THE VALUE OF PREGNANCY TESTING SPRING-CALVING BEEF COWS

Billy Cook, Jon T. Biermacher, and Dan Childs*
The Sam Roberts Noble Foundation, Inc.
2510 Sam Noble Parkway
Ardmore, OK 73401
E-mail: jtbiermacher@noble.org

Abstract

Implementation of best management practices into the beef cow enterprise is critical for long-term success. Previous literature suggests that pregnancy testing is valuable to the beef cow operation; however, less than half of producers in the southern Plains region of the United States utilize pregnancy testing. The objective of this research is to determine the expected value of pregnancy testing and the subsequent adoption of an effective culling practice on first-time non-pregnant beef cows relative to a system that does not use pregnancy testing or a culling strategy. Results show that the value of adopting pregnancy testing and an effective culling practice for first-time non-pregnant cows ranged between \$54 and \$76 head^{-1}, depending upon the year. With the cost of pregnancy testing ranging between \$2 and \$5 head^{-1}, the value of the risk-reducing information gleaned from pregnancy testing tends to warrant adoption.

Keywords: *adoption, beef cows, culling, pregnancy testing*

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There are approximately 37 thousand cow-calf producers operating in the south-central Oklahoma/north-central Texas region of the United States with herd sizes ranging between 10 and 4500 head (average of 35), accounting for approximately 1.3 million beef cows (USDA-Oklahoma, USDA-Texas, 2006)[1]. According to a recent survey, producers who manage herds larger than 100 head glean over 40 percent of their income from their cattle operations, and producers with herds smaller than 100 head received less than 40 percent of their income from cattle (Vestal et al. 2006). Regardless of the size, how well a herd is managed is critical for long-term profitability of the cow/calf business.

There are several components and techniques to a successful cow-calf management strategy—a management plan for beef cow replacement decisions should be one of them. Previous literature that focused on beef cow replacement decisions suggests that utilizing a strategic culling practice on unproductive cows is an essential management practice for herd profitability (Jarvis, 1974; Yager, Greer, and Burt, 1980; Melton, 1980; Blake and Gray, 1981; Bentley and Shumway, 1981; Rucker, Burt, and LaFrance, 1984; Trapp, 1986; Bourdon and Brinks, 1987; Foster and Burt, 1992, Frasier and Pfeiffer, 1994; Marsh 1999; Mathews and Short, 2001; and Ibendahl, Anderson, and Anderson, 2004). The literature makes note that a cow is not likely to recover the lost revenue from being open just once; however, some authors discuss situations when culling a younger open cow is not the best decision (e.g., when biannual calving seasons are considered, or when the cost of a replacement heifer is high relative to cow production expenses) (Tronstad and Gum, 1994; Ibendahl, Anderson, and Anderson, 2004, and others).

[1] This statistic does not include the number of dairy cows, which accounts for an additional 60 thousand head (USDA-NASS, Oklahoma and Texas Quick Stats).

Tronstad and Gum (1996) concluded that producers should utilize pregnancy testing as part of a comprehensive management strategy, even though there are circumstances when it may not be profitable in the short run to do so. Contrary to these conclusions, the survey by Vestal et al, 2007 reported that only approximately 14 percent of producers who manage less than 100 head of beef cows utilize pregnancy testing for the cows they own, and only about 25 percent of them utilize pregnancy testing on their raised heifer cows. More surprising, the survey reports that only about 30 percent of producers with herds larger than 100 head utilize pregnancy testing, and only about half use pregnancy testing on the heifers they raise. In addition, nearly half of the producers in the region do not adhere to a defined calving season; however, for the other half that does, approximately 75% utilize a spring-calving season that begins in late January and runs through the end of March (USDA, 2006 and 2007).

Findings from the survey and recommendations based on results from the literature do not match up well with what is observed in the region regarding the producer rate of utilization of pregnancy testing and culling strategies. That is, the practice of pregnancy testing and culling management is promoted, in general, as economical, but adoption has been limited. Ibendahl, Anderson and Anderson (2004) argue that the usability of dynamic programming models by farm producers is limited. We feel that this argument can be made for other types of simulation models such as Markovian simulations and net present value simulations, and may help to explain why the rate of adoption of recommendations from the literature that uses such modeling techniques has been limited. This observation along with the number of producers in the region that neglect to utilize a defined calving season provides the impetus for demonstrating to producers via an on-farm demonstration experiment the economic value associated with utilizing pregnancy testing and an effective culling protocol for first-time open beef cows.

The objectives of this research are to determine the expected maximum value of pregnancy testing and the subsequent adoption of an effective culling practice on first-time non-pregnant beef cows relative to a system that does not use pregnancy testing nor a culling strategy, and to communicate to producers in the region how this value affects the net profitability of the spring-calving cow/calf enterprise.

One contribution of our research to the current way of thinking about beef cow replacement decisions is that our experiment was utilized in order to provide an actual demonstration to producers in the region, allowing them the opportunity to see first hand what is required to carry out the operations associated with pregnancy testing and culling protocol.

Also noteworthy, our research does not make assumptions about calf weights, market prices, or input costs in our analysis. As a result, we feel that the findings from this research will likely have a substantial impact on the rate of adoption of pregnancy testing and an effective culling protocol by producers in our region. Moreover, we believe our research will have a sizeable effect on the rate at which producers adopt a defined calving season and a subsequent management protocol for that system, regardless of how it is defined (i.e., fall-calving, spring-calving, biannual-calving, etc.).

Conceptual Framework

Economic theory suggests that a producer operating in a competitive market will adopt a new technology or production practice if the expected profitability from the technology is unambiguously larger than their current method of production (Grilliches 1957, 1958; Feder, Just, and Zilberman, 1985). Conceptually, the profit-maximizing producer faces the following decision rule for whether or not he should adopt pregnancy testing and an effective culling practice into his cow/calf enterprise

$$(1) \qquad \text{Adoption} = \begin{cases} \text{yes}, & \text{if } \mathrm{E}(\max \mathrm{E}(R^P)) - \mathrm{E}(\max \mathrm{E}(R)) > \lambda, \\ \text{no}, & \text{otherwise}, \end{cases}$$

where $\lambda > 0$ is the cost of change, $\mathrm{E}(R^P)$ is the expected net return per cow when pregnancy testing is used, and $\mathrm{E}(R)$ is the expected per cow net return when pregnancy testing is not used.

More formally, we define the value of information gleaned from pregnancy testing as the difference between the expected net return per cow when pregnancy testing is administered and culling first-time open cows implemented and the expected per cow net return when pregnancy testing is forgone and culling of first-time open cows not implemented. We assume that adoption of pregnancy testing and a culling protocol on first-time open cows is a risk-reducing technology for producers, and so we utilize an expected net return framework as apposed to using the expected utility framework. Mathematically, the value of pregnancy testing can be written as

$$
\begin{aligned}
V &= \mathrm{E}(R^P) - \mathrm{E}(R), \\
&= \{[p_{kt}\mathrm{E}(w_{kt}) + p^F_{kt}\mathrm{E}(F_{kt}/N) + p^C_{kt}\mathrm{E}(C_{kt}/N) + p^B_{kt}\mathrm{E}(B_{kt}/N) - vc^P_t \\
&\qquad - (T_t/N) - (b^P_t/N)] \\
&\quad - [p_{kt}\mathrm{E}(w_{kt}) + p^F_{kt}\mathrm{E}(F_{kt}/N) + p^C_{kt}\mathrm{E}(C_{kt}/N) + p^B_{kt}\mathrm{E}(B_{kt}) - vc_t - (b_t/N)]\},
\end{aligned} \tag{2}
$$

where V is the average value of pregnancy testing per cow; E(.) is the expectations operator; the superscript P in equation 2 denotes the system (herd) that uses pregnancy testing; p is the price paid to the cow/calf producer for a calf of herd average weight w sold in marketing period k in year t; p^F is the price paid to producers for first-time open cows; p^C is the price paid to producers for non-productive, older cull cows; p^B is the price paid for bulls culled in marketing period k in year t; F, C, B are the total number of first-time open cows, sick or nonproductive older cows, and bulls culled from the herd in marketing period k in year t, respectively; N denotes the total number of cows in the herd; vc_t represent the average per cow production costs in year t; T is the per cow cost of pregnancy testing in year t; b denotes fixed production costs in year t associated with ownership of capital (cows, equipment, buildings, fences, etc.) used in the production process.

Note that management of cows is not expected to differ when pregnancy testing is adopted except for administering the pregnancy test itself, which is conducted by a certified technician at the same time spring-born calves are sorted and separated from their dams in the fall. Average net return between systems is expected to differ by the cow production expenses. The system (herd) that utilizes pregnancy testing would over time be expected to have a reduction in cow production expenses.

A positive expected value represents the average additional profit per cow that a producer would expect to earn from adopting pregnancy testing and a strict culling regiment of first-time open cows into his cow herd management practices.

Herd Description

A culling management strategy was initiated on a group of 30 head of spring calving, 3-6 year bred cows of Angus, Brahman and Simmental inheritance in 1998. Any cow that did not wean a calf or that was not palpated pregnant in the fall of each year was removed from the herd. Additional bred cows of similar breeding were added back to the herd in the fall of each year to maintain a 30 head herd.

Prior to project implementation in the fall of 2000 a comparison group of 35 head of Angus, Hereford or Angus/Hereford cross bred heifers were purchased directly from a local producer. These cattle were selected to represent a typical set of English influenced heifers for the region.

The cow herd composition used in the study, then, consisted of 27 mature cows with an average age of seven years, and 35 two-year old cows for a total of 62 cows. The herd was located at a research farm in south-eastern Oklahoma, near the town of Allen. During the three-year study (2001-2004), no cows from either group were culled unless they died or displayed chronic unacceptable infirmities (e.g., broken leg). All 62 cows were exposed to 3 full-sib Angus bulls for 60 days from June 1 to August 1 of each year and similar management practices for all three years of the study.

Methodology

The data provided the opportunity to determine the net return of keeping open cows in the herd for each of the three years of the study. Enterprise budgets were developed for each cow in each group (i.e., the mature group and the young group) for each year, including the non-pregnant cows. Cow costs for each group have been separated into variable expenses and fixed expenses. Variable expenses included the average costs for mineral, supplemental feed, hay for cows and bulls, pregnancy testing services, veterinary products for cows and bulls, machine hire/lease, pasture rent, pasture maintenance expenses (i.e., seed, custom hire, and fertilizer), labor, and miscellaneous expenses. Fixed costs include depreciation and interest for mature cows, young cows, bulls (sires), calf scales, and computer software used to keep track of the data and analysis. It is important to note here that the cost of an open cow was the same as the cost of a bred cow, except for any costs associated with the preconditioning program or any related feed yard expenses from the retained ownership program.

There are alternative strategies in the region regarding how producers market their calves. Some producers elect to background their calves using a preset preconditioning program where value is added to them for a defined period of time, and then retain ownership of them via a retained ownership program with a feed yard. Alternatively, some producers make arrangements with their neighbors to share ownership and profit margins associated with placing calves on winter rye or wheat pastures, which can be a relatively cheap source of gain over the winter months in the region. However, the large majority of cattle producers operating a spring-calving operation in the region sell their spring-born calf crop at the time of weaning in early October.

Under this system, producers will typically wean calves from their dams and immediately transport calves to a sale barn for quick sale so as to minimize shrink that is associated with stress due to transportation and handling. In an attempt to collect other useful information associated with the calves produced in this project, we elected to retain ownership of them with a feed yard. As a result, we did not actually sell calves from this study at the time of weaning. This required us to use an alternative approach to place value on the calves produced in our study.

We calculated calf value as the average calf weight by gender (which we recorded at the time of weaning) in pounds times the average price paid per pound to producers who sold calves of similar weight at the Oklahoma City National Stockyards sale in early October. Weaning weights were adjusted by a shrink factor of three percent, which is common for this system in the region. Transportation and commission fees have been excluded for analytical convenience.

Results and Discussion

Descriptive statistics for the cows for each year are reported in Table 1. After the calving season in 2003, three cows from the mature herd and one cow from were sold due to chronic illness, reducing the total herd size to 58 for the 2004 production season. In 2002 it was determined that a total of 12 cows were open based on the pregnancy testing results. Of the 12 cows, three were from the mature group and nine from the young group. In 2003, there were 15 open cows, 13 of which from the young group. In percentage terms, approximately 37 percent of the cows in the young group were open relative to only 13 percent of the mature cows. By 2004, the results were better with only 10 open cows between both groups.

Table 1: Descriptive Statistics for Cows and Calves by Cow Group and Year

Year	Number of Cows in Total Herd	Number of Cows in Mature Herd	Number of Cows in Young Herd	Number of Open Cows in Total Herd	Number of Open Cows in Mature Herd	Number of Open Cows in Young Herd
2002	62	27	35	12	3	9
2003	62	27	35	15	2	13
2004	58	24	34	10	3	7

Descriptive statistics for the calves for each year and group is reported in Table 2. The data show that there was a substantial difference between calving rates between the two groups in all three years. Over the three years of the study, the mature group of cows realized an average calving rate 17 percent greater than that of the younger group. The calving rate for the younger group was the lowest in 2003, which is not surprising given that almost 40 percent of the cows in that group were open.

Table 2. Descriptive Statistics for Calf Crop by Cow Group and Year

Year	Number of Cows in Herd	Number of Calves In Mature Group	Number of Calves in Young Group	Calving Rate Total Herd	Calving Rate Mature Group	Calving Rate Young Group
2002	50	24	26	81%	89%	74%
2003	47	24	23	76%	89%	66%
2004	47	21	26	81%	88%	76%

A count of non-pregnant cows for both groups by cow identification ear tag number is reported for each year in Table 3. Although several cows were identified as open over the three year period of the study, only two cows were identified as open in each of the three years of the study (i.e., cow number 1 in the mature group and cow number 72 in the young group). Table 3 also shows that cow number 41 from the younger group was found to be open in the first two years of the study (i.e., 2002 and 2003), but pregnant in the last year (2004). Moreover, we found that cows number 60, 61, and 65 from the younger group were open in the first year of the study (2002), pregnant in the second year (2003), but were found to be open again in the last year (2004).

Table 3: Open Cow Identification by Group, Year and Year-by-Year Interaction

Year	ID # Mature Group	ID # Young Group
2002	1,13,22	41,52,53,56,60,61,65,71,72
2003	1,10	38,41,51,54,55,57,59,63,66,68,69,72,75
2004	1,6,25	51,56,60,61,64,65,72
2002, 2003	1	41,72
2002, 2004	1	60,61,65,72
2003, 2004	1	51,72
2002, 2003, 2004	1	72

Interestingly, we see from Table 3 that cows 41, 60, 61 65, and 72 turned out to be open at least twice over the three years of the project while cows 52, 53, 56, and 71 were open only once over the three years of the project and appear to have become productive after just one year of being open. We can not say anything about cow number 64 in the final year of the study (2004), except to say that she was in fact open; we do not know whether or not she would have been more productive in time.

Weaned pay weights for each cow group and year are reported in table 4. As expected, calves in the younger group realized a lower average weaned pay weight than did the cows in the mature group. Calves from the younger group, on average, weighted 18 kg less than the average pay weight of calves in the mature group. In addition, weaning weights of calves from both cows groups increased steadily each year of the project, reflecting heavier calves as cow age increases. As one would expect due to differences in age, weaning weights per cow exposed was greater for the mature cows compared to the younger cows. This result was consistent with findings reported by the Beef Improvement Federation (BIC).

Table 4: Weaned Pay Weight by Group and Year (kg)

Variable	2002	2003	2004	Average
Mature Group	222	224	227	224
Young Group	202	196	221	206

Pay weights at weaning provide useful information, but that information can be misleading as it relates to open cows. A better measure of animal productivity is weaning weight of calves per cow exposed, reported in table 5. Significantly less weight of weaned calves are available from the younger group than from the mature group as a result of open cows. When accounting for open cows, we see that the average weight at weaning of a calf in the young group is, on average, is 54 kg less than the average weaned weight when open cows are not considered (i.e., 206-152). Although a difference in weight of 16 kg exists in the mature group when open cows are considered, the difference is not as significant as that found in the young group. This is because the mature group was substantially more productive in terms of producing calves than the younger group.

Table 5: Weaning Pay Weights per Exposed Cow by Group and Year

Variable	2002	2003	2004	Average
Total Herd	178	165	187	177
Mature Group	213	207	205	208
Young Group	151	131	174	152

The total cost of non-pregnant cows for each of the two groups and years are reported in table 6. As one can see, the total cost for all open cows in the herd (i.e., young and mature groups) over the duration of the study was approximately $18,600. Without much surprise we can see that there was an $11,250 difference between the total costs associated with the open cows in the mature herd versus that of the young herd. Over the span of the study, the average total cost of the open cows in the young herd was approximately $3,750 more than that of the mature group of cows.

Table 6. Total Cost of Open Cows by Group and Year ($)

Year	Total Herd	Mature Group	Young Group	Difference
2002	5,940	1,423	4,518	3,095
2003	7,772	905	6,867	5,963
2004	4,969	1,388	3,582	2,194
Total	18,681	3,716	14,967	11,250
Average	6,227	1,239	4,989	3,750

Prices for weaned calves by cow group and year are reported in table 7. The main point of this table is to highlight the fact that the lightweight calves from the younger group did receive as expected, in each of the three years, a higher price than did the heavier calves of the mature group. The significance of this is that we believe that the effect of the additional weight of the calves from the mature group relative to the young group on net return is not larger than the effect on net return of the additional weight in the mature group from having more calves relative to the younger group. This effect does not offset the losses from having fewer of the lighter weight animals, even if they do bring a higher price per kilogram.

Table 7. Prices for Weaned Calves by Group and Year ($ kg^{-1})

Variable	2002	2003	2004	Average
Mature Group	1.8771	2.3395	2.5887	2.2689
Young Group	1.9735	2.5093	2.6262	2.3704

Net return to all unpaid resources per cow for both the mature group and the young group of cows for each year is reported in Table 8. The older, more mature group of cows (those that received pregnancy testing and a strict culling protocol prior to the project implementation) outperformed the younger group (the group that did not receive testing or culling) on average and in all three years of the study. The average threshold value of information from pregnancy testing and implementation of a strict culling protocol on first-time open cows was equal to $64 cow^{-1} (i.e., the difference between the net return of the mature group and the net return of the young group). Net return, and hence the value of information varied substantially across years. However, the value appears to be substantial enough to cover the $2 cost head^{-1} of administering the pregnancy testing.

Table 8: Net Return for Weaned Calves by Group and Year ($)

Variable	2002	2003	2004	Average
Mature Group	-39	46	139	49
Young Group	-101	-30	85	-15

In addition to the analysis of the data generating in this project, it is important to report that demonstration field days were advertised and made available to producers in the region each of the four years pregnancy testing was administered to the mature group of cows prior to project implementation in 2001. These demonstrations provided cow/calf producers the opportunity to see first-hand the process of administering the pregnancy testing procedures used for this project, and allowed them the opportunity to ask question of production animal scientists and trained technicians regarding pregnancy testing and culling options. A substantial turnout each year by producers is worth noting, as where the level of questions fielded during these demonstrations.

An obvious limitation of this research is the total number of years the experiment was conducted. We would expect the average value of pregnancy testing to vary somewhat through the peaks and troughs of the cattle cycle. However, as the costs of testing remains low, and additional information useful for making better decisions is seen as a risk reducing technology, the net benefits from the information associated with the testing is believed to be beneficial to cattle producers.

Conclusions

A three year demonstration experiment was conducted in south-central Oklahoma to determine the expected value of adopting pregnancy testing and a strict culling protocol for first time open cows in spring-calving beef cow herds. The study yielded several useful pieces of information. First, it was discovered that the group of cows that did not utilize pregnancy testing and culling of first-time open cows realized a cost of $11,250 more than the group of cows that utilized pregnancy testing and culling of first time open cows. Second, the study was useful in that it demonstrated first-hand to producers in the region the technical aspects associated with pregnancy testing, and allowed them the opportunity to ask questions of certified technicians and animal scientists. Lastly, we found that the average value of information gained from pregnancy testing and culling first time open cows ranged from $54 and $76 head-1, providing ample justification for paying the $2 to $5 head-1 cost for testing.

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