2012

Cost Analysis of Cattle Feedlot Designs

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BEEF 2012-07

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SUMMARY

A cost analysis of fixed and non-fixed costs of gain was conducted on 3 cattle feedlot designs. The three facility designs compared were conventional open pens (OPN), open pens with shelter over the feeding area (OS), and a monoslope confinement barn (MON). The OPN design was the least expensive facility to build and operate. However, because of poorer cattle performance ($P < 0.05$), it was not the most cost effective. The MON design had significantly higher operating costs when compared to the OPN or OS designs, especially for the tractor/spreader ($P < 0.05$), skid loader ($P < 0.10$), labor ($P < 0.05$), and straw ($P < 0.05$). The operating and fixed costs, combined, made the MON design the most expensive cost of gain design ($P < 0.05$). The OS design was the most expensive facility to build but with current feed prices and the cattle performance, it was the most cost effective cattle feeding design.

INTRODUCTION

Various cattle feeding facility designs exist in the northern plains states with little information available to aid managers in making facility decisions. Cattle performance (ADG, F/G, and health), fixed, and non-fixed costs must all be considered to determine the most cost effective feedlot design. Fixed costs will include land and construction costs. Non-fixed, or operating costs include machinery hours, labor, and bedding. The amount and composition of manure generated by cattle housed in each design could also impact economic outcomes. This study was conducted to determine which cattle feedlot design is the most cost effective.

MATERIALS AND METHODS

The data were collected at the South Dakota State University Foundation Opportunities Farm near Lennox, South Dakota. The Opportunities Farm is home to a 960-head cattle feedlot consisting of three contrasting designs, confinement (MON), open (OPN), and partially covered (OS). Each design consists of four pens with a capacity of 80-head per pen. The confinement design is a 360 ft x 40 ft building with each pen being 90 ft wide and 40 ft deep (45 ft^2 per head). The open design is an earthen-mound pen design that is 80 ft wide and 275 ft deep (275 ft^2 per head). The partially covered design combines a building and earthen-mound pens. The building is 320 ft x 35 ft and covers the feed ally, bunk, water fountain, and front 20 ft of the pen. The earthen lots are 215 ft deep, combined with the building, to allow 235 ft^2 per head of pen space. All pens included 80 ft of fenceline feedbunk.

[1] Authors extend appreciation to E. Loe, S. Holt, and M. Loewe for their contributions to compilation of this data.
[2] This study was funded by the Beef Nutrition Program.

Land area required per design was calculated by using the stocking density for each respected design. This value was used to calculate the acres required per design and was multiplied by the current land value of $4,680/ac. The land expense was annualized over 20 years. The actual 2004 construction costs were corrected for inflation to estimate 2010 construction costs of OPN $521.23, OS $741.73, and MON $682.24. Each design was depreciated over 20 years. To establish a daily fixed cost per head, construction and land costs were summed, assuming a 90% occupancy rate.

Cattle feeding activities contributing to the non-fixed costs were recorded daily for a 3-yr period. These activities included machinery hours, labor, and straw and were totaled by week and divided by actual head days. This established an amount of each input required per head per day for each design. Values were assigned for each input (Table 1) and the cost per 1,000 head per day was calculated as the non-fixed cost.

Table 1. Unit of Measurement for Inputs

Input	Unit	Rate ($)
Land[1]	Acre	4680.00
Tractor[2]/Spreader[3]	Hour	142.60
Loader Tractor[2]	Hour	58.50
Skid Loader[3]	Hour	50.75
Labor[2]	Hour	12.50
Straw[4]	Large round bale	35.00

[1] South Dakota Agricultural Land Market Trends 1991-2010, Janssen, et al
[2] Farm Business Management, University of IL at Urbana-Champaign April 2010
[3] Ag Decision Maker, IA State University March 2010
[4] USDA-SD Ag Market News, Weekly East River SD Hay Market 6 August 2010

The historical database of cattle performance differences across pens by design at the Opportunities Farm was used to calculate costs of gain. There were 27 contemporary group comparisons in that database, spanning 7-yr. In the database, each group of cattle arriving at the Opportunities Farm was allocated across the three feedlot housing designs. This balanced data set allowed for a comparison, by system, of estimated ADG and F/G.

The fixed and non-fixed costs were summed to determine a total cost per 1,000 head per day. This number was divided by the respective ADG for each design to establish the non-feed cost of gain. Differences were calculated between the OPN vs. MON and OPN vs. OS. With these two comparisons, the feed to gain of each respective design was multiplied by the cost of feed to establish where feed price, feed costs and non-feed cost of gain reach equilibrium.

The costs generated during this study are not reflective of full yardage costs. Items assumed equal across designs were not accounted for. Therefore results represent only the relative differences in cost of gain. Items assumed equal across designs included:

- Sick / death loss
- Time required to pull a sick animal
- Weather
- Feed preparation and delivery

- Cattle gender
- Manure value
- Carcass merit, other than weight (Wulf, 2007)

The amount of each input and non-feed cost of gain was tested by constructing an ANOVA table using the Proc GLM (generalized linear model procedure) in SAS (SAS Institute, Cary, NC). It was a randomized block design, where year was included as the block and design means tested with error=year(system). Quarterly least square means were tested using the Fisher t-test. The yearly least square means were used to compare relative costs between systems.

RESULTS AND DISCUSSION

Loe (2007) reported that cattle performance differed between designs ($P < 0.01$). Cattle fed in the MON and OS covered designs achieved faster gains and were more efficient (Table 2).

Table 2. Cattle performance differences for open (OPN), open with shelter (OS), and monoslope confinement (MON) housing systems

	MON	OPN	OS	SEM	*P* Value
ADG	3.57[a]	3.51[b]	3.62[a]	0.075	0.008
F/G	6.75[b]	7.00[a]	6.77[b]	0.149	0.002

[1]Loe (2007 internal data summary)
[a,b] Means within main effect without common superscripts differ

Several of the operating inputs differed between designs. The confinement design required more ($P < 0.05$) tractor/spreader and skid loader hours, labor hours, and bedding (Table 3). The open and partially covered designs both required more loader tractor hours ($P < 0.10$).

Table 3. Amount of variable inputs for open (OPN), open with shelter (OS), and monoslope confinement (MON) housing systems[1]

	MON	OPN	OS	SEM
Tractor/Spreader, hours	0.914[b]	0.415[a]	0.540[a]	0.00013
Loader Tractor, hours	0.084[b]	0.294[a]	0.242[a]	0.00009
Skid Loader, hours	0.997[e]	0.268[d]	0.398[d]	0.00008
Labor, hours	1.995[b]	0.977[a]	1.180[a]	0.00023
Bedding, bales	3.282[b]	0.640[a]	0.667[a]	0.00015

[1]Inputs are per day per 1,000 head
[a, b] Means within row without common superscripts differ ($P < 0.05$)
[d, e] Means within row without common superscripts differ ($P < 0.10$)

The MON design was the most expensive to operate (non-fixed costs), with no difference between the OPN or OS covered design.

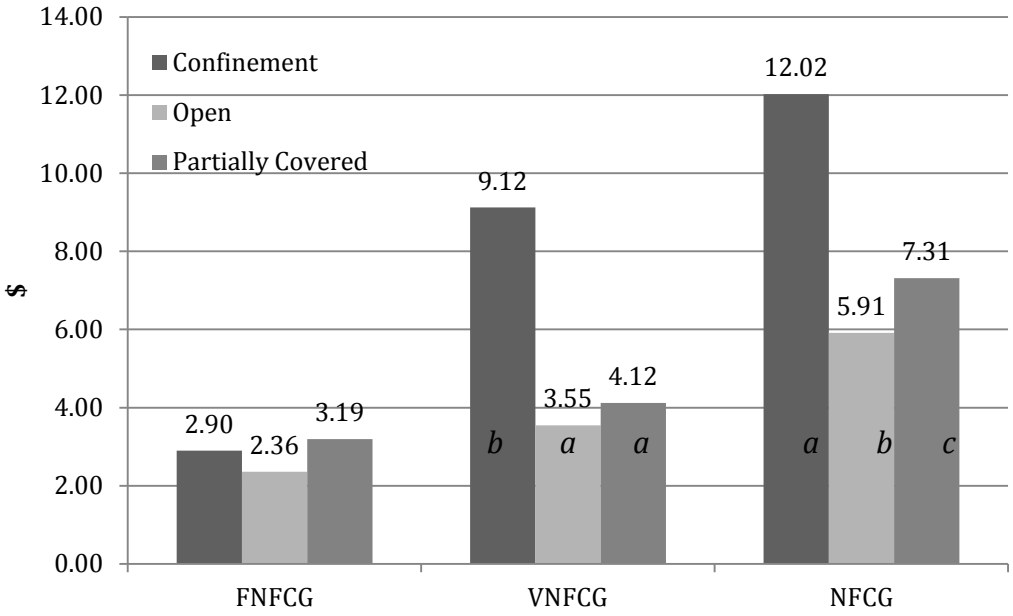

Figure 1. Costs/100lb of gain for open (OPN), open with shelter (OS), and monoslope confinement (MON) housing systems. FNFCG : Fixed Non-Feed Cost of Gain; VNFCG : Non-Fixed Non-Feed Cost of Gain; NFCG : Total Non-Feed Cost of Gain.
[a,b,c] Means within main effect without common superscripts differ (P<0.05)

A unique and powerful aspect of this data set is the 7-yr of commercial pen scale cattle performance available. Performance comparisons were replicated 27 times. These three feedlot designs are at the same location, and have common nutrition and management. This allows for the key comparison of costs per unit of production. Differences in operating costs per 100 lb of live weight gain (LWG) are shown in Figure 1. The fixed non-feed cost of gain (FNFCG) reflects depreciation cost for the land and facilities assuming a 90% occupancy rate. Costs ranged from $2.36 for the OPN to $3.19/cwt for the OS design. Statistical analysis was not applied to these costs because we have only a single construction cost observation for each design. The differences in FNFCG ($0.83) are relatively small when total cost of gain is exceeding $80/cwt.

The variable cost/LWG (VNFCG) were higher (P<.05) in MON; and similar between the OPN and OS designs. When fixed and variable costs were pooled the NFCG differed (P< .05) for each design. The NFCG difference between the MON and OPN designs was attributable to the additional $1.97 /CWT cost of gain for tractor/manure spreader, $1.03 /CWT cost of gain for skid loader, and $2.58 /CWT cost of gain for bedding. The difference in NFCG between the OPN and OS covered facilities was primarily due to the difference in fixed costs (land and construction).

The added expense associated with providing shelter in feedlot pens has to be offset by improved cattle performance, especially improved feed efficiency. In this study the MON and OS systems cost more to build and to operate but did result in improved feed efficiency over feeding in OPN pens. The economic value of the improved feed efficiency is dependent on the cost of feed. Cost equilibrium would be where saving in feed cost/LWG brought about by improved efficiency equals the added NFCG expense. Comparing the confinement and open designs, feed must reach roughly $489/T before the superior feed

efficiency of cattle fed in the confinement system would offset the $6.11 /cwt higher NFCG. Comparing the open and open with shelter designs, feed must cost more than $122/T for the added feed efficiency of cattle fed in the partially covered facility to offset the added cost to build the facility.
In the current feed cost environment open with shelter design is the most cost effective facility design for feeding cattle in this environment.