

Econometric estimation of profitability of cull cows in cow-calf enterprise: An application of a management production systems strategy[♦]

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Abstract

Traditionally, cow-calf producers cull and sell their cull cows in the fall when prices are low. An important question to ask is whether or not an alternative timing of cull cow marketing may increase net revenue that cull cows bring to the cow-calf enterprise systems. If so, using what management strategy? These research questions were investigated using a sample of 48 culled cows randomly assigned to two treatments, one fed on dry lot with grain supplement and the other, on grass or forage only management systems at the Noble Foundation Ranch in Ardmore Oklahoma. Feeding is an expensive component of cow-calf enterprise, the performance of the culled cows was evaluated over at five timing intervals from October to April. Regression analysis was carried out to test factors influencing net returns in the two management systems over the time period. Results revealed that, net returns were higher for both treatment groups at 111 and 134 days with the grass management system performing better than the dry fed lot. Beginning body weight and average daily weight gain all contributed positively to net returns with an R^2 value of 0.88 for the linear model and 0.80 for the semi-log model. Thus, considering risk factor in the deaths of aging culled cows, the study recommended that culled cows be sold at 111 days after culling and feed managed on forage system.

Keywords: cull-cows feeding management system net-returns regression analysis

JEL: Q12, Q13

[♦] A paper submitted for presentation at the 14th Annual Conference on Econometrics Modeling for Africa, Conference of the African Econometrics Society, 8 – 10th July 2009, Sheraton Hotel, Abuja, Nigeria. This paper is an offshoot of an earlier version presented by Amadou at the 2009 Annual Meeting of the Southern Agricultural Economics Association, in Atlanta, Georgia.

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Introduction

In Sub-Saharan Africa, cattle production system is predominantly managed under traditional production systems varying in size and scale be it for milk or meat production. With the exception of few countries such as Botswana and South Africa in the Southern African region, where livestock production is operated as an enterprise system, in most Sub-Saharan livestock producers operate with the bulk of production under small scale system www.ilri.org/html/trainingMat/policy_X5547e/x5547e0o.htm (May 25 2009). If Sub-Saharan Africa livestock production is to make important contribution to agricultural production system, then policy changes must be devised to improve operations of the production system in line with entrepreneurial system and objectives. This paper examines the role of cull cows in cow-calf production enterprise system which is very distinct from the traditional Sub-Saharan African livestock production system.

Cull cows can be considered as a by-product of the cow-calf production enterprise in which the main product is the calf produced by the cow. The calf can be sold to dairy farms (if dairy calves) or sold to feedlots (if steers and heifers). However, since the cow cannot continue producing calves forever, the enterprise must find use for its salvage value for some economic gains. This paper therefore tries to address the following important questions. Can cow – calf producers profitably feed cull cows? What feeding arrangements will be most profitable? How long should cull cows be placed on feeding arrangement?

According to Amadou *et al.* (2009) marketing cull cows provides a significant source of income to U.S. cow – calf producers. Thus, instead of spending time on feeding steers, heifers and reproductive cows, you can as well improve your revenue through cull cows production which represent 15 – 30 percent cow – calf revenue. However, it has been noted that most cow – calf enterprises generally cull and sell their cull cows in the fall when prices are low perhaps without due consideration for possible alternative marketing season that may improve revenues. This has been well documented by Feuz (1995) who reported that cull cow prices follow a pattern of lower prices in November to January and

higher prices in March to May and thus, suggested several considerations aimed at boosting revenue from cull cows. These considerations formed the basis for this paper.

Thus, from the foregoing, there are a number of important considerations in cow – calf and cull cows enterprises since there are seasons during which cull cow prices are low and seasons during which prices are high. It thus becomes imperative to ask whether selling cull cows at culling time is better compared to first feeding them for sometimes and then selling. Peel and Doye (2007) observed that many cow – calf producers decide to sell their cull cows as quickly and easily as possible with less consideration for increasing the salvage value of their animals. This decision is taken at the expense of increasing revenue from cull cows by 25 – 45 percent through better management and marketing strategies. It should however be noted that this management and marketing strategy should be hedged against feeding cost, risk of holding cows for long time periods, and price fluctuations as against only the potential for enhancing revenue. Furthermore, Wright (2005) stated that when deciding to hedge against feeding culled cows, you must consider the effects on facilities as well as time on feed. Management systems that can be used to improve animal performance will help improve the profitability of feeding cull cows. Wright (2005) further opined that cow type, as well as feed costs and marketing timeframe should be considered in identifying feeding and marketing strategies that could significantly increase the final weight and improve dressing percentage and quality grade and by implications value or revenues.

At this point, it is important to point out that the objective of this paper is to employ regression analysis to test factors influencing net returns in cull cows in cow – calf enterprise using two management systems over a particular time period and specifically analyze the impact on net revenues to the cow – calf enterprise from cull cow marketing of two production management systems.

Methodology

The objective of any cow-calf enterprise is to maximize profit, given a limited resources or amount of inputs. The timing of marketing cull cows, the management system and the decision to hold and feed cull cows beyond culling period impacts the net revenue of a cow-calf enterprise. However, the net return of keeping cull cows may increase or decrease depending on the availability and affordability of forage and grain. The key question is: Is it more profitable to sell cull cows immediately after they are culled or should they be fed for alternative time periods and marketed later?

An experiment involved feeding cull cows on grain and forage versus cull cows fed on forage only was conducted by the Noble Foundation from October 2007 to April 2008. Cows were checked for pregnancy and 48 open (unbred) cows were culled. The 48 culled cows were randomly assigned to two treatments at the Noble Foundation ranch in Ardmore, Oklahoma. In treatment one, cows were fed in a dry lot environment (dry lot) with grain supplement and forage. In treatment two, cows were fed in a grazing environment with forage only (grass). The contribution of cows to net revenue was evaluated at 42, 78, 111, 134, and 164 days. The experiment led to the following hypotheses:

1. Because of relatively high grain costs, we hypothesize that cull cows fed on hay and grain supplement (dry lot) have lower net returns compared to cull cows grazing on forages (grass).
2. Average daily gain, total gain, and cost per pound of gain from dry lot fed cull cows are higher than for grass fed cull cows.
3. Factors such as beginning weight, average daily gain (ADG), feed cost per pound of gain, and treatment significantly influence net returns.

Data

Data were collected on weight, USDA grade, dressing percentage, costs (feed, animal health, etc.), and estimated market value approximately on monthly basis. For each

interval, estimated animal performance and net returns were calculated. Both the estimated USDA grade and estimated dressing percentage were used to assign a price to each cow, based on prices reported by the Agricultural Marketing Services. (<http://www.ams.usda.gov/AMSV1.0/ams.fetchTemplateData.do?template=TemplateA&navID=MarketNewsAndTransportationData&leftNav=MarketNewsAndTransportationData&page=MarketNewsAndTransportationData&acct=AMSPW>). Thus, costs and value were estimated for each cow in each production system and for each feeding interval to give rise to the data used in the analysis. More specifically, data were generated on average daily gain in weight (ADG), the cost of feed per gain, treatment on net returns, the beginning weight were used to carry out regression analysis on net-returns for a particular period.

Model Specification

For the purposes of this analysis, two models were specified, one, a descriptive statistical model used to compare cost and returns at various levels of treatments and time periods and the other for econometric analysis.

The descriptive statistical model was specified as:

$$Y_{ijk} = \mu + \alpha_i + \beta_k + \alpha\beta_{ik} + \theta_{j(i)} + \varepsilon_{ijk} \dots\dots\dots (1)$$

Where :

Y_{ijk} = is the variable of interest to be compared such as ADG, net returns etc over time k (42, 78, 111, 134 and 164 days; treatment i (dry lot fed or grass fed), for observation j over the experimental unit (cull cows). μ is the overall mean, α_i is the treatment level effect, β_k is the time effect $\alpha\beta_{ik}$ is the time interval and treatment interaction term, $\theta_{j(i)}$ is a random effect term from the experimental unit j in the treatment i while ε_{ijk} is a random error term with the following statistical properties: $\varepsilon_{ijk} \approx N(0, \sigma_\varepsilon^2)$.

Next, the following model was specified for the purpose of analyzing the determinants of net returns on cull cows in cow – calf enterprise:

$$NR = f(BW, ADG, FCG, TRTM) \dots\dots\dots (2)$$

Where:

NR = the net margin for each feeding interval;

BW = is the beginning weight for each culled cow at time of culling;

ADG = is the average daily gain by the culled cow;

FCG = is feed cost per gain which is the cost of gain through feeding;

TRTM = is a zero – 1 dummy variable for treatment or management type where 1 is dry lot and 0 is grass.

Results and Discussions

The results of the descriptive statistical analysis on the experimental units (cull cows) randomly assigned to two treatments (dry lots and grass) revealed that ADG of cows on dry lots at 42, 78 and 134 feeding days after culling were significantly higher than ADG of cows fed longer (164 days) as presented in Table 1.

From Table 1, it can be inferred that net returns from cows fed on grass from time of culling to 42 days of feeding regime was negative (-85.49) and significant, while those from base to 111, 134, and 164 days intervals were found to be positive 116.06, 121.6 and 55.34, respectively and statistically significant, implying that grass fed cows should be marketed at either 111, 134 days or at 164 days. Similarly, net returns of cows on dry lot at 42 and 164 days were negative (-81.60 and -62.14) and statistically significant; while net returns of cows on dry lot at 111 and 134 days were positive (54.72 72.34) and statistically significant. This result shows that 111 days is the appropriate time to market both cows on grass and dry lot if risk is taken into consideration.

However, it is important to point out that the results of these findings did not corroborate previous research findings that concluded that economic gain from cull cows could be achieved between 56 to 90 days (Carter and Johnson 2006; Schnell *et al.*, 1997; Torell, *et al.*, 2001). One plausible explanation could be a difference in their placement weight. Cost per gain generally increased with longer feeding periods. Revenue per gain varied

for the marginal feeding periods, again reflecting a combination of seasonal price changes and weight changes for cows in both treatments.

Table 1: Descriptive statistical analysis results on key variables on the experimental unit assigned to two treatments and specific time interval for grass and dry lot fed cows

Treatment (i)	Time Interval (k)	LS Means Net returns	LS Means ADG	LS Means Gain	LS Means Cost per gain	LS Means Revenue per gain
Grass	42	-85.49*** (12.430)	2.21*** (0.274)	92.79** (11.534)	0.260 (0.398)	-0.22 (1.514)
	78	-6.22 (12.547)	1.04*** (0.1787)	81.33*** (13.958)	0.74*** (0.227)	1.55*** (0.238)
	111	116.06*** (22.510)	0.6133*** (0.165)	68*** (18.316)	-0.19 (0.768)	0.80 (0.627)
	134	121.6*** (18.352)	0.33*** (0.114)	44.25*** (15.337)	0.55 (0.774)	1.38* (0.73)
	164	55.34*** (19.908)	0.33*** (0.096)	53.42*** (16.009)	1.85** (0.764)	0.84*** (0.184)
Dry lot	42	-81.60*** (12.430)	2.34*** (0.274)	98.25*** (11.534)	0.845 ** (0.398)	-2.09 (1.514)
	78	4.70 (12.547)	2.06*** (0.178)	160.54** (13.958)	1.09*** (0.227)	-0.07 (0.237)
	111	54.72** (22.5102)	1.42*** (0.1649)	157.62*** (18.316)	1.97** (0.768)	0.01 (0.6276)
	134	72.34*** (18.352)	1.51*** (0.114)	202.42*** (15.338)	1.83** (0.774)	0.22 (0.732)
	164	-62.14*** (19.908)	1.23*** (0.0968)	216.79*** (16.009)	2.32*** (0.779)	-0.65*** (0.1840)
Ratio	Log-likelihood	-2295.8	-175.1	-2273.3	-1045.4	-1092.7

¹ * = significant at 10%, ** = significant at 5%, and *** = significant at 1%

² The numbers in parentheses are the standard error.

Table 1 further shows that the average daily gain (ADG) and overall gain for both treatments were generally statistically significant. The results revealed that as time of feeding increases, overall gain continues to increase but at a declining rate across feeding intervals for both total gain and average daily gain. This implies that cull cows rapidly gain weight during the first period of their placement, but then the rate of weight gain decreases. The results of the regression analysis from model 2 employing both linear and semi-log specifications using data generated for 111 days of feeding time revealed that

culled cows on both treatments could be marketed at 111 days when the risk of death loss from prolonged feeding beyond 111 days such as 134 days is taken into consideration. Table 2 presents the results of the regression analysis on factors influencing net returns from the two treatments fed for 111 days.

Both the linear and semi-log models had the *apriori* correct signs on the coefficients for ADG, feed cost per gain, and treatment which were correctly specified. This means that net returns increase with increase in average daily gains regardless of the treatment type, while increase in feed cost per weight gain reduces net returns. However, the sign for beginning weight in both models was positively related to net returns. The effect of beginning weight on net returns was not as hypothesized. One explanation is that heavier cows also were healthier and thus gained weight more efficiently than lighter cows when culled. However, the expectations were that lighter cows would have a lower body condition score than heavy cows, and thus, they might benefit from compensatory gain. Falconer, Bevers, and Bennett (2006) note the importance in terms of added value of adding weight to thin cull cows.

Table 2: Results of regression analysis of net returns of 111 days fed culled cows on key variables

Linear Model		Semi-Log Model	
Variables	Parameters	Variables	Parameters
Constant	-179.82*** (34.72)	Constant	-873.962*** (299.84)
BW	0.085*** (0.025)	lnBW	107.008*** (41.31)
ADG	96.12*** (6.57)	lnADG	208.567** (17.24)
FCG	-11.598** (5.65)	lnFCG	-15.622** (6.52)
TRTM (dry lot = 1, grass =0)	-51.479*** (8.76)	TRTM (dry lot = 1, grass = 0)	-53.446*** (10.12)
R ²	0.88	R ²	0.80

¹ * = significant at 10%, ** = significant at 5%, and *** = significant at 1% ² The numbers in parentheses are the standard error.

Results of the linear model indicate that a one unit increase in beginning weight would increase the net returns by \$0.085 while a one unit increase in feed cost per gain would decrease the net returns by \$11.60. On the other hand, cows fed on grass received \$51.48 more in net returns than those fed on dry lot. Similarly, the semi-log model shows that one percent increase in beginning weight and ADG would increase the net returns by 1.07 percent and 2.08 percent respectively, but one percent increase in feed cost per gain would decrease the net returns by 0.15 percent.

Conclusions and implications

This paper investigated whether cull cows from cow-calf enterprise should be sold immediately after being culled from the herd or kept and fed on grass or in a dry lot for alternative periods of time. To determine this, an experiment involving 24 cull cows each fed on grass and dry lot was conducted by Noble Foundation from October 2007 to April 2008 in which data on average daily gain, net returns, cost per gain, beginning weight etc were obtained and used in the analysis.

Results obtained revealed that cows in both treatments gained a significant amount of weight initially. Cows in the grass treatment then began losing weight on average while the dry lot cows increased weight significantly. ADG for both groups declined following the first 42 days. Cost of gain generally increased for both groups as the feeding period increased. However, per gain of cow on dry lot for all time intervals were higher than cost per gain of cows on grass.

Prices changed over the experimental period generally in line with the seasonal pattern. Therefore, increasing prices combined with modest weight gains led to higher net returns at 78 days or more for both treatment groups. Net returns for grass-fed cows exceeded those for dry lot cows for each period at and beyond 111 days. Increasing cost per gain led to lower net returns for the dry lot cows.

Regression analysis results revealed that across the two treatments, average daily gain and beginning weight positively and significantly affected net returns, both in the linear

and semi-log model specifications. Feed cost per gain was inversely related to net returns.

Finally, holding cull cows beyond culling generated more returns than selling them immediately after culling, regardless of the feeding program type. Producers need to consider the weight and condition of cows at culling, potential for gain at reasonable cost, and the normal seasonal pattern when considering how long to feed cows before marketing them. Farmers in Sub-Saharan Africa should borrow a leaf from intensification of production system in which livestock production can be made more profitable than hitherto.

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