FACILITIES FOR FEEDING HOLSTEIN AND BEEF CATTLE

Steven Rust
Department of Animal Science
Michigan State University
Lansing, MI

Adverse climatic conditions impose additional restrictions and requirements on cattle. Since cattle are homeotherms, energy must be expended to maintain body temperature within a defined range (NRC, 1981; Figure 1). This range is called the thermoneutral zone. As external temperature increase or decrease outside of this range, the metabolic machinery must expend energy to maintain body temperature. Consequently, more energy is needed for maintenance and less is available for productive purposed. For growing-finishing cattle, this translates into less gain. As environmental temperatures decrease below the thermoneutral zone, the animal must generate more body heat to survive. This is accomplished by increasing dry matter intake and cellular metabolism. However, extremely cold conditions may cause a cessation of intake. As temperatures elevate above the uppermost portion of the thermoneutral zone, an animal must dissipate excess body heat. Dry matter intake and cellular activity will decrease. Figure 2 demonstrates the effects of temperature on dry matter intake. Notice the behavioral shift that can occur under extremely cold conditions. Unfavorable pen conditions such as excessive mud or frozen clods can severely impact behavior patterns and intake. Given the opportunity, cattle will seek relief from adverse conditions by moving to sheltered areas or shade.

The thermoneutral zone can shift to lower or higher temperatures with adequate adaptation. Maintenance requirements at 15°F will be 10% lower for an animal adapted to 15°F than at 33°F. In addition, wind, moisture, and muddy conditions can also increase maintenance requirements.

In the final analysis, the animal regulates intake and metabolism to adjust to changing climatic conditions, however, there are limits. Severe environmental stresses result in lowered weight gain. The examples in Table 1 indicate the importance of temperature adaptation, shelter from the wind and dry conditions. For yearling steers and calves, maintenance requirements and dry matter consumption increase as the ambient temperature decreases. For example, a yearling steer at 15°F needs 14 lb of DM per day to meet maintenance requirements. As temperature decreases to 0°F, maintenance requirements increase, so the steer eats an additional 2 lb of DM (16 lb/d). At -30°F, the steer needs to consume 20 lb of DM to maintain body weight; however, that level of intake exceeds the physical capacity of the digestive system. Consequently, the steer loses or gains less weight depending on the caloric density of the diet. Providing shelter and dry lot conditions will lessen many of the stresses associated with climate. Cattle have the ability to acclimate and withstand cold temperature; however, the rapid changes in temperature, wind, and moisture conditions

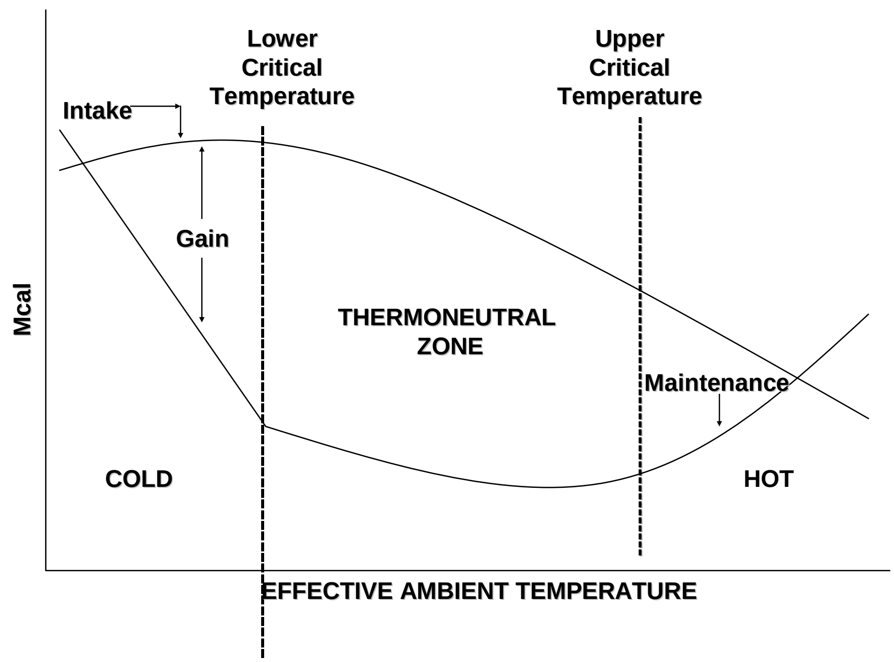

Figure 1. Schematic Drawing Indicating Effect of Temperature on Rate of Intake, Maintenance Energy Requirement, Energy Stored as Product (Adapted from NRC, 1981).

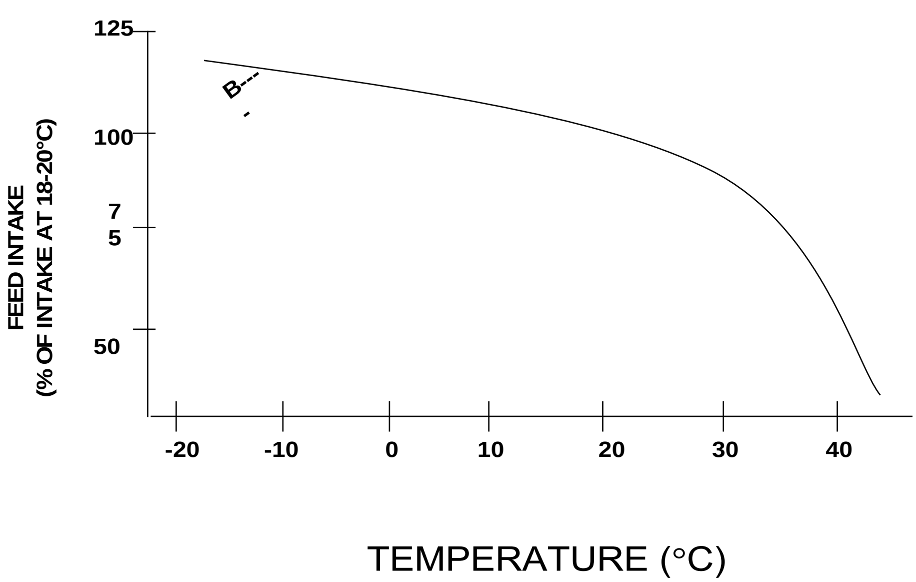

Figure 2. Estimated changes in dry matter intake of feedlot cattle on a ration with 70 % apparent digestibility "B" indicated behavioral changes.

can have devastating effects. Construction of feedlots and housing should be designed to alleviate the stressful conditions associated with wind and moisture. Careful consideration should balance the expected benefits against the cost of the facility. There are many cost-effective methods to provide these needs without elaborate building construction.

The most important concept to consider in construction of a feedlot is site selection and preparation. Select a site which has a well drained soil and minimal adverse environmental impacts. The proper use of windbreaks, mounds, and diversion ditches will greatly enhance cattle performance in outside lots. For undercapitalized producers, construction of outside lots may be more economical. However, adequate containment will be necessary to control potential runoff that would occur from the worst storm that has occurred during a 24 hour period within the last 25 years. In Michigan, the cost of runoff containment can approach the construction cost of new animal facilities. For more details on construction and design of feedlots, refer to the Midwest Plan Service booklet entitled “Beef Housing and Equipment Handbook” (MWPS-6) which can be obtained from your local Cooperative Extension Service.

A comparison of costs, cattle density, and convenience factors for four common types of feedlot facilities is shown in Table 2. Confinement facilities will improve the efficiency of feed conversion into tissue growth; however, the economics should be carefully considered. For instance, a Minnesota study (Smith et. al., 1981) conducted over seven years compared five housing systems on cattle performance and profitability. The five housing systems were: 1) open lot – open lot with fenceline bunks, mounds, and a windbreak; 2) manure scrape – pole barn with manure scrape alley near feed bunk and a manure pack under roof; 3) conventional – pole barn with concrete outside lot and manure pack; 4) cold confinement slot – pole barn with slotted floor; and 5) warm confinement slot – enclosed, insulated building with slotted floor. Cattle in the manure scrape facility gained more weight than cattle in the open or conventional housing system ($P < .05$). Dry matter intake was similar for cattle housed in the five facilities. Cattle in the open lots required the most feed per unit of gain, whereas cattle fed in the manure scrape facility were the most efficient (Table 3). Cattle in the three confinement barns had larger ribeye areas and more finish at a given final weight than cattle in the open lot or conventional facility. An economic analysis of the returns for each facility is shown in Table 4. Non-feed costs and total costs were lower for the open lot facility. Feed costs were lowest for the slotted floor facilities. The data clearly suggests that economic returns from the open lot system are superior to the other systems. However, depending on site location, runoff containment may negate the economic benefits of open lot systems. Environmental regulations and local concerns may determine the type of livestock facility that is built. It is advantageous for producers entering into a cattle feeding enterprise to consider low cost facilities until sufficient capital and experience is accumulated to reduce the risk of large deficits in cash flow or lease agreements on existing, unused facilities. Additionally, a low capital investment would allow more flexibility in deciding whether to feed cattle with current market conditions.

Assuming the other variable costs are fixed, corn price ($/bu) would have to be 11.29, 4.22, 3.58, and 13.54 for the conventional, manure scrape, cold slot, and warm slot, respectively, to be competitive with the open lot under the conditions used in this analysis. Again, this analysis did not include costs for runoff containment from the worst 24 hour rain event in the past 25 years. It is important to remember, these projections assume the lots are full 365 days of the year. Empty facilities would favor the construction of less capital intensive systems. Other factors which impact the decision to build housing include convenience, finished animal value and environmental concerns. More extensive housing facilities require less labor (Table 4) and the ease of cattle handling is increased. For many producers with accumulated capital, this consideration is sufficient reason to build confinement livestock facilities. Cattlemen with cold confinement, slotted floor facilities report a $.50/cwt premium for cattle finished in those facilities. This would provide an additional increase of $8.25 per unit of feedlot capacity, which would reduce the non-feed and the total cost of production by $1.00/cwt. Management from various slaughter plants routinely report increased dressing percents for cattle finished on slotted floors. In support of this claim, the Minnesota studies reported increased yield of trimmed lean cuts (yield grade, Table 3) with the manure scrape or slotted floor facilities. This additional value would make the cold confinement slotted floor facilities the most profitable system. A blend of the two housing systems has been very popular in Michigan. Cattle are fed in open lots or partially covered lots until the last 60-90 days, at which time the cattle are moved onto slotted floors. Holstein cattle are not well adapted to slotted floor facilities and cattlemen feeding Holsteins should consider the other alternative housing systems. Environmental impacts such as odor and surface runoff should be carefully considered in the decision of facility construction. Proper site selection is extremely important.

Several experiment station reports have compared open lots versus cold confinement units with slotted floors (Table 5). During the winter months at each of the four locations, cattle fed in the slotted floor facilities consumed less feed and were more efficient than cattle in open lots. The difference in performance between the two facilities is much less during the summer months. Clearly, the more adverse the winter conditions, the more favorable closeouts will be for cattle housed in a confinement facility; however, during hot weather, slotted floor facilities appear to decrease performance slightly.

Summary

many issues must be considered in the decision to build facilities. The data presented indicates advantages in cattle performance for slotted floor confinement; however, total costs of gain favor facilities with less capital expenditure. Feedlot operations with intentions to utilize and depreciate facilities over 10-20 years should consider a portion of capacity as slotted floor.

References

Farlin, S.D. 1974. Beef confinement vs. open lot feeding. 1974 Nebraska Beef Cattle Rep. EC 74-218:13.

NRC. 1981. EFFECT OF ENVIRONMENT ON NUTRIENT REQUIREMENTS OF DOMESTIC ANIMALS. National Academy Press, Washington, D.C.

Sewell, H.B. 1988. Performance of steers fed in outside lots compared to those fed inside on slatted floors. Univ. Missouri 1988 Beef Cattle Rep. 116:67-73.

Smith, R.E., H.E. Hanke,, L.K. Lindor, D.D. Goodrich, and J.C. Meiske. 1981. Performance of steer calves fed in various housing systems—A seven-year summary (1970-1976). 1981 Minnesota Cattle Feeder's Rep. B-273:41-43.

Standorf, D., k. Metz, and S.R. Rust. 2001. Comparison of facility type and time on feed on growth and carcass characteristics of growing-finishing steers. Mich. State Univ. Beef Cattle, Sheep Forage res. Dem. Rep. 575:54-59.

Vetter, R.L., M.R. Geasler, E. Mobley, G. Frankl, and R. Lorenzen. 1971. Feedlot performance and production costs of cattle fed on slotted-floor-cold-confinement vs. outside mounded lots. Iowa State Univ.Beef Cattle Res. A.S. R150.

Table 1. Effects of temperature, wind and moisture on energy requirements and lower critical temperature for growing-finishing cattle.

Condition	**Lower critical temperature, °F**	**Ambient temperature, °F**		
		15	**0**	**-30**
Yearling steer, 650 lb gaining 2.0 lb/d		Corn silage intake (DMB) Needed to gain 2 lb/d		
Dry, low wind	-29	14	14	14
Wet snow, mud, 10 mph wind	15	14	16	20
Calf, 220 lb gaining 1.1 lb/d				
Dry. Low wind	0	9	9	10
Wet snow, mud, 10 mph wind	50	12	13	16

Table 2. Comparison of various types of feedlot facilities

Capital Requirement ($/unit of capacity)	Cattle Density, ft^2/animal	Frequency of manure handling	Convenience[a]	Flexibility[b]
Outside lots, fenceline feedbunks, concrete apron, mounds and windbreaks				
125-200	200-400	Seldom	Poor	High
Concrete lots with partial shelter				
200-275	20 inside 30 outside	Often	Good	Medium
Cold confinement, concrete floor				
275-350	30-40	Often	Good	Low
Cold confinement, slotted floor				
375-450	17-22	Seldom	Excellent	Low

[a] Convenience refers to ease of cleaning, cattle movement, etc.
[b] Flexibility refers to option to utilize facilities at any given time based on current markets

Table 3. Performance of Steer Calves Fed in Various Housing Systems

	Housing system				
Item	**Conven-tional**	**Manure scrape**	**Cold slot**	**Warm slot**	**Open lot**
No. of steers	536	403	451	682	328
No. of pens	14	14	14	14	11
Initial wt, lb	438	440	442	436	444
Final wt, lb	1015	1042	1033	1029	1016
Daily gain, lb	2.44[a]	2.54[b]	2.48[ab]	2.49[ab]	2.41[a]
Dry matter intake, lb/d	15.07	15.20	15.11	15.09	15.25
Feed/100 lb gain,lb DM	618[b]	599[c]	609[bc]	606[bc]	633[a]
Carcass characteristics					
Marbling score	SL+	SL+	SL+	SL+	Sm-
KHP, %	2.98[a]	3.03[ab]	3.11[b]	3.09[b]	2.96[a]
Ribeye area, sq. in.	11.5[b]	11.3[a]	11.5[b]	11.5[b]	11.2[a]
Fat depth, in.	.61[a]	.67[ab]	.66[b]	.68[b]	.59[a]
Quality grade	SE+	SE+	SE+	SE+	SE+
Yield grade	3.4[a]	3.6[b]	3.6[b]	3.6[b]	3.4[a]

[abc] Means in a row with different superscripts differ ($P < .05$).

Table 4. Economic comparison of the five housing systems in the Minnesota studies.

300 Head Capacity	Housing system: Open Lot	Manure Scrape	Conventional	Cold Slot	Warm Slot
Head Fed Annually[1]	438	465	444	450	459
Labor, hours/head	2.30	2.39	2.40	2.12	2.12
Capital, $/head capacity					
Lot and shelter	$107.33	$220.83	$193.33	$316.67	$470.00
Waste handling	31.15	9.45	26.81	24.26	24.26
Feed storage & handling	146.30	146.30	146.30	146.30	146.30
Total	**$284.78**	**$376.58**	**$366.44**	**$487.23**	**$640.56**
Cost, $/100 lb. gain					
Facilities @ 25.5% ann[2]	$9.10	$11.34	$11.55	$15.16	$19.54
Labor @ 5.00/hr	1.92	2.00	2.00	1.75	1.75
Bedding[3]	3.99	4.82	4.45	0	0
Interest on animal[4]	5.82	5.48	5.74	5.67	5.56
Insurance and utilities	.46	.46	.46	.46	1.40
Veterinary and medicine	1.25	1.25	1.25	1.25	1.25
Death loss[5]	.54	.54	.54	.54	.54
Trucking	3.00	3.00	3.00	3.00	3.00
Non-feed Total	**$26.08**	**$28.89**	**$28.99**	**$27.83**	**$33.04**
Feed cost[6]	25.32	23.96	24.72	24.36	24.24
Total	**$51.40**	**$52.85**	**$53.71**	**$52.19**	**$57.28**
Total Capital Investment	**$80,283**	**$102,375**	**$100,653**	**$130,968**	**$169,609**
Total Labor Required (hrs)	**1,007**	**1,111**	**1,066**	**954**	**973**

[1]Based on 5 yr average daily gains, in Minn. research, 600 lb. gain, (1.46, 1.55, 1.48, 1.50, 1.53 turnovers annually in open lot, manure scrape, conventional, cold slot, warm slot, respectively).
[2](Depreciation, 10.00%; Interest, 12%; Repairs, 5.0%; Taxes, .5%; Insurance, .5%) x initial capital investment – turnovers/yr. – 6 cwt.
[3]Bedding @ $85/ton
[4]Interest, 12% annual, $425.00 purchase price, (250, 235, 247, 243, 239 days for open lot, manure scrape, conventional, cold slot and warm slot, respectively).
[5]Death loss calculated at % of initial cost.
[6]Feed Costs: HM corn @ .04/lb., corn silage @ .025/lb., supplement @ $.11/lb. total ration cost, $80.00/ton of dry matter.

Table 5. Comparison of cattle performance in outside lots versus cold confinement slotted floor facilities during winter and summer.

	Open lot		Slotted floor	
	Summer	Winter	Summer	Winter
Iowa (Vetter, et.al. 1971)				
No. of cattle	1313	1438	1254	1035
Days on feed	117	104	117	104
ADG, lb	2.96	2.51	2.88	2.60
DMI, lb/d	21.5	23.0	20.0	20.5
Feed/gain	7.31	10.40	6.97	8.38
Dressing percent	62.5	63.0	62.9	63.4
Yield grade	2.35	2.37	2.52	2.31
Feed cost/cwt, $	19.16	26.49	18.19	22.09
Non-feed cost/cwt $	3.21	4.16	4.69	5.38
Total cost/cwt, $	22.38	30.65	22.89	27.47
Nebraska (Farlin, 1973)				
No. of cattle	188	189	189	192
Days on feed	155	161	155	161
ADG, lb	2.45	1.97	2.37	2.07
DMI, lb/d	19.2	15.4	18.8	13.8
Feed/gain	7.94	7.82	1.97	6.65
Dressing percent	59.7	60.7	61.2	62.2
Missouri (Sewell,1987)				
No. of cattle	8850	11693	5020	7622
Days on feed	121	122	116	114
ADG, lb	3.09	2.84	2.71	2.81
DMI, lb/d	20.8	21.6	19.70	20.4
Feed/gain	6.73	7.60	7.28	7.26
Feed cost/cwt, $	46.00	49.00	49.00	47.00
Non-feed cost/cwt, $	4.00	4.00	7.00	6.00
Total cost/cwt, $	50.00	53.00	56.00	53.00
Michigan (Standorf et.al., 2001)				
No. of cattle		88		88
ADG, lb		2.95		3.09
DMI, lb/d		24.7		24.3
Feed/gain		8.3		75
Backfat, in.		.48		.43
Choice, %		80		75