

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

Dissertations and Theses in Agricultural
Economics

Agricultural Economics Department

5-2011

Replacement Alternatives for Beef Cow Herds: An Analysis of Retaining Non-pregnant Cows

Trenton T. Bohling

University of Nebraska-Lincoln, trenton.bohling@huskers.unl.edu

Follow this and additional works at: <https://digitalcommons.unl.edu/agecondiss>



Part of the [Agribusiness Commons](#), [Agricultural and Resource Economics Commons](#), and the [Other Animal Sciences Commons](#)

Bohling, Trenton T., "Replacement Alternatives for Beef Cow Herds: An Analysis of Retaining Non-pregnant Cows" (2011). *Dissertations and Theses in Agricultural Economics*. 6.

<https://digitalcommons.unl.edu/agecondiss/6>

This Article is brought to you for free and open access by the Agricultural Economics Department at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Dissertations and Theses in Agricultural Economics by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

REPLACEMENT ALTERNATIVES FOR BEEF COW HERDS:
AN ANALYSIS OF RETAINING NON-PREGNANT COWS

by

Trenton T. Bohling

A THESIS

Presented to the Faculty of
The Graduate College at the University of Nebraska
In Partial Fulfillment of Requirements
For the Degree of Master of Science

Major: Agricultural Economics

Under the Supervision of Professor Darrell R. Mark

Lincoln, Nebraska

May, 2011

REPLACEMENT ALTERNATIVES FOR BEEF COW HERDS:
AN ANALYSIS OF RETAINING NON-PREGNANT COWS

Trenton T. Bohling, M.S.

University of Nebraska, 2011

Advisor: Darrell R. Mark

A non-pregnant cow is a liability to a producer. Over the last four years, cow-calf producers have had an increased number of non-pregnant cows due to factors like environmental conditions and diseases like trichomoniasis. While most research has indicated that culling a non-pregnant female and replacing the cow with retained heifers, purchased heifers, or purchased cows are the only economic alternatives, recent trends in the cattle market have suggested that keeping a non-pregnant cow may also be an alternative.

Annual beef cow budgets were created based on typical Nebraska Sandhills conditions. Revenues and costs in these budgets vary according to different classes and age of cattle and replacement strategy. Cash flows are then projected for five years to compare the replacement alternatives. Five-year averages from 2006-2010, as well as an additional analysis that used Winter 2010/2011 prices, were used to determine the cash flow values.

The Total 5-year Discounted Cash Flow values showed unprofitable levels in the cow-calf industry based on five-year averages whereas the Winter 2010/2011 price data resulted in profits. Based on the Total 5-year Discounted Cash Flow values using five-

year averages, the replacement alternative of purchasing cows surfaced as the highest return. Retaining heifers was the highest return replacement alternative when Winter 2011 prices were used. Keeping the non-pregnant cow alternative did not prove to be the highest return alternative in either price data used. However, it was not the lowest return either.

Different replacement alternatives become attractive at different cull cow values. Lower cull cow values created higher cash flow values when keeping a non-pregnant cow, whereas extremely valuable cull cows negated this alternative. Furthermore, Winter 2011 prices suggested that keeping a non-pregnant cow was a more feasible alternative than that of purchasing a bred heifer.

TABLE OF CONTENTS

LIST OF FIGURES	vi
LIST OF TABLES	vii
ACKNOWLEDGEMENTS	xi
CHAPTER 1: INTRODUCTION	1
1.1 Motivation.....	1
1.2 Objectives	4
1.3 Organization.....	5
CHAPTER 2: LITERATURE REVIEW	7
2.1 The Non-pregnant Cow.....	7
2.2 Non-pregnant Cow Economics	9
2.3 Special Considerations of Disease: Trichomoniasis	12
2.4 Trichomoniasis and Economics	15
2.5 Summary of Literature Reviewed.....	16
CHAPTER 3: BUDGETING METHODS, ASSUMPTIONS, AND RESULTS.....	18
3.1 Overview and Introduction of Alternatives	18
3.2 Assumptions.....	22
3.3 Budgeting Results	29
3.3.1 Retained Heifer Budget Results.....	29
3.3.2 Purchased Heifer Budget Results.....	33
3.3.3 Purchased Cow Budget Results	34
3.3.4 Bred and Non-pregnant Cow Budgets	35
CHAPTER 4: COMPARISONS OF ALTERNATIVES: 5-YEAR CASH FLOW RESULTS	38
4.1 Overview of Methods	38
4.2 Results.....	39
4.2.1 Retained Heifer Results	39
4.2.2 Purchase Bred Heifer Results	51
4.2.3 Purchase Bred Cow Results	61
4.2.4 Keep Non-pregnant Cow Results.....	68
4.3 Conclusions.....	76
CHAPTER 5: WINTER 2011 RESULTS	80
5.1 Market Trends.....	80
5.2 5-Year Cash Flow Results	82
5.3 Alternative Comparisons Based on Winter 2011 Price Levels.....	87
5.4 An Approach to Combining Alternative.....	89
5.4.1 Combination Alternative 1 and 3.....	90
5.4.2 Combination Alternative 1 and 4.....	94
5.4.3 Summary of Combination Strategies.....	97

5.5 The Effects of Cull Cow Values on Return Potential	99
5.6 Conclusions.....	104
CHAPTER 6: CONCLUSIONS AND IMPLICATIONS	106
6.1 Conclusions and Implications	106
6.2 Areas of Future Research.....	109
REFERENCES	112

LIST OF FIGURES

FIGURE

4.1 Annual Cash Flow Values of Differing Non-pregnant Cow Rates (Alternative 1: Retain Heifers).....	50
4.2 Annual Cash Flow Values of Differing Non-pregnant Cow Rates (Alternative 2: Purchase Heifers).....	60
4.3 Annual Cash Flow Values of Differing Non-pregnant Cow Rates (Alternative 3: Purchase Cows)	68
4.4 Annual Cash Flow Values of Differing Non-pregnant Cow Rates (Alternative 4: Keep Non-pregnant cows)	76
4.5 Discounted 5-Year Total Cash Flow Values of the Alternatives at Differing Non-pregnant Cow Rates	77
5.1 Discounted 5-Year Total Cash Flow Values of the Alternatives at Differing Non-pregnant Cow Rates, Winter 2011 Prices	89

LIST OF TABLES

TABLE

3.1	Cow Herd Distribution	25
3.2	Weaning Weight Adjustments for Dams 4 Years of Age and Younger	28
3.3	Retained Replacement Heifer Cost (Year 1)	30
3.4	Retained Replacement Heifer Cost (Year 2)	32
3.5	Culled, Retained Heifer Expense (Culled in March of Year 1).....	33
3.6	Purchased Heifer Expense (Year 1).....	34
3.7	Purchased Cow Expense (Year 1).....	35
3.8	Bred Cow Expenses (Annual).....	36
3.9	Non-pregnant Cow Expenses (Annual)	37
4.1	Herd Inventory and Cash Flow for Alternative 1 (Retain Heifers), 0% Non-pregnant Cow Rate	41
4.2	Herd Inventory and Cash Flow for Alternative 1 (Retain Heifers), 25% Non-pregnant Cow Rate	43
4.3	Herd Inventory and Cash Flow for Alternative 1 (Retain Heifers), 50% Non-pregnant Cow Rate	45
4.4	Herd Inventory and Cash Flow for Alternative 1 (Retain Heifers), 75% Non-pregnant Cow Rate	47
4.5	Herd Inventory and Cash Flow for Alternative 1 (Retain Heifers), 100% Non-pregnant Cow Rate	49
4.6	Annual Cash Flow and Total 5-Year Discounted Cash Flow Values for Alternative 1.....	51
4.7	Herd Inventory and Cash Flows for Alternative 2 (Purchase Heifers), 0% Non-pregnant Cow Rate	52
4.8	Herd Inventory and Cash Flows for Alternative 2 (Purchase Heifers), 25% Non-pregnant Cow Rate	53

4.9	Herd Inventory and Cash Flows for Alternative 2 (Purchase Heifers), 50% Non-pregnant Cow Rate	55
4.10	Herd Inventory and Cash Flows for Alternative 2 (Purchase Heifers), 75% Non-pregnant Cow Rate	56
4.11	Herd Inventory and Cash Flows for Alternative 2 (Purchase Heifers), 100% Non-pregnant Cow Rate	58
4.12	Annual Cash Flow and Total 5-Year Discounted Cash Flow Values for Alternative 2.....	59
4.13	Herd Inventory and Cash Flows for Alternative 3 (Purchase Cows), 0% Non-pregnant Cow Rate	63
4.14	Herd Inventory and Cash Flows for Alternative 3 (Purchase Cows), 25% Non-pregnant Cow Rate	64
4.15	Herd Inventory and Cash Flows for Alternative 3 (Purchase Cows), 50% Non-pregnant Cow Rate	65
4.16	Herd Inventory and Cash Flows for Alternative 3 (Purchase Cows), 75% Non-pregnant Cow Rate	66
4.17	Herd Inventory and Cash Flows for Alternative 3 (Purchase Cows), 100% Non-pregnant Cow Rate	67
4.18	Annual Cash Flow and Total 5-Year Discounted Cash Flow Values for Alternative 3.....	68
4.19	Herd Inventory and Cash Flows for Alternative 4 (Keep Non- pregnant cows), 0% Non-pregnant Cow Rate.....	71
4.20	Herd Inventory and Cash Flows for Alternative 4 (Keep Non- pregnant cows), 25% Non-pregnant Cow Rate.....	72
4.21	Herd Inventory and Cash Flows for Alternative 4 (Keep Non- pregnant cows), 50% Non-pregnant Cow Rate.....	73
4.22	Herd Inventory and Cash Flows for Alternative 4 (Keep Non- pregnant cows), 75% Non-pregnant Cow Rate.....	74
4.23	Herd Inventory and Cash Flows for Alternative 4 (Keep Non- pregnant cows), 100% Non-pregnant Cow Rate.....	75

4.24	Annual Cash Flow and Total 5-Year Discounted Cash Flow Values for Alternative 4.....	76
4.25	Discounted 5-Year Total Cash Flow Values for the Alternatives at Differing Non-pregnant Cow Rates	77
5.1	5-Year Average Livestock Prices and Winter 2011 Prices.....	81
5.2	Annual Cash Flow and Total 5-Year Discounted Cash Flow Values for Alternative 1, Winter 2011	83
5.3	Annual Cash Flow and Total 5-Year Discounted Cash Flow Values for Alternative 2, Winter 2011 Prices.....	84
5.4	Annual Cash Flow and Total 5-Year Discounted Cash Flow Values for Alternative 3, Winter 2011 Prices.....	86
5.5	Annual Cash Flow and Total 5-Year Discounted Cash Flow Values for Alternative 4, Winter 2011 Prices.....	87
5.6	Total 5-Year Discounted Cash Flow Values for All Alternatives, Winter 2011 Prices.....	88
5.7	Herd Inventory and Cash Flows for Combination Alternative 1 & 3, 25% Non-pregnant Cow Rate	92
5.8	Herd Inventory and Cash Flows for Combination Alternative 1 & 3, 100% Non-pregnant Cow Rate	93
5.9	Annual Cash Flow and Total 5-Year Discounted Cash Flow Values for Alternative 1& 3 Combination, Winter 2011 Prices.....	94
5.10	Herd Inventory and Cash Flows for Combination Alternative 1 & 4, 25% Non-pregnant Cow Rate	95
5.11	Herd Inventory and Cash Flows for Combination Alternative 1 & 4, 100% Non-pregnant Cow Rate	97
5.12	Annual Cash Flow and Total 5-Year Discounted Cash Flow Values for Alternative 1 & 4 Combination, Winter 2011 Prices.....	97
5.13	Cull Value versus Non-pregnant Cow Percentage: Total 5-Year Discounted Cash Flow Values for Alternative 1	100
5.14	Cull Value versus Non-pregnant Cow Percentage: Total 5-Year Discounted Cash Flow Values for Alternative 2	101

5.15	Cull Value versus Non-pregnant Cow Percentage: Total 5-Year Discounted Cash Flow Values for Alternative 3.....	101
5.16	Cull Value versus Non-pregnant Cow Percentage: Total 5-Year Discounted Cash Flow Values for Alternative 4.....	102
5.17	Ranking of Alternatives (Highest Return First) at Differing Non-pregnant Cow Percentages and Cull Cow Values, Winter 2011 Prices	104

ACKNOWLEDGEMENTS

“Success means having the courage, the determination, and the will to become the person you believe you were meant to be.” – Dr. George Sheehan

My courage, determination and success have been to the credit of others, and an acknowledgements section of a thesis does little justice to this deserved credit. However, this is at least an attempt at that feat.

First of all, the encouragement, ideas, and abilities to persuade the development of applied concepts by Dr. Darrell Mark deserves special credit. He allowed me to mature as an individual and as a student. The countless hours of reading drafts and providing direction were well beyond expectations and job descriptions. For this, I must acknowledge the valued input that Dr. Mark had in not only this written work, but also in two years of a Master’s education.

Dr. Rick Rasby and Dr. David Smith also deserve the recognition of providing feedback and expertise in their disciplines. These two individuals, serving as thesis committee members, were an important building block in developing new ideas and thought processes. Mrs. Sandy Sterkel and Mr. Roger Wilson were often asked for ideas and more importantly, provided daily support and encouragement. The faculty and staff of the third floor of Filley Hall made the time spent there enjoyable.

This section could not be completed without acknowledging why I am in this position today. My passion for agriculture and education are the direct products of the way I was raised by my parents, Rob and Janet. I can only hope to one day become this influential, successful, and supportive. Furthermore, the encouragement by my family, especially my sister, brother-in-law, niece McKenna and nephew Kellen, always allowed me to see the important things in life during stressful situations. Ashton Meints

deserves special recognition for not only her proofreading abilities, but also keeping me motivated and in high spirits. She is truly a special and patient girl. I can only hope that these people realize how important of a role they played in this process and I love them all.

This thesis is a part of my individual success, but is more a part of the success of the mentioned individuals and others. Their ability to persuade my courage and encourage my determination have developed me to the person I am today, and I thank them for this. They have been the ones to mold me into the person I strive to be.

CHAPTER 1

INTRODUCTION

Reproductive failure in cattle is the leading cause of culling cattle from a herd. The losses caused by a non-pregnant cow are estimated to cost United States beef producers over \$1.06 billion annually (Lamb, Dahlen, and Maddox, 2008). With Nebraska being home to 1.88 million beef cows, a large burden of this loss falls on Nebraska producers. According to USDA NAHMS (1997), pregnancy failure is the second leading cause of culling a cow from a herd with only age consideration being a larger factor. More importantly, numerous operations have noted an increase of non-pregnant cows since 2009 resulting in producers forced to make management decisions associated with uncommon production occurrences, especially those involving replacement of large numbers of non-pregnant cows.

1.1 Motivation

A non-pregnant cow (also commonly called “open” or “unbred”) is a cow that is not bred and will not calve the following calving season. This has numerous implications from an economic perspective. These include the costs of breeding that cannot be recovered, as well as the process of determining the most feasible option for the future of the individual non-pregnant cow. Most often, these non-pregnant cows are culled and sold into the slaughter market. Keeping the non-pregnant cow to re-breed the following year is not a common option; however, doing so has little recent biological or economic analysis to support the decision.

The cause of having a non-pregnant cow in the herd can vary from operation to operation. Herd management, such as nutrition, bull fertility, bull to cow ratio, and supplementation practices can have major effects on the cow herd's calf production. Additionally, factors such as adverse weather conditions are beyond the producer's control yet can cause drastic fertility changes. Disease, such as trichomoniasis, can increase the percentage of non-pregnant cows found in a herd as well.

Trichomoniasis has surfaced in recent years affecting Nebraska herds. This venereal protozoan disease affects the reproductive system of both the male and female. Trichomoniasis causes early-term abortions as well as inflammation in the oviducts of the cow. This creates a time frame in which establishing pregnancy is difficult, and often results in not only an extended calving season, but high percentages of non-pregnant cows. Trichomoniasis will clear from the infected cow if the cow is given a significant rest period (often over 6 months) without exposure to an infected bull. In order to be sure the cow is cleared of the infection, the possibility of entering the cow into a fall-calving herd (if she was originally a spring-calving cow) is not a management option (Smith, 2010a). Thus, the cow must wait an entire year to be re-bred, indicating no production from the cow for an entire year.

The culmination of geographically localized outbreaks of trichomoniasis and other unknown causes of non-pregnant cows may create concern for producers and force them to make decisions based around abnormally high non-pregnant cow rates. In spring calving systems, non-pregnant cows are regularly culled in the fall following pregnancy diagnosis. The industry average annual cull rate ranges from 15-25%. USDA NAHMS (1997) numbers suggest that in herds of over 100 head, 60% of all cull cattle are

culled due to pregnancy failure. The remaining cull decisions are frequently based on factors such as age, structure of feet and legs, udders, disposition and overall performance (Fuez, 2001).

Sales of cull cows represent 10-20% of total gross income for the herd on average (Gill, 2008). While culling a non-pregnant cow is still an appropriate option and may be economically optimal in many cases, it has not been confirmed to be the best economic strategy in all cases. The variability in agricultural prices suggests other possible alternatives could exist. In certain circumstances, based on input and cattle prices, it may be economically advantageous to keep a non-pregnant cow in the herd. For example, if feed resources are plentiful during years of abnormally high rainfall and feeder, replacement heifer, and bred cow prices are all relatively higher than cull cow prices, there is greater potential in keeping a non-pregnant cow for long term maximum returns.

Unique situations such as these allow deterministic budgeting to be used, potentially finding optimal economic conditions that allow producers to realize profits of a particular scenario. Additionally, cash flows that account for not only a single year decision, but also the long term effects of the operation's bottom line are a valuable analysis. This allows an operation to gain an insight into the financial implications surrounding major changes in the production setting such as an abnormally high non-pregnant cow rate. Many operations follow strict culling and replacement guidelines, and it is the intent of this research to begin analysis of uncommon strategies when faced with a high percentages of non-pregnant cows in a herd.

1.2. Objectives

The following research focuses on decisions related to having non-pregnant cows without regard to the underlying cause of the loss of fertility. While certain diseases, management conditions, individual cow performance or structure are incurable, there are still many causes of having a non-pregnant cow that only has a one year production effect. These causes, such as poor nutrition, improper management, bull fertility, or a disease such as trichomoniasis, create an opportunity for a cow to re-enter the productive cow herd once the issue is resolved, usually by the next breeding season. Thus, a non-pregnant cow has the potential to be treated as a long-term productive asset instead of a terminal slaughter cow.

The objectives of this research, then, are to:

- 1) Create budgets to analyze the costs of various non-pregnant cow replacement alternatives. These include retaining replacement heifers from within the herd, purchasing bred heifers, purchasing bred cows, and retaining the non-pregnant cow for rebreeding. Doing so will involve creating budgets for the carrying costs and expenses associated with each biological age-group of cattle and of non-pregnant and bred cows.
- 2) Build a case study using deterministic budgets to determine whether it is advantageous to keep a non-pregnant cow in relationship to other common alternatives of replacement.
- 3) Analyze how price relationships between cull and replacement stock may affect the feasibility of keeping a non-pregnant cow.

- 4) Analyze the relationships in which cull cow prices affect the long-term cash flow and feasibility of a replacement decision.

The research will focus on building upon past University of Nebraska-Lincoln Extension budgets (Small et al., 2008) to model a case study that analyzes issues associated with above average non-pregnant cow rates. In following the guidelines of the stated objectives, analysis based upon differing percentages of non-pregnant cows will be added to the foundation of past budgets. These four objectives will ultimately allow producers to make informed management decisions that best fit the resources available when faced with the decision of non-pregnant cows in the herd.

1.3. Organization

To set a foundation for the problem, Chapter 2 presents a literature review that evaluates past work based on the implications surrounding having non-pregnant cows in the herd. This includes previous work related to the proper time to replace a cow in the cow herd and a study that examines at the feasibility of keeping a non-pregnant cow. As trichomoniasis has been an increasingly prevalent disease in open range areas of the western states, the disease and studies that involve the economics of the disease are reviewed as well. A brief overview that compares the most common replacement methods of the cow herd is provided, which lays the groundwork for the alternatives of replacement presented in the following pages.

A case study will be presented in Chapter 4 that will determine cash flow values later used throughout the analysis. The case study will allow the options to be looked at in a deterministic sense by comparing total cash flow values of different alternatives. The goal is to use the deterministic budgets to create viable baselines and variable values

that will be extrapolated to the case study by using the assumptions that are described in Chapter 3. In turn, these will analyze replacement alternatives at different percentages in which the cow herd is found to be non-pregnant. Discounted cash flow values over a 5-year period are then used to compare the alternatives of replacement, as well as discussing how feasible keeping the non-pregnant cow can be. Two sets of price data are used in this thesis. Chapter 4 shows a 5-year average trend, while Chapter 5 focuses on Winter 2011 prices and a future outlook. Finally, relationships between cull cow values and the overall profitability of a herd are analyzed.

CHAPTER 2

LITERATURE REVIEW

The non-pregnant cow is a liability in a productive cow herd. While true, producers may find it beneficial to carefully analyze the decision of what to do with a non-pregnant cow. By first recognizing the non-pregnant cow at pregnancy diagnosis and determining the most likely cause, the producer is able to make a decision as to the future productivity of the cow. If the cause does not pertain to a chronic physical, biological, or disease condition, the producer can then analyze the most economically advantageous decision for the individual cow, which may or may not involve culling the animal.

The following literature review follows a similar thought process of determining the status of the non-pregnant cow, or cows, and then discussing economic options pertaining to the next step in the process. Additionally, as trichomoniasis was noted to be an emerging cause of non-pregnant cows in some areas of the United States, past work based upon the disease itself, as well as the economics surrounding the disease, are evaluated. While trichomoniasis is one disease that may cause non-pregnant cows, the ability of the cow to clear of the disease allows a similar relationship to be built between a trichomoniasis infected cow, and a cow that is diagnosed non-pregnant for reasons that do not affect the productivity of the cow beyond the next production year.

2.1 The Non-pregnant Cow

A non-pregnant cow is one that fails to conceive within the specified breeding season. Most often, this is discovered shortly after weaning by pregnancy diagnosis;

however, it can occur much later in operations that do not utilize pregnancy diagnosis (such as during the calving season). The cause of the cow being un-bred can sometimes be unknown, however much research has been done in regards to potential culprits.

Whittier (2004) suggests four major areas that cause reproductive failure: nutrition, bull failure, grazing plant effects and disease. These causes are found throughout all breeds of cattle, as well as all geographical locations, but possibly to differing degrees.

Proper body condition at parturition, which leads to a greater chance of the proper body condition at the time of breeding, can be difficult to obtain without appropriate management. Additionally, adverse climate conditions can magnify improper nutrition management. There are obvious relationships between poor nutrition and low fertility as noted in a multi-decade overview of nutrition and fertility studies by Whittier (2009).

Whittier (2004) suggests that in some instances, different forages may negatively impact conception rates. Fescue toxicity can cause problems in those areas that typically graze the grass, as it commonly elevates body temperature to a point that affects embryo development. While the effects of all grasses are not known, there may be a correlation between spring turn out on lush pastures before breeding season. However, any major change in feeding habits, whether it be moving a herd from a winter drylot to lush grass or simply changing the quality of the supplement, has been discussed as a potential cause of fertility issues.

Whittier (2004) also overviews diseases and how they can negatively impact fertility. Many diseases, such as leptosporosis, vibriosis, IBR, and BVD can be vaccinated against. Additionally, it is possible to vaccinate against trichomoniasis (see Section 4.2) however it is not useful in all instances. All diseases present a risk to

conception rates, as infections even as simple as pinkeye or foot rot may compromise the immune system and negatively impact fertility. Finally, many potential fertility problems can be traced back to the bull. Whittier (2004) suggests that breeding soundness exams are useful to determine if the bull is able to breed. These pre-breeding exams not only test sperm count, but ejaculatory responses and overall soundness of the animal. Injury throughout the breeding season, to either the bull or the cow, can also influence cow herd conception rates.

It must be noted that in some instances, such as any incurable problem that affects the cow's ability to produce a viable calf in subsequent years, the non-pregnant cow should be culled. However, many of the previously mentioned causes of a non-pregnant cow can be either prevented or cured. Those causes are the basis of discussion for the current research as their effect is likely only felt for one production year. Again, this allows the potential alternative of keeping the non-pregnant cow, while not sacrificing the operation's cow herd health or future production.

2.2 Non-pregnant Cow Economics

Numerous research studies have suggested optimal conditions of culling a non-pregnant cow. Tronstad and Gum (1994) indicated that a fall/spring calving system is useful in many production settings and considered the possibility of keeping a non-pregnant cow. They concluded that in 26% of the cases analyzed in their research, non-pregnant cows could potentially be kept in the herd. However, this is also in relationship to turning a spring calving cow into a fall calving cow, or vice versa, where breeding seasons are set 6 months apart instead of single-calving season systems in which breeding seasons are 12 months apart.

Ibendahl, Anderson, and Anderson (2004) are unique in their research in saying “younger open (non-pregnant) cows should not automatically be culled.” Additionally, the research recognizes the price differentials between cull cows, replacement heifers, calves, and feed costs that may influence a decision. In agreement with normal industry practices; however, Azzam and Azzam (1991) and Fraiser and Pfeiffer (1994) disregarded the potential option of keeping a non-pregnant cow and recommend culling any non-pregnant female. Ibendhal, Anderson, and Anderson (2004) created a foundation of discussion pertaining to the alternative of keeping the non-pregnant cow, and serves as a motivation for the research in Chapters 4 and 5.

The ability to determine actual economic costs and benefits of culling or keeping a non-pregnant cow varies drastically with each management system. However true, a typical cost associated with a non-pregnant cow is described by Lamb, Dahlen and Maddox (2008). If, for example, a 500 pound calf is worth \$1/lb, the \$500 calf revenue is directly associated with the cow. However, if non-pregnant cows create only an 85% calf crop, the producer now has \$425 of revenue per cow exposed (Lamb et al. 2008), thus a loss of \$75/head is associated with the lower fertility.

As most prior research has suggested culling non-pregnant cows, and normal replacement rates are 15-25% as described by Fuez (2001), those culls must be replaced to maintain a constant herd size. While continuously debated, the decision of whether to retain heifers or purchase bred heifers can often change with input price fluctuations. Feuz (1996) notes the potential issues of placing value on certain aspects of raising a replacement heifer. For example, the Beef Improvement Federation (2010) recommendations state that a cow reaches productive maturity at the time of the fourth

calf, so adjustments in weaning weight of the first three calves must be made (Cassady et al., 2010). With this in mind, there are disadvantages to replacing mature cows with younger cows. Additionally, younger animals have a much higher risk of pregnancy failure in their second and third calves, as noted by Ibendahl and Anderson (2001).

Determining accurate values for increased management costs of heifers based on labor and feed are also continually debated, but compared to mature cows there are increased capital investment needs and higher risk (Feuz, 1996). Often, producers use a value of the weaned heifer and calculate expected feed costs to calving. This; however, does not include those factors such as increased labor, management and breeding. Fuez (1996) notes that an average of \$50-100 cost savings can be attributed to raising bred heifers versus purchasing them, although management practices of the ranch can dramatically change outcomes.

Dhuyvetter, Langemeier and Johnson (2011) created budgets to determine the costs of a raised replacement heifer. Breakeven price was determined at \$1,328, however initial opportunity costs of the heifer neared \$550, the highest price in the literature reviewed. Although this was the highest opportunity costs found with respect to a weaned heifer calf, prices were noted to be much higher in Winter 2010/2011 reports. Feed costs were the highest in the Dhuyvetter, Langemeier and Johnson (2011) study. Feuz (1996) concluded that an average cost of \$1,099 can be attributed to retaining a heifer. This cost represents the cow at the age of completing her first weaned-calf production cycle. After cull credit and calf income is adjusted, a final value that represents the costs to a producer for a re-bred, two year old cow that has weaned her first calf is \$757. While an interesting point, no other studies used this net cost formula. So,

the relevant comparison is the \$1,328 and \$1,099 values of a bred heifer. Analyzing CattleFax market reports, the average for a bred heifer purchased in the Midwest from February 2008 to February 2010 was \$1,088 (CattleFax Inc., 2010).

Retaining heifers has certain tax implications that would be important to analyze on a case-by-case scenario. Tax liabilities could potentially change the overall feasibility in determining purchased versus raised heifers, however would require additional assumptions. Although some instances may suggest one would have an advantage over another for certain operations, Clark et al., (2005) notes that the differences are not large enough to drastically change the outcomes.

Research has focused on the possibilities of replacing a non-pregnant cow with a purchased or retained replacement heifer. However, later discussion will center on the unlikely event that a producer would be able to replace large numbers (greater than the 15-25% industry average) with replacement heifers. Furthermore, none of the previous studies mentioned have estimated the feasibility of purchasing bred cows (those calving for the second time or more), which represents an alternative in subsequent chapters.

2.3 Special Considerations of Disease: Trichomoniasis

Infectious diseases can be a major cause of conception failure. Research has shown that simply a fever during the breeding season can drastically influence conception rates. These causes, most notably foot rot, respiratory illness or pinkeye, can often be cured with treatment. Similarly, a cow with a trichomoniasis infection has a good probability of clearing the infection. Regardless of the curable disease that can cause a cow to miss a pregnancy, the cow may remain productive in subsequent years. Thus, the

situation offers numerous potential decisions for the producer. In all cases of disease, a thorough understanding of the biological impact is necessary.

A vast amount of research has been accumulated over the past half-century with respect to *Tritrichomonas foetus* (commonly called trichomoniasis or “trich”).

Trichomoniasis is a protozoan microbe similar in size to the bovine sperm cell. The disease mirrors that of the human protozoa *Trichomonas vaginalis*, however it is species specific. While the human disease was first described in 1837, the first reported cases in the United States of bovine trichomoniasis occurred in 1932 (Davidson, 2009).

Trichomoniasis affects both the cow and bull in a cow-calf operation. However, the bull is considered the “host” of the microbe because it is responsible for harboring the microbe, transmission of the infection, and oftentimes cannot clear of the disease.

Microscopic epithelial crypts of the glans penis create an environment for trichomoniasis in which it thrives. As bulls mature, these crypts enlarge in both size and number, with the microbes following suit (Smith, 2010a). A common misconception is that younger bulls will not become infected with trichomoniasis, but Davidson (2009) notes that this is a serious misconception. Although younger bulls may not be as prone to becoming a chronic carrier due to the size of the epithelial crypts, they are equally as likely to transmit the disease if infected.

As sexual contact increases during breeding season, trichomoniasis is transmitted to the cow. At insemination of the cow, the protozoa attaches to the lining of the vagina. With the ability to form colonies, the disease spreads to the uterus and oviducts where inflammation occurs in conjunction with an immune response from the cow. This inflammation is ultimately the cause of abortion and likely takes place 50-90 days after

breeding (Daly, 2005). Although abortion is often described as expelling an unviable fetus, the short gestation period before fetal death occurs suggests the process of expelling a fetus could go unnoticed to producers. Often, the cow will simply absorb the developing embryo or pass a mucus-like substance, far from that of a distinguished late-term abortion. While it is impossible to specify the exact time the organism may last in the cow, the cow will usually clear the infection. Daly (2005) notes a two to four-month time frame in which the cow will clear. Others, including Smith (2010a), recommend at least 9-12 months in the absence of any sexual activity to rid potential of transmission. The longer rest period increases the confidence of the herd clearing of the disease.

A cow that aborts the pregnancy can re-breed in the same breeding season. In doing so, this abortion will usually not be detected and a producer may only notice a large window of late heat cycles throughout the cow herd. This not only makes diagnosis of the disease difficult, but will create a much larger calving window for the herd if bulls remaining in the herd for an extended period. In some instances, it has been documented by culture of the placental fluids that an infected cow may carry a healthy calf full term (Striegel, Ellis, and Deering, 2009). Although the cow can build up immunity to the disease, it is often short-lived if an infected bull is still transmitting the disease during the same breeding season (Striegel, Ellis, and Deering, 2009). In addition, Davidson (2009) reports that cows potentially can carry a calf full term and re-infect the bull during the next breeding season, although this would account for less than 1% of all cases.

Bull-to-bull transmission is also possible, which makes infection possible during the non-breeding season if all bulls are housed in the same unit (Parker et al., 2003). Additionally, during the breeding season, multiple bulls in a single pasture can easily

become infected by a single cow. For example, multiple bulls may breed the same cow in any given heat cycle. In this instance, if the cow was infected by a bull, there is potential contamination to the other bulls that subsequently try to breed her. The ease of transmission in natural service herds, especially those in open range areas with multiple bulls per pasture, warrants cause for concern and represents the main culprit in the transmission of the disease (Smith, 2010a).

Additionally, the overall size of the herd may influence the transmission of trichomoniasis, as well as numerous other diseases. An open range or large grassland area could potentially house 1,000 or more cattle in a continuous pasture. Potential contamination throughout the cow herd is clearly more prominent in these situations compared to smaller, one-bull breeding pastures with a herd divided into many separate management blocks of cattle.

Trichomoniasis has no visual or individual performance effects past reproductive failure, such as decrease in weight gain or loss of appetite. Moreover, there is no legal, approved treatment for the disease. Vaccinations that trigger trichomoniasis antibodies are commercially available and represent an additional preventative measure for persistently infected cowherds. The vaccination does not prevent the disease. Instead, it limits the duration, which increases fetus survival rates and potentially lessens transmissible organisms (Hall et al., 1993).

2.4 Trichomoniasis and Economics

Little economic analysis of trichomoniasis infected herds has been done, especially in recent years. Rae (1949) examined impacts of trichomoniasis from not only the biological standpoint, but also an economic standpoint. This research showed income

estimates based on the number of infected bulls used in the researched herd. Two different rates of bull infection were observed at either the 20% or 40% level. In a breeding pasture that consisted of 5 bulls, losses were associated with both infection rates. The greater percentage of infected bulls magnified the effects of trichomoniasis losses, with a 5.1% reduction in revenue associated with the 20% infection rate and a 35.2% reduction associated with a 40% infection rate.

The exponentially increasing reduction in revenue found by Rae (1949) may suggest that testing for trichomoniasis in breeding bulls is a profitable defense strategy. Striegel, Ellis, and Deering (2009) used veterinary surveys to estimate trichomoniasis testing costs. This study found testing costs to be \$4.43 per head, which in most situations would outweigh the potential cow herd losses such as those described by Rae (1949). In a related article, Davidson (2009) reviewed past studies of the economics and costs associated with an infection of trichomoniasis. Davidson reviewed Rae's (1949) data of the economic costs associated with trichomoniasis, as well as unpublished work by Wikse and McGrann (2001). Wikse and McGrann (2001) evaluated a trichomoniasis-infected herd in Texas. Their work highlighted a 27% reduction in pregnancy rates with trichomoniasis infection in a herd of 161 cows from 2000 to 2001. Estimates of this research concluded the cost of the first year's outbreak was \$78,000. More importantly is the three-year data suggesting economic losses of over \$100,000.

2.5 Summary of Literature Reviewed

Reproductive failure has caused concern to producers for many years. Culling decisions have played important roles in the prosperity of a mature cow herd, as well as adding to the gross income of an operation. When the non-pregnant cow enters into an

operation's cull cow battery, the future production from the particular animal has ended and must be replaced to maintain a constant herd size.

When comparisons are made between different cow-calf operations, it is easy to note the differences in profitability. This stems from differences in cost of production and income generating potential. Likewise, the previously reviewed studies focus on certain assumptions that have generated their respective results. When dealing with the non-pregnant cow, whether it be for trichomoniasis or any of the other causes that are not chronic, differences in production settings can create large discrepancies. Based on this literature review, the subsequent chapters will illustrate an up-to-date analysis of the potential of keeping a non-pregnant cow by building upon previous ideas, results, and discussion.

CHAPTER 3

BUDGETING METHODS, ASSUMPTIONS, AND RESULTS

Budgets have many applications in cow-calf production, one of which is to aid in the estimation of long-term cash flows. The diversification of many beef operations today makes it impossible to define one production scheme or one budget that applies to all producers who could be faced with a large percentage of non-pregnant cows. However, considering a typical possibility is helpful in illuminating the complex budgeting process and the impact of decisions made to rebuild herds. The average values and production practices for a typical Nebraska Sandhills operation are used in the following budgets to depict costs and income calculations in one of the most geographically concentrated areas of cow-calf production.

3.1 Overview and Introduction of Alternatives

The Nebraska Sandhills are unique in that they often have predominantly year-round grazing production systems. Not only do cow-calf pairs graze summer grass, often native range, but also remain on the range during dormant seasons and graze stockpiled forages with supplementation provided as needed. The supplementation often comes in the form of processed proteins, grains, or harvested forages (prairie, alfalfa, cane, or other forms of hay), and is used in times of low stockpiled forage production or extreme climate conditions.

This year-round grazing scenario assumes spring calving herds, consistent with Clark et al. (2002), who report 70% of Sandhills operations have spring herds. Thus,

calves are born in March-April, and cows are bred beginning three months later in June and July. Weaning calves in October assumes an average of 180-205 days for a suckling calf, consistent with industry practices. The following alternatives, and the budgets that allow analysis of the alternatives, are structured to best fit this standard production scenario.

All cow-calf producers face a decision at some point that involves the replacement of the mature cows within the herd. At some point the cow is culled or lost to death. Non-calf revenue is an important source of gross income for an economically feasible herd in most cases, and many factors are involved in a cull decision. Phenotypic attributes such as poor feet, legs, and udder are common reasons to cull. These factors can affect a producer's bottom line in the form of lower production. Additionally, disposition, genetics, and age become a factor in many circumstances. The normal industry practices are that a non-pregnant cow is almost always culled, as noted in Chapter 2.

Typically, culling a percentage of the cowherd is an annual decision that is linked to one of three alternatives to replace the culled cows. These three alternatives are retaining replacement heifers from the cow herd, purchasing bred heifers, or purchasing cows. In addition to these three common methods of replacement, this analysis includes keeping a non-pregnant cow and re-breeding her in the next breeding season as another alternative for the producer. This option has implications that are discussed in not only the following assumptions, but throughout Chapter 4 and 5. The following discussion overviews each alternative's process of replacing a cow herd, as well as highlighting the positive and negative aspects of each.

Alternative 1, retaining heifer calves, is a normal practice in the cow-calf industry. This alternative is generally a long-term decision for an operation as it has a multi-year impact, thus decisions must be made well in advance of any potential need of replacements. The retained heifers, initially retained in Year 1, are non-pregnant, weaned heifer calves. After weaning in October, they will be bred approximately eight months later and calve in Year 2. This biological timeframe does not allow quick replacement as it must be planned out two years in advance of the needed replacements. Producers see retaining heifers as a genetic investment, which makes the option feasible and economical in many instances. Genetics that meet producer's goals are often valued by the producer above market prices, suggesting that equal genetics may not be available for purchase. A retained heifer offers youth to a cowherd, and in some instances, a low cost replacement option.

Purchasing versus raising replacement heifers has been a debated topic for years, and quite often comes to indeterminate conclusions. Each year's market prices and production costs can cause drastic changes in determining the optimal answer. Furthermore, disease transmission can be greatly reduced in a closed herd that does not purchase new animals on an annual basis.

Purchasing pregnant or "bred" heifers represents Alternative 2 of the analysis that follows in Chapters 4 and 5. Many producers choose to sell all their calves (including heifers) and purchase a bred heifer when they need a young cow to enter the herd as a replacement. Increased labor and management costs for developing a bred heifer causes many producers to purchase heifers instead of retaining their own heifers, and ranch resources are a major determination in this decision. Purchasing bred heifers also allows

producers to purchase top genetics proven by others and the purchases can often be in late winter or early spring, which would offer feed costs savings over winter.

The ease of purchasing heifers compared to two years of development of a retained bred heifer makes this alternative attractive. As noted in the retained heifer introduction, it is an individual decision whether to purchase or retain heifers. These decisions are influenced by labor, feed, and facility resources that are decided on a case-by-case basis. Because of this, the purchased bred heifer can be a viable alternative.

Purchasing bred cows is a common alternative to expand a herd in addition to replacing cull cows. This represents Alternative 3 for Chapter 4 and 5 analyses. The bred cow alternative offers generally lower purchase costs with the same benefits of genetic potential and winter feed savings. This alternative is also attractive in terms of labor. Mature cows that have calved one or more times require less labor and care throughout the year and at calving, on average. Bred cows also offer savings in feed compared to that of a heifer in the year of purchase. Heifers commonly need supplementation to meet the requirements of both individual growth and providing nutrition for the calf. Bred cows often have proven their ability to support a calf, which also decreases risk.

What has long been an industry practice to remove non-pregnant cows from the herd, recent market trends and outlook suggests a thorough analysis and discussion should ask questions based upon the feasibility of culling non-pregnant cows that are otherwise free of any other reason for culling. In analyzing market trends for slaughter cow prices, seasonal lows occur from September to November, suggesting producers normally cull during this time that coincides with pregnancy diagnosis. While some of

these slaughter cows may be culled for phenotypical or disposition issues as discussed, many are simply non-pregnant cows that otherwise are productive. Because they have weaned at least one calf, perceived fertility is not a concern.

Keeping the non-pregnant cow is represented as Alternative 4 in this analysis. As an alternative for replacement of a cowherd with higher than average non-pregnant cow rates, keeping a non-pregnant cow has certain implications that must be noted. First, the cow has an obvious production loss as there will not be a calf produced in the subsequent year after the cow is diagnosed non-pregnant. Second, this analysis assumes there is not a fall herd to move the cow into, such that the cow will not have a pregnancy for an entire year. This assumption is made to be consistent with the inadvisability of moving trichomoniasis-infected cows into a fall calving herd. Third is the costs savings to this alternative for the year that the cow is non-pregnant. The non-pregnant cow has lower nutritional requirements because of absence of lactation, which implies lower feed resources, thus lower feed costs. Additional assumptions must be created for this alternative. For example, the normal herd replacement alternative is to purchase bred cows. Other assumptions are noted in Section 3.2.

3.2 Assumptions

The budgets described in the following pages of this chapter represent the foundation of a cash flow analysis. These budgets begin with numerous assumptions, many that focus around the general production setting introduced in Section 3.1 of the Nebraska Sandhills region. The following is a list of major assumptions that are used throughout the thesis.

- 1) Mature cows weigh 1,250 pounds, requiring 1.25 AUMs (Animal Unit Months) without a calf. For summer grazing, with calf, 1.55 AUMs are required per pair once a calf reaches two months of age. Thus, two months of summer grazing are at the rate of 1.25 AUMs, while the next four months AUM requirements are 1.55.
- 2) First-calf heifers (two year-olds), whether purchased or retained, weigh an average of 1100 lbs, thus requiring 1.1 AUMs. Summer grazing with calf requires 1.4 AUMs for 4 months.
- 3) Forage is available in the form of native range and native stockpiled range. Feed may be purchased in the form of grains, hay, and supplements.
- 4) Interest costs of 5.5% are assessed to purchased feed. One-half of all feed, less the grazing costs, are charged interest. This means that half of all hay, supplements, and minerals are charged interest for 6 months. Charging interest for 6 months allows feed to be purchased as needed instead of on an annual basis that would suggest higher annual interest charges.
- 5) Average annual culling rate is 20%. Fuez (1996) notes industry replacement rates vary from 10-30% annually, with long term rates closer to 15-25%. The assumed 20% cull rate fits within this range and is a representation of normal industry practices. Additionally, Alternative 1 retains 25% of the calf crop on a normal year, and culls 12% of the 25% retained. Thus, 22% of the total herd inventory is retained in heifers annually, which allows for total replacement to be met as 20% of the mature cowherd is culled and 2% are removed in the form of death loss.

- 6) Cows culled are taken from the oldest age group up to the 20% rate of culling (normal cull rates). If there are no cows available to cull in the 7 years and older group, the 6 year old group is culled next, and so forth. When non-pregnant cow rates rise above 20%, the respective non-pregnant cow rate is taken from each age group (excluding retained, bred heifers) at equal percentages. For example, if there are 10 cows in the 5 year-old age group, and there is a 50% non-pregnant cow rate, five 5-year-old cows are culled. This creates a uniform distribution among the non-pregnant cows that would be consistent with a disease outbreak affecting pregnancy rates.
- 7) Death loss is assumed at 2% of the mature cow herd, and 2% of all calves born. Death loss is determined before any non-pregnant cow rate calculations are created. Thus, in a herd of 100 cows, the 2% death loss leaves 98 total cows. The non-pregnant cow rate is then calculated from the cows after death loss (98 head).
- 8) Cow ages are distributed in two distinct forms based on normal herd practices. If retained heifers or purchased heifers are normal herd practices, the normal demographics of herd are shown in Table 3.1, depicted by the column “Including Heifers”. For the purchasing cow and keeping non-pregnant cows (Alternatives 3 and 4, respectively), the herd distribution is slightly changed as there are no two year-olds (heifers) in the herd at any time. This is shown by the column heading “Excluding Heifers”.

Table 3.1 Cow Herd Distribution¹

	Including Heifers	Excluding Heifers
First Calf Heifers (2 Year-Olds)	22%	0%
3 Year-Olds	20%	26%
4 Year-Olds	16%	20%
5 Year-Olds	12%	16%
6 Year-Olds	6%	8%
7 Years and Older	24%	30%
Total Herd	100%	100%

¹Smith (2010b) "Age Distribution of Three Cowherds in the Nebraska Sandhills"

- 9) The budgets to determine feed and carrying costs do not assume any heifer retention costs or credits. These heifer budgets are independent from the mature cow herd budget.
- 10) Breeding costs are \$35/head/year, consistent with Small et al. (2008).
- 11) Interest is charged at 5.5% on the cows. In the mature cow budget, this is equivalent to \$8.25/year when using the given cow value averages of \$1050/head on a 7-year life depreciation schedule.
- 12) Marketing costs are \$3.78 per cow, annually, consistent with Small et al. (2008). These costs are not used in the purchased heifer and cow alternatives, as it is expected these purchased animals will not be culled until they enter the bred cow budgets in Year 2. At this time, marketing costs are assigned to the animal. The culled retained heifer budget charges a 2% commission rate to the sale of the heifer, or \$14.24 base on normal marketing costs that would be found at a local livestock auction.
- 13) Veterinary and medical expenses are \$25/year, also consistent with Small et al. (2008). With the same reasoning as marketing cost adjustments for certain alternatives, modifications are made to fit each budget's time of ownership if it

does not include an entire year (e.g. purchasing heifer or cow alternatives are charged 7/12 of the veterinary and medicine expenses as ownership is for 7 months the first year).

- 14) Cash costs of buildings, equipment and repairs are consistent with Small et al. (2008) and are \$4.00/head annually. Adjustments are made similar to Assumption 9 and 10 for each budget that is not on a full-year term.
- 15) Insurance is charged at \$3.00/head for a 1250 pound cow. This is adjusted for the age and value of the animal, such that a retained heifer with an average weight of 700 lbs is charged at \$1.50/head/year due to the assumed lower value of the animal.
- 16) Miscellaneous cash costs are charged at \$5.00/head/year and account for any ownership costs not individually listed. This includes fuel, utilities, and miscellaneous supplies.
- 17) In Alternative 1 (retaining heifers), heifers are treated as a separate entity of the livestock operation. Thus, reasons for abnormally high non-pregnant cow rates are assumed to not affect this class of bred animals. For example, many producers have separate breeding pastures to aid in management of breeding heifers. If the mature cowherd becomes infected with trichomoniasis or any of the reasons for non-pregnant cows discussed in Chapter 2, the separate breeding heifers are treated as an immune group. While not certain in all circumstances, it allows for the retained heifer alternative to potentially rebuild a herd after a devastating loss of the entire mature cow herd to be considered.

- 18) For use in Chapter 4 and 5 that will analyze the net present value of future cash flows, a 5% discount rate applies.
- 19) Calf income is calculated by using average weaning weights and United States Department of Agriculture (USDA) Agricultural Marketing Service (AMS) weighted average prices from the combined 7-Auction Nebraska averages from 2006-2010. These prices are \$126.72/cwt for steer calves, and \$114.67/cwt for heifer calves. Average weaning weights are 550 and 500, respectively. Thus, the total cash price received for a steer calf is \$696.96/head and a heifer calf is \$573.37/head.
- 20) Cull cow prices are also calculated using USDA AMS Livestock Market News data. This is \$50.99/cwt, for a total price of \$637.36/head using the average weight of 1250 lbs.
- 21) In the retained heifer alternative, 12% of the retained heifers are culled (see Assumption 5). These are sold as short yearlings and before breeding at an USDA AMS weighted average price of \$109.52/cwt. At an assumed weight of 650 lbs, the total value of this cull heifer is \$711.88/head.
- 22) Purchase prices of bred heifers and bred cows are calculated using 5-year averages of the USDA AMS prices reported for the Burwell Livestock Market. These reports coincide with the annual auction sale that occurs the last week of the year at the Burwell Livestock Market. Bred heifer prices from 2006-2010 ranged from \$1,108.98 to \$1,385 per head as an annual average, with the 5-Year calculated average at \$1192.58/head. Bred cow prices in the three to seven year-old age range had annual averages ranging from \$924.73 to \$1,310.00/head, with

a 5-Year average of \$1,069.19/head. These 5-Year average values are used in Chapter 4 as the assumed purchase price of a bred heifer or cow.

23) Heifer calf adjustments represent the decreased production from a heifer for her first three calves. The Beef Improvement Federation (Cassady et al., 2010) has determined guidelines that adjust the weaning weights of a cow's first three calves to aid in comparison to mature herd mates. This assumption is used to account for the lower production from younger animals, which has greater implications in Alternatives 1 and 2 compared to Alternatives 3 and 4. Table 3.2 shows the average lower weaning weight produced by either a 2, 3, or 4 year old dam and their respective cash values using the previous price assumptions. These adjustments are charged as expenses in the cash flow analysis in Chapter 4, representing decreased production by choosing an alternative that includes the younger classes of cows (Cassady et al., 2010).

Table 3.2 Weaning Weight Adjustments for Dams 4 Years of Age and Younger¹

Age of Dam	2 Year-Old	3 Year-Old	4 Year-Old
Bull Calf (lbs/calf adjustment)	59.97	39.90	20.06
Bull Value Loss(\$/calf)	\$ 75.99	\$ 50.56	\$ 25.42
Heifer Calf (lbs/calf adjustment)	54.01	35.93	18.08
Heifer Value Loss (\$/calf)	\$ 61.99	\$ 40.07	\$ 20.15
Average Value Losses Compared to Mature Cow Herd (\$/calf)	\$ 68.99	\$ 45.32	\$ 22.79

¹ Adapted from Cassady et al., 2010

24) No genetic potential is accounted for in any of the following analysis. It is discussed how genetic factors may have implications for each alternative, however it is not valued in this analysis.

25) With respect to culling decisions, the assumed goal is to maintain a constant herd size, or return to the original herd size of 100 cows as soon as possible.

Additionally, Year 1 is the only year in which the non-pregnant cow rate fluctuates. Years 2-5 of the cash flow analysis in Chapter 4 return to normal non-pregnant cow rates of 5%, which has little impact on cash flow values since the 5% non-pregnant cows are assumed to enter the 20% of the herd which is culled annually.

3.3. Budgeting Results

The following results are used in Chapter 4 and Chapter 5, which uses 5-year averages and Winter 2011 prices, respectively, to create 5-year cash flows. Budgets are presented for the bred cows, non-pregnant cows, and purchased cows. Additionally, bred heifers budgets (both from weaned calves and purchased bred heifers) and the retained cull heifer budgets are presented to show total annual costs of using each different alternative. Alternatives 1 through 4 use appropriate combinations of these budgets to analyze cash flows in the next chapter.

3.3.1 Retained Heifer Budget Results

There are three major retained heifer budgets that represent annual costs. By using only cash expenses to the producer, it is imperative to charge costs as they are incurred. This means that the two year process of developing a retained heifer is divided into annual budgets, as well as an additional budget for the retained heifer that is not held for the entire year timeframe as the other retained budgets as she is culled in March. Thus, the three budgets depicted are the weaned heifer calf development budget, the first year of production, and the weaned heifer calf that is culled before breeding in the first year of development.

Table 3.3 shows the retained heifer budget for the first year of development. This covers the year from weaning on October 1 through the late spring breeding season and ends as a bred heifer on September 30. Winter dormant season grazing, which accounts for October through April at an average heifer weight of 700 lbs, has total costs of \$75.60 per head. Summer grazing of the bred heifer (average weight 800 lbs) accounts for 4.8 AUMs of the budget, and at \$27/AUM, this is the largest cost at \$129.60. Prairie hay and heifer supplement add \$20 and \$31.20/head, respectively, and are added to the budget due to the potential of needing the supplement when stockpiled grass production is not adequate. No marketing costs are charged to the retained heifer, and veterinary/medicine and breeding costs are constant at \$25 and \$35, respectively, throughout all annual budgets. Cash costs on buildings, equipment, and repairs are constant at \$4/year as stated in the assumptions. Interest on purchased feed is \$1.62. Insurance for the 700 pound heifer is \$1.50 per year. Miscellaneous cash costs are charged at \$5/head/year. Total retained heifer costs for the first year of development are \$336.12 per head.

Table 3.3 Retained Replacement Heifer Costs (Year 1)

<i>Feed Costs</i>	<i>Quantity</i>	<i>Unit</i>	<i>\$/Unit</i>	<i>\$/Head</i>
Growing Season Grazing	4.80	AUM	27.00	129.60
Dormant Season Grazing	4.20	AUM	18.00	75.60
Prairie Hay (Large Round Bales)	0.25	ton	80.00	20.00
32% Protein	-	cwt	12.00	
Heifer Supplement	480.00	lbs	0.07	31.20
Salt	20.00	lbs	0.07	1.40
Mineral with Phosphorus	20.00	lbs	0.31	6.20
<i>Total Feed Cost</i>				264.00
Veterinary/Medicine				25.00
Breeding Costs				35.00
Cash Costs on Buildings/Equipment/Repairs				4.00
Interest on Purchased Feed				1.62
Insurance				1.50
Misc. Cash Costs				5.00
<i>Total Operating/Mgt Cost</i>				72.12
Total Cost of Retaining Replacement Heifer (Year 1)				\$ 336.12

Table 3.4 is similar in structure to Table 3.3, however it shows the second year of development of the retained heifer, which includes the production of the heifer's first calf. This budget is from October 1 of the second year of development (the ending of the budget discussed in Table 3.3) to the next year that includes calving and nursing her first calf. The highest cost is again the growing season grazing. The AUM requirements are based on using a 1100 pound first-calf heifer (slightly lighter than the mature cow assumption) as noted in Section 3.2. Additionally, there are supplement and prairie hay costs. This suggests that the first-calf heifers may need additional supplementation throughout the first year, which is accepted as common by industry standards. The same costs for marketing, breeding, veterinary/medicine, and buildings/equipment/repairs as are used in the first year of the retained heifer budgets are included in the second year to bring the total cost to \$488.01. Other differences between Tables 3.3 and 3.4, other than feed costs, are associated with higher interest on purchased feed and insurance costs. With two years of development, total costs to the producer for the two years development of the retained heifer are \$824.13. This value is similar Fuez (1996) as discussed in Chapter 2.

Table 3.4 Retained Replaced Heifer Costs (Year 2)

<i>Feed Costs</i>	<i>Quantity</i>	<i>Unit</i>	<i>\$/Unit</i>	<i>\$/Head</i>
Growing Season Grazing	7.80	AUM	27.00	210.60
Dormant Season Grazing	6.00	AUM	18.00	108.00
Prairie Hay (Large Round Bales)	0.70	ton	80.00	56.00
32% Protein	-	cwt	12.00	
Heifer Supplement	480.00	lbs	0.07	31.20
Salt	20.00	lbs	0.07	1.40
Mineral with Phosphorus	20.00	lbs	0.31	6.20
<i>Total Feed Cost</i>				413.40
Veterinary/Medicine				25.00
Breeding Costs				35.00
Cash Costs on Buildings/Equipment/Repairs				4.00
Interest on Purchased Feed				2.61
Insurance				3.00
Misc. Cash Costs				5.00
<i>Total Operating/Mgt Cost</i>				74.61
Total Cost of Retaining Replacement Heifer (Year 2)				\$ 488.01

The last budget in this alternative is for the expenses of the retained heifers that are eventually culled. This budget represents the 12% of the retained heifers that are culled in March as 10-12 month olds. The major difference between this budget and Year 1 of the retained heifer budget is the absence of summer feed costs and the 6 months carrying costs as opposed to the yearly cash costs. This difference lowers the costs to producer by \$184.80 for a total cost of the retained heifer that is culled of \$151.32/head. This budget is shown in Table 3.5.

Table 3.5 Culled, Retained Heifer Cost (Culled in March of Year 1)¹

<i>Feed Costs</i>	<i>Quantity</i>	<i>Unit</i>	<i>\$/Unit</i>	<i>\$/Head</i>
Growing Season Grazing				
Dormant Season Grazing	4.20	AUM	18.00	75.60
Prairie Hay (Large Round Bales)	0.25	ton	80.00	20.00
32% Protein	-	cwt	12.00	-
Heifer Supplement	240.00	lbs	0.07	15.60
Salt	10.00	lbs	0.07	0.70
Mineral with Phosphorus	10.00	lbs	0.31	3.10
<i>Total Feed Cost Weaning to Calving</i>				115.00
Marketing (culls)				14.24
Veterinary/Medicine				12.50
Cash Costs on Buildings/Equipment/Repairs				2.00
Interest on Purchased Feed				1.08
Insurance				1.50
Misc. Cash Costs				5.00
<i>Total Operating/Management Costs</i>				36.32
Total Cost of Culled, Retained Heifer (Year 1, Culled in March)				\$ 151.32

¹Heifer that is retained at weaning, but is culled 6 months later and will not enter the heifer breeding herd.

3.3.2 Purchased Heifer Budget Results

The purchased heifer budgets are similar to that of retained heifer budgets in the second year of development. With the assumption of purchasing the heifer near calving time (March), dormant season grazing and winter feed costs are not included. This is five months worth of feed savings to the producer. The growing season AUMs are calculated the same as the retained heifer budget in Year 2, and allow prairie hay and supplementation to be used to meet the higher nutritional requirements of a first calf heifer.

As the producer is purchasing the heifer, it assumed there are no marketing costs for the first production year (7 months). Breeding costs stay constant as the first calf heifer is re-bred that summer, and all other costs are charged at 7 months instead of the 12 months as in the previous budgets. The purchase price of \$1,192.58 is charged the assumed interest rate of 5.5% for 7 months. Interest costs on the purchased heifer are

\$5.47/head for the first seven months of ownership. Table 3.6 shows the purchased heifer budget at a total cost of \$1,557.68 per head.

Table 3.6 Purchased Heifer Expense (Year 1)

<i>Purchased Heifer Price</i>					1,192.58
<i>Feed Costs</i>	<u>Quantity</u>	<u>Unit</u>	<u>\$/Unit</u>	<u>\$/Head</u>	
Growing Season Grazing	7.80	AUM	27.00	210.60	
Dormant Season Grazing	1.10	AUM	18.00	19.80	
Prairie Hay (Large Round Bales)	0.70	ton	80.00	56.00	
32% Protein	-	cwt	12.00	-	
Heifer Supplement	180.00	lbs	0.07	11.70	
Salt	10.00	lbs	0.07	0.70	
Mineral with Phosphorus	10.00	lbs	0.31	3.10	301.90
<i>Total Feed Cost Weaning to Calving</i>					
Veterinary/Medicine				14.58	
Breeding Costs				35.00	
Cash Costs on Buildings/Equipment/Repairs				2.33	
Interest on Purchased Feeds				1.15	
Insurance				1.75	
Misc. Cash costs				2.92	
Interest on Purchased Heifer				5.47	
<i>Total Operating/Mgt Cost</i>					63.20
Total Cost of Purchased Heifer (Year 1, 7 Months)					\$ 1,557.68

3.3.3 Purchased Cow Budget Results

The purchased cow budget has greater feed costs compared to that of a purchased heifer. This is attributed to the mature cow weight of 1250 pounds compared to the assumed heifer weight of 1100 pounds in determining AUMs as the heifers are still developing. The purchased cow and purchased heifer budgets, which are for the same time frame of March to October, are composed of different individual feed costs but have similar total feed costs. Similarities in the operating costs of marketing, breeding, veterinary/medicine, cash costs on buildings/equipment/repairs are consistent with the bred cow budget discussed in Section 3.3.4. The purchase price of the cow is nearly \$130/head less than the bred heifer which leads to a total costs for the purchased cow of \$1,422.25. Table 3.7 shows the first year's budget for the purchased bred cow.

Table 3.7 Purchased Cow Expense (Year 1)

<i>Purchase Price of Cow</i>					1,069.19
<i>Feed Costs</i>	<i>Quantity</i>	<i>Unit</i>	<i>\$/Unit</i>	<i>\$/Head</i>	
Growing Season Grazing	8.70	AUM	27.00	234.90	
Dormant Season Grazing	1.25	AUM	18.00	22.50	
Prairie Hay (Large Round Bales)	0.20	ton	80.00	16.00	
32% Protein	0.58	cwt	12.00	7.00	
Heifer Supplement	-	lbs	0.31	-	
Salt	28.00	lbs	0.07	1.96	
Mineral with Phosphorus	28.00	lbs	0.31	8.68	
<i>Total Feed Cost Weaning to Calving</i>					291.04
Veterinary/Medicine				14.58	
Breeding Costs				35.00	
Cash Costs on Buildings/Equipment/Repairs				2.33	
Interest on Purchased Feeds				0.54	
Insurance				1.75	
Misc. Cash Costs				2.92	
Interest on Purchased Cow				4.90	
<i>Total Operating/Mgt Cost</i>					62.02
Total Cost of Purchased Cow (Year 1, 7 Months)					\$ 1,422.25

3.3.4 Bred and Non-pregnant Cow Budgets

The bred cow budgets are used in all alternatives. This budget represents the mature cow herd, and is especially used in Years 2-5 in all alternatives. No matter what alternative is analyzed in Chapter 4 and 5, bred and/or non-pregnant cows are used in the analysis, however possibly to differing degrees. The following budgets, consistent in most regards to Small et al. (2008), show the total annual cash costs to the producer for October 1 to September 30.

Table 3.8 Bred Cow Expense (Annual)

<i>Feed Costs</i>	<u>Quantity</u>	<u>Unit</u>	<u>\$/Unit</u>	<u>\$/Head</u>	
Growing Season Grazing	8.70	AUM	27.00	234.90	
Dormant Season Grazing	7.50	AUM	18.00	135.00	
Prairie Hay (Large Round Bales)	1.20	ton	80.00	96.00	
32% Protein	1.00	cwt	12.00	12.00	
Heifer Supplement	-	lbs	0.07	-	
Salt	48.00	lbs	0.07	3.36	
Mineral with Phosphorus	48.00	lbs	0.31	14.88	
Total Year Feed Costs					496.14
<i>Other Cash Costs</i>					
Marketing					3.78
Veterinary/Medicine					25.00
Breeding					35.00
Cash/Owner Costs on Buildings/Eqpt					4.00
Interest on Purchased Feeds					3.47
Insurance					3.00
Misc Cash Costs					5.00
Interest on Animals					8.25
Total Operating Costs					87.50
Total Annual Bred Cow Cost					\$ 583.64

Table 3.8 is described by the assumptions listed previously in Section 3.2, such as in feed costs calculations (AUMs). The cash costs are consistent with Small et al. (2008) and show the total annual cash expenses to a producer. The annual bred cow operating costs total \$87.50, while the feed costs are at \$496.14. These values show a total net cost for carrying a bred cow, with calf at side for 7 months, at \$583.64. This bred cow total is used in Chapters 4 and 5.

Alternative 4, as described previously, keeps the non-pregnant cows for an entire year without any calf production. The NRC (1996) denotes the changes in nutrient requirements based on bred cows that are lactating for a certain timeframe and those cattle that simply require maintenance (non-lactating). Because of this, major changes in nutrient needs are realized. The bred cow requires total yearly feed costs of \$496.14, whereas the non-pregnant cow (all else constant) totals \$355.74 annual feed costs (Table 3.9). At a difference of \$140.40, the feed savings is substantial. The non-pregnant cow budget in Table 3.9 has similarities with the bred cow budget in Table 3.8. First,

marketing, veterinary medicine, cash/ownership costs, insurance and miscellaneous costs are held constant. Therefore, the differences are in the feed costs as well as the interest on the purchased feed, which is charged on half of the purchased feed costs.

Table 3.9 Non-pregnant Cow Expense (Annual)

<i>Feed Costs</i>	<i>Quantity</i>	<i>Unit</i>	<i>\$/Unit</i>	<i>\$/Head</i>
Growing Season Grazing	7.50	AUM	27.00	202.50
Dormant Season Grazing	7.50	AUM	18.00	135.00
Prairie Hay (Large Round Bales)	-	ton	80.00	-
32% Protein	-	cwt	12.00	-
Heifer Supplement	-	lbs	0.07	-
Salt	48.00	lbs	0.07	3.36
Mineral with Phosphorus	48.00	lbs	0.31	14.88
Total Year Feed Costs				355.74
<i>Other Cash Costs</i>				
Marketing				3.78
Vet/Med				25.00
Breeding				35.00
Cash/Owner Costs on Buildings/Eqpt				4.00
Interest on Purchased Feeds				0.50
Insurance				3.00
Misc Cash Costs				5.00
Interest on Animals				8.25
Total Operating Costs				84.53
Total Annual Open Cow Cost				\$ 440.27

Feed costs savings are found in growing season grazing costs. In the bred cow budget, the suckling calf accounts for .3 AUMs. The absence of a calf lowers Table 3.9 to 7.5 AUMs required, a difference of 2.2 AUMs from that of a bred cow with calf. Additionally, no supplement is needed to meet the maintenance and lactation requirements found in Table 3.8. Total feed costs are \$355.74 and operating costs are \$84.53, for a total annual cost of a non-pregnant cow of \$440.27.

CHAPTER 4

COMPARISONS OF ALTERNATIVES: 5-YEAR CASH FLOW RESULTS

Net present values of future cash flows can be used to evaluate the outcome of present-day management decisions. Four alternatives for rebuilding herds after large numbers of non-pregnant cows are discovered in the herd are evaluated across varying levels of non-pregnant cow rates by calculating the multi-year cash flows for those outcomes. Based on the same long-term averages and assumptions listed in Section 3.2, cash flow values were calculated using cash accounting methods and the budgets in Section 3.3. Only realized cash revenues and expenses to the producer are calculated in the scenarios. Economic costs, such as depreciation and opportunity costs, are not included in these budgets because net cash flow on a yearly basis is a critical and primary decision criterion for producers facing a production shock. These shocks include changes in the herd based upon the non-pregnant cow rate and the different alternatives of replacing a non-pregnant cow. These alternatives include retaining heifers, purchasing heifers, purchasing cows, or keeping the non-pregnant cows.

4.1 Overview of Methods

A five-year cash and herd inventory is framed by a similar template for the four alternatives. The herd inventory accounts for the number of steer and heifer calves produced, bred cows in the herd, cull cows, cow death loss, bred and non-pregnant heifers, and any group of purchased animals. Each alternative varies slightly in that some do not use all the different classes of cattle (e.g., retained heifers are only used in Alternative 1). This herd inventory allows for comparison between the options, as well

as providing an outline to meet the target goal of maintaining a constant herd size, in this case 100 cows.

The herd inventory is used in calculating the income and expense for the production year. The ending cash flow (difference between income and expense) is then used as the beginning cash in the next year. Each individual year's cash flow is then discounted at a rate of 5% to calculate a net present value of the five year cash flow for each of the four alternatives. This allows comparison and discussion centered on not only an individual year's profit or loss outcome, but the longer term feasibility of the producer's decisions and potential options to increase the likelihood of recovery from higher than normal non-pregnant cow rates.

4.2 Results

4.2.1 Retained Heifer Results

One common way to replace the culled non-pregnant cows is for producers to retain their own heifer calves for breeding. Whenever non-pregnant cow rates are less than 20% in this case study, 25 heifers are retained from the 49 available, and the rest are sold. At a 12% cull rate on the retained heifers, 3 (2.94 due to death loss) head are sold as 10-12 month old heifers and the rest are developed and bred. Twenty cows are culled and 78 bred cows remain in the herd. Normal death loss applies to 2% of the mature herd. It is assumed that with normal practices of retaining heifers, the producer will have normal rates (22 head) of 2-year-old bred heifers ready to enter the herd due to the previous year's similar decisions. Additionally, this different development group is often handled separately from the cow herd, thus it is assumed to not be affected by the causes of an increased non-pregnant cow rate in the scenarios to follow with higher non-

pregnant rates. So, even with a 100% non-pregnant cow rate, the producer still has 22 bred heifers producing calves in Year 2, and the retained heifers from Year 1 produce calves in Year 3.

Table 4.1 shows the herd inventory and cash flow of Alternative 1 at the non-pregnant cow rate of 0%. First, the herd inventory is calculated beginning with Year 1. As the assumptions in Section 3.2 described, the inventory without any non-pregnant cows has a 20% cull rate of the mature cow herd, with additional losses associated with the 2% death loss. Thus, 22 mature cows leave the herd. Additionally, Table 1 shows the process of retaining heifers by separating the heifer calf retained (first year of development) as well as the retained bred heifer (second year of development, including calving). Alternative 1 also inventories the retained heifers that are then culled (at 12% of the retained heifers), as well as the cows that will be culled. Bred cows remaining in the herd are accounted for and death loss is shown to track herd inventory and meet the target of 100 bred cows. Each inventory row is then listed as either an income (calf and cull sales) or charged their respective expense in the cash flow section of the table based on the budget results from Section 3.3

**Table 4.1 Herd Inventory and Cash Flow For Alternative 1 (Retain Heifers),
0% Non-pregnant Cow Rate**

	----- head -----				
	Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>					
Steer Calf	49.00	49.00	49.00	49.00	49.00
Heifer Calf (Sales)	24.50	24.50	24.50	24.50	24.50
Heifer Calf (Retained)	24.50	24.50	24.50	24.50	24.50
Cull Heifer	3.00	3.00	3.00	3.00	3.00
Cull Cow	20.00	20.00	20.00	20.00	20.00
Bred Cow	78.00	78.00	78.00	78.00	78.00
Retained Heifer (2 Year Old)	22.00	22.00	22.00	22.00	22.00
Cow Deathloss	2.00	2.00	2.00	2.00	2.00
	----- \$/head -----				
<i>Income</i>					
Beginning Cash	-	(2,493.19)	(5,108.73)	(7,695.53)	(10,229.25)
Steer Calf Sales	696.96	34,151.04	34,151.04	34,151.04	34,151.04
Heifer Calf Sales	620.50	15,202.34	15,202.34	15,202.34	15,202.34
Cull Cow Sales	637.36	12,747.12	12,747.12	12,747.12	12,747.12
Cull Heifer Income	711.88	2,135.64	2,135.64	2,135.64	2,135.64
Total Income	64,236.13	64,236.13	64,236.13	64,236.13	64,236.13
<i>Expenses</i>					
Bred Cow Expense	583.64	45,523.92	45,523.92	45,523.92	45,523.92
Retained Heifer Calf Expense	336.12	7,226.58	7,226.58	7,226.58	7,226.58
Retained Bred Heifer Expense	488.01	10,736.22	10,736.22	10,736.22	10,736.22
Cull Heifer Expense	151.32	453.96	453.96	453.96	453.96
Heifer Calf Adjustments		2,788.64	2,911.00	2,882.25	2,810.60
Total Expense	66,729.32	66,851.68	66,822.93	66,769.85	66,751.28
Annual Cash Flow	(2,493.19)	(2,615.55)	(2,586.80)	(2,533.72)	(2,515.15)
Accumulated Cash Flow	(2,493.19)	(5,108.73)	(7,695.53)	(10,229.25)	(12,744.39)
Total 5-Year Discounted Cash Flow					(11,036.59)

Table 4.1 shows a normal year that does not have abnormally high non-pregnant cow rates. Retaining heifers is not profitable in any year based on the assumed 5-year average values for income and expenses in this non-pregnant cow rate. Additionally, with the losses associated with the cow-calf industry in relationship to the five-year average assumptions, losses are shown in all non-pregnant cow rates. Average losses to the cow herd are nearly \$2,500 annually in Table 4.1. As noted in Section 3.3.1, the total cost for two years of development of the retained heifer is \$824.13, which is found by adding both years of development for the individual retained heifer (i.e., \$336.12 and \$488.01 from Table 3.3 and 3.4, respectively). This does not include the value of the

heifer at weaning, which must be considered as an opportunity cost in an economic budget. Here, it is included as decreased numbers of heifer calves to sell.

The cash flow portion (shown in the bottom half of Table 4.1) gives both an annual and accumulated cash flow value. Essentially, the budgeted income and expense values are multiplied by the inventory for each respective class of cattle in the herd. Total income less total expenses result in the annual cash flow, while Year 2 and beyond carry over the ending cash of the previous year as “Beginning Cash”. In determining a Total 5-Year Discounted Cash Flow value, each annual cash flow is discounted at 5% per Chapter 3 assumptions. In Table 4.1, this value is -\$11,036.59.

The 25% non-pregnant cow rate (Table 4.2) has only slight changes from the 0% non-pregnant cow rate in Year 1. There are now 30 heifer calves retained compared to 24.5, and after culling 3.6, 26.4 are available to enter the herd. By Year 3, however, the herd returns to the normal rate of 22 heifers entering the herd annually. The process of making decisions on the number heifers to retain can be challenging as multi-year planning must be considered. In Year 1, by retaining 30 heifers for a total of 26.40 that will enter the productive herd in Year 3, it allows all other years to continue the normal rates of 25%.

However, as will be shown in subsequent non-pregnant cow rates (50, 75, and 100%), the first year’s group of retained heifers cannot meet the total number of heifers needed to rebuild the herd to the target of 100 cows by simply using the heifer calf crop from Year 1. Herd inventories need to be managed such that in any given year, the herd does not drastically change from the target of 100 cows. When extremely high non-pregnant cow rates are realized, it takes years for the cow herd to rebuild by choosing to

use only Alternative 1. This will be noted in the subsequent tables of section 4.2.1 that have higher non-pregnant cow rates.

Table 4.2 Herd Inventory and Cash Flow For Alternative 1 (Retain Heifers), 25% Non-pregnant Cow Rate

	----- head -----				
	Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>					
Steer Calf	49.00	46.80	49.00	49.00	49.00
Heifer Calf (Sales)	19.00	23.40	24.50	24.50	24.50
Heifer Calf (Retained)	30.00	23.40	24.50	24.50	24.50
Cull Heifer	3.60	2.80	3.00	3.00	3.00
Cull Cow	20.00	19.00	20.00	20.00	20.00
Bred Cow	74.00	75.50	78.00	78.00	78.00
Retained Heifer (2 Year Old)	22.00	26.40	22.00	22.00	22.00
Cow Deathloss	2.00	2.00	2.00	2.00	2.00
	----- \$/head -----				
<i>Income</i>					
Beginning Cash	-	(4,882.05)	(10,492.67)	(18,705.94)	(24,958.13)
Steer Calf Sales	696.96	34,151.04	32,617.73	34,151.04	34,151.04
Heifer Calf Sales	620.50	11,789.57	14,519.78	15,202.34	15,202.34
Cull Cow Sales	637.36	12,747.12	12,109.76	12,747.12	12,747.12
Cull Heifer Income	711.88	2,562.77	1,993.26	2,135.64	2,135.64
Total Income	61,250.49	61,240.54	64,236.13	64,236.13	64,236.13
<i>Expenses</i>					
Bred Cow Expense	583.64	43,189.36	44,064.82	45,523.92	45,523.92
Retained Heifer Calf Expense	336.12	8,873.57	6,924.07	7,226.58	7,226.58
Retained Bred Heifer Expense	488.01	10,736.22	12,883.46	10,736.22	10,736.22
Cull Heifer Expense	151.32	544.75	423.70	453.96	453.96
Heifer Calf Adjustments		2,788.64	2,555.11	3,063.06	2,949.19
Total Expense	66,132.54	66,851.16	67,003.74	66,889.87	66,812.00
Annual Cash Flow	(4,882.05)	(5,610.63)	(2,767.61)	(2,653.74)	(2,575.87)
Accumulated Cash Flow	(4,882.05)	(10,492.67)	(18,705.94)	(24,958.13)	(31,210.32)
Total 5-Year Discounted Cash Flow					(16,330.83)

The Total 5-Year Discounted Cash Flow value for the 25% non-pregnant rate is -\$16,330.83. The first and second years create the most negative annual cash flow values due to the increased retention rate in Year 1 and the loss of calf income in Year 2 from higher retention rates. Compared to Table 4.1, this is over \$5,000 in additional losses in the Total 5-Year Discounted Cash Flow.

Major changes occur from the 25% non-pregnant cow rate to the 50% non-pregnant cow rate. As Table 4.3 shows, the first year does not allow any heifers to be

sold as all are retained. Another notable change is the Year 1 Annual cash flow value being positive. This is caused by the higher cull cow rates generating cull cow sales that account for more total income than the income forfeited by retaining the replacement heifers in calf sales in Year 1. By Year 3, however, the producer is back to normal rates of retention, culling, and total cow herd numbers. Table 4.3 begins to depict an interesting implication of retaining heifers, which is shown to greater effect in the subsequent tables (Tables 4.4 and 4.5). Whenever the non-pregnant cow or cull rate is greater than the normal replacement rate, more retained heifers are needed than that of the normal 25% of the calf crop. Even more so, when non-pregnant cow rates rise above 43%, it is impossible to replace the non-pregnant cows with retained heifers within two years. The assumption that calls for 12% of the retained heifers to be culled is the cause for the inability to replace a non-pregnant cowherd in the two year timeframe with non-pregnant (or cull) rates greater than 43% non-pregnant cows. To reach the needed 43% replace rate that is needed, all of the heifers (49% of the calf crop, or half of the calf crop, less death loss) is retained. Twelve percent of these retained heifers are culled, leaving 43.12% of the heifers available for retention in the herd, or in this 100 head herd study, 43 heifers. At rates above 43% non-pregnant cows, all heifers are retained and enter the herd, or the maximum of 43 heifers.

The biological development of the heifers create long-term forecasting problems, as a decision in Year 1 will not be realized until Year 3, when the heifer retained in Year 1 weans and sells her first calf. Slight changes also occur in the herd inventory. In Year 3, for example, the mature cow herd returns to near target herd numbers of 98.4 cows. This can be found by adding Year 2's bred cow and retained heifer (2 year-old) inventory

values. With a 2% calf death loss, total calves are 97.6. This slightly lower number of calves translates to .2 less heifers retained and sold when compared to that of a normal year, such as shown in Table 4. While this has no serious implications, it is interesting to note that the herd inventory values do not consistently settle on original numbers in all years, however they are very close indicating the target herd size is practically met. The final 5-Year Discounted Cash Flow value for the 50% non-pregnant cow as shown in Table 4.3 rate is -\$17,945.54.

Table 4.3 Herd Inventory and Cash Flow For Alternative 1 (Retain Heifers), 50% Non-pregnant Cow Rate

	----- head -----				
	Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>					
Steer Calf	49.00	34.80	48.60	49.00	49.00
Heifer Calf (Sales)	-	9.00	24.30	24.50	24.50
Heifer Calf (Retained)	49.00	25.80	24.30	24.50	24.50
Cull Heifer	6.00	3.00	2.90	3.00	3.00
Cull Cow	49.00	14.20	20.00	20.00	20.00
Bred Cow	49.00	55.40	77.50	78.00	78.00
Retained Heifer (2 Year Old)	22.00	43.00	22.80	22.00	22.00
Cow Deathloss	2.00	2.00	2.00	2.00	2.00
	<i>\$/head</i>	----- \$/herd -----			
<i>Income</i>					
Beginning Cash	-	12,168.46	(10,441.50)	(14,806.29)	(18,342.20)
Steer Calf Sales	696.96	34,151.04	24,254.21	33,872.26	34,151.04
Heifer Calf Sales	620.50	-	5,584.53	15,078.23	15,202.34
Cull Cow Sales	637.36	31,230.44	9,050.45	12,747.12	12,747.12
Cull Heifer Income	711.88	4,271.28	2,135.64	2,064.45	2,135.64
Total Income	69,652.76	41,024.83	63,762.06	64,236.13	64,236.13
<i>Expenses</i>					
Bred Cow Expense	583.64	28,598.36	32,333.66	45,232.10	45,523.92
Retained Heifer Calf Expense	336.12	14,453.16	7,663.54	7,192.97	7,226.58
Retained Bred Heifer Expense	488.01	10,736.22	20,984.43	11,126.63	10,736.22
Cull Heifer Expense	151.32	907.92	453.96	438.83	453.96
Heifer Calf Adjustments		2,788.64	2,199.21	4,136.33	3,831.36
Total Expense	57,484.30	63,634.79	68,126.85	67,772.04	67,231.80
Annual Cash Flow	12,168.46	(22,609.96)	(4,364.79)	(3,535.91)	(2,995.67)
Accumulated Cash Flow	12,168.46	(10,441.50)	(14,806.29)	(18,342.20)	(21,337.87)
Total 5-Year Discounted Cash Flow					(17,945.54)

The 75% non-pregnant cow rate scenario continues to decline in terms of cash flow from the lower non-pregnant cow rates previously shown. Again, no heifers are

available for sale in Year 1. Additionally, Years 2 and 3 are continuing to rebuild the cowherd and retain all available heifer calves. Year 5 returns to the target of a 100 head herd. Similar to Table 4.3 at the 50% non-pregnant cow rate, the Year 1 annual cash flow is positive. However, Year 2 and 3 are the most negative annual cash flow values in this alternative thus far. Because of this, the producer is faced with three years of considerable losses culminating to a Total 5-Year Discounted Cash Flow value of -\$25,250.15.

Table 4.4 presents interesting herd inventory implications. As stated, no heifer calves are sold in Years 1-3. Thus, the total number of heifers retained, less the cull heifers is presented in the following year's "Retained Heifer (2-Year Old)" category. This pattern continues throughout, and in Year 5, 22 two-year old, bred heifers are in the herd. This is consistent with target goals of 22% replacement rates. The results of Year 4's herd inventory shows not all heifers are retained, however more than normal rates are retained. While not consistent with retaining 25% of the calf crop, these goals have little value if the calf crop is not at target levels (e.g. 98 calves). Therefore, with the foresight of the Year 5 herd inventory returning to target herd numbers, near normal replacements are kept (26 retained heifers versus the normal 25 head of retained heifers). In Year 5's herd inventory, these 26 heifers are culled at normal rates, resulting in a consistent (and the target) herd inventory by Year 5.

In determining herd inventories, Table 4.4 shows the process clearly. For example, the Year 2 "Retained Heifer (2 Year Old)" category is the Year 1 "Heifer Calf (Retained)" less the "Cull Heifer" inventories. With the large percentage of heifers retained in Year 1, Year 2 shows the highest value in the "Retained Heifer (2 Year Old)"

category. Furthermore, as the mature cow herd inventory declines in Year 2 (with only 45.4 mature cows), the Year 3 inventories for the “Retained Heifer (2 Year Old)” category falls significantly. This category then increases as the herd is rebuilt, and is able to return to normal levels by Year 5, showing that the cow herd has also returned to the target level of 100 cows.

Table 4.4 Herd Inventory and Cash Flow for Alternative 1 (Retain Heifers), 75% Non-pregnant Cow Rate

	----- head -----				
	Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>					
Steer Calf	49.00	22.70	39.33	40.50	49.00
Heifer Calf (Sales)	-	-	-	14.50	24.50
Heifer Calf (Retained)	49.00	22.70	39.33	26.00	24.50
Cull Heifer	6.00	2.70	4.72	3.10	3.00
Cull Cow	73.50	9.30	16.00	16.50	20.00
Bred Cow	24.50	36.30	62.60	64.50	78.00
Retained Heifer (2 Year Old)	22.00	43.00	20.00	34.40	22.00
Cow Deathloss	2.00	0.93	1.60	1.65	2.00
	----- \$/head -----				
<i>Income</i>					
Beginning Cash	-	40,066.14	11,684.25	(11,596.10)	(29,120.62)
Steer Calf Sales	696.96	34,151.04	15,820.99	28,226.88	34,151.04
Heifer Calf Sales	620.50	-	-	8,997.30	15,202.34
Cull Cow Sales	637.36	46,845.66	5,927.41	10,516.37	12,747.12
Cull Heifer Income	711.88	4,271.28	1,922.08	2,206.83	2,135.64
Total Income	85,267.98	23,670.48	40,969.20	49,947.38	64,236.13
<i>Expenses</i>					
Bred Cow Expense	583.64	14,299.18	21,186.13	37,644.78	45,523.92
Retained Heifer Calf Expense	336.12	16,469.88	7,629.92	13,219.60	8,234.94
Retained Bred Heifer Expense	488.01	10,736.22	20,984.43	9,760.20	10,736.22
Cull Heifer Expense	151.32	907.92	408.56	714.23	453.96
Heifer Calf Adjustments		2,788.64	1,843.32	4,019.66	3,291.12
Total Expense	45,201.84	52,052.37	64,249.55	67,471.90	68,240.16
Annual Cash Flow	40,066.14	(28,381.89)	(23,280.35)	(17,524.52)	(4,004.03)
Accumulated Cash Flow	40,066.14	11,684.25	(11,596.10)	(29,120.62)	(33,124.64)
Total 5-Year Discounted Cash Flow					(25,250.15)

Table 4.5 shows that the 100% non-pregnant cow rate does not allow the herd to reach 100 cows within the 5 years of the cash flow analysis presented. More interesting is the fact that this option appears to have the most desirable cash flow outcome. The implications surrounding these results are numerous. First, as has been shown in the

previous tables, the normal cash flow values are negative. Therefore, decreasing total cow herd numbers will decrease total annual losses (increasing profit potential). In the 100% non-pregnant cow rate scenario, culling the entire herd in Year 1 causes a large influx of cash in Year 1, and the subsequent accumulated cash flows do not become negative until Year 5.

The herd inventory in Table 4.5 shows how no heifer calves are sold throughout the five years. Moreover, with only 22 bred heifers available to calve in Year 2, only 21.6 calves are produced. This creates a problem in building the herd, as only 10.8 heifers can be retained. At the 12% cull rate on the retained heifers, only 9.5 heifers are developed shown by the “Retained Heifer (2 Year old)” row of the third year’s inventory. Year 2 has a total of 60 bred animals that will produce calves for sale in Year 3 (17 Bred cows and 43 two-year old retained heifers). Furthermore, Years 3, 4, and 5 do not ever reach the target of 100 cows. Year 5 has 80 bred animals that will produce calves in Year 6, and with the 34.78 heifer calves retained, Year 6 would be the first year to reach to target herd size of 100.

Table 4.5 Herd Inventory and Cash Flow For Alternative 1 (Retain Heifers), 100% Non-pregnant Cow Rate

	----- head -----				
	Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>					
Steer Calf	49.00	10.80	30.00	28.00	34.78
Heifer Calf (Sales)	-	-	-	-	-
Heifer Calf (Retained)	49.00	10.80	30.00	28.00	34.78
Cull Heifer	6.00	1.30	3.60	3.36	4.17
Cull Cow	98.00	4.40	12.20	11.40	14.20
Bred Cow	-	17.00	47.70	44.60	55.37
Retained Heifer (2 Year Old)	22.00	43.00	9.50	26.37	24.63
Cow Deathloss	2.00	0.44	1.22	1.65	1.40
	----- \$/head -----				
<i>Income</i>					
Beginning Cash	-	71,997.26	47,470.65	33,087.02	11,940.56
Steer Calf Sales	696.96	34,151.04	7,527.17	20,908.80	19,514.88
Heifer Calf Sales	620.50	-	-	-	-
Cull Cow Sales	637.36	62,460.88	2,804.37	7,775.74	9,050.45
Cull Heifer Income	711.88	4,271.28	925.44	2,562.77	2,968.54
Total Income	100,883.20	11,256.98	31,247.31	29,172.65	36,259.26
<i>Expenses</i>					
Bred Cow Expense	583.64	-	9,921.88	27,839.63	26,030.34
Retained Heifer Calf Expense	336.12	14,453.16	3,193.14	8,873.57	10,288.63
Retained Bred Heifer Expense	488.01	10,736.22	20,984.43	4,636.10	12,868.82
Cull Heifer Expense	151.32	907.92	196.72	544.75	631.00
Heifer Calf Adjustments	-	2,788.64	1,487.42	3,736.90	2,629.51
Total Expense	28,885.94	35,783.59	45,630.94	50,319.11	58,233.57
Annual Cash Flow	71,997.26	(24,526.61)	(14,383.63)	(21,146.46)	(21,974.31)
Accumulated Cash Flow	71,997.26	47,470.65	33,087.02	11,940.56	(10,033.75)
Total 5-Year Discounted Cash Flow					(717.35)

At a Total 5-Year Discounted Cash Flow value of -\$717.35, the 100% non-pregnant cow rate is the most cost minimizing outcome. However, this does not allow for target herd size (e.g. 100 cows) to be reached quickly. Additionally, if the original cash flows (Table 4.1, 0% non-pregnant cow rate) were at profitable levels, the ranking order of these non-pregnant cow rate scenarios examined in this alternative would change. In the same sense that Table 4.5 shows lower cow numbers are more profitable (less negative returns), but the opposite would hold true if the normal year (less than 20% non-pregnant cow rates) offered positive returns. Figure 4.1 shows the comparison of annual cash flow values for the 5 non-pregnant cow rate scenarios for Alternative 1.

Figure 4.1 Annual Cash Flow Values of Differing Non-pregnant Cow Rates (Alternative 1: Retain Heifers)

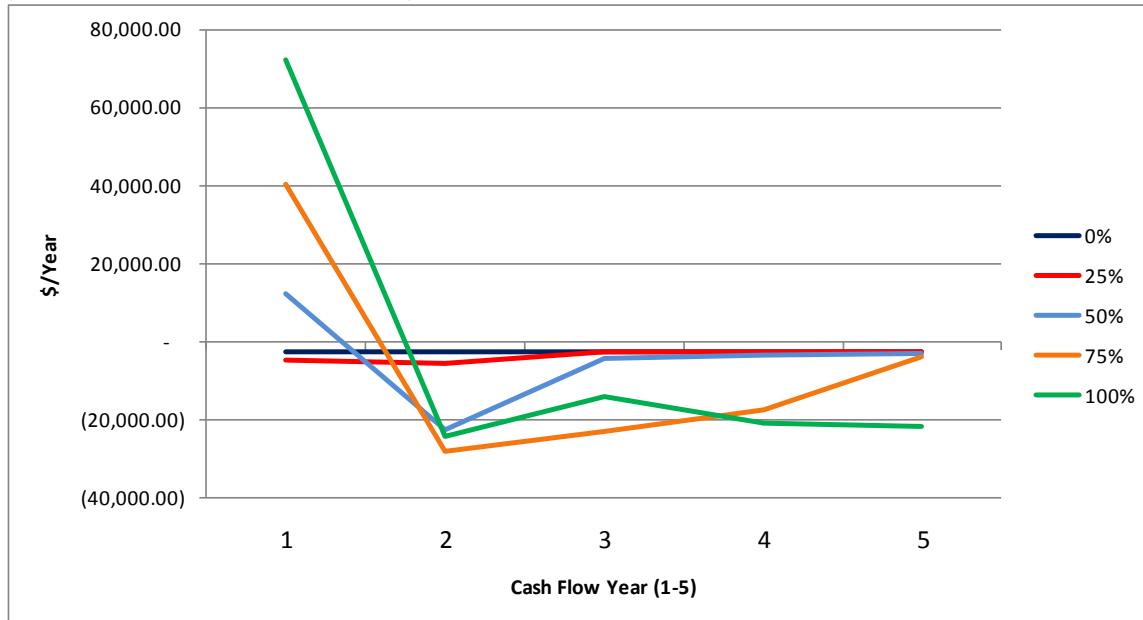


Table 4.6 summarizes the same data as in Figure 4.1 with the addition of the total discounted cash flow value. As previously mentioned, Year 1 creates positive cash flow values for non-pregnant cow rates of 50% or greater. However, Year 2 of these positive Year 1 cash flow cases are the largest negative cash flow values. This is due to the loss of calf sales and the retained heifer development costs. Furthermore, at the 100% rate, rebuilding the herd is costly in later years with cash flows over -\$20,000 for Years 4 and 5. This cash flow shows that normal year practices can return within 5 years for a non-pregnant cow rates except the 100% rate as shown by the convergence of the lines in Year 5 in Figure 4.1.

Table 4.6 Annual Cash Flow and Total 5-Year Discounted Cash Flow Values For Alternative 1

Non-pregnant Cow Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Total 5-Year Discounted Cash Flow
0%	(2,493.19)	(2,615.55)	(2,586.80)	(2,533.72)	(2,515.15)	(11,036.59)
25%	(4,882.05)	(5,610.63)	(2,767.61)	(2,653.74)	(2,575.87)	(16,330.83)
50%	12,168.46	(22,609.96)	(4,364.79)	(3,535.91)	(2,995.67)	(17,945.54)
75%	40,066.14	(28,381.89)	(23,280.35)	(17,524.52)	(4,004.03)	(25,250.15)
100%	71,997.26	(24,526.61)	(14,383.63)	(21,146.46)	(21,974.31)	(717.35)

4.2.2 Purchase Bred Heifer Results

Purchasing bred heifers is another alternative for the replacement of cull or non-pregnant cows. While purchasing heifers allows greater longevity than purchasing cows, it also presents extra costs. These costs are commonly reflected in the purchase price. For example, five-year average bred heifer prices from the Burwell Livestock Market as reported by the Agricultural Marketing Service (USDA) suggest an average \$125/head premium on bred heifers compared to that of a bred cow. Other heifer-related costs may also include increased labor, care, and feed resources that are accounted for in the budgets created in Chapter 3, which are used in the cash flow analysis. Additionally, purchased or retained bred heifer alternatives have a larger negative adjustment for decreased productivity (lower sales weight of calves). This stems from a larger percentage of the cow herd being in the first to third calf production cycle.

When a bred heifer is purchased to replace a non-pregnant or otherwise culled cow, it is assumed the heifers replace all of the non-pregnant cows in Year 1, the decision year when the cows are discovered non-pregnant. Keeping in mind the goal to remain at the target 100 cows, purchasing bred animals (heifers or cows) is an effective way to return to optimal herd size quickly. Table 4.7 is the cash flow analysis of purchasing a bred heifer to replace cows at rate of 0% non-pregnant cows. Although there are no

unbred cows, the producer still replaces normal rates (20%) of the cow herd by purchasing heifers. So, the producer would purchase 22 bred heifers to replace 20 culled cows and two head that died (assumed 2% death loss).

The annual cash flow values for the purchase bred heifer alternative at a 0% non-pregnant rate range from -\$5,223.10 to -\$5,401.23. In this case, the major change is found in the heifer calf adjustments. The cow herd distribution changes slightly due to the assumptions given, as cull cows are taken from the oldest cattle first. Clearly, this is not true in all cases, however it offers the best representation of a normal herd. This adjustment is much greater, and potentially more important, as the non-pregnant cow rate increases and a larger percentage of younger animals are purchased and brought into the herd.

Table 4.7 Herd Inventory and Cash Flows for Alternative 2 (Purchase Heifers), 0% Non-pregnant Cow Rate

		----- head -----				
		Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>						
Steer Calf		49.00	49.00	49.00	49.00	49.00
Heifer Calf		49.00	49.00	49.00	49.00	49.00
Cull Cow		20.00	20.00	20.00	20.00	20.00
Bred Cow		78.00	78.00	78.00	78.00	78.00
Purchased Heifer		22.00	22.00	22.00	22.00	22.00
Cow Deathloss		2.00	2.00	2.00	2.00	2.00
	<i>\$/head</i>					
<i>Income</i>						
Beginning Cash		-	(5,223.10)	(10,624.33)	(15,996.80)	(21,345.94)
Steer Calf Sales	696.96	34,151.04	34,151.04	34,151.04	34,151.04	34,151.04
Heifer Calf Sales	620.50	30,404.50	30,404.50	30,404.50	30,404.50	30,404.50
Cull Cow Sales	637.36	12,747.20	12,747.20	12,747.20	12,747.20	12,747.20
Total Income		77,302.74	77,302.74	77,302.74	77,302.74	77,302.74
<i>Expenses</i>						
Bred Cow Expense	583.64	45,523.92	45,523.92	45,523.92	45,523.92	45,523.92
Purchased Price of Heifer	1,192.58	26,236.85	26,236.85	26,236.85	26,236.85	26,236.85
Purchased Heifer Expense	365.10	8,032.20	8,032.20	8,032.20	8,032.20	8,032.20
Heifer Calf Adjustments		2,732.87	2,911.00	2,882.25	2,858.91	2,858.91
Total Expense		82,525.84	82,703.97	82,675.22	82,651.88	82,651.88
Annual Cash Flow		(5,223.10)	(5,401.23)	(5,372.48)	(5,349.14)	(5,349.14)
Accumulated Cash Flow		(5,223.10)	(10,624.33)	(15,996.80)	(21,345.94)	(26,695.09)
Total 5-Year Discounted Cash Flow						(23,106.34)

Cull cow sales increase as there becomes more non-pregnant cows to cull from the herd (e.g., the non-pregnant cow rate increases). The number of purchased heifers needed to remain at the constant herd size of 100 cows is simply the number of culled and non-pregnant cows plus the death loss. Table 4.8 presents herd inventory and cash flow for the purchased heifer alternative at the 25% non-pregnant cow rate, which is above the normal cull rate (20%). Therefore, 27 bred heifers must be purchased to replace the non-pregnant cows and death loss cows.

Table 4.8 Herd Inventory and Cash Flows for Alternative 2 (Purchase Heifers), 25% Non-pregnant Cow Rate

		----- head -----				
		Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>						
Steer Calf		49.00	49.00	49.00	49.00	49.00
Heifer Calf		49.00	49.00	49.00	49.00	49.00
Cull Cow		24.50	20.00	20.00	20.00	20.00
Bred Cow		73.50	78.00	78.00	78.00	78.00
Purchased Heifer		26.50	22.00	22.00	22.00	22.00
Cow Deathloss		2.00	2.00	2.00	2.00	2.00
	<i>\$/head</i>	----- \$/herd -----				
<i>Income</i>						
Beginning Cash		-	(6,738.18)	(12,139.40)	(17,511.88)	(22,861.02)
Steer Calf Sales	696.96	34,151.04	34,151.04	34,151.04	34,151.04	34,151.04
Heifer Calf Sales	620.50	30,404.50	30,404.50	30,404.50	30,404.50	30,404.50
Cull Cow Sales	637.36	15,615.32	12,747.20	12,747.20	12,747.20	12,747.20
Total Income		80,170.86	77,302.74	77,302.74	77,302.74	77,302.74
<i>Expenses</i>						
Bred Cow Expense	583.64	42,897.54	45,523.92	45,523.92	45,523.92	45,523.92
Purchased Price of Heifer	1,192.58	31,603.48	26,236.85	26,236.85	26,236.85	26,236.85
Purchased Heifer Expense	365.10	9,675.15	8,032.20	8,032.20	8,032.20	8,032.20
Heifer Calf Adjustments		2,732.87	2,911.00	2,882.25	2,858.91	2,858.91
Total Expense		86,909.04	82,703.97	82,675.22	82,651.88	82,651.88
Annual Cash Flow		(6,738.18)	(5,401.23)	(5,372.48)	(5,349.14)	(5,349.14)
Accumulated Cash Flow		(6,738.18)	(12,139.40)	(17,511.88)	(22,861.02)	(28,210.16)
Total 5-Year Discounted Cash Flow						(24,549.27)

With five more heifers purchased compared to that in Table 4.7 (0% non-pregnant cow rate), the expense adjustments for calf weaning weights from younger cows is higher (Heifer Calf Adjustments). However, the 25% non-pregnant cow rate is only \$1,442.93

more costly to the producer based on the discounted accumulated 5-year cash flow. This would suggest that although there are extra losses in terms of a greater percentage of non-pregnant cows, there is little difference because the normal 20% cull rate accounted for the first 20 of the 25 non-pregnant cows. In this instance, only 5 more cows need to be replaced beyond that of a normal year. Without an adjustment for selling a non-pregnant cull versus a bred cull cow, which has historically been a very small difference, there is little change when comparing non-pregnant cow rates of 0% and 25%. Chapter 5 will address this point and discuss recent market trends.

With a 50% non-pregnant cow rate, larger negative annual cash flows are realized. It is important to note that the death loss of the cow herd is counted before the non-pregnant cows. Thus, in Table 4.9 at the 50% non-pregnant cow rate, 49 cows are found to be non-pregnant (50% of 98 head). With culling 49 non-pregnant cows, and counting two death losses, there are 51 purchased heifers, which costs the producer an out-of-pocket expense of over \$79,000 after summer feed and care is accounted for. Again, the heifer calf adjustments increase in Year 2, as over half the calf crop would be from the purchased heifers. In comparison terms, it takes four years for the herd to become distributed similar to the original herd, settling at a heifer production adjustment of \$2,858.91. The differences between Year 1 and Year 5's heifer calf adjustment are due to the assumed herd inventories at the beginning, and throughout the five years these inventories shift slightly towards a younger herd. Moreover, the assumptions of a 20% cull rate are not necessarily consistent with the three herds evaluated for the original herd inventories, causing these inventory discrepancies. The initial price of the heifer creates a negative cash flow in Year 1 of \$14,986.93. The Total 5-Year Discounted Cash Flow

value for the 50% non-pregnant cow rate by replacing the herd with purchased heifers is -\$32,496.21.

Table 4.9 Herd Inventory and Cash Flows for Alternative 2 (Purchase Heifers), 50% Non-pregnant Cow Rate

		----- head -----				
		Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>						
Steer Calf		49.00	49.00	49.00	49.00	49.00
Heifer Calf		49.00	49.00	49.00	49.00	49.00
Cull Cow		49.00	20.00	20.00	20.00	20.00
Bred Cow		49.00	78.00	78.00	78.00	78.00
Purchased Heifer		51.00	22.00	22.00	22.00	22.00
Cow Deathloss		2.00	2.00	2.00	2.00	2.00
	<i>\$/head</i>	----- \$/herd -----				
<i>Income</i>						
Beginning Cash		-	(14,986.93)	(20,336.51)	(25,782.17)	(31,222.00)
Steer Calf Sales	696.96	34,151.04	34,151.04	34,151.04	34,151.04	34,151.04
Heifer Calf Sales	620.50	30,404.50	30,404.50	30,404.50	30,404.50	30,404.50
Cull Cow Sales	637.36	31,230.64	12,747.20	12,747.20	12,747.20	12,747.20
Total Income		95,786.18	77,302.74	77,302.74	77,302.74	77,302.74
<i>Expenses</i>						
Bred Cow Expense	583.64	28,598.36	45,523.92	45,523.92	45,523.92	45,523.92
Purchased Price of Heifer	1,192.58	60,821.78	26,236.85	26,236.85	26,236.85	26,236.85
Purchased Heifer Expense	365.10	18,620.10	8,032.20	8,032.20	8,032.20	8,032.20
Heifer Calf Adjustments		2,732.87	2,859.35	2,955.43	2,949.60	2,858.91
Total Expense		110,773.11	82,652.32	82,748.40	82,742.57	82,651.88
Annual Cash Flow		(14,986.93)	(5,349.58)	(5,445.66)	(5,439.83)	(5,349.14)
Accumulated Cash Flow		(14,986.93)	(20,336.51)	(25,782.17)	(31,222.00)	(36,571.14)
Total 5-Year Discounted Cash Flow						(32,496.21)

Table 4.10, purchasing heifers for a 75% non-pregnant cow rate, is higher in costs compared to previous non-pregnant cow rates (Tables 4.7, 4.8, and 4.9). This is to be expected and strong linear relationships are revealed consistent with the accounting methods used. If the only change was in the amount of heifers purchased, the relationship would be strictly linear as the non-pregnant cow rates progress upward. However, the heifer calf adjustment expense that takes into account herd distribution is a major cause of an imperfect linear relationship.

Bred cow expenses also decrease in Year 1 as the non-pregnant cow rate is increased, however the budgets assume that mature, bred cows have lower annual feeding

and carrying costs than a bred heifer. These two factors play a role in the total cash flow outcome for all non-pregnant cow scenarios, however differences are more evident beyond the 50% non-pregnant cow rate. For example, the purchased heifer expense is calculated for feed and carrying costs from the purchase date (March) to the weaning of the heifer's first calf (October). This is a seven month budget. While this is an added benefit in the purchasing alternatives (Alternatives 2 and 3), on a per-month basis the purchased heifer has higher carrying costs (feed and operating). This implication is further discussed in later sections, which compares Alternatives 2 and 3, suggesting the purchased cow is more favorable to a cash flow analysis compared to that of a purchased heifer.

Table 4.10 Herd Inventory and Cash Flows for Alternative 2 (Purchase Heifers), 75% Non-pregnant Cow Rate

		----- head -----				
		Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>						
		49.00	49.00	49.00	49.00	49.00
	Steer Calf	49.00	49.00	49.00	49.00	49.00
	Heifer Calf	73.50	20.00	20.00	20.00	20.00
	Cull Cow	24.50	78.00	78.00	78.00	78.00
	Bred Cow	75.50	22.00	22.00	22.00	22.00
	Purchased Heifer	2.00	2.00	2.00	2.00	2.00
	Cow Deathloss					
		----- \$/head -----				
<i>Income</i>						
		-	(23,235.69)	(29,885.83)	(36,248.43)	(42,181.99)
	Beginning Cash	696.96	34,151.04	34,151.04	34,151.04	34,151.04
	Steer Calf Sales	620.50	30,404.50	30,404.50	30,404.50	30,404.50
	Heifer Calf Sales	637.36	46,845.96	12,747.20	12,747.20	12,747.20
	Cull Cow Sales					
	Total Income	111,401.50	77,302.74	77,302.74	77,302.74	77,302.74
<i>Expenses</i>						
		583.64	14,299.18	45,523.92	45,523.92	45,523.92
	Bred Cow Expense	1,192.58	90,040.09	26,236.85	26,236.85	26,236.85
	Purchased Price of Heifer	365.10	27,565.05	8,032.20	8,032.20	8,032.20
	Purchased Heifer Expense		2,732.87	4,159.91	3,872.37	3,443.33
	Heifer Calf Adjustments		134,637.19	83,952.88	83,665.34	83,236.30
	Total Expense		(23,235.69)	(6,650.14)	(6,362.60)	(5,933.56)
	Annual Cash Flow		(23,235.69)	(29,885.83)	(36,248.43)	(42,181.99)
	Accumulated Cash Flow					(47,531.12)
	Total 5-Year Discounted Cash Flow					(42,730.10)

Table 4.11 summarizes the 100% non-pregnant cow rate results for Alternative 2. Although it would be unlikely that a producer would face 100% non-pregnant cows in most cases, this rate also could have similar implications to purchasing an entirely new herd while culling the old herd. At a discounted 5-year cash flow value of -\$52,761.18, it is the lowest cash flow value for Alternative 2. Again, the heifer calf adjustments increase because of the herd distribution. In this case, the producer is forced to completely start with a new herd of heifers. In certain circumstances, this may allow progress to be made such as in genetics (which are not valued herein), but with all else constant, it is still the least profitable non-pregnant cow rate scenario in Alternative 2.

The relationship of cull cow prices and purchased heifer prices create large losses the first year. By Year 5, however, the annual cash flow of -\$5,349.14 is the same in all the previous non-pregnant cow rate scenarios in Alternative 2. When this value is reached, or within close proximity, it means the herd has similar distribution and value as the original herd before any non-pregnant cows were discovered. With this in mind, it will take approximately 5 years to return to normal cash flow values and rebuild a herd to original standards if 100% of the cowherd is non-pregnant in the same year and they are replaced with purchased bred heifers.

**Table 4.11 Herd Inventory and Cash Flows for Alternative 2 (Purchase Heifers),
100% Non-pregnant Cow Rate**

		----- head -----				
		Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>						
Steer Calf		49.00	49.00	49.00	49.00	49.00
Heifer Calf		49.00	49.00	49.00	49.00	49.00
Cull Cow		98.00	20.00	20.00	20.00	20.00
Bred Cow		-	78.00	78.00	78.00	78.00
Purchased Heifer		100.00	22.00	22.00	22.00	22.00
Cow Deathloss		2.00	2.00	2.00	2.00	2.00
	<i>\$/head</i>	----- \$/herd -----				
<i>Income</i>						
Beginning Cash		-	(31,484.45)	(39,435.14)	(46,714.68)	(52,895.47)
Steer Calf Sales	696.96	34,151.04	34,151.04	34,151.04	34,151.04	34,151.04
Heifer Calf Sales	620.50	30,404.50	30,404.50	30,404.50	30,404.50	30,404.50
Cull Cow Sales	637.36	62,461.28	12,747.20	12,747.20	12,747.20	12,747.20
Total Income		127,016.82	77,302.74	77,302.74	77,302.74	77,302.74
<i>Expenses</i>						
Bred Cow Expense	583.64	-	45,523.92	45,523.92	45,523.92	45,523.92
Purchased Price of Heifer	1,192.58	119,258.40	26,236.85	26,236.85	26,236.85	26,236.85
Purchased Heifer Expense	365.10	36,510.00	8,032.20	8,032.20	8,032.20	8,032.20
Heifer Calf Adjustments		2,732.87	5,460.46	4,789.31	3,690.57	2,858.91
Total Expense		158,501.27	85,253.43	84,582.28	83,483.54	82,651.88
Annual Cash Flow		(31,484.45)	(7,950.69)	(7,279.54)	(6,180.80)	(5,349.14)
Accumulated Cash Flow		(31,484.45)	(39,435.14)	(46,714.68)	(52,895.47)	(58,244.61)
Total 5-Year Discounted Cash Flow						(52,761.18)

Because all non-pregnant cows are replaced in Year 1 and the process of replacing cows at 20% is constant throughout Years 2-5, Year 1 creates the most variability throughout the differing non-pregnant cow rates in all scenarios for Alternative 2. Cow herd distribution remains similar at normal cull and non-pregnant cow rates; however, it becomes quite skewed as mature cows are culled and bred heifers are brought in at increasing rates. Because of this, the adjustment factor for the upper limits of non-pregnant cow rates in the “Heifer Calf Adjustments” is much larger and peaks at \$5,460.46 in Year 2 of the 100% non-pregnant cow rate.

With cull cow prices at \$637.36 and a purchased heifer price of \$1,192.58, a negative cash flow will necessarily be found in the first year for all scenarios, given assumed calf and cull prices. More important, however, are the losses found each year

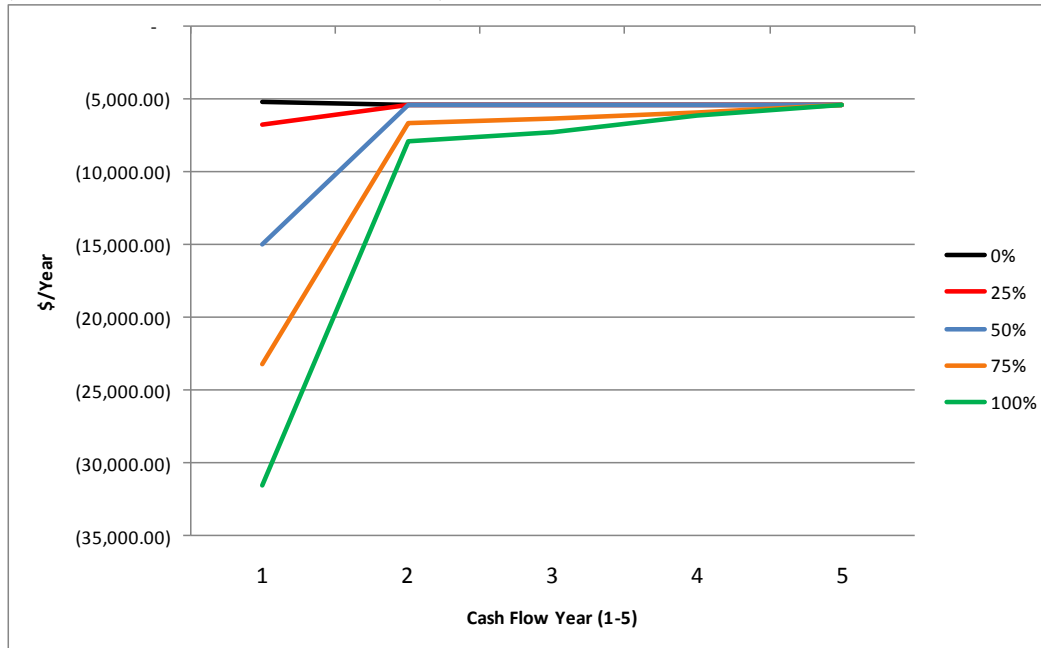
with the assumptions given. In Year 1, losses are -\$5,223.10 for the 0% non-pregnant cow rate (Table 4.7) and serve as a baseline for discussion. As the non-pregnant cow rate increases in Year 1, the process of replacing a cull cow (valued at less than half the purchase price of a bred heifer) creates losses that increase rapidly.

The option of purchasing a bred heifer to replace a non-pregnant cow is quite common. However, it also seems quite unprofitable as shown in Table 4.12. It is important to note that this represents five-year price averages for most income and expense values. Average annual income per cow unit translates to losses from \$46.21/head to \$105.52/head based on the Total 5-Year Discounted Cash Flow values. Chapter 5 outlines a deterministic cash flow based solely on Winter 2011 prices and creates a more accurate depiction of recent market trends. This also allows purchasing heifers to be a more feasible option, especially if other factors, such as genetic progress, are considered.

Table 4.12 Annual Cash Flow and Total 5-Year Discounted Cash Flow Values For Alternative 2

Non-Pregnant Cow Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Total 5-Year Discounted Cash Flow
0%	(5,222.92)	(5,401.06)	(5,372.31)	(5,348.97)	(5,348.97)	(23,106.34)
25%	(6,738.01)	(5,401.06)	(5,372.31)	(5,348.97)	(5,348.97)	(24,549.27)
50%	(14,986.76)	(5,349.41)	(5,445.49)	(5,439.66)	(5,348.97)	(32,496.21)
75%	(23,235.52)	(6,649.97)	(6,362.43)	(5,933.39)	(5,348.97)	(42,730.10)
100%	(31,484.28)	(7,950.52)	(7,279.37)	(6,180.63)	(5,348.97)	(52,761.18)

Figure 4.2 Annual Cash Flow Values of Differing Non-pregnant Cow Rates (Alternative 2: Purchase Heifer)



Discussion of these results should be centered on the relationship between the scenarios. As shown in Figure 4.2, the cash flow of Year 3 approaches the original herd inventory and distribution of the cow herd for the high non-pregnant cow rates. This inventory and cow herd distribution calculation drives the cash flow. Furthermore, by Year 5, the original herd productivity is returned to some degree of normalcy. Although the values are not desirable in terms of being negative, the general relationships hold true at any price level if all classes of livestock remain at their same respective relationships compared to one another.

As expected, having 100% of the herd non-pregnant creates major distress for the operation's cash flow. It is interesting to note the continued convergence by Years 3, 4, and 5, which may have positive implications for a producer's decisions. If these cash flows were at profitable levels, it would suggest that in all circumstances of non-pregnant

cows, the producer could potentially be at the same position (as before a non-pregnant cow problem) within five years and creates implications discussed in Section 4.3.

4.2.3 Purchase Bred Cow Results

Similar to the previous section of purchasing bred heifers, purchasing bred cows allows producers to replace large percentages of the herd in a single year. As discussed in Section 4.2.2, bred cow prices have historically been lower than bred heifer prices, which make this alternative attractive. Additionally, bred cows, on average, require less expense in terms of carrying costs and labor. The differences in supplementation and feed requirements create the differences between the purchasing alternatives, in addition to the lower purchase price of a bred cow. Moreover, the herd distribution becomes more skewed towards the older, mature cow, which decreases the negative adjustments for lower productivity of younger cows (i.e., Heifer Calf Adjustments).

Using the same assumptions, the major difference between the purchase cows and purchase heifers alternatives are the purchase price of the cow versus the heifer, the carrying/feed costs of the purchased cow, and the heifer calf adjustment values. All income values (calf and cull sales) are held constant, as well the bred cow expenses for the mature cow herd. Table 4.13 serves as a baseline value for comparison of Alternative 3 as it purchases bred cows at the 0% non-pregnant cow rate.

Similar to that to that of the previous alternatives, the 0% non-pregnant cow rate still culls the assumed normal 20% rate as there are no non-pregnant cows to cull. Table 4.13 shows that there are constant returns from calf sales, as 98 calves are available for sale each year. Twenty cows are culled each year, two are lost to death, and 22 bred cows are purchased.

The USDA AMS cow price data reported from the Burwell Livestock Market are not age-group specific, so additional assumptions must be created for Alternative 3. The budgets disperse the purchased cows evenly throughout the age groups; that is, an equal number of cows goes into each yearly group from three year old to age seven and older. With this assumption, the herd distribution moves towards an older herd for the first two years due to the fact that the purchased cows are not exclusively the youngest in the herd. In the Year 3 cash flow, the heifer calf adjustment settles to \$386.98. At this point, roughly 15% of the herd is in the three to four-year-old category and is effected by the adjustment.

Similar to the previous alternatives, the purchase cow alternative at a 0% non-pregnant cow rate does not yield positive returns in terms of the Total 5-Year Discounted Cash Flow. However, positive gains are realized after Year 2, although minimal. In the cash flow of Year 1, in which the herd distribution is still more equally distributed across the age groups, a -\$1,111.76 cash flow is realized. Once the herd becomes more mature, with fewer cows in the 2-4 year age groups, the heifer calf adjustments decrease to give an annual cash flow value for years 3-5 of \$102.47. The Total 5-Year Discounted Cash flow value is still negative at -\$1,154.71, however is shown to have positive annual cash flows in the latter years.

Table 4.13 Herd Inventory and Cash Flow For Alternative 3 (Purchase Cows), 0% Non-pregnant Cow Rate

	-----head-----				
	Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>					
Steer Calf	49.00	49.00	49.00	49.00	49.00
Heifer Calf	49.00	49.00	49.00	49.00	49.00
Cull Cow	20.00	20.00	20.00	20.00	20.00
Bred Cow	78.00	78.00	78.00	78.00	78.00
Purchased Cow	22.00	22.00	22.00	22.00	22.00
Cow Deathloss	2.00	2.00	2.00	2.00	2.00
	-----\$head-----				
<i>Income</i>					
Beginning Cash	-	(1,111.76)	(1,496.53)	(1,394.06)	(1,291.59)
Steer Calf Sales	696.96	34,151.04	34,151.04	34,151.04	34,151.04
Heifer Calf Sales	620.50	30,404.67	30,404.67	30,404.67	30,404.67
Cull Cow Sales	637.36	12,747.20	12,747.20	12,747.20	12,747.20
Total Income	77,302.91	77,302.91	77,302.91	77,302.91	77,302.91
<i>Expenses</i>					
Bred Cow Expense	583.64	45,523.92	45,523.92	45,523.92	45,523.92
Purchased Price of Cow	1,069.19	23,522.22	23,522.22	23,522.22	23,522.22
Purchased Cow Expense	353.06	7,767.32	7,767.32	7,767.32	7,767.32
Heifer Calf Adjustments		1,601.21	874.21	386.98	386.98
Total Expense		78,414.67	77,687.67	77,200.44	77,200.44
Annual Cash Flow		(1,111.76)	(384.76)	102.47	102.47
Accumulated Cash Flow		(1,111.76)	(1,496.53)	(1,394.06)	(1,291.59)
Total 5-Year Discounted Cash Flow					(1,154.71)

At the 25% non-pregnant cow rate, the Total 5-Year Discounted Cash Flow value is -\$1,956.55. With this scenario of non-pregnant cows compared to the normal cull rate of 20%, there is not a noticeable difference in total cash flow values. The majority of the difference is made up in the first year, with 26 cows purchased instead of 22. The cash flows for Year 2-5 are similar, except for the difference in heifer calf adjustments in Years 2 and 3.

Table 4.14 Herd Inventory and Cash Flow For Alternative 3 (Purchase Cows), 25% Non-pregnant Cow Rate

		----- head -----				
		Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>						
	Steer Calf	49.00	49.00	49.00	49.00	49.00
	Heifer Calf	49.00	49.00	49.00	49.00	49.00
	Cull Cow	24.50	20.00	20.00	20.00	20.00
	Bred Cow	73.50	78.00	78.00	78.00	78.00
	Purchased Cow	26.50	22.00	22.00	22.00	22.00
	Cow Deathloss	2.00	2.00	2.00	2.00	2.00
		----- \$/head -----				
<i>Income</i>						
	Beginning Cash	-	(2,017.40)	(2,317.08)	(2,233.71)	(2,131.25)
	Steer Calf Sales	696.96	34,151.04	34,151.04	34,151.04	34,151.04
	Heifer Calf Sales	620.50	30,404.67	30,404.67	30,404.67	30,404.67
	Cull Cow Sales	637.36	15,615.32	12,747.20	12,747.20	12,747.20
	Total Income		80,171.03	77,302.91	77,302.91	77,302.91
<i>Expenses</i>						
	Bred Cow Expense	583.64	42,897.54	45,523.92	45,523.92	45,523.92
	Purchased Price of Heifer	1,069.19	28,333.59	23,522.22	23,522.22	23,522.22
	Purchased Heifer Expense	353.06	9,356.09	7,767.32	7,767.32	7,767.32
	Heifer Calf Adjustments		1,601.21	789.13	406.08	386.98
	Total Expense		82,188.43	77,602.59	77,219.54	77,200.44
	Annual Cash Flow		(2,017.40)	(299.68)	83.37	102.47
	Accumulated Cash Flow		(2,017.40)	(2,317.08)	(2,233.71)	(2,131.25)
	Total 5-Year Discounted Cash Flow					(1,956.55)

As the non-pregnant cow percentages increase, the linear relationships begin to emerge more clearly. At 50% non-pregnant cow rates, the Total 5-Year Discounted Cash flow value is -\$6,907.19 (Table 4.15). Furthermore, each increase of 25% in non-pregnant cow rates (e.g., 75% and 100%) creates additional losses of \$4,950 (Tables 4.16 and 4.17). By Year 4, all Heifer Calf Adjustments are equal. The changes in the adjustments in the previous year are due to the larger number of younger cows distributed into those age groups, which is constant throughout all non-pregnant cow rates in this alternative. As more cows are purchased, the overall numbers of cows moving into each group of the cow herd increases, thus increasing the adjustment. Table 4.16 shows a Total 5-Year Discounted Cash Flow value of \$11,857.82.

Table 4.15 Herd Inventory and Cash Flow For Alternative 3 (Purchase Cows), 50% Non-pregnant Cow Rate

		----- head -----				
		Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>						
		49.00	49.00	49.00	49.00	49.00
	Steer Calf	49.00	49.00	49.00	49.00	49.00
	Heifer Calf	49.00	20.00	20.00	20.00	20.00
	Cull Cow	49.00	78.00	78.00	78.00	78.00
	Bred Cow	51.00	22.00	22.00	22.00	22.00
	Purchased Cow	2.00	2.00	2.00	2.00	2.00
	Cow Deathloss					
		----- \$/head -----				
<i>Income</i>						
		-	(6,948.07)	(7,429.63)	(7,450.21)	(7,347.74)
	Beginning Cash	696.96	34,151.04	34,151.04	34,151.04	34,151.04
	Steer Calf Sales	620.50	30,404.67	30,404.67	30,404.67	30,404.67
	Heifer Calf Sales	637.36	31,230.64	12,747.20	12,747.20	12,747.20
	Cull Cow Sales		95,786.35	77,302.91	77,302.91	77,302.91
	Total Income					
<i>Expenses</i>						
		583.64	28,598.36	45,523.92	45,523.92	45,523.92
	Bred Cow Expense	1,069.19	54,528.79	23,522.22	23,522.22	23,522.22
	Purchased Price of Heifer	353.06	18,006.06	7,767.32	7,767.32	7,767.32
	Purchased Heifer Expense		1,601.21	971.01	510.02	386.98
	Heifer Calf Adjustments		102,734.42	77,784.47	77,323.48	77,200.44
	Total Expense					
	Annual Cash Flow		(6,948.07)	(481.56)	(20.57)	102.47
	Accumulated Cash Flow		(6,948.07)	(7,429.63)	(7,450.21)	(7,347.74)
	Total 5-Year Discounted Cash Flow					(6,907.19)

Table 4.16 Herd Inventory and Cash Flow For Alternative 3 (Purchase Cows), 75% Non-pregnant Cow Rate

		----- head -----				
		Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>						
Steer Calf		49.00	49.00	49.00	49.00	49.00
Heifer Calf		49.00	49.00	49.00	49.00	49.00
Cull Cow		73.50	20.00	20.00	20.00	20.00
Bred Cow		24.50	78.00	78.00	78.00	78.00
Purchased Cow		75.50	22.00	22.00	22.00	22.00
Cow Deathloss		2.00	2.00	2.00	2.00	2.00
	<i>\$/head</i>	----- \$/herd -----				
<i>Income</i>						
Beginning Cash		-	(11,878.75)	(12,542.18)	(12,666.69)	(12,564.22)
Steer Calf Sales	696.96	34,151.04	34,151.04	34,151.04	34,151.04	34,151.04
Heifer Calf Sales	620.50	30,404.67	30,404.67	30,404.67	30,404.67	30,404.67
Cull Cow Sales	637.36	46,845.96	12,747.20	12,747.20	12,747.20	12,747.20
Total Income		111,401.67	77,302.91	77,302.91	77,302.91	77,302.91
<i>Expenses</i>						
Bred Cow Expense	583.64	14,299.18	45,523.92	45,523.92	45,523.92	45,523.92
Purchased Price of Heifer	1,069.19	80,724.00	23,522.22	23,522.22	23,522.22	23,522.22
Purchased Heifer Expense	353.06	26,656.03	7,767.32	7,767.32	7,767.32	7,767.32
Heifer Calf Adjustments		1,601.21	1,152.88	613.96	386.98	386.98
Total Expense		123,280.42	77,966.34	77,427.42	77,200.44	77,200.44
Annual Cash Flow		(11,878.75)	(663.43)	(124.51)	102.47	102.47
Accumulated Cash Flow		(11,878.75)	(12,542.18)	(12,666.69)	(12,564.22)	(12,461.76)
Total 5-Year Discounted Cash Flow						(11,857.82)

The 100% non-pregnant cow rate of Alternative 3, shown in Table 4.17, replaces the entire herd in Year 1. While this creates losses of -\$16,809.42 the first year, subsequent years quickly return to normal rates (e.g., Table 4.14) as found in previous non-pregnant cow rates of this alternative as well. The relationship between cull and bred cow prices would have serious implications at this non-pregnant cow rate, such as a narrowing margin between the two. This would create an incentive to cull cows to realize abnormally high cull prices respective to bred cow prices. Thus, the time it would take to recover the purchase price of the cow and enter profitable levels (if returns were regularly realized in the cow-calf industry) would be significantly less once the cull cow value is subtracted from the purchase price of the cow. However, because of the spread in this particular scenario, the process of rebuilding an entirely new herd creates losses in

the first year which are not quickly recovered as shown by the Total 5-Year Discounted Cash flow values of -\$16,808.46.

Table 4.17 Herd Inventory and Cash Flow For Alternative 3 (Purchase Cows), 100% Non-pregnant Cow Rate

		----- head -----				
		Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>						
		49.00	49.00	49.00	49.00	49.00
	Steer Calf	49.00	49.00	49.00	49.00	49.00
	Heifer Calf	98.00	20.00	20.00	20.00	20.00
	Cull Cow	-	78.00	78.00	78.00	78.00
	Bred Cow	100.00	22.00	22.00	22.00	22.00
	Purchased Cow	2.00	2.00	2.00	2.00	2.00
	Cow Deathloss					
		----- \$/head -----				
<i>Income</i>						
		-	(16,809.42)	(17,654.73)	(17,883.19)	(17,780.72)
	Beginning Cash	696.96	34,151.04	34,151.04	34,151.04	34,151.04
	Steer Calf Sales	620.50	30,404.67	30,404.67	30,404.67	30,404.67
	Heifer Calf Sales	637.36	62,461.28	12,747.20	12,747.20	12,747.20
	Cull Cow Sales	127,016.99	77,302.91	77,302.91	77,302.91	77,302.91
	Total Income					
<i>Expenses</i>						
		583.64	-	45,523.92	45,523.92	45,523.92
	Bred Cow Expense	1,069.19	106,919.20	23,522.22	23,522.22	23,522.22
	Purchased Price of Heifer	353.06	35,306.00	7,767.32	7,767.32	7,767.32
	Purchased Heifer Expense		1,601.21	1,334.76	717.90	386.98
	Heifer Calf Adjustments	143,826.41	78,148.22	77,531.36	77,200.44	77,200.44
	Total Expense					
	Annual Cash Flow	(16,809.42)	(845.31)	(228.45)	102.47	102.47
	Accumulated Cash Flow	(16,809.42)	(17,654.73)	(17,883.19)	(17,780.72)	(17,678.25)
	Total 5-Year Discounted Cash Flow					

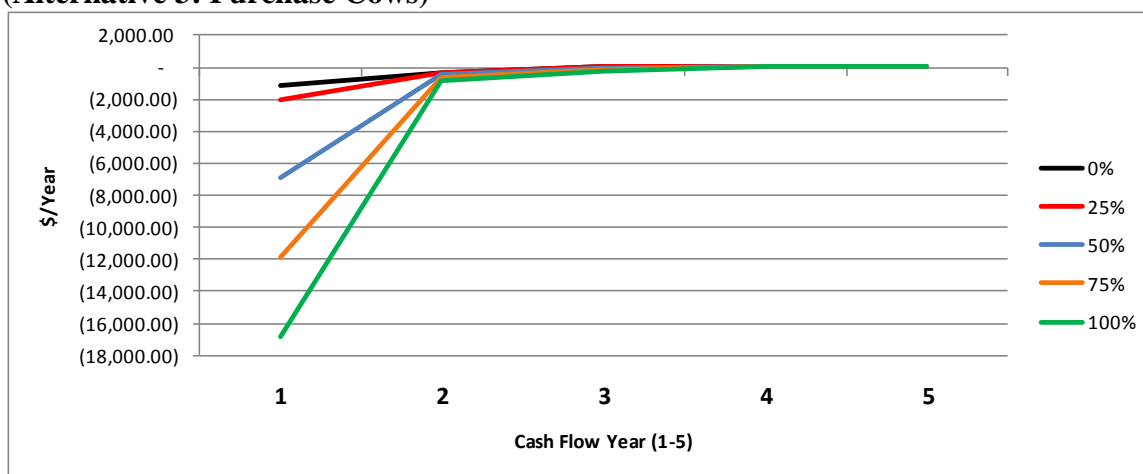
The purchased cow and heifer alternatives are high cost due to their purchase price. Nevertheless, the purchase alternatives create the opportunity to return quickly to not only original cow numbers, but also original calf production in all years. So, although the producer is incurring higher costs than a normal year (e.g., 0% Non-pregnant Cow Rates), they are still able to offset a portion of the purchase investment with the calf income. It is important to note that changes in the feasibility of the purchasing alternatives can occur if the ratios comparing bred cow/heifer prices to that of weaned calf prices become higher or lower.

Table 4.18 and Figure 4.3 show that returns under Alternative 3 quickly converge towards original levels (0% non-pregnant cow rate), which suggests a producer may return to normal production years promptly. If there is a significant increase in calf prices that is not associated with a higher bred cow price, the implications are numerous and high returns may be realized quickly. This option is also attractive for producers who prefer to keep a mature cow herd compared to either purchasing or retaining heifers.

Table 4.18 Annual Cash Flow and Total 5-Year Discounted Cash Flow Values For Alternative 3

Non-Pregnant Cow Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Total 5-Year Discounted Cash Flow
0%	(1,111.76)	(384.76)	102.47	102.47	102.47	(1,154.71)
25%	(2,017.40)	(299.68)	83.37	102.47	102.47	(1,956.55)
50%	(6,948.07)	(481.56)	(20.57)	102.47	102.47	(6,907.19)
75%	(11,878.75)	(663.43)	(124.51)	102.47	102.47	(11,857.82)
100%	(16,809.42)	(845.31)	(228.45)	102.47	102.47	(16,808.46)

Figure 4.3 Annual Cash Flow Values of Differing Non-pregnant Cow Rates (Alternative 3: Purchase Cows)



4.2.4 Keep Non-pregnant Cow Results

With little past research on the possibility of keeping or retaining a non-pregnant cow, certain additional assumptions must be made. First is the assumption of not having

a fall calving herd (or the absence of a spring calving herd in regularly fall calving herds) as noted in Chapter 3. This simply assumes that spring calving cows cannot be moved into the fall calving herd, and vice versa. There are two major reasons for this assumption. First, to correctly identify and make recommendations regarding trichomoniasis or another similar disease resulting in non-pregnant cows, it is necessary to give the infected cow sufficient time to clear of the infection if it is a possible alternative. If this time frame is shortened for trichomoniasis, a risk of transmission of the disease increases.

The second assumption pertains to the cause of why the cow tests non-pregnant. Factors that cause a drop in nutritional levels of the cowherd such as drought, heat/cold stress, or improper management may suggest that developing the cow properly for a year would better control any long term production effects on the cow. Other causes that would have similar implications for the cow, yet still suggesting an otherwise productive cow in subsequent years, were listed in Chapter 2. Research suggests those cows that are held unbred for a season should have increased fertility as well.

The non-pregnant cow alternative presents a new area of analysis. The most noticeable change in that of previous alternatives is the addition of a non-pregnant cow expense. Non-pregnant cows have lower nutritional requirements, translating to lower carrying costs. The annual cow expenses for a bred cow in all alternatives is \$583.64, whereas the annual non-pregnant cow expense is less at \$440.27 (shown in Section 3.3.4). This increases the feasibility of this alternative.

At the 0% non-pregnant cow rate, there are no unbred cows to keep. However, the normal cull rate of 20% is still used and the mature herd in Alternative 4 is normally

replaced with bred cows, consistent with Alternative 3. Because of this, Table 4.19 has the same properties of Table 4.13 of Alternative 3 and shows the Total 5-Year Discounted Cash Flow value at -\$1,154.71. This is simply the value of replacing the normal 20% of the herd with bred cow. At all non-pregnant cow rates (0%-100%), the minimum rate that is culled annual is 20%. This value coincides with normal herd practices and previous assumptions. At rates less than 20% non-pregnant (e.g., 0% non-pregnant cow rate), the oldest cows in the herd are culled first. However, in rates greater than 20% non-pregnant rates, the cull cows are culled at equal percentages throughout all age groups in Alternatives 1-3 as noted in Section 3.2. For example, if a 50% non-pregnant rate was analyzed, 50% of each age group (excluding heifers, if applicable) are culled. Alternative 4, keeping the non-pregnant cows, culls the normal 20% rate throughout all non-pregnant cow rates and these cull cows are dispersed from the oldest age group. Thus, at the 0% rate, Alternative 3 and 4 have equal cash flow values throughout. These two alternatives will be the same with any non-pregnant cow rate less than or equal to 20%, or the normal cull rate.

Table 4.19 Herd Inventory and Cash Flow For Alternative 4 (Keep Non-pregnant cows), 0% Non-pregnant Cow Rate

		-----head-----				
		Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>						
Steer Calf		49.00	49.00	49.00	49.00	49.00
Heifer Calf		49.00	49.00	49.00	49.00	49.00
Cull Cow		20.00	20.00	20.00	20.00	20.00
Bred Cow		78.00	78.00	78.00	78.00	78.00
Open Cow		-	-	-	-	-
Purchased Cow		22.00	22.00	22.00	22.00	22.00
Cow Deathloss		2.00	2.00	2.00	2.00	2.00
		-----\$/head-----				
<i>Income</i>						
Beginning Cash		-	(1,111.76)	(1,496.53)	(1,394.06)	(1,291.59)
Steer Calf Sales	696.96	34,151.04	34,151.04	34,151.04	34,151.04	34,151.04
Heifer Calf Sales	620.50	30,404.67	30,404.67	30,404.67	30,404.67	30,404.67
Cull Cow Sales	637.36	12,747.20	12,747.20	12,747.20	12,747.20	12,747.20
Total Income		77,302.91	77,302.91	77,302.91	77,302.91	77,302.91
<i>Expenses</i>						
Bred Cow Expense	583.64	45,523.92	45,523.92	45,523.92	45,523.92	45,523.92
Non-pregnant Cow Expense	440.27					
Purchased Price of Cow	1,069.19	23,522.22	23,522.22	23,522.22	23,522.22	23,522.22
Purchased Cow Expense	353.06	7,767.32	7,767.32	7,767.32	7,767.32	7,767.32
Heifer Calf Adjustments		1,601.21	874.21	386.98	386.98	386.98
Total Expense		78,414.67	77,687.67	77,200.44	77,200.44	77,200.44
Annual Cash Flow		(1,111.76)	(384.76)	102.47	102.47	102.47
Accumulated Cash Flow		(1,111.76)	(1,496.53)	(1,394.06)	(1,291.59)	(1,189.13)
Total 5-Year Discounted Cash Flow						(1,154.71)

Table 4.20, which shows the 25% non-pregnant cow rate, begins to retain non-pregnant cows. There are 73 bred cows in the herd, two death losses, 5 non-pregnant cows kept, and 22 bred cows purchased to replace normal culling. The total mature cow herd totals 100 cows, however in Year 2, only 93.6 calves are available for sale. With the five non-pregnant cows, there are 95 calves born, less the 2% death loss. By Year 2, the non-pregnant cows are bred again, and normal replacement and cull rates apply as the herd is at original totals.

Table 4.20 notes that the first year annual cash flow is better than in previous alternatives at the respective non-pregnant cow rates. The savings in the bred cow versus the non-pregnant cow expense accounts for some of this. Furthermore, when comparing Table 4.20 with Alternative 3's same non-pregnant cow rate (Table 4.14), there are three

less cows purchased, which account for the rest of the difference. By Year 3 and beyond, the annual cash flow value are similar to that of the respective non-pregnant cow rates of Alternative 3.

Table 4.20 Herd Inventory and Cash Flow For Alternative 4 (Keep Non-pregnant cows), 25% Non-pregnant Cow Rate

		----- head -----				
		Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>						
Steer Calf		49.00	46.80	49.00	49.00	49.00
Heifer Calf		49.00	46.80	49.00	49.00	49.00
Cull Cow		20.00	20.00	20.00	20.00	20.00
Bred Cow		73.50	78.00	78.00	78.00	78.00
Open Cow		4.50	-	-	-	-
Purchased Cow		22.00	22.00	22.00	22.00	22.00
Cow Deathloss		2.00	2.00	2.00	2.00	2.00
<i>Income</i>						
	<i>\$/head</i>	----- \$/herd -----				
Beginning Cash		-	(466.60)	(3,668.19)	(3,584.82)	(3,482.35)
Steer Calf Sales	696.96	34,151.04	32,614.24	34,151.04	34,151.04	34,151.04
Heifer Calf Sales	620.50	30,404.67	29,039.56	30,404.67	30,404.67	30,404.67
Cull Cow Sales	637.36	12,747.20	12,747.20	12,747.20	12,747.20	12,747.20
Total Income		77,302.91	74,401.01	77,302.91	77,302.91	77,302.91
<i>Expenses</i>						
Bred Cow Expense	583.64	42,897.54	45,523.92	45,523.92	45,523.92	45,523.92
Non-pregnant Cow Expense	440.27	1,981.22	-	-	-	-
Purchased Price of Cow	1,069.19	23,522.22	23,522.22	23,522.22	23,522.22	23,522.22
Purchased Cow Expense	353.06	7,767.32	7,767.32	7,767.32	7,767.32	7,767.32
Heifer Calf Adjustments		1,601.21	789.13	406.08	386.98	386.98
Total Expense		77,769.51	77,602.59	77,219.54	77,200.44	77,200.44
Annual Cash Flow		(466.60)	(3,201.59)	83.37	102.47	102.47
Accumulated Cash Flow		(466.60)	(3,668.19)	(3,584.82)	(3,482.35)	(3,379.88)
Total 5-Year Discounted Cash Flow						(3,111.71)

As the non-pregnant cow rate increases from 25% to 50%, major changes occur. More non-pregnant cows are being held back, which creates positive values in the annual cash flow values of Year 1 due to lower costs. Year 1 still has 98 calves available to sell, and the absence of production from the non-pregnant cows is not noted until Year 2. The purchased cow expenses remain constant (at 20% replacement rates) throughout all five years and throughout all options of this alternative. Out of the 50 non-pregnant cows in this scenario, 29 are kept by the producer. Twenty of those non-pregnant cows are culled due to normal cull rates, and one cow is lost in both the bred and non-pregnant groups of

cows. Year 2 calf production decreases substantially, as only 49 cows calve from the original herd, and 22 cows are purchased to stay consistent with normal replacement rates. However, by Year 3, similar annual cash flows are noticed to that of a normal year (Table 4.19). The Year 2 annual cash flow of -\$19,189.54 is the major cause of the Total 5-Year Discounted Cash Flow value of -\$14,357.75.

Table 4.21 Herd Inventory and Cash Flow For Alternative 4 (Keep Non-pregnant cows), 50% Non-pregnant Cow Rate

		----- head -----				
		Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>						
Steer Calf		49.00	34.80	49.00	49.00	49.00
Heifer Calf		49.00	34.80	49.00	49.00	49.00
Cull Cow		20.00	20.00	20.00	20.00	20.00
Bred Cow		49.00	78.00	78.00	78.00	78.00
Open Cow		29.00	-	-	-	-
Purchased Cow		22.00	22.00	22.00	22.00	22.00
Cow Deathloss		2.00	2.00	2.00	2.00	2.00
	<i>\$/head</i>	----- \$/head -----				
<i>Income</i>						
Beginning Cash		-	3,045.97	(16,143.58)	(16,164.15)	(16,061.68)
Steer Calf Sales	696.96	34,151.04	24,254.21	34,151.04	34,151.04	34,151.04
Heifer Calf Sales	620.50	30,404.67	21,593.52	30,404.67	30,404.67	30,404.67
Cull Cow Sales	637.36	12,747.20	12,747.20	12,747.20	12,747.20	12,747.20
Total Income		77,302.91	58,594.93	77,302.91	77,302.91	77,302.91
<i>Expenses</i>						
Bred Cow Expense	583.64	28,598.36	45,523.92	45,523.92	45,523.92	45,523.92
Non-pregnant Cow Expense	440.27	12,767.83	-	-	-	-
Purchased Price of Cow	1,069.19	23,522.22	23,522.22	23,522.22	23,522.22	23,522.22
Purchased Cow Expense	353.06	7,767.32	7,767.32	7,767.32	7,767.32	7,767.32
Heifer Calf Adjustments		1,601.21	971.01	510.02	386.98	386.98
Total Expense		74,256.94	77,784.47	77,323.48	77,200.44	77,200.44
Annual Cash Flow		3,045.97	(19,189.54)	(20.57)	102.47	102.47
Accumulated Cash Flow		3,045.97	(16,143.58)	(16,164.15)	(16,061.68)	(15,959.22)
Total 5-Year Discounted Cash Flow						(14,357.75)

The 75% and 100% non-pregnant cow rates continue in the same manner. As more cows are non-pregnant, translating into more cows being kept as non-pregnant cows, the losses between Years 1 and 2 grow. Table 4.22 contains results for the 75% non-pregnant cow rate. In Year 2, with 24 bred cows in the herd and 22 bred cows purchased in Year 1, only 45.6 calves are available for sale after death loss. This significantly lowers the profit levels by increasing losses, as noted by the Year 2 annual

cash flow of -\$35,180.98. However, in comparison to similar non-pregnant cow rates in the previous alternatives, the Total 5-Year Discounted Cash Flow value of -\$25,606.94 is not as different as might be expected.

Table 4.22 Herd Inventory and Cash Flow For Alternative 4 (Keep Non-pregnant cows), 75% Non-pregnant Cow Rate

	----- head -----				
	Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>					
Steer Calf	49.00	22.80	49.00	49.00	49.00
Heifer Calf	49.00	22.80	49.00	49.00	49.00
Cull Cow	20.00	20.00	20.00	20.00	20.00
Bred Cow	24.50	78.00	78.00	78.00	78.00
Open Cow	53.50	-	-	-	-
Purchased Cow	22.00	22.00	22.00	22.00	22.00
Cow Deathloss	2.00	2.00	2.00	2.00	2.00
	----- \$/head -----				
<i>Income</i>					
Beginning Cash	-	6,558.53	(28,622.44)	(28,746.96)	(28,644.49)
Steer Calf Sales	696.96	34,151.04	15,890.69	34,151.04	34,151.04
Heifer Calf Sales	620.50	30,404.67	14,147.48	30,404.67	30,404.67
Cull Cow Sales	637.36	12,747.20	12,747.20	12,747.20	12,747.20
Total Income		77,302.91	42,785.37	77,302.91	77,302.91
<i>Expenses</i>					
Bred Cow Expense	583.64	14,299.18	45,523.92	45,523.92	45,523.92
Non-pregnant Cow Expense	440.27	23,554.45	-	-	-
Purchased Price of Cow	1,069.19	23,522.22	23,522.22	23,522.22	23,522.22
Purchased Cow Expense	353.06	7,767.32	7,767.32	7,767.32	7,767.32
Heifer Calf Adjustments		1,601.21	1,152.88	613.96	386.98
Total Expense		70,744.38	77,966.34	77,427.42	77,200.44
Annual Cash Flow		6,558.53	(35,180.98)	(124.51)	102.47
Accumulated Cash Flow		6,558.53	(28,622.44)	(28,746.96)	(28,644.49)
Total 5-Year Discounted Cash Flow					(25,606.94)

The highest losses throughout Alternative 4 occur in Year 2 of the 100% non-pregnant cow rate. In this scenario, Year 2's annual cash flow value is -\$51,172.42 (Table 4.23). More importantly, the Year 1 annual cash flow of \$10,071.10 provides support for the Total 5-Year Discounted Cash Flow value to be -\$36,856.13. By keeping 78 non-pregnant cows non-pregnant, over \$11,000 is realized in feed savings compared to that of the normal routine of feeding 78 bred cows. In Year 2, the lower calf income is devastating to the cash flow. However by Year 3, the herd is back to original cash flow values as seen in Table 4.19 at the 0% non-pregnant cow rate.

Table 4.23 Herd Inventory and Cash Flow For Alternative 4 (Keep Non-pregnant cows), 100% Non-pregnant Cow Rate

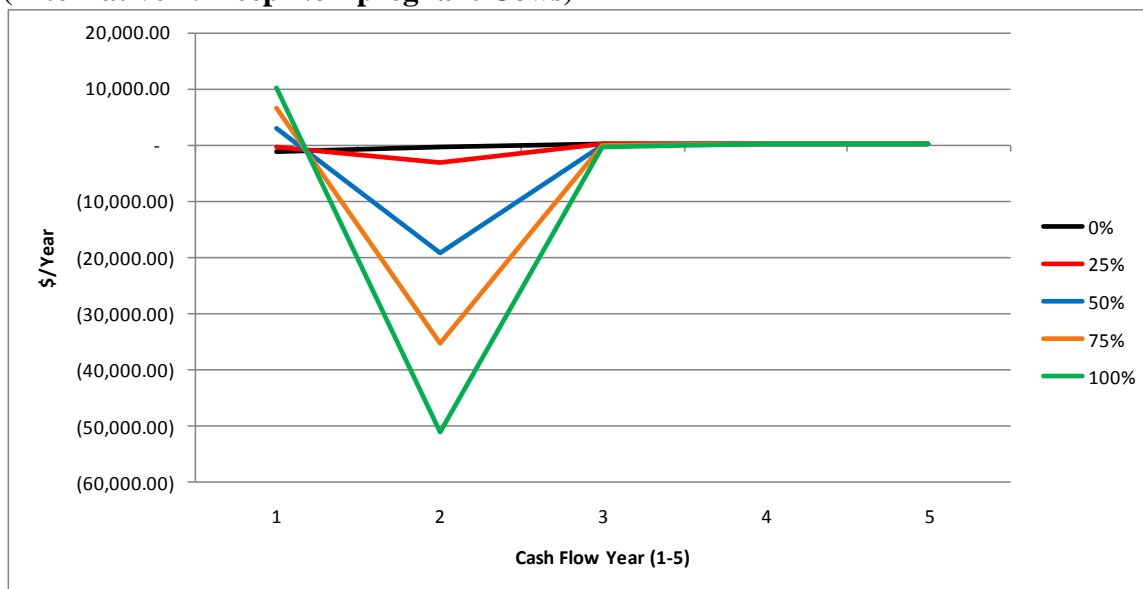
		----- head -----				
		Year 1	Year 2	Year 3	Year 4	Year 5
<i>Herd Inventory</i>						
		49.00	10.80	49.00	49.00	49.00
		49.00	10.80	49.00	49.00	49.00
		20.00	20.00	20.00	20.00	20.00
		-	78.00	78.00	78.00	78.00
		78.00	-	-	-	-
		22.00	22.00	22.00	22.00	22.00
		2.00	2.00	2.00	2.00	2.00
		----- \$/head -----				
<i>Income</i>						
		-	10,071.10	(41,101.32)	(41,329.77)	(41,227.31)
	696.96	34,151.04	7,527.17	34,151.04	34,151.04	34,151.04
	620.50	30,404.67	6,701.44	30,404.67	30,404.67	30,404.67
	637.36	12,747.20	12,747.20	12,747.20	12,747.20	12,747.20
		77,302.91	26,975.81	77,302.91	77,302.91	77,302.91
<i>Expenses</i>						
	583.64	-	45,523.92	45,523.92	45,523.92	45,523.92
	440.27	34,341.06	-	-	-	-
	1,069.19	23,522.22	23,522.22	23,522.22	23,522.22	23,522.22
	353.06	7,767.32	7,767.32	7,767.32	7,767.32	7,767.32
		1,601.21	1,334.76	717.90	386.98	386.98
		67,231.81	78,148.22	77,531.36	77,200.44	77,200.44
		10,071.10	(51,172.42)	(228.45)	102.47	102.47
		10,071.10	(41,101.32)	(41,329.77)	(41,227.31)	(41,124.84)
						(36,856.13)

Figure 4.4 shows how quickly the original herd productivity can be returned to the operation. In all scenarios that have non-pregnant cow rates greater than 20%, the first year cash flow is positive. However, when the producer experiences the losses in calf revenue, the second year's cash flow quickly becomes negative. Year 3 and beyond are constant and comparable to what is seen at the 0% non-pregnant cow rate. Table 4.24 presents the values used to create Figure 4.4, in addition to the Total 5-Year Discounted Cash Flow values for each respective non-pregnant cow rate for Alternative 4. As Table 4.24 shows, all non-pregnant cow rates are able to return to normal levels of cash flow at Year 3 and beyond, however the Year 2 losses created in the higher non-pregnant cow rates still suggest major losses.

Table 4.24 Annual Cash Flow and Total 5-Year Discounted Cash Flow Values For Alternative 4

Non-Pregnant Cow Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Total 5-Year Discounted Cash Flow
0%	(1,111.76)	(384.76)	102.47	102.47	102.47	(1,154.71)
25%	(466.60)	(3,201.59)	83.37	102.47	102.47	(3,111.71)
50%	3,045.97	(19,189.54)	(20.57)	102.47	102.47	(14,357.75)
75%	6,558.53	(35,180.98)	(124.51)	102.47	102.47	(25,606.94)
100%	10,071.10	(51,172.42)	(228.45)	102.47	102.47	(36,856.13)

Figure 4.4 Annual Cash Flow Values of Differing Non-pregnant Cow Rates (Alternative 4: Keep Non-pregnant Cows)



4.3 Conclusion

Not only are there large changes in annual cash flow values in the changing non-pregnant cow rates within each specific alternative, but also between the differing alternatives. While these must be examined carefully, the single most important question to answer pertains to the long term feasibility of the alternatives. This can be done by analyzing the 5-Year Total Cash Flow Values for each alternative. Figure 4.5 summarizes the previous section's data.

Figure 4.5 Discounted 5-Year Total Cash Flow Values of the Alternatives at Differing Non-pregnant Cow Rates

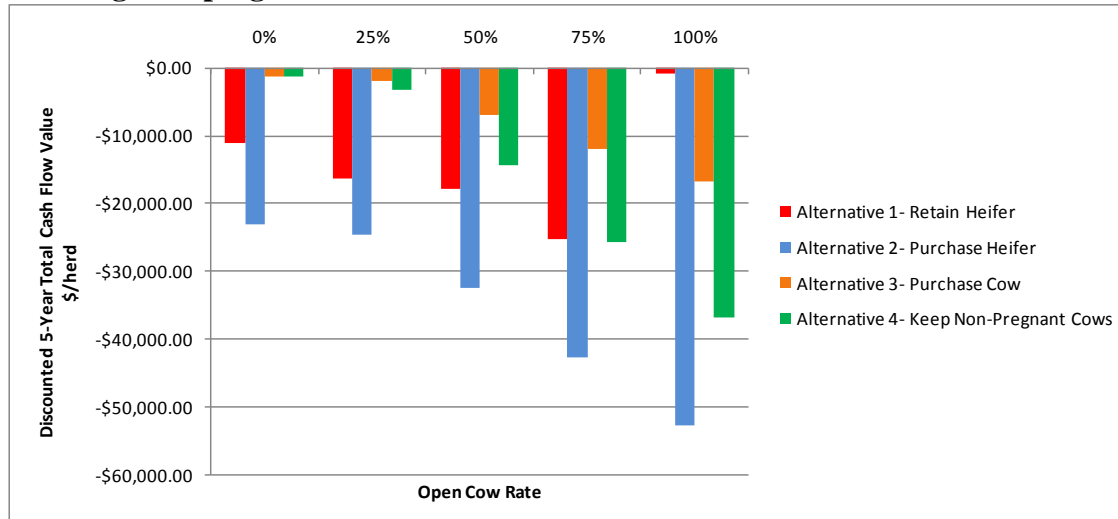


Table 4.25 Discounted 5-Year Total Cash Flow Values for the Alternatives at Differing Non-pregnant Cow Rates

	Non-pregnant Cow Rate				
	0%	25%	50%	75%	100%
Alternative 1- Retain Heifer	(11,036.59)	(16,330.83)	(17,945.54)	(25,250.15)	(717.35)
Alternative 2- Purchase Heifer	(23,106.34)	(24,549.27)	(32,496.21)	(42,730.10)	(52,761.18)
Alternative 3- Purchase Cow	(1,154.71)	(1,956.55)	(6,907.19)	(11,857.82)	(16,808.46)
Alternative 4- Keep Non-Pregnant Cows	(1,154.71)	(3,111.71)	(14,357.75)	(25,606.94)	(36,856.13)

The 0% non-pregnant cow rate serves as the baseline non-pregnant cow rate for all alternatives. At this level, purchasing heifers (Alternative 2) is the least profitable, with retaining heifers (Alternative 1) slightly better. Purchasing bred cows (Alternative 3) and retaining the non-pregnant cows (Alternative 4) are equal, however this is to be expected there are no unbred cows to keep. The producer simply replaced 20 of the bred cows (assumed 20% cull rate) with purchased cows, which is synonymous with Alternative 3. The 25% non-pregnant cow rate shows similar outcomes with the heifer alternatives still the least profitable. Purchasing bred cows surfaced as the most profitable at the 25% non-pregnant cow rate as well. With only 3 non-pregnant cows

retained in this non-pregnant cow rate for Alternative 4, there are only small differences between Alternative 3 and 4.

At the 50% and 75% non-pregnant cow rates, Figure 4.5 shows that the rankings of the most profitable options remain constant with lower rates, only to differing degrees. Purchasing heifers has the worst long-term returns, followed by retaining heifers. Purchasing bred cows is the most viable alternative with the assumptions given, and keeping non-pregnant cows begins to add additional costs. The cost of the purchased replacement heifer causes Alternative 2 to be significantly less profitable (greater losses) than the purchased cow. Not only is the heifer \$130/head more expensive to purchase, but the adjustment factors for her first three calves add to the difference between the alternatives.

When whole herd replacement is necessary at the 100% non-pregnant cow rate, Alternative 1 seems to be the best alternative. However, as previously discussed in Section 4.2.1, Alternative 1 has a smaller cow herd in this case. It would make sense that if, at all levels, the cow-calf operation is unprofitable, lower cow herd numbers would result in more profitable cash flows (or in this case, lower losses). That is, the producer can minimize losses by decreasing the herd size. If rebuilding quickly was not the goal of the operation, Alternative 1 at a non-pregnant cow rate of 100% also seems attractive. Long-term consequences of rebuilding the herd by retained heifers are not included in this analysis, however large cash flow losses will occur for Year 6 as well. After Year 6, the herd is rebuilt to the target of 100 head, and similar cash flow values are found as in the 0% non-pregnant cow rate, which suggests a normal yearly scenario for a cow-calf producer.

The most interesting point of Figure 4.5 is in regards to keeping the non-pregnant cow. By comparison, this alternative is never the lowest return. In all scenarios, except that of at the 100% non-pregnant cow rate, this alternative actually has greater long-term profit outlooks than either the retained heifer option or purchasing a bred heifer. Discussion in Chapter 5 will center on this point, especially as the market price for bred cows and heifers has increased substantially.

This analysis also has important implications depending on the producer's general outlook on their operation. If value-added animals were found to be non-pregnant (those deemed more valuable than market prices assessed for this analysis), Table 4.5 would suggest a possible alternative of keeping them non-pregnant for a year, especially if future production from those animals were profitable. Many producers have genetic investments in their herd that may influence the decision making process. While the previous sections have analyzed these alternatives at determined average prices and costs, current prices are much different. However, this analysis does set a foundation to answer questions centered on the potential of keeping a non-pregnant cow.

CHAPTER 5

WINTER 2011 RESULTS

Cattle prices for all classes of cattle from feeder calves to cull cows sharply increased in late 2010 and early 2011. While an analysis should look at long-term averages and trends as was done in Chapter 4 when making general or long-term decisions, it is important to understand how market conditions can change the optimal decision. The following section describes Winter 2011 (December 2010-February 2011) prices and their respective influences on the 5-year cash flows for the four alternatives that were overviewed in Chapter 3 and analyzed in Chapter 4. Additionally, record high cull cow values were realized during Winter 2011. The effect of these higher cull cow values is further examined in Section 5.5.

5.1 Market Trends

The results of the Annual Cow Classic at the Burwell, Nebraska Livestock Market were obtained from USDA AMS. Five-year averages of bred heifer and cow prices from that market were used in Chapter 4 and were described in the Chapter 3 assumptions. These were \$1,192.58/head for a bred heifer and \$1069.19/head for a bred cow for the 2006-2010 time period. For the last year of the data set (December 2010), bred heifer and cow prices were \$1,385 and \$1,310/head, respectively, and are used as the Winter 2011 prices in the analysis in this chapter. Similar to Chapter 4, Winter 2011 calf prices were determined by using the Nebraska Combined 7-Auction Weighted Average Price reported by USDA AMS. Average prices for these weight ranges and groups of steers

and heifers in the winter months of 2010 and 2011 were \$151.76/cwt and \$136.26/cwt, respectively. The changing calf values necessarily cause changes in the “Heifer Calf Adjustment” factors as well. Additionally, cull cow prices reported in the same USDA AMS sources (Livestock Market News, Various Issues) used in Chapter 3 assumptions and Chapter 4 analysis, averaged \$62.63/cwt for all classes of cull cows during Winter 2011. Table 5.1 illustrates the 5-year averages used in Chapter 4 compared to the values used for Chapter 5.

Table 5.1 5-Year Average Cattle Prices and Current (Winter 2011) Prices

	5-Year Average	Winter 2011	Net Change	% Change
550 lb Steer Calf (\$/cwt)	126.72	151.76	25.04	19.76%
500 lb Heifer Calf (\$/cwt)	114.67	136.26	21.59	18.83%
650 lb Cull Heifer (\$/cwt)	109.52	125.45	15.93	14.55%
Cull Cow Value (\$/cwt)	50.99	62.63	11.64	22.83%
Purchase Price of Heifer (\$/head)	1,192.58	1,385.00	192.42	16.13%
Purchase Price of Cow (\$/head)	1,069.19	1,310.00	240.81	22.52%

These price changes are significant and create an opportunity for producers to use new or different optimal replacement alternatives when faced with higher than average non-pregnant cow rates. Moreover, the budget assumptions for the typical Nebraska Sandhills region are held constant in Chapter 5 compared to Chapter 4, with differences noted only in the cash expenses of the purchased animal price in those alternatives, as well as the additional interest associated with a higher purchase price. The five-year average values used for grazing costs in the budgets by Small et al. (2008), were reported at a rate of \$27.00/AUM. The most recent (2010) cash rental rates for pasture on a monthly basis were \$26.40/pair (Johnson, 2006-2010). Thus, the \$27/AUM cost used in Chapter 3’s budgets is consistent with Winter 2011 values. The low supplementation grazing systems of the Nebraska Sandhills allow Winter 2011 commodity input prices to have a smaller effect on feed costs.

Section 5.2 follows the same process as the analysis in Chapter 4. Herd inventories are the same in Section 5.2 as they were in Section 4.2. This means that all number of calves sold, heifers retained, purchased animals, and cows culled are consistent with those in the Chapter 4 cash flow tables with respect to each individual alternative's non-pregnant cow rate. Thus, the basis for discussion will be centered on the Total 5-Year Discounted Cash Flow value, as well as the annual cash flow values for each alternative. Moreover, changes between Chapter 4 and Chapter 5 analysis are noted throughout, depicting how price changes of inputs and outputs can change the most attractive alternative.

5.2 5-Year Cash Flow Results

Similar to the analysis in Chapter 4, replacement alternatives under Winter 2011 prices are evaluated in the same manner. Annual cash flow values, as well as Total 5-Year Discounted Cash Flow values are presented in the following tables and comparisons are made between the original five-year average analyses found in Chapter 4 to that of Winter 2011 cash flow values. The Winter 2011 prices listed in Section 5.1 are used for all five years of analysis in this section. Moreover, the expense and income values to determine cash flows cause major increases in cash flow values and these are noted throughout. The individual cash flow analysis at the different non-pregnant cow rates are not included in Chapter 5, but follow the same herd inventories listed in Chapter 4's analysis for each respective alternative, and each respective non-pregnant cow rate.

The retained heifer alternative (Alternative 1) Total 5-Year Discounted Cash Flow values are profitable at all non-pregnant cow rate levels using Winter 2011 prices. At normal non-pregnant cow rates (below 20% non-pregnant cow rate), returns of over

\$8,000/year are realized (Table 5.2). This suggests that at Winter 2011 prices, a producer that retains heifers and has normal non-pregnant cow rates can return \$70/head per year on a cash basis for the 100-head target cow herd.

As the non-pregnant cow rate increases, 5-Year Discounted Cash Flow returns to the cow herd decrease except at the 100% non-pregnant cow rate (Table 5.2). Large returns are noted in Year 1 of non-pregnant cow rates that are 25% and greater. This is due to the low-costs of raising a retained heifer in terms of actual cash expenses, and the influx of cash due to the valuable cull cows that are culled.

Negative yearly cash flow values are presented in Table 5.2 in non-pregnant cow rates of 50% and above, and are associated with the herd rebuilding process. Recall from Section 4.2.1 that the herd inventories of Alternative 1 are not at the target level of 100 cows in the extreme non-pregnant cow rates. As these inventories are constant between Chapter 4 and 5 analysis, it is shown that when the cow-calf industry is at profitable levels (as found by the 0% non-pregnant cow rates of Alternative 1), the target herd size becomes increasingly important. Whereas Section 4.2.1 shows positive implications (in terms of cash flow values) for a lower herd inventory at unprofitable industry values and prices, the opposite is true when profits are realized in the industry. Thus, during years of positive returns to the cow-calf industry, the producer is negatively affected by their inability to quickly build the herd up to the target level of 100 cows.

Table 5.2 Annual Cash Flow and Total 5-Year Discounted Cash Flow Values For Alternative 1, Winter 2011 Prices

Non-Pregnant Cow Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Total 5-Year Discounted Cash Flow
0%	8,435.90	8,290.29	8,324.50	8,387.67	8,409.77	36,234.57
25%	5,774.79	4,826.74	8,109.34	8,244.84	8,337.51	30,198.65
50%	26,138.88	(15,310.89)	6,230.63	7,195.06	7,837.95	28,449.62
75%	57,601.90	(23,972.92)	(15,810.42)	(9,071.11)	6,829.59	17,345.51
100%	93,098.36	(22,546.92)	(8,813.87)	(15,783.00)	(15,252.00)	35,665.57

At the 100% non-pregnant cow rate in the Winter 2011 analysis of Alternative 1, negative cash flow values still do not outweigh the positive value found by the influx of cull cow cash in Year 1. However, similar to the analysis in Section 4.2.1, the Year 5 cash flow value still shows significant negative values. Thus, the \$35,665.57 Total 5-Year Discounted Cash Flow value for the 100% non-pregnant cow rate should not be interpreted to be the second most favored non-pregnant cow rate when retaining heifers (Alternative 1). The 100% non-pregnant cow rate has not reached a “steady state” by Year 5, and analysis of the Total Discounted Cash Flow values over 8 or more years would reveal it has the lowest return.

The purchased heifer option has more positive cash flow values shown by Table 5.3 when compared to Table 4.12 (Winter 2011 prices versus 5-Year average prices). While Year 1 creates losses to the producer at non-pregnant cow rates above 25%, by Year 4 all non-pregnant cow rates have positive returns. Moreover, by Year 5, all non-pregnant cow rates settle at the normal herd inventory and distribution, which allows constant values throughout all rates. The 0% non-pregnant cow rate is the most profitable, as expected. Interesting, however, is the fact that even at a purchased heifer price of \$1385/head, positive returns can be found in Table 5.3 in the latter years of analysis even for high non-pregnant cow rates.

Table 5.3 Annual Cash Flow and Total 5-Year Discounted Cash Flow Values For Alternative 2, Winter 2011 Prices

Non-Pregnant Cow Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Total 5-Year Discounted Cash Flow
0%	1,582.39	1,370.41	1,404.62	1,432.39	1,432.39	10,939.99
25%	(386.72)	1,431.87	1,317.54	1,324.48	1,432.39	4,280.55
50%	(11,107.43)	(115.79)	226.38	736.94	1,432.39	(8,759.38)
75%	(21,828.14)	(1,663.45)	(864.78)	442.72	1,432.39	(21,557.99)
100%	(32,548.85)	(3,211.11)	(1,057.55)	442.72	1,432.39	(33,338.49)

The cash flows in Table 5.3 are much more attractive than the same alternative's cash flow values described in Section 4.2.2. Recall at the 100% non-pregnant cow rate for Alternative 2 in Chapter 4, the Total 5-Year Discounted Cash Flow value was -\$52,761. Table 5.3 shows a value of -\$33,338.49, indicating a smaller loss with Winter 2011 Prices. Furthermore, Table 5.3 shows profit levels in Years 4 and 5 for all non-pregnant cow rates, and in earlier years for the lower non-pregnant cow rates. Some of this change in Chapter 4 compared to that of Chapter 5's analysis of Alternative 2 can be attributed to the decreased premium of a bred heifer compared to that of a cull cow. For example, the prices used in Chapter 4 shows that cull cows are priced at 55.5% of the purchased heifer. Winter 2011 prices suggest the cull cows are more valuable in relationship to the bred heifer, with a cull cow valued at 58.8% of a purchased heifer.

Table 5.4 shows Alternative 3's outcome with Winter 2011 prices. The Total 5-Year Discounted Cash Flow values rank the differing non-pregnant cow rates from 0% being the highest return rate, to the 100% non-pregnant cow rate with the lowest return. This is expected and is consistent with Table 4.18 that uses 5-Year average prices. Moreover, as herd inventories move towards levels consistent with the assumed 20% non-pregnant cow rate, returns average over \$6,500 annually. Note that at all non-pregnant cow percentages, returns are higher using Winter 2011 compared to the 5-year averages as shown in Chapter 4.

Table 5.4 post a negative cash flow value in Year 1 for non-pregnant cow rates above 50%. For example, the 100% non-pregnant cow rate is at -\$17,206.18, however the Total 5-Year Discount Cash Flow value is \$7,135.37. This suggests that the producer can cull the entire cow herd of 100 cows, purchase bred cows that are similar in age

distribution, and create enough revenue to pay for a very large percentage of the newly purchased cows within the first year. This is partly attributed to the winter feed costs savings. Recall, from Chapter 3 assumptions, that in the purchased alternatives (Alternatives 2, 3 and 4 at rates below the normal culling rate), the cows are culled in the fall and replacement animals are purchased in the spring. This assumption, coupled with the higher calf prices, is very attractive to individuals who are considering rebuilding an entire herd.

Table 5.4 Annual Cash Flow and Total 5-Year Discounted Cash Flow Values For Alternative 3, Winter 2011 Prices

Non-Pregnant Cow Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Total 5-Year Discounted Cash Flow
0%	5,923.94	6,789.07	7,368.87	7,368.87	7,368.87	30,001.33
25%	4,589.51	6,890.31	7,346.15	7,368.87	7,368.87	28,802.65
50%	(2,675.72)	6,673.88	7,222.46	7,368.87	7,368.87	21,580.22
75%	(9,940.95)	6,457.45	7,098.77	7,368.87	7,368.87	14,357.79
100%	(17,206.18)	6,241.02	6,975.07	7,368.87	7,368.87	7,135.37

Alternative 4, keeping a non-pregnant cow, has positive Total 5-Year Discounted Cash Flow values for non-pregnant cow rates at 75% or less. More important, however, is that the expenses and lost revenue in Year 2 when non-pregnant cow rates are 50%-75% are recovered by Year 5. The 100% non-pregnant cow rate does show a Total 5-Year Discounted Cash Flow value that is negative, however this is only because of the large losses associated with Year 2's annual cash flow. Thus, in most of the high non-pregnant cow rates, one can expect to return to normalcy quickly if non-pregnant rates return to normal after one year. This has implications surrounding the potential of a producer's ability to handle one year (Year 2) of major cash flow deficits.

Consistent with the other alternatives described in this Chapter, Alternative 4 is much more feasible at Winter 2011 prices compared to using five-year averages as

described in Chapter 4. Recall Table 4.24 values that ranged from -\$1,154.71 to -\$36,856.13 for the 0% and 100% non-pregnant cow rates, respectively. Table 5.5, at Winter 2011 prices, shows consistently higher returns ranging from \$30,001.33 to -\$11,956.38 for the 0% and 100% non-pregnant cow rates, respectively. Moreover, the losses associated with Year 2 in the non-pregnant cow rates of 50% or greater are significantly less than those found in Table 4.24. This is caused by the overall profitability of the cow-calf industry at Winter 2011 prices as the calves that are sold from the remaining productive cow herd are much more valuable. By the latter years of the cash flow analysis, herd inventories reach a “steady state” and are constant throughout Years 4 and 5 of non-pregnant cow rates between 0% and 75%. Slight differences are noted in the annual cash flow values (Year 4 and 5) of the 100% non-pregnant cow rate due to changes in herd inventory and how the normal cull rate (20%) replacement cows are distributed equally throughout the differing age groups of the bred cows.

Table 5.5 Annual Cash Flow and Total 5-Year Discounted Cash Flow Values For Alternative 4, Winter 2011 Prices

Non-Pregnant Cow Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Total 5-Year Discounted Cash Flow
0%	5,923.94	6,789.07	7,368.87	7,368.87	7,368.87	30,001.33
25%	6,569.10	3,550.98	7,346.15	7,368.87	7,368.87	27,659.10
50%	10,081.67	(14,853.04)	7,222.46	7,368.87	7,368.87	14,204.57
75%	13,594.23	(33,261.23)	7,098.77	7,368.87	7,368.87	746.24
100%	17,411.03	(51,415.82)	7,111.48	7,442.40	7,442.40	(11,956.38)

5.3 Alternative Comparisons Based on Winter 2011 Price Levels

Table 5.6 and Figure 5.1 summarize the data presented in Chapter 5 up to this point. Similar to Table 4.25 in Chapter 4, Table 5.6 shows the return potential of all alternatives throughout all non-pregnant cow rates with Winter 2011 prices. Alternative 4 does not have the lowest returns at any non-pregnant cow rate described. This is a

noteworthy result, and in all cases, purchasing heifers actually has lower returns than keeping the non-pregnant cow. With the high heifer prices used, this is expected.

Although cull cow values increased significantly in the Winter 2011 analysis, the capital cost of purchasing a heifer or cow creates a shock to the operation for Alternative 2 and 3, and to a lesser extent in Alternative 4. While these shocks are quickly absorbed and returns become positive again, the magnitude of the non-pregnant cow rate plays a major impact. As more cows are non-pregnant and more bred animals purchased, the Total 5-Year Discounted Cash Flow decreases. As noted earlier, retaining heifers looks quite profitable at the 100% non-pregnant cow rate levels, however this is due to the influx of cash in culling all the non-pregnant cows. This value would decrease significantly if a longer-term analysis was continued (past that of a 5-year cash flow), and this must be noted.

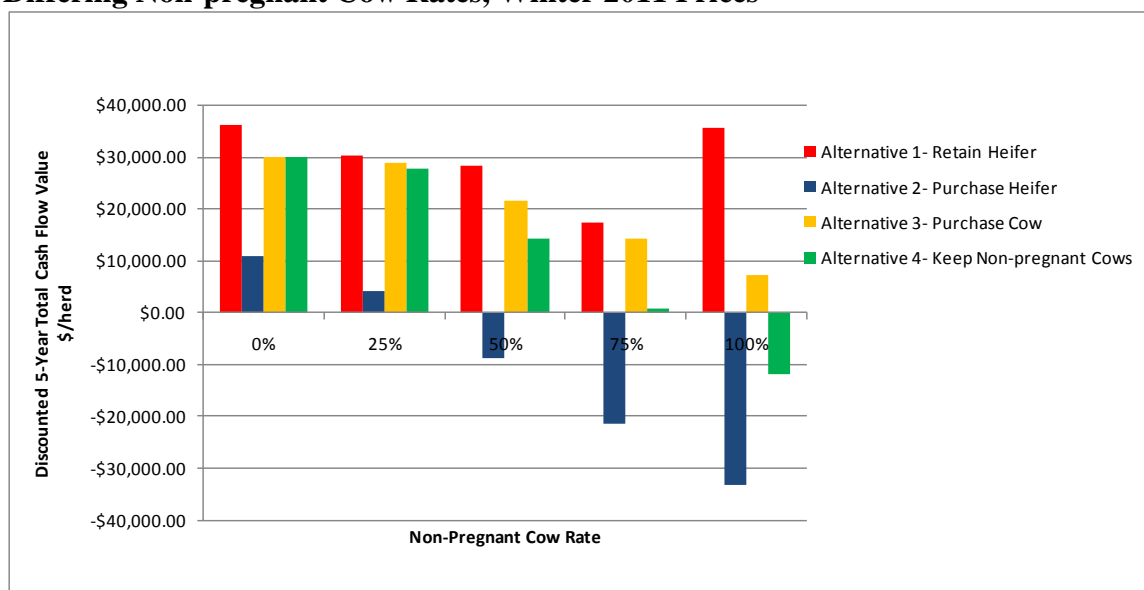
Table 5.6. Total 5-Year Discounted Cash Flow Values For All Alternatives, Winter 2011 Prices

	Non-pregnant Cow Rate				
	0%	25%	50%	75%	100%
Alternative 1- Retain Heifer	36,234.57	30,198.65	28,449.62	17,345.51	35,665.57
Alternative 2- Purchase Heifer	10,939.99	4,280.55	(8,759.38)	(21,557.99)	(33,338.49)
Alternative 3- Purchase Cow	30,001.33	28,802.65	21,580.22	14,357.79	7,135.37
Alternative 4- Keep Non-pregnant Cows	30,001.33	27,659.10	14,204.57	746.24	(11,956.38)

Purchasing heifers is the lowest-return alternative. Furthermore, the rankings of the alternatives returns (highest to lowest returns) remains constant throughout all of the differing non-pregnant cow rates at 5-Year average prices and Winter 2011 prices. That is, Alternative 1 (retaining heifers) has the highest returns associated with the cash flow values, followed by purchasing cows, keeping the non-pregnant cows and lastly, purchasing heifers. Alternative 4 is not the least profitable, which suggest profits can be

made and more importantly, that purchasing of bred animals at higher than normal rates can potentially be eliminated as non-pregnant cow may be kept.

Figure 5.1 Discounted 5-Year Total Cash Flow Values of the Alternatives at Differing Non-pregnant Cow Rates, Winter 2011 Prices



5.4 An Approach to Combining Alternatives

The previous data in Chapter 5 are solely based upon a producer's ability, or desire, to choose only one unique alternative when faced with abnormally high non-pregnant cow rates. While this may be beneficial in some regards, Alternative 1 had the limitation of not being able to maintain a constant herd size at high non-pregnant rates. Thus, using combinations of alternatives, most notably when Alternative 1 (Retaining Heifers) is desirable, could allow producers to maintain the target herd size while potentially increasing return potential.

The cash flow calculation methods in this section are consistent with those previously described. Alternative 1, retaining heifers, is analyzed by combining this alternative with either purchasing cows or retaining non-pregnant cows (Alternatives 3 or 4, respectively). As was shown earlier in Chapter 5 and Figure 5.1, purchasing heifers is

the lowest return alternative. Therefore, purchasing cows is developed as a combination alternative with retaining heifers instead of purchasing heifers, as Alternative 1 and 3 would suggest greater return potential than Alternative 1 and 2. Additionally, this combination can be beneficial as a more uniform age distribution (heifers and cows) can be realized by the producer.

5.4.1 Combination Alternative 1 and 3

Additional assumptions must be created for this combination alternative. The target herd size is still 100 cows. The combination of Alternative 1 and 3 allows herd inventories to reach this requirement in Year 2 for all non-pregnant cow rates, whereas Alternative 1 alone was unable to meet this objective. As noted previously in Chapter 4 and Chapter 5, Alternative 1 retains more than 25% of the cow herd as retained heifers at the higher non-pregnant rates. This lowers calf income when more of the heifer calves are retained and also increases development costs of those heifers. In the combination analysis in this section, the producer only retains 25% of the mature cow herd, or in this case, 25 heifers, on any given year and at any non-pregnant cow rate. This 25% retained heifer rate, or 25 heifers, is assumed to stay constant in this section (5.4) for two reasons. First, Alternative 1 alone creates deficits in cow herd inventories at the higher non-pregnant cow rates. Ultimately, large losses due to lower calf sales are observed in Year 2 of the cash flow analysis. This is also true for Alternative 4 of retaining non-pregnant cows. Thus, to analyze this scenario from an equal viewpoint between both combinations, constant herd inventories are critical. This is accomplished by recognizing and using the highest-return alternative (Alternative 1, retaining heifers) while using only normal replacement rates of 25% under all non-pregnant cow rate scenarios.

Secondly, maintaining a typical heifer retention rate may be desirable in some circumstances. As per the assumptions noted previously throughout Chapter 4 and 5, the goal of the replacement alternatives is to remain at the target herd of 100 head and return to normal operation as quickly as possible. Although the combination of Alternative 1 and 4 still has undesirable Year 2 cash flow values and lower herd inventories because of the lower calf sales, consistent returns are realized throughout all other years following a major production shock of the higher non-pregnant cow rates in Year 1.

Table 5.7 shows the annual cash flow values as well as the Total 5-Year Discounted Cash Flow values for the combination of Alternative 1 and 3, Retaining Heifers and Purchasing Cows using Winter 2011 prices at the 25% non-pregnant cow rate. It is important to note that at the 0% non-pregnant cow rate, the Total 5-Year Discounted Cash Flow value mirrors that of retaining heifers because no bred cows would be purchased to make up for a herd inventory shortfall, and all herd inventories are consistent with that alternative.

**Table 5.7 Herd Inventory and Cash Flows for Combination Alternative 1 & 3,
25% Non-pregnant Cow Rate**

	-----head-----					
	Year 1	Year 2	Year 3	Year 4	Year 5	
Herd Inventory						
Steer Calf	49	49	49	49	49	
Heifer Calf (Sales)	19	24.5	24.5	24.5	24.5	
Heifer Calf (Retained)	30	24.5	24.5	24.5	24.5	
Cull Heifer	3.6	3	3	3	3	
Cull Cow	24	20	20	20	20	
Bred Cow	74	74	78	78	78	
Retained Heifer (2 Year Old)	22	26.4	22	22	22	
Cow Deathloss	2	2	2	2	2	
Purchase Bred Cows	0	0	0	0	0	
	<i>\$/head</i>	-----\$/herd-----				
Income						
Beginning Cash		-	8,906.31	8,477.60	8,324.50	8,387.67
Steer Calf Sales	834.68	40,899.32	40,899.32	40,899.32	40,899.32	40,899.32
Heifer Calf Sales	681.30	12,944.70	16,691.85	16,691.85	16,691.85	16,691.85
Cull Cow Sales	782.88	18,789.12	15,657.60	15,657.60	15,657.60	15,657.60
Cull Heifer Income	815.43	2,935.55	2,446.29	2,446.29	2,446.29	2,446.29
Total Income		75,568.69	75,695.06	75,695.06	75,695.06	75,695.06
Expenses						
Bred Cow Expense	583.64	43,189.36	43,189.36	45,523.92	45,523.92	45,523.92
Retained Heifer Calf Expense	336.12	8,873.57	7,226.58	7,226.58	7,226.58	7,226.58
Purchase Bred Cows	1,310.00	-				
Retained Bred Heifer Expense	488.01	10,736.22	12,883.46	10,736.22	10,736.22	10,736.22
Cull Heifer Expense	151.32	544.75	453.96	453.96	453.96	453.96
Heifer Calf Adjustments		3,318.48	3,464.09	3,429.88	3,366.71	3,344.61
Total Expense		66,662.38	67,217.46	67,370.56	67,307.39	67,285.29
Annual Cash Flow		8,906.31	8,477.60	8,324.50	8,387.67	8,409.77
Accumulated Cash Flow		8,906.31	8,477.60	8,324.50	8,387.67	8,409.77
Total 5-Year Discounted Cash Flow						36,852.48

Recall from Section 5.3 the 25% non-pregnant rate Total 5-Year Discounted Cash Flows are \$30,198.65 and \$28,802.65 for Alternative 1 and Alternative 3, respectively.

The combination alternative, with a value of \$36,449.89, shows a higher return for the producer. This is largely in part to reducing the heifer calf adjustment factors from Alternative 1's results, while decreasing purchasing expenses of cows found in Alternative 3. At the 25% non-pregnant rate, the producer is able to retain 25% of the cow herd in the form of replacement heifers and purchase 4 cows in Year 1, both values less than those if the producer chose only one of the alternatives.

Major return differences are noted at the 100% non-pregnant cow rate when the combination alternative of 1 and 3 are used. Most of the differences realized between

Section 5.3 and this section are due to the number of calves available for sale in Year 2. Whereas choosing only Alternative 1 alone significantly dropped calf revenue in Year 2, the combination of alternative 1 and 3 allowed 98 calves to be sold even at high non-pregnant cow rates. This allows the 100% non-pregnant cow rate cash flow (Table 5.8) to reach Total 5-Year Discounted Cash Flow Values of \$40,433.20 compared to Section 5.3 data of Alternative 1 and 3 individually of \$35,665.57 and \$7,135.37, respectively.

Table 5.8 Herd Inventory and Cash Flows for Combination Alternative 1 & 3, 100% Non-pregnant Cow Rate

	<i>head</i>				
	Year 1	Year 2	Year 3	Year 4	Year 5
Herd Inventory					
Steer Calf	49	49	49	49	49
Heifer Calf (Sales)	24.5	24.5	24.5	24.5	24.5
Heifer Calf (Retained)	24.5	24.5	24.5	24.5	24.5
Cull Heifer	3	3	3	3	3
Cull Cow	98	20	20	20	20
Bred Cow	0	78	78	78	78
Retained Heifer (2 Year Old)	22	22	22	22	22
Cow Deathloss	2	2	2	2	2
Purchase Bred Cows	78	0	0	0	0
	<i>\$/head</i>	<i>\$/herd</i>			
Income					
Beginning Cash	-	12,844.46	21,134.75	29,459.25	37,846.92
Steer Calf Sales	834.68	40,899.32	40,899.32	40,899.32	40,899.32
Heifer Calf Sales	681.30	16,691.85	16,691.85	16,691.85	16,691.85
Cull Cow Sales	782.88	76,722.24	15,657.60	15,657.60	15,657.60
Cull Heifer Income	815.43	2,446.29	2,446.29	2,446.29	2,446.29
Total Income		136,759.70	75,695.06	75,695.06	75,695.06
Expenses					
Bred Cow Expense	583.64	-	45,523.92	45,523.92	45,523.92
Retained Heifer Calf Expense	336.12	7,226.58	7,226.58	7,226.58	7,226.58
Purchase Bred Cows	1,310.00	102,180.00			
Retained Bred Heifer Expense	488.01	10,736.22	10,736.22	10,736.22	10,736.22
Cull Heifer Expense	151.32	453.96	453.96	453.96	453.96
Heifer Calf Adjustments		3,318.48	3,464.09	3,429.88	3,366.71
Total Expense		123,915.24	67,404.77	67,370.56	67,307.39
Annual Cash Flow		12,844.46	8,290.29	8,324.50	8,387.67
Accumulated Cash Flow		12,844.46	21,134.75	29,459.25	37,846.92
Total 5-Year Discounted Cash Flow					40,433.20

As the non-pregnant cow rates increase, the combination alternative becomes more attractive than either Alternative 1 or 3 alone as shown by comparing Table 5.9 to Table 5.6. The higher valued heifer calves with Winter 2011 prices suggest that retaining

the normal rate (25%) allows more returns to be realized compared to Alternative 1 alone because of the additional heifers available for sale. Additionally, heifer calf adjustment factors for lower productivity do not rise in the combination of Alternative 1 and 3 as they do in Alternative 1. Moreover, major differences are noted in the lower development costs of retaining heifers (at higher non-pregnant cow rates) compared to that of Alternative 1 alone as the number of retained heifers are not increasing past that of 25% of the cow herd. Also, the ability to maintain 100 cows in the herd at all times by purchasing cows in Year 1 suggests that at profitable Winter 2011 prices, returns are realized and being able to maintain this herd size become increasingly important.

Table 5.9 Annual Cash Flow and Total 5-Year Discounted Cash Flow Values For Alternative 1 & 3 Combination, Winter 2011 Prices

Non-Pregnant Cow Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Total 5-Year Discounted Cash Flow
0%	8,435.90	8,290.29	8,324.50	8,387.67	8,409.77	36,234.57
25%	8,661.98	8,290.29	8,324.50	8,387.67	8,409.77	36,449.89
50%	10,074.98	8,290.29	8,324.50	8,387.67	8,409.77	37,795.60
75%	9,696.74	7,281.93	7,316.14	7,379.31	7,401.41	34,030.04
100%	12,844.46	8,290.29	8,324.50	8,387.67	8,409.77	40,433.20

5.4.2 Combination Alternative 1 and 4

Results that yield more favorable returns are also found using the combination of Alternative 1 and 4. By keeping non-pregnant cows, losses at the higher non-pregnant cow rates are still found in Year 2. However, these losses are not as substantial as those found in Alternative 4's analysis because a lower number of non-pregnant cows are kept due to the ability to retain 22 heifers that will eventually enter the herd in Year 3. Table 5.10 shows the annual cash flow values for 25% non-pregnant cow rate of the combination of Alternatives 1 and 4. When compared to Winter 2011 price analysis of

Alternative 1 at \$30,198.65 and Alternative 4 at \$27,659.10, the combination of the alternatives shows potential to be an option that yields higher returns.

Table 5.10 Herd Inventory and Cash Flows for Combination Alternative 1 & 4, 25% Non-pregnant Cow Rate

	----- head -----					
	Year 1	Year 2	Year 3	Year 4	Year 5	
Herd Inventory						
Steer Calf	49	49	49	49	49	
Heifer Calf (Sales)	19	24.5	24.5	24.5	24.5	
Heifer Calf (Retained)	30	24.5	24.5	24.5	24.5	
Cull Heifer	3.6	3	3	3	3	
Cull Cow	24	20	20	20	20	
Bred Cow	74	74	78	78	78	
Retained Heifer (2 Year Old)	22	26.4	22	22	22	
Cow Deathloss	2	2	2	2	2	
Purchase Bred Cows	0	0	0	0	0	
	<i>\$/head</i>	----- \$/herd -----				
Income						
Beginning Cash		-	8,906.31	8,477.60	8,324.50	8,387.67
Steer Calf Sales	834.68	40,899.32	40,899.32	40,899.32	40,899.32	40,899.32
Heifer Calf Sales	681.30	12,944.70	16,691.85	16,691.85	16,691.85	16,691.85
Cull Cow Sales	782.88	18,789.12	15,657.60	15,657.60	15,657.60	15,657.60
Cull Heifer Income	815.43	2,935.55	2,446.29	2,446.29	2,446.29	2,446.29
Total Income		75,568.69	75,695.06	75,695.06	75,695.06	75,695.06
Expenses						
Bred Cow Expense	583.64	43,189.36	43,189.36	45,523.92	45,523.92	45,523.92
Retained Heifer Calf Expense	336.12	8,873.57	7,226.58	7,226.58	7,226.58	7,226.58
Purchase Bred Cows	1,310.00	-				
Retained Bred Heifer Expense	488.01	10,736.22	12,883.46	10,736.22	10,736.22	10,736.22
Cull Heifer Expense	151.32	544.75	453.96	453.96	453.96	453.96
Heifer Calf Adjustments		3,318.48	3,464.09	3,429.88	3,366.71	3,344.61
Total Expense		66,662.38	67,217.46	67,370.56	67,307.39	67,285.29
Annual Cash Flow		8,906.31	8,477.60	8,324.50	8,387.67	8,409.77
Accumulated Cash Flow		8,906.31	8,477.60	8,324.50	8,387.67	8,409.77
Total 5-Year Discounted Cash Flow						36,852.48

At the 100% non-pregnant cow rate, similar to analysis of Alternative 4 in Chapter 4, there are only 22 cows that will produce calves in Year 2. Thus, only 11 heifers are retained (50% of the calf crop). This is noticed in the Year 4 losses of the 100% non-pregnant cow rate shown in Table 5.11. Furthermore, the 100% non-pregnant cow rate is the only rate that has bred cow inventories that fall below the target herd size using this combination strategy. This is only found in Year 4 due to the lesser number of heifers retained in Year 2 and the assumed 20% cull rate. In Year 5, the herd is able to quickly return to the target of 100 cows. Interestingly, the high-valued cull cow creates

such an influx of cash in the first year, the 100% non-pregnant cow rate still produces a positive 5-year return. In contrast, Section 5.3 shows negative returns for Alternative 4 at the 100% non-pregnant cow rate. However, this combination alternative does not have higher returns than Alternative 1 alone at Winter 2011 prices. Due to this availability of cash in Year 1 by choosing Alternative 1, the slow reinvestment into the herd (building the herd back to the target of 100 cows) does not return the herd to normal levels of inventory or returns. Thus, the combination of Alternative 1 and 4 may be an appealing choice for those producers who wish to return to the normal target herd size within five years.

Table 5.11 Herd Inventory and Cash Flows for Combination Alternative 1 & 4, 100% Non-pregnant Cow Rate

	head					
	Year 1	Year 2	Year 3	Year 4	Year 5	
Herd Inventory						
Steer Calf	49	11	49	43.84	49	
Heifer Calf (Sales)	24.5	0	15	19.34	24.5	
Heifer Calf (Retained)	24.5	11	24.5	24.5	24.5	
Cull Heifer	2.94	1.32	2.94	2.94	2.94	
Cull Cow	20	20	20	17.5	20	
Bred Cow	0	78	78	70.18	78.44	
Retained Heifer (2 Year Old)	22	21.56	9.68	21.56	21.56	
Cow Deathloss	2	2	2	2	2	
Keep Non-pregnant	78	0	0	0	0	
	\$/head	-\$/herd				
Income						
Beginning Cash		-	19,558.74	(17,488.70)	(9,108.77)	(5,781.98)
Steer Calf Sales	834.68	40,899.32	9,181.48	40,899.32	36,592.37	40,899.32
Heifer Calf Sales	681.30	16,691.85	-	10,219.50	13,176.34	16,691.85
Cull Cow Sales	782.88	15,657.60	15,657.60	15,657.60	13,700.40	15,657.60
Cull Heifer Income	815.43	2,397.36	1,076.37	2,397.36	2,397.36	2,397.36
Total Income		75,646.13	25,915.45	69,173.78	65,866.48	75,646.13
Expenses						
Bred Cow Expense	583.64	-	45,523.92	45,523.92	40,959.86	45,780.72
Retained Heifer Calf Expense	336.12	7,246.75	3,253.64	7,246.75	7,246.75	7,246.75
Non-Pregnant Cow Expense	440.27	34,341.06				
Retained Bred Heifer Expense	488.01	10,736.22	10,521.50	4,723.94	10,521.50	10,521.50
Cull Heifer Expense	151.32	444.88	199.74	444.88	444.88	444.88
Heifer Calf Adjustments		3,318.48	3,464.09	2,854.37	3,366.71	4,212.18
Total Expense		56,087.39	62,962.89	60,793.85	62,539.69	68,206.03
Annual Cash Flow		19,558.74	(37,047.44)	8,379.93	3,326.79	7,440.11
Accumulated Cash Flow		19,558.74	(17,488.70)	(9,108.77)	(5,781.98)	1,658.13
Total 5-Year Discounted Cash Flow						829.63

Table 5.12 Annual Cash Flow and Total 5-Year Discounted Cash Flow Values For Alternative 1 & 4 Combination, Winter 2011 Prices

Non-Pregnant Cow Rate	Year 1	Year 2	Year 3	Year 4	Year 5	Total 5-Year Discounted Cash Flow
0%	8,435.90	8,290.29	8,324.50	8,387.67	8,409.77	36,234.57
25%	9,009.38	5,258.33	8,324.50	8,387.67	8,409.77	34,030.67
50%	12,593.63	(12,856.74)	8,324.50	8,387.67	8,409.77	21,013.33
75%	15,169.52	(26,827.62)	7,316.14	7,379.31	7,401.41	8,303.85
100%	19,558.74	(37,047.44)	8,379.93	3,326.79	7,440.11	829.63

5.4.3 Summary of Combination Strategies

Recall that in Table 5.6, Alternative 1 returns declined sharply between the 50% and 75% non-pregnant cow rates and subsequently rise at the 100% rate. With the Alternative 1 and 3 combination, this is also true and noted in Table 5.9. Furthermore,

the combination allows the positive aspects of Alternative 1 (low cash cost replacement) to be complimented by the ability to maintain the target herd size that Alternative 3 allows.

Table 5.12 shows a linearly declining return outcome to the producer as non-pregnant cow rate rise. As previously noted, this is to be expected as the Year 2 losses in the higher non-pregnant cow rates are prevalent in both Alternative 1 and 4. However, this combination becomes feasible if the producer wishes to keep a portion of the non-pregnant cow due to reasons such as genetic superiority and allows returns to be realized at even the 100% non-pregnant cow rate.

Section 5.4 suggests that retaining heifers at a constant rate of 25%, while supplementing cow herd inventory with either purchasing cows or keeping non-pregnant cows, is potentially a high-return option. The ability to merge the positive aspects of retaining heifers (a low-cost replacement alternative) with the positive aspects of purchasing or keeping open cows (ability to maintain the target herd size) create greater returns than that of each alternative used alone. Furthermore, with Winter 2011 prices analyzed, being able to sell more calves and reducing the burden of purchasing bred animals is attractive in terms of cash flow analysis. This is also a result of the high-valued cull animal and its effects of cash flow values, as discussed previously.

Many producers often use combinations of these alternatives in a normal year, based upon the market structure and costs associated with each alternative at the particular decision time. By using one point in time, Winter 2011 prices, the combination approach of replacement may be the highest return.

5.5 The Effects of Cull Cow Values on Return Potential

The relationships between cull cow prices and the returns associated with cow-calf production would indicate that higher cull values create greater return potential. With correlations between all cattle prices, it is to be expected that as feeder and bred animal prices rise, cull cow prices would follow suit. This section presents a sensitivity analysis of the impact of cull prices, most notably if the correlations between cull prices and other prices of cattle change. These results conclude Chapter 5 by determining different levels of returns for the herd when faced with Winter 2011 calf and bred animal price, yet allowing changing cull cow values.

Because Winter 2011 prices resulted in positive returns, cull cow prices could potentially be lower and still result in positive returns. In Alternative 1, at normal non-pregnant cow rates (or those that are at or below 20%) cull cow prices of \$350/head create positive returns as shown in Table 5.13. As expected, profit levels are noted at all non-pregnant cow rates when cull cow values rise above \$550/head. However, the conclusions of this section will show a better relationship of how the lower herd numbers found by the 80, 90, and 100% non-pregnant cow rates can have positive or negative implications for Alternative 1 depending on return potential of the operation.

Table 5.13 Cull Value versus Non-pregnant Cow Percentage: Total 5-Year Discounted Cash Flow Values for Alternative 1

	Shead	\$/cwt	Non-pregnant Cow Percentage (Year 1)										
			0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	\$ 300	\$ 24	(2,501.50)	(2,489.67)	(2,489.67)	(9,910.53)	(16,624.05)	(20,114.91)	(24,204.97)	(28,999.00)	(35,278.62)	(35,707.53)	(25,693.55)
	350	28	1,815.48	1,820.59	1,820.59	(5,211.23)	(11,535.75)	(14,693.84)	(18,486.32)	(23,040.22)	(29,157.50)	(29,446.57)	(19,292.76)
	400	32	6,132.47	6,130.84	6,130.84	(511.94)	(6,447.44)	(9,272.77)	(12,767.67)	(17,081.43)	(23,036.39)	(23,185.62)	(12,891.97)
C	450	36	10,449.45	10,441.10	10,441.10	4,187.36	(1,359.13)	(3,851.70)	(7,049.01)	(11,122.65)	(16,915.28)	(16,924.67)	(6,491.18)
	500	40	14,766.43	14,751.35	14,751.35	8,886.65	3,729.18	1,569.37	(1,330.36)	(5,163.86)	(10,794.16)	(10,663.72)	(90.39)
u	550	44	19,083.41	19,061.61	19,061.61	13,585.95	8,817.49	6,990.44	4,388.29	794.92	(4,673.05)	(4,402.77)	6,310.40
	600	48	23,400.40	23,371.86	23,371.86	18,285.24	13,905.80	12,411.51	10,106.94	6,753.71	1,448.06	1,858.19	12,711.19
l	650	52	27,717.38	27,682.12	27,682.12	22,984.54	18,994.11	17,832.58	15,825.59	12,712.49	7,569.18	8,119.14	19,111.98
	700	56	32,034.36	31,992.37	31,992.37	27,683.83	24,082.42	23,253.65	21,544.25	18,671.28	13,690.29	14,380.09	25,512.77
o	750	60	36,351.34	36,302.63	36,302.63	32,383.13	29,170.73	28,674.72	27,262.90	24,630.06	19,811.40	20,641.04	31,913.56
	800	64	40,668.33	40,612.88	40,612.88	37,082.42	34,259.04	34,095.79	32,981.55	30,588.84	25,932.52	26,901.99	38,314.35
w	850	68	44,985.31	44,923.14	44,923.14	41,781.72	39,347.35	39,516.86	38,700.20	36,547.63	32,053.63	33,162.95	44,715.14
	900	72	49,302.29	49,233.39	49,233.39	46,481.01	44,435.66	44,937.93	44,418.86	42,506.41	38,174.75	39,423.90	51,115.93
v	950	76	53,619.27	53,543.65	53,543.65	51,180.31	49,523.96	50,359.01	50,137.51	48,465.20	44,295.86	45,684.85	57,516.72
	1000	80	57,936.26	57,853.90	57,853.90	55,879.60	54,612.27	55,780.08	55,856.16	54,423.98	50,416.97	51,945.80	63,917.51
a	1050	84	62,253.24	62,164.16	62,164.16	60,578.90	59,700.58	61,201.15	61,574.81	60,382.77	56,538.09	58,206.75	70,318.30
	1100	88	66,570.22	66,474.41	66,474.41	65,278.19	64,788.89	66,622.22	67,293.46	66,341.55	62,659.20	64,467.70	76,719.09
u	1150	92	70,887.20	70,784.67	70,784.67	69,977.49	69,877.20	72,043.29	73,012.12	72,300.34	68,780.31	70,728.66	83,119.88
	1200	96	75,204.19	75,094.92	75,094.92	74,676.78	74,965.51	77,464.36	78,730.77	78,259.12	74,901.43	76,989.61	89,520.67

Table 5.14 shows Alternative 2's results. With a 20% normal cull rate assumed, similar cash flow values are realized for the first three columns of the table (0, 10, and 20% non-pregnant cow rates) with only slight changes noticed due to the "Heifer Calf Adjustments" and herd distributions. However, quickly after the normal cull rates are surpassed, the producer is unable to create long-term profits if cull cows are valued at less than \$800/head, or \$66/cwt. Table 5.14 ranges from -\$97,782.07 to \$51,645.50. The most profitable levels are obvious as cull prices increase, and non-pregnant cow rates are below 20%.

Most important, however, is the feasibility of Alternative 2 when analyzed from this standpoint. With Winter 2011 cull prices averaging \$62.63/cwt, or about \$783/head, profits can be realized until nearly the 60% non-pregnant cow rate. This allows the alternative to look more attractive, especially since Chapter 4 analysis noted such drastic losses from the 25% non-pregnant cow rate compared to the 50% non-pregnant cow rate. Table 5.14 shows that although the 50% non-pregnant cow rate produces 5-year losses at Winter 2011 prices, the non-pregnant cow rates between 25% and 50% are not always

unprofitable, even if average cull values are realized in conjunction with the higher calf prices noted in this chapter.

Table 5.14 Cull Value versus Non-pregnant Cow Percentage: Total 5-Year Discounted Cash Flow Values for Alternative 2

		Non-pregnant Cow Percentage (Year 1)										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
C u l l C o w v a l u e	\$300 \$24	(26,285.08)	(26,232.42)	(26,179.76)	(34,958.85)	(44,113.76)	(53,268.66)	(62,423.57)	(71,456.93)	(80,449.36)	(89,146.79)	(97,782.07)
	350 28	(21,955.60)	(21,902.94)	(21,850.29)	(30,181.75)	(38,870.00)	(47,558.24)	(56,246.48)	(64,813.17)	(73,338.93)	(81,569.69)	(89,738.31)
	400 32	(17,626.13)	(17,573.47)	(17,520.81)	(25,404.66)	(33,626.23)	(41,847.81)	(50,069.38)	(58,169.41)	(66,228.50)	(73,992.60)	(81,694.54)
	450 36	(13,296.65)	(13,243.99)	(13,191.33)	(20,627.56)	(28,382.47)	(36,137.38)	(43,892.28)	(51,525.64)	(59,118.07)	(66,415.50)	(73,650.78)
	500 40	(8,967.17)	(8,914.51)	(8,861.86)	(15,850.47)	(23,138.71)	(30,426.95)	(37,715.19)	(44,881.88)	(52,007.64)	(58,838.41)	(65,607.02)
	550 44	(4,637.70)	(4,585.04)	(4,532.38)	(11,073.37)	(17,894.95)	(24,716.52)	(31,538.09)	(38,238.12)	(44,897.22)	(51,261.31)	(57,563.26)
	600 48	(308.22)	(255.56)	(202.90)	(6,296.28)	(12,651.18)	(19,006.09)	(25,361.00)	(31,594.36)	(37,786.79)	(43,684.21)	(49,519.49)
	650 52	4,021.26	4,073.92	4,126.57	(1,519.18)	(7,407.42)	(13,295.66)	(19,183.90)	(24,950.59)	(30,676.36)	(36,107.12)	(41,475.73)
	700 56	8,350.73	8,403.39	8,456.05	3,257.92	(2,163.66)	(7,585.23)	(13,006.81)	(18,306.83)	(23,565.93)	(28,530.02)	(33,431.97)
	750 60	12,680.21	12,732.87	12,785.53	8,035.01	3,080.10	(1,874.80)	(6,829.71)	(11,663.07)	(16,455.50)	(20,952.93)	(25,388.21)
	800 64	17,009.69	17,062.35	17,115.00	12,812.11	8,323.87	3,835.63	(652.61)	(5,019.31)	(9,345.07)	(13,375.83)	(17,344.45)
	850 68	21,339.16	21,391.82	21,444.48	17,589.20	13,567.63	9,546.06	5,524.48	1,624.46	(2,234.64)	(5,798.74)	(9,300.68)
900 72	25,668.64	25,721.30	25,773.96	22,366.30	18,811.39	15,256.48	11,701.58	8,268.22	4,875.79	1,778.36	(1,256.92)	
950 76	29,998.12	30,050.78	30,103.43	27,143.39	24,055.15	20,966.91	17,878.67	14,911.98	11,986.22	9,355.46	6,786.84	
1000 80	34,327.59	34,380.25	34,432.91	31,920.49	29,298.92	26,677.34	24,055.77	21,555.74	19,096.65	16,932.55	14,830.60	
1050 84	38,657.07	38,709.73	38,762.39	36,697.59	34,542.68	32,387.77	30,232.86	28,199.51	26,207.07	24,509.65	22,874.37	
1100 88	42,986.55	43,039.21	43,091.86	41,474.68	39,786.44	38,098.20	36,409.96	34,843.27	33,317.50	32,086.74	30,918.13	
1150 92	47,316.02	47,368.68	47,421.34	46,251.78	45,030.20	43,808.63	42,587.06	41,487.03	40,427.93	39,663.84	38,961.89	
1200 96	51,645.50	51,698.16	51,750.82	51,028.87	50,273.97	49,519.06	48,764.15	48,130.79	47,538.36	47,240.93	47,005.65	

Similar to Chapter 4 analysis, the purchased cow alternative (Alternative 3) has more profitable scenario outcomes compared to Alternative 2. Table 5.15 indicates positive returns once cull cow prices rise above \$700/head. This shows that the cull cow versus purchased cow spread is realized to be profitable at this level, while in comparison, Table 5.14 does not reach this point until cull cow prices are at \$750/head.

Table 5.15 Cull Value versus Non-pregnant Cow Percentage: Total 5-Year Discounted Cash Flow Values for Alternative 3

		Non-pregnant Cow Percentage (Year 1)										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
C u l l C o w v a l u e	\$300 \$24	(11,189.01)	(11,136.35)	(11,083.69)	(18,156.95)	(25,533.44)	(32,909.93)	(40,286.42)	(47,662.91)	(55,039.40)	(62,415.89)	(69,792.37)
	350 28	(6,859.53)	(6,806.87)	(6,754.21)	(13,379.85)	(20,289.68)	(27,199.50)	(34,109.32)	(41,019.14)	(47,928.97)	(54,838.79)	(61,748.61)
	400 32	(2,530.06)	(2,477.40)	(2,424.74)	(8,602.76)	(15,045.91)	(21,489.07)	(27,932.23)	(34,375.38)	(40,818.54)	(47,261.69)	(53,704.85)
	450 36	1,799.42	1,852.08	1,904.74	(3,825.66)	(9,802.15)	(15,778.64)	(21,755.13)	(27,731.62)	(33,708.11)	(39,684.60)	(45,661.09)
	500 40	6,128.90	6,181.56	6,234.22	951.43	(4,558.39)	(10,068.21)	(15,578.03)	(21,087.86)	(26,597.68)	(32,107.50)	(37,617.33)
	550 44	10,458.37	10,511.03	10,563.69	5,728.53	685.37	(4,357.78)	(9,400.94)	(14,444.09)	(19,487.25)	(24,530.41)	(29,573.56)
	600 48	14,787.85	14,840.51	14,893.17	10,505.62	5,929.14	1,352.65	(3,223.84)	(7,800.33)	(12,376.82)	(16,953.31)	(21,529.80)
	650 52	19,117.33	19,169.99	19,222.65	15,282.72	11,172.90	7,063.08	2,953.25	(1,156.57)	(5,266.39)	(9,376.22)	(13,486.04)
	700 56	23,446.80	23,499.46	23,552.12	20,059.82	16,416.66	12,773.50	9,130.35	5,487.19	1,844.04	(1,799.12)	(5,442.28)
	750 60	27,776.28	27,828.94	27,881.60	24,836.91	21,660.42	18,483.93	15,307.44	12,130.95	8,954.47	5,777.98	2,601.49
	800 64	32,105.76	32,158.42	32,211.08	29,614.01	26,904.18	24,194.36	21,484.54	18,774.72	16,064.89	13,355.07	10,645.25
	850 68	36,435.23	36,487.89	36,540.55	34,391.10	32,147.95	29,904.79	27,661.64	25,418.48	23,175.32	20,932.17	18,689.01
900 72	40,764.71	40,817.37	40,870.03	39,168.20	37,391.71	35,615.22	33,838.73	32,062.24	30,285.75	28,509.26	26,732.77	
950 76	45,094.19	45,146.85	45,199.51	43,945.29	42,635.47	41,325.65	40,015.83	38,706.00	37,396.18	36,086.36	34,776.54	
1000 80	49,423.66	49,476.32	49,528.98	48,722.39	47,879.23	47,036.08	46,192.92	45,349.77	44,506.61	43,663.45	42,820.30	
1050 84	53,753.14	53,805.80	53,858.46	53,499.49	53,123.00	52,746.51	52,370.02	51,993.53	51,617.04	51,240.55	50,864.06	
1100 88	58,082.62	58,135.28	58,187.94	58,276.58	58,366.76	58,456.94	58,547.11	58,637.29	58,727.47	58,817.65	58,907.82	
1150 92	62,412.09	62,464.75	62,517.41	63,053.68	63,610.52	64,167.37	64,724.21	65,281.05	65,837.90	66,394.74	66,951.59	
1200 96	66,741.57	66,794.23	66,846.89	67,830.77	68,854.28	69,877.79	70,901.31	71,924.82	72,948.33	73,971.84	74,995.35	

As Chapter 4 analysis showed potential to keep a non-pregnant cow, this chapter's analysis furthers that observation. Similar results are inherent at non-pregnant cow rates less than 20% compared to Alternative 3. This is expected, as Alternative 4 follows the same culling rates and culling alternative (purchasing bred cows) as Alternative 3 shown by Table 5.15. Cull cow prices at Winter 2011 prices, or \$782.88/head, are at profitable levels with most non-pregnant cow rates. Furthermore, once cull cow values are greater than \$900/head, all Total 5-Year Discounted Cash Flow values in Table 5.16 are positive.

Table 5.16 Cull Value versus Non-pregnant Cow Percentage: Total 5-Year Discounted Cash Flow Values for Alternative 4

	Shead	\$/cwt	Non-pregnant Cow Percentage (Year 1)										
			0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
	\$ 300	\$ 24	(11,189.01)	(11,136.35)	(11,083.69)	(16,080.96)	(21,293.11)	(26,505.27)	(31,717.43)	(36,929.58)	(42,141.74)	(47,353.90)	(52,485.42)
	350	28	(6,859.53)	(6,806.87)	(6,754.21)	(11,751.48)	(16,963.64)	(22,175.79)	(27,387.95)	(32,600.11)	(37,812.26)	(43,024.42)	(48,155.95)
	400	32	(2,530.06)	(2,477.40)	(2,424.74)	(7,422.00)	(12,634.16)	(17,846.32)	(23,058.47)	(28,270.63)	(33,482.79)	(38,694.94)	(43,826.47)
C	450	36	1,799.42	1,852.08	1,904.74	(3,092.53)	(8,304.68)	(13,516.84)	(18,729.00)	(23,941.15)	(29,153.31)	(34,365.47)	(39,496.99)
U	500	40	6,128.90	6,181.56	6,234.22	1,236.95	(3,975.21)	(9,187.36)	(14,399.52)	(19,611.68)	(24,823.83)	(30,035.99)	(35,167.52)
I	550	44	10,458.37	10,511.03	10,563.69	5,566.43	354.27	(4,857.89)	(10,070.04)	(15,282.20)	(20,494.36)	(25,706.51)	(30,838.04)
	600	48	14,787.85	14,840.51	14,893.17	9,895.90	4,683.75	(528.41)	(5,740.57)	(10,952.72)	(16,164.88)	(21,377.04)	(26,508.56)
	650	52	19,117.33	19,169.99	19,222.65	14,225.38	9,013.22	3,801.07	(1,411.09)	(6,623.25)	(11,835.40)	(17,047.56)	(22,179.09)
C	700	56	23,446.80	23,499.46	23,552.12	18,554.86	13,342.70	8,130.54	2,918.39	(2,293.77)	(7,505.93)	(12,718.08)	(17,849.61)
O	750	60	27,776.28	27,828.94	27,881.60	22,884.33	17,672.18	12,460.02	7,247.86	2,035.71	(3,176.45)	(8,388.61)	(13,520.13)
W	800	64	32,105.76	32,158.42	32,211.08	27,213.81	22,001.65	16,789.50	11,577.34	6,365.18	1,153.03	(4,059.13)	(9,190.66)
V	850	68	36,435.23	36,487.89	36,540.55	31,543.29	26,331.13	21,118.97	15,906.82	10,694.66	5,482.50	270.35	(4,861.18)
A	900	72	40,764.71	40,817.37	40,870.03	35,872.76	30,660.61	25,448.45	20,236.29	15,024.14	9,811.98	4,599.82	(531.70)
I	950	76	45,094.19	45,146.85	45,199.51	40,202.24	34,990.08	29,777.93	24,565.77	19,353.61	14,141.46	8,929.30	3,797.77
U	1000	80	49,423.66	49,476.32	49,528.98	44,531.72	39,319.56	34,107.40	28,895.25	23,683.09	18,470.93	13,258.78	8,127.25
E	1050	84	53,753.14	53,805.80	53,858.46	48,861.19	43,649.04	38,436.88	33,224.72	28,012.57	22,800.41	17,588.25	12,456.73
	1100	88	58,082.62	58,135.28	58,187.94	53,190.67	47,978.51	42,766.36	37,554.20	32,342.04	27,129.89	21,917.73	16,786.20
	1150	92	62,412.09	62,464.75	62,517.41	57,520.15	52,307.99	47,095.83	41,883.68	36,671.52	31,459.36	26,247.21	21,115.68
	1200	96	66,741.57	66,794.23	66,846.89	61,849.62	56,637.47	51,425.31	46,213.15	41,001.00	35,788.84	30,576.68	25,445.16

While the previous tables (Table 5.13-5.16) show each individual alternative's areas of profitability with respect to cull cow values at differing non-pregnant cow rates, Table 5.17 ranks the most profitable outcomes at each cull cow price and non-pregnant rate. As retaining heifers is the most profitable at all levels of cull cow values and the different non-pregnant cow rates, it is ranked first in all categories. The most common rankings place Alternative 1 first (retaining heifers), followed by purchasing cows, keeping non-pregnant cows, and lastly, purchasing bred heifers. As noted previously,

Alternative 3 will always be more profitable than Alternative 2 given the assumptions made and prices used. Interestingly, at certain scenarios, rankings slightly change and these changes are highlighted in Table 5.17.

The first major change in the rankings of the most profitable alternatives happens when keeping a non-pregnant cow is the second most profitable option. This is when non-pregnant cow percentages rise above 30%, and cull cow values are at \$500/head or below. Thus, with the assumed price in this chapter for cull cows at \$788.28/head, cull cow values would need to increase significantly higher for this alternative to become ranked more profitable than the alternative of purchasing cows (Alternative 3). Through most of the scenarios, purchasing a bred heifer is the least desirable. However, as cull values rise along with higher non-pregnant cow rates, purchasing heifers becomes more feasible than keeping the non-pregnant cows. This is due to the narrowing spread between purchased heifers and cull cows. For example, at the \$1200 cull cow value, a purchased heifer can be purchased for only \$185 greater than the cull cow value. Thus, this investment is quickly returned when compared to the loss of production for a year that Alternative 4 would create.

Table 5.17 Ranking of Alternatives (Highest Return First) at Differing Non-pregnant Cow Percentages and Cull Cow Values, Winter 2011 Prices

	Shead	\$/cwt	Non-pregnant Cow Percentage (Year 1)											
			0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	
C u l l C o w V a l u e	\$300	\$24	1,3,4,2	1,3,4,2	1,3,4,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2
	350	28	1,3,4,2	1,3,4,2	1,3,4,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2
	400	32	1,3,4,2	1,3,4,2	1,3,4,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2
	450	36	1,3,4,2	1,3,4,2	1,3,4,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2
	500	40	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2	1,4,3,2
	550	44	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2
	600	48	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2
	650	52	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2
	700	56	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2
	750	60	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2
	800	64	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2
	850	68	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2
900	72	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	
950	76	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,2,4	1,3,2,4	1,3,2,4	
1000	80	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,2,4	1,3,2,4	1,3,2,4	1,3,2,4	
1050	84	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,2,4	1,3,2,4	1,3,2,4	1,3,2,4	1,3,2,4	
1100	88	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,2,4	1,3,2,4	1,3,2,4	1,3,2,4	1,3,2,4	
1150	92	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,2,4	1,3,2,4	1,3,2,4	1,3,2,4	1,3,2,4	
1200	96	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,4,2	1,3,2,4	1,3,2,4	1,3,2,4	1,3,2,4	1,3,2,4	1,3,2,4	

5.6 Conclusions

The Winter of 2011 brought much needed relief to cow-calf producers, many who had been experiencing an otherwise unprofitable operation in previous years. The relationships between Chapter 4 and Chapter 5 analysis conclude that different alternatives are more attractive depending on the returns of the cow-calf sector. For example, Alternative 1 is the highest return alternative in all non-pregnant cow rates with Winter 2011 prices.

The relationship of cull cow prices to the profitability of the cow-calf industry is a point worth noting. With Winter 2011 cull prices, most non-pregnant cow rates can potentially meet profitable 5-year returns for all alternatives. Only at the very high non-pregnant cow rates of 75% and 100% do many alternatives fall below profitable long-term cash flows. Chapter 5 concludes that retaining heifers can potentially lead to high returns if the cow-calf industry is at profitable price levels. Additionally, purchasing heifers (Alternative 2) remains the least profitable because of the high bred heifer price, except at very high cull prices and non-pregnant cow rates. Again, keeping the non-

pregnant cows at Winter 2011 price levels, as shown by Alternative 4 or Table 5.16 at the given cull cow values, is profitable up until the 75% non-pregnant cow rate. Further analysis in Section 5.4 notes that cull cow levels above \$700/head show profit potential at rates below 70% non-pregnant cow rates, and cull cow prices must increase by \$50/head for each 10% increase in non-pregnant cow rates above this rate to stay profitable.

Overall, the findings of Chapter 5 further recognize the relationships between the alternatives. While slight changes occur in terms of ranking of the alternatives for the most profitable outcome, the general theme stays consistent with the purchasing alternatives (2 and 3). That is, purchasing cows suggests higher profit potential compared to that of purchasing heifers. Once again, the non-pregnant cow alternative remains viable, signifying the possibilities of keeping a non-pregnant cow are worth considering.

CHAPTER 6

CONCLUSIONS AND IMPLICATIONS

This chapter summarizes the previous results found in Chapters 4 and 5, as well as the implications surrounding the use of the assumptions noted in Chapter 3. Additionally, the implications of the results will be outlined with respect to a producer's opportunities when faced with a major percentage of their cowherd diagnosed as non-pregnant. Finally, Section 6.2 will conclude with suggestions for future research and the potential of a continuance of this study.

6.1 Conclusions and Implications

Chapter 4 developed assumptions based on five-year averages for feed and operating expenses, as well as the values for each class of cattle (e.g., calves, purchased animals, cull cows). As expected, the normal cash flow values, those of which were at the 20% non-pregnant cow rate or under (less than normal culling rates) were negative. This is consistent with the cow-calf sector price averages in 2006-2010. The alternative with the greatest return potential, or in this case the least amount of losses associated with the alternative, focused on purchasing a bred cow at the assumed price of \$1069/head. As Alternative 3 and 4 are identical in terms of cash flow values at non-pregnant cow rates less than the normal culling rate, they have the same returns until non-pregnant cow rates rise above 20%.

Keeping the non-pregnant cow looked possible in the Chapter 4 analysis, especially at the 25% and 50% non-pregnant cow rate. By forgoing the costs of purchasing a replacement heifer or cow, the producer can minimize the additional capital

investments in the herd that create positive outcomes in the cash flow values compared to that of Alternative 1 and 2. Alternative 1, retaining replacement heifers, was not as feasible as keeping the non-pregnant cow because the loss in calf income at the higher non-pregnant cow rates was not quickly offset by those heifers entering production. This is mainly caused by not only the fact that two years of development are needed for a retained heifer to enter production, but also by the costs associated with building a young herd that may not be as productive as a mature herd (valued by the Heifer Calf Adjustment factor). The purchased heifer alternative was similarly affected by the heifer calf adjustments more so than Alternative 3 and 4, further adding to the losses associated with Alternative 2 compared to Alternative 3 or 4.

A noteworthy result in Chapter 4 was that Alternative 1 surfaced as the most loss-minimizing outcome of all alternatives when whole-herd replacement was needed at the 100% non-pregnant cow rate. As previously discussed, this does not meet the target herd of 100 head by year 5. Thus, although it may have appeared to be the most attractive alternative, it may create a false depiction. As losses are realized in the cow-calf sector, lower cow herd numbers would obviously suggest lower cash-flow losses. However, the fifth year of the cash flow analysis had losses of over \$22,000. This was the highest loss associated with any alternative in the fifth year of the cash flow. So, as all cows were culled in Year 1 and the re-building process was continuing, the cash from the Year 1 cull cows was reinvested slowly into the herd, compared to other alternatives. This suggests that the lower the investment in the herd at high non-pregnant cow rates, the more feasible the alternative becomes at price levels that generate losses. As more heifers were able to be retained, the annual cash flow values decreased significantly because of the

loss of calf income due to the opportunity costs of the heifers, coupled with more animals entering production with an overall annual loss.

Due to the losses associated with using 5-year averages for cow-calf production for a normal Nebraska Sandhills herd, Chapter 5 used Winter 2011 prices. This time period resulted in the baseline scenario being profitable, contrary to Chapter 4 analysis. At normal cull rates, Alternative 1 had the greatest returns while purchasing heifers still was the least feasible alternative. At a price of \$1385/head for a purchased heifer, the investment needed created large cash flow losses the first year. The decreased production for purchasing large percentages of the herd in the first year do not make the option any more feasible until normal herd inventories were realized in the latter years. Moreover, it would be assumed that as purchase prices rise for cows and heifers, there is more of an opportunity for retaining heifers. Thus, lower cash expenses would be realized by the producer, in turn allowing a more attractive cash flow in the early years of replacing a herd.

Similar to Chapter 4, the analysis in Chapter 5 consistently ranked purchasing cows higher than purchasing heifers, and for the same reasons as noted for the Chapter 4 analysis. Most importantly, with respect to this research, are the positive returns realized in Alternative 4 of keeping non-pregnant cows. At Winter 2011 prices, keeping non-pregnant cows did not result in 5-year cash flow losses until 75% of the herd or more is diagnosed non-pregnant. Furthermore, in all non-pregnant cow rates discussed in Chapter 5, keeping a non-pregnant cow has greater returns (or lower losses) than Alternative 2 of purchasing heifers.

While the past data do not necessarily suggest every operation will realize similar returns as shown in Chapter 4 or 5, it does suggest a major implication of the opportunities to keep a non-pregnant cow. What has often been considered a normal practice of culling all non-pregnant cows, keeping a non-pregnant cow may have advantages in terms of cash flow. Furthermore, when cows are valued above market price, more desirable outcomes may appear. This could have implications for those operations that raise breeding stock, are associated with specialty marketing programs, or even those that have strong genetic investments in the herd. This is continuing to encompass a larger percentage of commercial cattle producers.

The previous chapters described one baseline scenario and production scheme, that of the Nebraska Sandhills. By using various assumptions to create common budgets, the case studies in Chapter 4 and 5 were able to discuss the most feasible alternatives when a producer is faced with abnormally high non-pregnant cow rates. In doing so, keeping the non-pregnant cow was found to be a viable option in some instances, especially when compared with 2011 prices that force a large capital investment into the herd as found in the purchasing of bred animals (Alternative 2 and 3). Furthermore, with respect to cash flow outcomes, retaining heifers looks to be a more promising alternative with Winter 2011 prices than that of five year averages where the cow-calf industry experienced losses.

6.2 Areas of Future Research

This study focused on one of the nation's most geographically concentrated regions of cow-calf production. While it served as a representative baseline, other production settings may point towards different alternative of replacement based upon

costs of production. The Winter 2011 results showed profitable levels for the cow-calf producers. While this covers a short period of time, the Winter 2011 prices will not be constant for the next 5 years, which encourages similar studies to report future findings.

As noted throughout Chapter 3, as well as previously in this chapter, all prices were based on market values at the time of determining the averages. There are major implications of this research with respect to seed stock production or those operations that are realizing premiums in the marketplace for various reasons. Furthermore, it would be common to expect an even more favorable outcome for keeping a non-pregnant cow if she tended to be valued above market value as the opportunity to purchase an equally productive replacement may not be feasible.

This research focused on the lack of a dual-season calving herd, which may not necessarily be the case when dealing with all causes of a non-pregnant cow. While this research mentions trichomoniasis as a potential cause of a non-pregnant cow, an advanced study that focuses only on a trichomoniasis-infected herd may be valuable to producers affected by the disease. These results do not account for any of the trichomoniasis effects from a bull standpoint, which are critical in doing a whole-herd analysis and for long-term planning. This study outlined the thought process that may be involved in a trichomoniasis outbreak in terms of choosing an applicable replacement alternative; however, it did not solely rely on the assumption that the cause of the non-pregnant cow is created by trichomoniasis.

Stochastic simulations may also be useful if further research is developed to analyze relationships between all of the market values of the different classes of cattle used in the study. While Chapter 5 highlighted how cull prices may affect outcomes, it

would be imperative to determine correlations between the observed prices in such an analysis. In doing so, a study may be able to create a simulation that shows breakeven price levels for differing levels of non-pregnant cow rates, while suggesting the single-best alternative of replacement. Moreover, this would possibly need inputs based on expenses and income from the individual producers. By using similar methods found in the Chapter 4 and 5 analyses, a user-tool could also be created. By tailoring a cash flow to each producer's operation, a deterministic answer may then be obtained.

REFERENCES

- Azzam, S.M. and A.M. Azzam. "A Markovian Decision Model for Beef Cattle Replacement That Considers Spring and Fall Calving." *Journal of Animal Science*. 69(1991): 2329-2341.
- Cassady, J., L.V. Cundiff, L.D. Van Vleck, and W.D. Hohenboken. "Guidelines For Uniform Beef Improvement Programs." *Beef Improvement Federation*. (2010)
- CattleFax Inc. Personal Communications of Bred Cow and Heifer Price Data, 2000-2010. Centennial, CO. (2010).
- Clark, R.T., R.K. Wilson, D.C. Adams, J.D. Volesky, and R.E. Sandberg. "Breeding and Feeding Management: Practices Used by Cow-Calf Producers in Western and North Central Nebraska." *ARD, IANR, UNL*. (2002).
- Clark, R.T., K.W. Creighton, H.H. Patterson, and T.N. Barrett. "Economic and Tax Implications for Managing Beef Replacement Heifers." *Professional Animal Scientist*. 21(2005):164:173.
- Davidson, J. M. "Bovine Trichomoniasis: Understanding this Tricky Profit Taker!" (2009) Available online: http://aevm.tamu.edu/files/2010/06/Trich-Article-Feb_2009-Davidson.pdf.
- Daly, Russ. "Bovine Trichomoniasis." *Range Beef Cow Symposium*. (2005):123-132.
- Dhuyvetter, K.C., M. Langemeier, and S. Johnson. "Raising Beef Replacement Heifers" *Farm Management Guide*. (2011). MF-2566.
- Feuz, D.M. "The Cost of Raising Replacement Heifers and the Value of a Purchased Versus Raised Replacement." *Management for Today's Cattle Market and Beyond*. (1996).
- Feuz, D.M. "Economics of Young Female Management." *Range Beef Cow Symposium XVII*. (2001).
- Fraiser, W.M. and G.H. Pfeiffer. "Optimal Replacement and Management Policies for Beef Cows" *American Journal of Agricultural Economics*. 76(November 1994): 847-858.
- Gill, R. "Marketing Cull Cows: Understanding What Determines Value." 2008. Available online at <http://animalscience.tamu.edu/images/pdf/beef/beef-marketing-cull-cows.pdf>.

- Hall, M. R., W. G. Kvasnicka, D. Hanks, L. Chavez, and D. Sandblom. "Improved Control of Trichomoniasis with Trichomoniasis foetus Vaccine". *Agri-Practice*. 14:1(1993).
- Ibendahl, G.A. and J.D. Anderson. "Non-pregnant Cow Replacement Decisions: an Application of Asset Replacement Theory". *Western Agricultural Economics Association Annual Meetings- Logan, Utah*. (2001).
- Ibendahl, G.A., J.D. Anderson, and L.H. Anderson. "Deciding When to Replace a Non-pregnant Beef Cow." *Agricultural Finance Review*. 64(2004):61-74.
- Johnson, B.B. "Nebraska Farm Real Estate Market Highlights." Various issues. (2006-2010).
- Lamb, G.C., C. Dahlen, and M. Maddox. "What is the Economic Impact of Infertility in Beef Cattle." *Florida Cooperative Extension Service, Animal Science Department, University of Florida*. (2008). Available Online at <http://if-srvv-edis.ifas.ufl.edu/an208>.
- National Research Council (NRC). "Nutrient Requirements for Beef Cattle (7th Ed.)". *National Academy Press*. Washington, DC. (1996).
- Parker, S., J. Campbell, K. McIntosh, and A. Gajadhar. "Diagnosis of trichomoniasis in 'virgin' bulls by culture and polymerase chain reaction". *Canadian Veterinary Journal*. (2003): 732-734.
- Rae, D.O. "Impact of Trichomoniasis on the Cow-Calf Producers Profitability." *Journal of American Veterinary Medicine Association*. 194 (1949):771-775.
- Small R.M., J.A. Waterbury, J.C. Cool, D.R. Mark, R.J. Rasby, G.E. Erickson, L.M. Kovarik, and T.L. Holman. "Nebraska Cattle Budgets." EC 857 (200). Available online: marksmarketing.net.
- Smith, D.R. Personal Communication. (2010a).
- Smith, D.R. Age Distribution of Three Cowherds in the Nebraska Sandhills. (2010b)
- Striegel, N., R. Ellis, and J. Deering. "Trichomoniasis Prevention: The Cost per Cow to Prevent." *Colorado State University Extension Livestock Management Series*. 1.628(2009).
- Tronstad, R., and R.Gum. "Cow Culling Decisions Adapted for Management with CART." *American Journal of Agricultural Economics*. 76(May 1994):237-249.

- U.S. Department of Agriculture (USDA). Agricultural Marketing Service. "Livestock Market News." Various publications, Various issues. (2006-2011).
- U.S. Department of Agriculture (USDA APHIS) National Animal Health Monitoring System (NAHMS). "Culling Practices In Beef Cow-Calf Operations." *USDA APHIS Info Sheet*. 1997. Available online at http://www.aphis.usda.gov/animal_health/nahms/beefcowcalf/downloads/beef97/Beef97_is_CullingPrac.pdf.
- Whittier, J.C. "Profitable Cow and Heifer Pregnancy Rates" *Range Beef Cow Symposium*. (2009).
- Whittier, W.D. "Too Many Non-pregnant Cows?" *Virginia Cooperative Extension: Livestock Update*. (2004) Available online at http://www.sites.ext.vt.edu/newsletter-archive/livestock/aps-04_12/aps-387.html.
- Wikse, S., and J. McGrann. Unpublished Presentation and Manuscript. Investigation Proceedings, Texas A&M College of Veterinary Medicine. (2001).