initial investment is higher, the higher annual fixed costs will be more than offset by increased manure value and by savings in labor and bedding. In areas where labor and/or bedding is expensive the relative advantage becomes even more substantial. To show the greatest advantage these facilities should be used to maximum capacity and additional cattle should be fed with the labor that is saved.

Other advantages of confined, slotted floor systems include the reduced chance of polluting streams and wells. Flies and odors have caused fewer problems. Cattle are easier to sort, handle, treat, and observe, especially during rainy or snowbound conditions. Problems with liquid manure disposal have been minimal if the building has been well-designed. Liquid manure disposal may be easier to schedule with seasonal labor supply than solid manure. Confinement facilities also lend themselves more readily to mechanized and automatic feed handling and distribution equipment.

On the other hand, there are certain disadvantages with this system. The high investment makes expansion difficult in situations where real estate capital is limited. And flexibility of the owner is reduced once investments are made. If the facility is idled, high fixed costs will not be recovered.

Warm Confinement, Slotted Floor

Warm confinement, slotted floor facilities will not be economically justified unless further research demonstrates an increase in feed efficiency with environmental control features. Further research and experience may also solve the ventilation and condensation problems which have been encountered by many Minnesota feeders with warm confinement facilities. Experience indicates that the building does not have to stay warm to keep the manure moving through the slotted floor. The other advantages of slotted floor facilities apparently can be obtained in cold confinement buildings -- at least in southern Minnesota.

SUMMARY

The major purpose of this study was to make an economic evaluation of slotted floor beef housing systems. To accomplish this, two slotted floor systems, cold and warm, were compared with typical drylot systems and an open lot system.

Traditional drylot systems, or confinement with solid floor, appear to provide the lowest cost feedlot facilities for small scale feedlots when bedding and labor are plentiful.

Slotted floor systems are most advantageous when bedding and labor are expensive. Also, capital for housing must be readily available to justify these systems. If size is large enough, the slotted floor system may be justifiable even though no extra credit is allowed for manure value in this system. Warm confinement, however, will not be economically justifiable unless further research can demonstrate increased feed efficiency for this system over cold confinement.

The open lot system may be the cheapest when little or no value is placed on the manure and/or investment capital is quite limited. The biggest factor affecting the relative cost of this system is the effect it has on feed conversion. If the lot site is such that losses from this factor are much greater or less than the 6 percent average added feed cost assumed for open lots in this study, total comparative costs would change considerably.

Appendix Table A. Approximate costs of components of lot facilities

Item	Cost	
	200 head	500 head
Drylot Paved [1]		
Pole barn @ $1.25/sq. ft.	$6,250	$15,625
Fencing @ $1.50/ft.	400	585
Concrete @ $.30/sq. ft.	2,100	5,250
Bunk @ $5/ft.	500	1,250
Roof over bunk @ $3/ft.	300	750
Feeding auger @ $9/ft.	900	2,250
Motors and electric service	400	1,000
Water @ $150/unit	150	450
Open Lot [2]		
Land	200	500
Fencing	900	1,350
Fenceline bunks @ $6/ft.	1,200	3,000
Water	300	750
Concrete	600	1,500
Feed delivery equipment -- self-unloading wagon	1,550	2,600
Cold Confinement [3]		
Building, water, bunk, feed delivery system	11,100	25,300
Slotted floor and pit @ $2.50-3.00/sq. ft.	12,000	25,000
Warm Confinement [3]		
Buildings, water, bunk, feed delivery system	15,500	22,500
Ventilation equipment and wiring	1,000	2,000
Slotted floor and pit	12,000	25,000

[1] The drylot, part paved has the same breakdown as drylot, paved except that less concrete is used in the partly paved lot and more fencing is used to enclose the larger lot.

In the cold confinement, solid floor no fencing is required. Less concrete is required because the amount of concrete used in the floor of the building is less than the amount used in the lot area of the paved drylot.

[2] Source: Estimated Investment Costs -- Open Lot Fenceline Bunk Systems by Size of Feedlot, Oklahoma State University Study, 1965.

[3] Results obtained through personal interviews with farm feeders.

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