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November 4 & 5, 2014
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North Platte

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The State of Beef Conference

November 4 and 5, 2014
Sandhills Convention Center
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NEBRASKA AGRICULTURE FACTS

A cooperative effort of the Nebraska Department of Agriculture; USDA, NASS, Nebraska Field Office; Nebraska Bankers Association; Nebraska AgRelations Council; February 2014

Nebraska's Top National Rankings

1st Commercial red meat production, 2013 – ,353,100,000 lbs. (3,335,310,055 kg.) Commercial cattle slaughter, 2013 – 6,869,800 head
Commercial cattle slaughter, 2013, live weight – 9,389,940,000 lbs. (4,259,205,138 kg.) All cattle on feed, Jan 1, 2014 – 2,450,000 head
Great Northern beans production, 2013 – 1,243,000 cwt. (563,815,315 kg.) Irrigated land harvested, 2007 - 8,558,559 acres
Popcorn production, 2007 – 294,541,958 lbs. (133,601,984 kg.)
2nd All cattle and calves, Jan. 1, 2014 – 6,150,000 head
Pinto beans production, 2013 – 1,174,000 cwt. (53,251,744 kg.)
Beef and veal exports, 2012 – $840,000,000
3rd Corn for grain production, 2013 – 1,623,500,000 bushels (57,210,630 m^3) Corn Exports, 2012 – $1,149,600,000
All dry edible beans production, 2013 – 2,750,000 cwt. (124,737,901 kg.)
Cash receipts from all farm commodities, 2012 – $24,465,882,000
Proso millet production, 2013 – 4,576,000 bushels (161,253 m^3)
4th Cash receipts from all livestock and products, 2012 – $11,771,253,000
Net farm income, 2012 – $5,952,230,000
Land in farms and ranches, 2012 – 45,500,000 acres (18,413,196 ha.)
On-farm grain storage capacity, Dec. 1, 2013 – 1,150,000,000 bushels (40,524,930 m^3)
Off-farm commercial grain storage capacity, Dec. 1, 2013 – 1,150,000,000 bushels (40,524,930 m^3)
5th Agricultural exports, 2012 – $7,285,500,000
Soybean production, 2013 – 252,280,000 bushels (8,890,112 m^3)
Soybean exports, 2012 - $1,829,400,000
Cash receipts from all crops, 2012 – $12,694,629,000
6th Harvested acres of principal crops, 2013 – 18,756,000 acres (7,590,283 ha.)
All hogs and pigs on farms, Dec. 1, 2013 – 3,100,000 head
7th Commercial hog slaughter, 2013 – 7,595,900 head
Commercial hog slaughter, 2013, live weight – 2,076,018,000 lbs. (941,665,848 kg.)
Grain sorghum production, 2013 – 9,380,000 bushels (330,542 m^3)
8th Alfalfa hay production, 2013 – 2,415,000 tons (2,190,851,147 kg.)
10th Table egg layers (flocks of 30,000+), Dec. 2013 – 9,257,000 layers

Nebraska Ag Facts

- Cash receipts from farm marketings contributed over $24 billion to Nebraska's economy in 2012 and 6.2 percent of the U.S. total.
- Nebraska's ten leading commodities (in order of importance) for 2012 cash receipts are cattle and calves, corn, soybeans, hogs, wheat, dairy products, hay, chicken eggs, dry beans, and sugar beets, which represent 98 percent of the State's total cash receipts.
- Every dollar in agricultural exports generates $1.29 in economic activities such as transportation, financing, warehousing, and production. Nebraska's$7.3 billion in agricultural exports in 2012 translate into $9.4 billion in additional economic activity. Nebraska's top five agricultural exports in 2012 were soybeans, corn, beef and veal, feeds and fodder, and grain products.
- Nebraska had 49,969 farms and ranches during 2012; the average operation consisted of 907 acres (367 ha.); average net income per farm averaged $119,002 during the 2008-2012 period.
- In 2013, Nebraska ranked second in ethanol production capacity, with 23 operating plants having production capacity of 1.96 billion gallons (741,940,709 dal). Over 40% of the State's 2012 corn crop was utilized in ethanol production.
- Livestock or poultry operations were found on 50% of Nebraska farms.
- The top five counties ranked by agricultural sales in 2007 were Cuming, Dawson, Custer, Phelps, and Lincoln.
- In 2011, Nebraska was eighth nationally in certified organic cropland acres (129,858) (52,551 ha.) and eighth in certified organic pasture acres (53,174) (21,518 ha.).

Nebraska's Natural Resources

- Nebraska's farms and ranches utilize 45.5 million acres – 93% of the state's total land area.
- Nebraska is fortunate to have aquifers below it. If poured over the surface of the state, the water in those aquifers would have a depth of 37.9 feet. The state has 95,170 registered, active irrigation wells supplying water to over 8.5 million acres of harvested cropland and pasture. Of the total cropland harvested during 2007, 46 percent was irrigated.
- Nearly 24,000 miles of rivers and streams add to Nebraska's bountiful natural resources.
- There are nearly 23 million acres (9,307,806 ha) of rangeland and pastureland in Nebraska – half of which are in the Sandhills.

Source: USDA NASS, Lincoln,, NE
(More detailed list of rankings available from USDA NASS,
Nebraska Field Office (Phone (402) 437-5541)

To receive more information, call the Nebraska Department of Agriculture at (402) 471-2341.

The State of Beef Conference
November 4 and 5, 2014
North Platte, Nebraska

Schedule and Proceedings Contents

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10:40 ECONOMICS OF REBUILDING THE COWHERD

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11:20 DETERMINING UNIT COST OF PRODUCTION

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Noon Lunch

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Panel Members: Rosemary Anderson, Anderson Ranch, Whitman, Nebraska

John Maddux, Maddux Cattle Company, Wauneta, Nebraska

Steve Scholz, Lincoln Co. Feeders, Stapleton, NE

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FUTURE OF THE BEEF INDUSTRY-WHY REBUILD?

Jim Robb
Livestock Marketing Information Center

NOTES

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November 4 and 5, 2014, North Platte, Nebraska

EXPANSION OF BEEF COWS IN NEBRASKA

K.R. Brooks[1], J. Parsons[1], and A. Stalker[2]

Department of Agricultural Economics[1] and West Central Research & Extension Center[2],
University of Nebraska, Lincoln

The United States has continued to see a decline in the cattle herd with the smallest inventory since 1951. As of January 1, 2013 total cattle and calves was reported at 87.7 million head. The beef cow inventory was the lowest since 1962 at 29.0 million head. Improving drought conditions through the end of 2013 and continuing through 2014, coupled with strengthening cattle prices, sends strong market signals for expansion of the beef cow inventory. As calf prices have continued to rise, potential returns for cow/calf producers have also continued to rise.

After a year of expansion in 2011, severe drought caused liquidation of the Nebraska cow herd in 2012 and 2013 (Figure 1). Some of the expansion in Nebraska in 2011 can be attributed to the drought in Texas which caused relocation of cattle to the north. As of January 1, 2014, Nebraska beef cow inventory was 1.797 million head. Heifers held for beef replacement was the highest in over 10 years at 387,000 head. This was a 10.6% increase over the previous year. The last time we saw heifers held for beef replacement this high was in the January 1, 2012 report. The drought in 2012 caused most of those heifers to enter the feedlots instead of the cowherds which coupled with cow culling caused the decline in beef cow inventory. Continued improvements in drought conditions coupled with current market signals, signify growth within the beef cattle inventory in Nebraska over the next several years.

If market conditions are signaling growth within the beef cattle inventory in Nebraska, the question is to what level can we reach and with what methods. The following paper looks at land allocation in Nebraska and the use of corn stalk residue. It also addresses issues that include buying heifers versus raising them and other considerations for expanding the beef cow herd in Nebraska.

According to the Ag Census, total farm land in Nebraska has stayed fairly steady since 1987 at 45.3 million acres with a peak of 45.9 million acres in 2002 down to 45.3 million acres in 2012. Currently, total pasture land makes up roughly 50% of the total acres of farm land or 22.83 million acres. Total pasture land can be divided into three categories: 1) other pasture and grazing land that could have been used for crops without additional improvement (1.41%), 2) woodland pastured (0.93%), and 3) permanent pasture and rangeland other than cropland and woodland pastured (97.66%). All three of these categories have decline since 2007 causing total pastureland in Nebraska to decline 3.8%. Grazing lands have been converted to cropland across Nebraska. This is particularly evident in the decline of other pasture and grazing land that could have been used for crops without additional improvement (category 1) from 891,810 acres in 2007 to 322,093 in 2012, a 36% decline over five years. This continues a trend that has been in place since 1987 (Figure 2).

As available pastureland declines, and livestock producers compete for less land, cost of land and rental rates continue to increase. According to the UNL 2014 Nebraska Farm Real Estate

Survey[1], average grassland values increased in 2014 for both tillable grazing land (up 14% at $1,390 per acre) and nontillable grazing land (up 24% at $865 per acre) from 2013. Current cash rental rates for pasture land also increased for the majority of the agricultural districts. 2014 cow-calf per month basis rates were on average 20 to 25 percent higher compared to 2013.

Growth in the Nebraska beef cowherd to pre-drought levels and beyond may take some thinking outside of the box and use of "nontraditional" feed resources. Some alternatives would be the use of cover crops or the use of corn residue in feeding rations. Both of these could be included in a producer's portfolio of alternative feedstuffs as potential economically available feed sources.

Looking at the use of corn residue within Nebraska, the first question that needs to be addressed is how much corn residue could be sustainably used. Wilhelm et al. (2010) [2] performed an extensive review of sustainability indicators for agricultural residue removal. The result of this review was the identification of six environmental factors that potentially limit agricultural residue removal—soil erosion from wind and water; soil organic carbon; plant nutrient balances; soil, water, and temperature dynamics; soil compaction; and off-site environmental impacts. This then leads to the question of how much residue is available. Muth et al. (2012)[3] accounted for all the factors listed by Wilhelm et al. (2010) and determined that in 2011, 18,609,000 metric tons of residue were available to be sustainably removed in Nebraska. Based on these calculations approximately 40% of the corn residue could be sustainably removed from corn acres. Based on 2013 numbers, there was 9.55 million acres of corn acres harvested in Nebraska leaving an estimated 16.5 million MT of residue available to be removed sustainably.

From a cow/calf perspective this corn residue could be utilized by harvesting the residue and feeding it to the animals or by simply grazing the corn fields after grain harvest. If the residue is removed by grazing, cow performance limits the amount of residue removed because, without supplemental feeds, cows would lose body weight and body condition before removing the sustainable amount available. Based on a survey (Edgerton, 2012 unpublished data), only about 43% of cornstalks that could be sustainably grazed were actually grazed as of 2012. This signals a potential opportunity to cow/calf producers to expand the grazing of cornstalks during winter months and/or the harvesting of cornstalk residues for use during other times of the year.

Cover crops are becoming another potential opportunity for producers to capitalize on as a feed source in Nebraska. The net benefit of cover crops can vary greatly depending upon the cover crop(s) being planted, how they are grazed, and ultimately, how the crop is terminated. Research is still being conducted on the economic benefits of cover crops for the crop producer and the livestock producer. For the livestock producer, the benefit to using cover crops as an alternative feed source is based on what crop is planted, how well it germinates and grows, and its effects on animal performance compared to other more traditional feed sources.

If cow/calf producers have the available land and resources to expand their cow herd, another question to address would be the question of how to increase their herd size. The producer could

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[1] Jansen, J. and R. Wilson. 2014. "Nebraska Farm Real Estate Market Highlightes, 2013-2014. http://agecon.unl.edu/realestate

[2] Wilhelm, W.W., J.R. Hess, D.L. Karlen, J.M.F. Johnson, D.J. Muth, J.M. Baker, et al. 2010. Review: Balancing limiting factors & economic drivers for sustainable Midwestern US agricultural residue feedstock supplies. Ind. Biotechnol. 6:271-287

[3] Muth, D. J., K. M. Bryden and R. G. Nelson. 2012. Sustainable agricultural residue removal for bioenergy: A spatially comprehensive US national assessment. App. Energy. 102:403-417. http://www.sciencedirect.com/science/article/pii/S0306261912005508

use the available resources by expanding their breeding stock, or by looking at other alternatives such as running additional stockers. The answer to this will vary depending on each individual producer.

If the producer decides to expand the breeding stock, they will need to decide whether to raise their own replacement heifers or to buy them into the herd. Based on current market conditions and feed costs, one might consider one option over the other. Again, every producer will have a different answer to this question. Current feed costs will play a vital role in the decision. The relationship between those feed costs for the heifer from weaning until a viable calf is born in relation to the cost of buying a bred heifer is important. Producers can use the tool[4] "The Stochastic Partial Budgeting for Beef Cow Replacement" to help determine the scenario that would be most economical for their individual situation.

If the producer decides to expand the breeding stock by buying replacement heifers, the producer needs to understand what he can afford to pay for the heifer and her breakeven value. The average breakeven value of a heifer will depend on numerous factors. These factors include: the number of calves she will produce, how much feed she will eat and the cost of the feed as well as what prices her calves will sell for. Costs and revenues play a critical role in a heifer's breakeven value. The article "Buyer Beware: What is the Breakeven Value of Beef Replacement Heifers?" provides more details[5].

As we move into 2015, there are strong market signals for beef herd expansion. If producers decide to expand their breeding herd, there are several decisions they need to decide on. Each possible question, needs to be addressed and analyzed and will vary for every producer.

[4] The buying versus raising tool can be found at: https://westcentral.unl.edu/agecon3

[5] http://agecon.unl.edu/documents/2369805/5842081/6-4-14.pdf/c6ed0e2d-512e-4d41-a916-b576abfec951

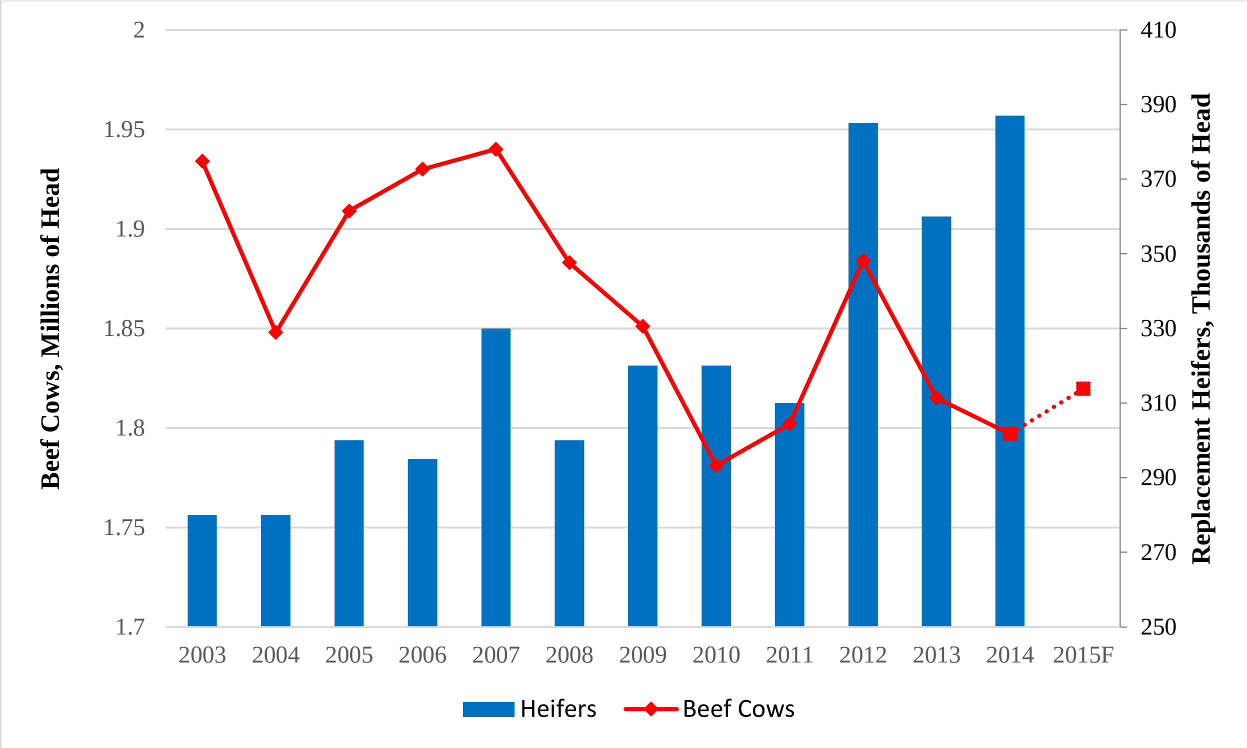

Figure 1. January 1 Beef Cow & Replacement Heifer Inventory for Nebraska, 2003 to 2014.

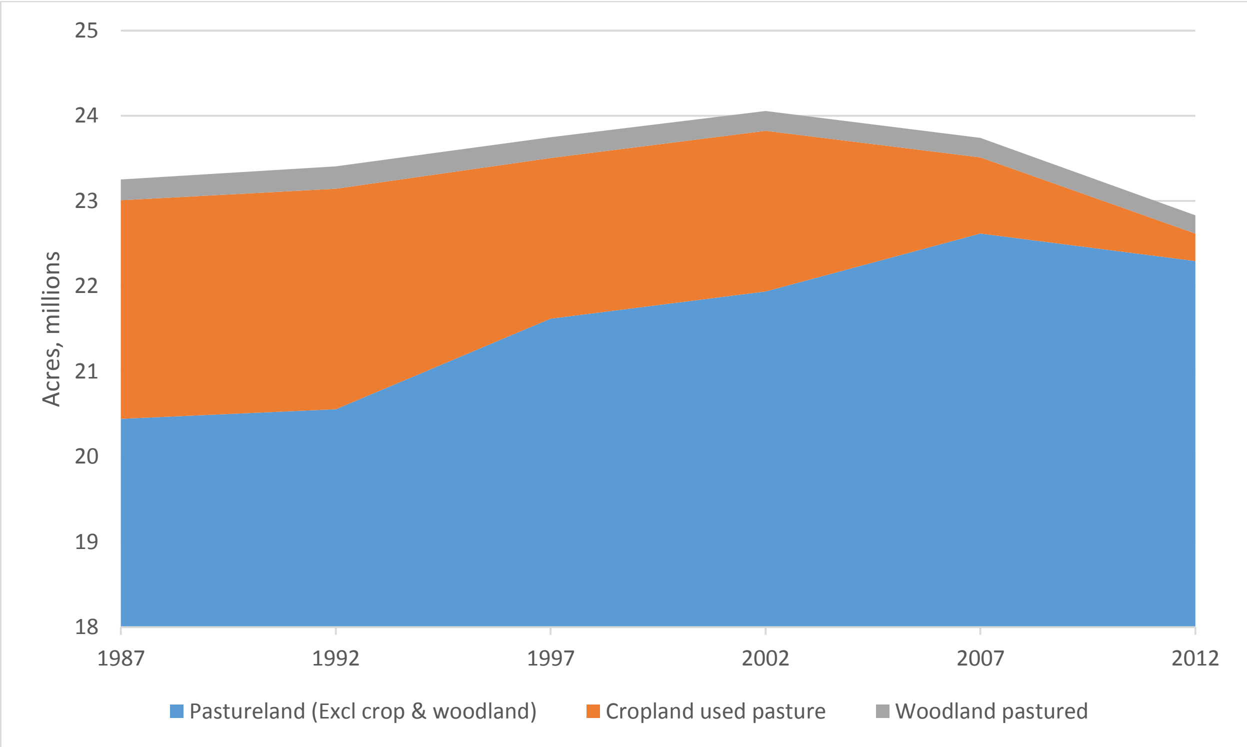

Figure 2. Total Pastureland in Nebraska.

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DETERMINING UNIT COSTS OF PRODUCTION

A.L. Berger
Extension Educator, University of Nebraska-Lincoln Extension

Unit Cost of Production – What is it?

Unit cost of production (UCOP) is a value based on a relationship in production or manufacturing between costs and units of product made or produced.

$$\textbf{Unit Cost of Production} = \frac{\textbf{Costs}}{\textbf{Units Produced}}$$

The relationship between the numerator (Costs) and the denominator (Units Produced) is what drives the UCOP value. For example, if costs increase, while units produced increase at a proportionally slower pace, stay the same or decrease, than UCOP values go up. If units produced increase while costs increase at a proportionally slower rate, stay constant or decrease, than UCOP values go down. The difference between the selling price of products produced and unit cost of production is the gross margin.

The power of the UCOP ratio for cow-calf producers is that everything involved in the production of a pound of calf is represented in the numerator or denominator of the equation. For example, if a producer wants to buy a pickup that will be used in the production of calves, he can estimate how the purchase of that new pickup will affect his UCOP in terms of cost per pound of calf produced. The same thing goes for the purchase of a new bull. Evaluating the purchase of a bull in light of how many estimated pounds of calf that bull will produce in relation to his cost can give insight into what a producer might be willing to spend.

Unit Cost of Production and Enterprise Analysis

The old adage "you can't effectively manage what you don't measure" is true in relation to managing the cow-calf enterprise. The first step in calculating UCOP is to have production and financial records. These records do not have to be complicated, but they need to be accurate and thorough. They also need to allow for the allocation of expenses to different enterprises within the operation, if multiple enterprises exist. Many computerized financial record keeping programs are designed to easily track and allocate expenses to enterprises.

It can be very challenging to evaluate ways to improve unit cost of production for a cow-calf enterprise without conducting an enterprise analysis. If an operation's financials basically consist of a yearend financial statement prepared for tax purposes, knowing where to make changes to improve profit can be difficult. This is especially true if the cow-calf enterprise is part of an operation made up of a number of different enterprises.

For example, let's take a central Nebraska Sandhills ranch that is operated on owned land, has a cow-calf operation, calves are retained and sold as yearlings and the ranch harvests hay. One of the major products this ranch markets every year is yearling steers. However, this ranch also markets non-pregnant heifers, heiferettes, bred heifers, non-pregnant cows, bred cows and salvage bulls. What are the different enterprises on this operation? Which enterprises are profitable and which ones may be just breaking even or losing money? With only the information found on a yearend financial statement used to prepare a tax return, it is really difficult to know.

For the sake of this example, let's break this ranch into major enterprises or businesses.

1. Land
2. Cow-calf
3. Stocker/Yearling
4. Heifer Development
5. Hay

Frequently, the first enterprise, land, is often overlooked when evaluating the operation as a whole. This is especially true if the land is owned. The land business should be a standalone enterprise on the ranch that the other enterprises, on paper, should pay the equivalent of a fair market value lease rate for. The cow-calf, stocker/yearling, heifer development and hay business all need to pay the land business for the use of the land. All of the costs associated with the land business need to be allocated to that enterprise. Even though this "paying" of the land business only occurs on paper with records utilized within the ranch, it allows the ranch manager to accurately analyze the profitability of and returns to the land business. By treating the five major enterprises on the ranch as individual businesses and having each enterprise "pay" a fair market value rate as resources are utilized or moved between enterprises the manager can accurately see where costs as well as revenue are occurring.

One of the challenges producers and others frequently cite when discussing the separating of the ranch into enterprises is the difficulty in knowing how to break out expenses that occur. For example, the tractor that is used to pull the baler to put up hay is also used to feed hay in the cow-calf enterprise as well as the stocker/yearling and heifer development enterprises. How should expenses related to that tractor be allocated? Initially, take a best guess as to the amount of time or hours a piece of equipment is used within a respective enterprise and then break out related expenses accordingly. The goal is to get close and provide a figure that will allow for a reasonably accurate enterprise analysis. In subsequent years, simple records such as writing down the number of hours the tractor has at the start and end of the haying season can be used to refine these numbers.

Allocating Overheads

A risk a manager should be aware of when allocating expenses to enterprises is the fact that elimination of an enterprise won't always remove all the associated costs involved with that business. For example, let's say the manager of our example ranch is tired of harvesting hay and wants to determine what the ranch might look like financially if he grazed his meadows and purchased hay. Discontinuing the hay operation will not eliminate all costs that were associated with that enterprise, since the tractor used in harvesting hay is also used in the feeding of hay. The taxes, insurance, depreciation, repairs and any interest on money owed on the tractor are now going to be paid entirely by other ranch enterprises that use it. Eliminating the haying enterprise, which would reduce the hours the tractor is used, will actually raise the overall tractor expenses related to the cow-calf and stocker/yearling business, since they are now responsible for all tractor related expenses. Evaluating the ripple effects of a decision made within one enterprise across other enterprises is an important consideration when making management decisions.

Major Costs in a Cow-Calf Enterprise

There are two types of cost in a cow-calf enterprise: overhead and direct costs. Overhead costs are costs that don't change very much in relation to the number of cows that are in the herd. For example, if you have 300 cows and buy your neighbor's 100 cows and lease their land, you are probably not going to go hire another person to help you, buy another pickup, horse and livestock trailer to care for those 100 cows. Overhead costs are reduced per cow as numbers grow, until the business reaches some level where a decision needs to be made to add additional labor and equipment. Direct costs are those costs that increase incrementally with each cow that is in production. Supplement, vaccine, salt and mineral, tags etc. are examples of direct costs.

Feed

For most cow-calf enterprises, the largest expense is feed. Grazed and fed feed along with supplements typically make up 40-60% of the costs associated with cow-calf production. Effectively controlling feed costs is a critical component to keeping costs of production in check.

Cow Depreciation and/or Replacement Heifer Development

The second largest major cost for cow-calf operators and one which is often overlooked is cowherd depreciation.

$$\textbf{Depreciation} = \frac{\textbf{Purchase Price - Salvage Value}}{\textbf{Years of Service}}$$

Depreciation expense can be addressed by reducing replacement purchase price, increasing salvage value or by increasing the years of service. The cost of depreciation is often "hidden" in cow-calf operations because many of the costs associated with developing bred replacement heifers are not expenses the producer writes a check for. The market value of a weaned heifer calf plus all of the associated costs with getting her developed, calved, wean a calf and back into the herd as a pregnant coming three-year-old are significant. Cow-calf producers who develop their own replacement heifers should enterprise replacement heifer development as part of their operations. Heifers should be "purchased" from the cowherd at weaning at what is deemed a fair market price. From that time all costs associated with developing that heifer are tracked through the point in time that she is identified as pregnant and ready to enter the cowherd as a bred heifer. At that time the bred heifers are then "purchased" by the cowherd from the heifer development enterprise at a fair market value. Enterprising replacement heifer development can bring clarity to the true costs associated with developing bred heifers from the cowherd. They can also help producers evaluate whether they are better off raising or buying bred replacements.

Equipment, Buildings and Labor

Equipment, buildings and labor expenses can vary greatly between cow-calf operations. These overhead expenses need to be accurately tracked and accounted for. The depreciation, interest, repairs, taxes, and insurance associated with buildings and equipment for the cowherd can be a substantial expense. Managers of consistently profitable cow-calf enterprises work hard to minimize building and equipment expense.

Labor is a cost that many cow-calf producers struggle to figure as they frequently "pay" themselves from returns after all other expenses are met. If you are wondering what you should charge the cowherd for the labor you contribute, figure in the total cost of what it would cost to hire someone else to replace you. The cow-calf enterprise should be charged accurately for both hired and family member/ownership labor.

Bulls or Breeding Expense

Bulls and/or breeding expenses associated with getting heifers/cows pregnant are a significant expense for most operations. Utilizing genetics that fit a producer's production system and marketing program are important. Carefully analyze investment in this area and examine ways to capture greater returns per dollar invested.

Other Cash Costs

Other cash costs are operating expenses related to things such as veterinary supplies and care, utilities, fuel, marketing, professional development etc. Even though this category is often a smaller percentage of total annual cow costs, this area still should be scrutinized to identify ways to efficiently utilize input expenses.

Ownership or Opportunity Costs

These are "costs" such as interest on equity invested in the cowherd. Most cow-calf producers have equity in the cowherd but don't charge themselves interest for that capital investment. If someone asked you for an interest-free loan, you probably wouldn't give them one! Yet many cow-calf producers fail to consider what should be a "fair" return on the equity they have invested in their cowherd. Charge the cows what you believe to be a fair interest rate on their value. If the cow-calf enterprise can pay all expenses plus interest on equity, it is a signal that this enterprise is a profitable one, and expansion opportunities should be evaluated.

Developing a Unit Cost of Production Analysis

If you have never performed a UCOP analysis on your cow-calf enterprise or broken the ranch into different enterprises, it can initially seem overwhelming. However, like most things in life, the more you work at something, the easier it gets. If you are familiar with the use of Excel® spreadsheets, they are available for download at http://hpranchpracticum.com/. These spreadsheets use the information and formats developed by Dr. Harlan Hughes and have been put into forms that can be easily used in Excel®. At the High Plains Ranch Practicum website are sample ranches that have UCOP numbers calculated for them as well as instructional videos that help producers walk through the process. There are additional Extension personnel and programs available that can assist producers in calculating UCOP for enterprises on their ranch.

Using UCOP to Drive Your Cow-Calf Enterprise

The rearview mirror in a pickup is helpful since it lets you see what is behind you, but if your entire focus when you are driving is in the rearview mirror you are likely to end up in the ditch. Obviously when you are driving, the majority of your time needs to be looking ahead through the windshield, focusing on where you want to go. The same is true when knowing and using UCOP numbers. We can do nothing about the past when we look at UCOP values as well as production and cost numbers. These only tell us about what has happened. However, there is tremendous power in using these values along with current information to plan, project and make decisions that will move the operation toward desired goals.

Summary

Unit Costs of Production is the one ratio that takes into account both product produced and input costs. Knowing UCOP allows a manager to look forward utilizing both present and projected input costs with production numbers to make informed decisions. Cow-calf producers who know UCOP numbers for their operation's enterprises and understand the interaction between input costs and production can implement strategies to effectively manage resources to meet business and personal goals.

On the next page, Table 1 shows the costs to produce a weaned calf from a sample central Nebraska ranch. In this example, the cowherd is static with a 16% replacement rate. The number of bred heifers entering the herd is equal to the number of cows that are culled or lost due to death loss. All costs including labor, depreciation, and opportunity cost on cowherd value is included in this example.

Table 1. Central Neb. Est. Costs/Calf Produced. Mar/April Calve & Wean Nov. 20% of Heifers Retained as Replacements. 2-Yr-Old Heifers Calving Feb. 10.			
Mature Cows Feed Costs	Quantity	Price	Cost/Cow
Crop Residue Nov 1 - Feb 28	4 Mths	$20	$80.00
Protein Supplement Jan 1 - Feb 28 alf. hay	200 lbs	$150/T	$15.00
Pasture Mar 1 - May 15 (For Calving/Pairs)	2.5 Mths	$8	$20.00
Alfalfa and Grass/Millet/Sorg. Sudan Hay	1.2 Ton	$120/T	$144.00
Pasture May 15 - Oct 31	5.5 Mths	$50	$275.00
Salt and Mineral for 12 Months	70 lbs	$.30/lb	$21.00
Total			**$555.00**
Two-Yr-Old Heifers Feed Costs 16% of the Herd			
Crop Residue Nov 1 - Feb 1	3 Mths	$20	$60.00
Protein Supplement Dec 15 - Feb 1 (alfalfa)	250 lbs	$150/T	$18.75
Pasture Feb 1 - May 15 (For Calving/Pairs)	3.5 Mths	$8	$28.00
Alfalfa and Grass/Millet/Sorg. Sudan Hay	1.7 ton	$120/T	$204.00
Pasture May 15 - Oct 31	5.5 Mths	$50	$275.00
Salt and Mineral for 12 Months	70 lbs	$.30/lb	$21.00
Total			**$606.75**
Replacement Heifers 20% Replacement			
Crop Residue/Alfalfa Aftermath Nov 1 - Feb	3.5 Mths	$15	$52.50
Protein Supplement Dec 15 - Feb 15	300 lbs	$150/T	$22.50
Growing Ration Dry Lot Feb 15 - May 15	3 Mths	$45	$135.00
Pasture May 15 - Oct 31	5.5 Mths	$35	$192.50
Salt and Mineral for 12 Months	45 lbs	$.30/lb	$13.50
Total			**$416.00**
Estimated Annual Bull Feed Costs			**$600.00**
Feed Costs per Cow Unit Includes Bulls, 2-Yr-Olds & Rep. Heifers			**$670.48**
Total Other Cash Costs Vet. Med. Bldngs. Equip. Mrkting. Int. Etc.			**$120.00**
Labor	5 hours/yr	$15.00/hr	**$75.00**
Total Operating Costs			**$865.48**
Ownership Costs			
Int. on Cattle Value (Ave. Val. Over Life)	$1800	4.0%	$72.00
Purchase of bull every 4 years for 25 cows	$5000/100		$50.00
Taxes and Insurance Buildings and Equip.			$5.00
Equipment and Facilities Depreciation			$30.00
Total Ownership Costs			**$157.00**
Total Costs Excluding Cull Credits			**$1022.48**
Cull Credits			
Cull cow - death loss (0.16-0.015 = 0.145)	1250 lbs	$1.10	$199.38
Cull heifer - death loss (0.04-0.003 = 0.037)	850 lbs	$2.00	$62.90
Cull bull - death loss (0.01 - 0.0005 =.0095)	1800 lbs	$1.30	$22.23
Total Cull Credits			**$284.51**
Capital Cost of Rep. Heifer Calf at	20% Rep. Rate	$1400	**$280.00**
	Net Capital Cost		**($4.51)**
	Net Cost Per Cow		**$1,017.97**
Cost/calf weaned/cow exposed at 80% = $1272.46, 85%=$1197.61, 90%=$1131.07			

Proceedings, The State of Beef Conference
November 4 and 5, 2014, North Platte, Nebraska

REBUILDING THE COWHERD FROM A FEEDER AND PACKER PERSPECTIVE

Tom Brink
Brink Consulting and Trading

NOTES

Proceedings, The State of Beef Conference
November 4 and 5, 2014, North Platte, Nebraska

TERMINAL AND MATERNAL BREEDING PROGRAMS

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Justification

Efficiency seems to be a global buzzword that is thrown about with multiple, and often unclear, meanings. Generally it is used in the context of improved feed utilization or reproductive performance. However the premise of this paper is to argue that efficiency can also be gained by simply using available genetic resources in a more optimal manor. An example of optimal use is the clear delineation of maternal and terminal breeding systems. There exists a pervasive thought that some breeds, or some bulls, can maximize profit in any scenario. Moreover, the most common breeding objective is to sell steer calves and cull heifers at weaning (terminal) and retain replacement heifers (maternal). Dividing a firm (ranch), particularly if cow herd size is small, into two distinct and potentially antagonistic goals can lead to minimal progress in either objective or worse, improvement in one at the sacrifice of the other. Unfortunately these beliefs and practices ultimately lead to sub-optimal breeding decisions and thus decreased beef system efficiency.

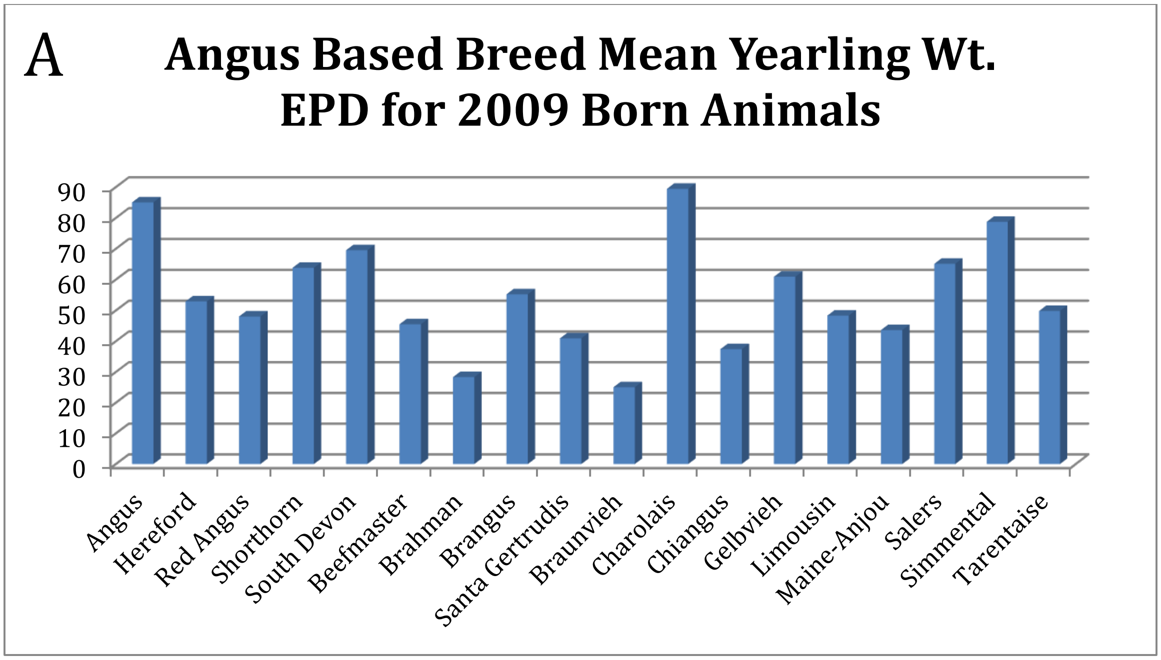
Breeding Programs Review

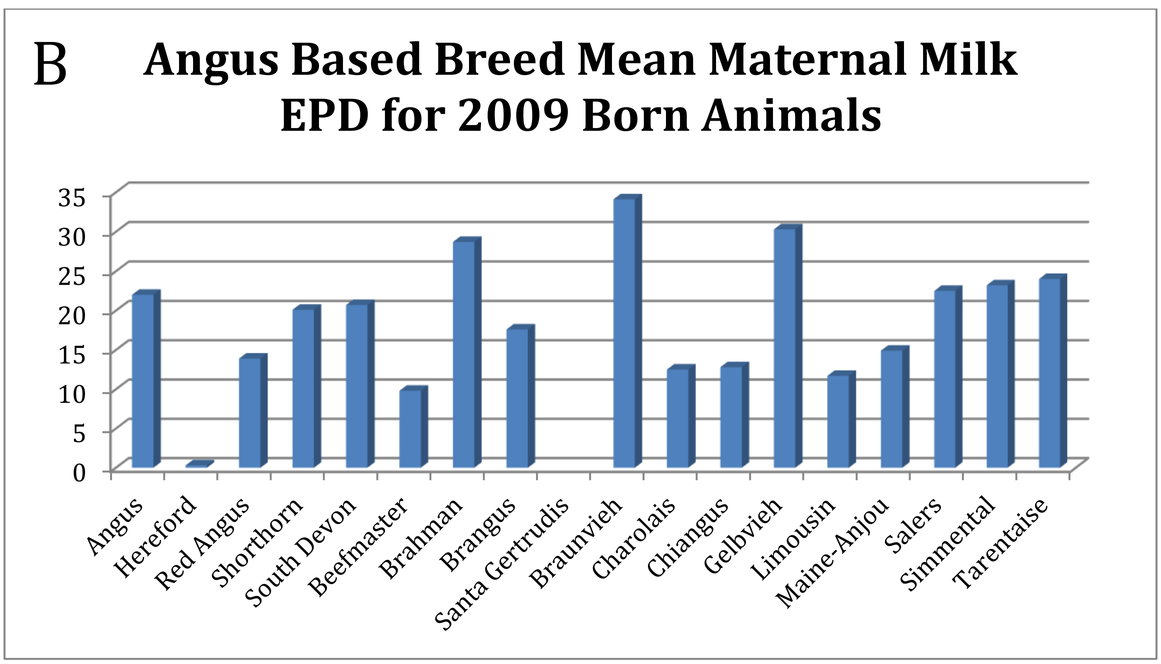
Despite well-documented benefits of heterosis and breed complementarity, the majority of germplasm utilized in the US has migrated towards a single breed. In 2012, the National Association of Animal Breeders (NAAB) reported that Angus semen accounted for over 74% of domestic semen sales. The second most was Simmental with 8.4% of the semen sales market. As a point of reference, domestic dairy semen sales are dominated by Holstein (86.7%) followed by Jersey (10.7%). The 2011-2012 report from the National Pedigreed Livestock Council (NPLC) summarized the annual registrations of 15 beef breeds. From this, 47.8% of registered beef cattle were Angus. From 1995 to 2010, the percentage of fed cattle marketed that were black hided doubled reaching 64%. Furthermore, some surveys have suggested that upwards of 60% of bull turn out is Angus. Although a uniform distribution of semen sales and breed registrations is not expected, nor necessarily desired, some degree of balance relative to commercial bull breed composition is beneficial.

The pervasive thought that one breed can excel in all areas of production in a geographically diverse industry with multiple marketing goals is simply not logical. Every breed has strengths and weaknesses relative to an individual firm's production and marketing goals. That is the benefit of crossbreeding, blending strengths from various breeds to meet production goals while fitting within environmental constraints, and heterosis becomes the reward for having done so. Consequently, knowledge of current breed differences, not historic generalizations, and honest accounting of environmental constraints coupled with identified marketing goals are among the first steps in developing a sustainable and profitable breeding system.

A great deal of research has been conducted over the last 30 years at various federal and state experiment stations to characterize beef breeds in the U.S. These studies have been undertaken to examine the genetic merits of various breeds in a wide range of production environments and management systems. During this time, researchers at the U.S. Meat Animal Research Center (MARC) have conducted the most comprehensive studies of sire breed genetic merit via their long term Germplasm Evaluation (GPE) project. This project evaluated over 30 sire breeds in a common environment and management system. The data summarized by the MARC scientists consisted of records on more than 20,000 animals born between 1978 and 1991, with a re-sampling of the most popular sire breeds in 1999-2000. The various sire breeds evaluated were mated to Angus, Hereford and crossbred cows. Thus, the data reported were for crossbred progeny. During the study, Angus-Hereford crossbred calves were produced in the study as a control for each cycle of the GPE project.

One of the major outcomes of the GPE project was the characterization of sire breeds for a wide variety of economically important traits. Because all of the animals were in a common management system and production environment, the average differences observed in performance were due to genetic differences. Historically, British breeds such as Hereford, Angus, Red Angus and Shorthorn have been evaluated as moderate in growth and mature size, relatively higher in carcass fat composition, reach puberty at relatively younger ages and are moderate in milk production. However, with the dramatic changes growth rate and lactation potentials of several popular British breeds, these views need updated. Contemporary evaluations of lactation potential and growth rate to a yearling endpoint suggest that some British breeds have closed the gap that once existed between British and Continental breeds. Figure 1 panel A and B illustrate the Angus based breed mean Yearling Weight and Maternal Milk EPD for 2009 born animals for a number of breeds resulting from the application of the US MARC 2012 across-breed EPD adjustment factors. Continental European breeds, with a heritage that includes milk production, including Simmental, Maine-Anjou, and Gelbvieh tend to have high growth rates, larger mature sizes, moderate ages at puberty and relatively high levels of milk production. Another group of Continental European breeds, with a heritage of meat and draft purposes, including Charolais, Chianina and Limousin tend to have high growth rate, large mature size, older ages at puberty, very lean carcasses and low milk production. Cundiff et al. (2007) summarized a large body of data collected at US MARC for a variety of traits. The most recent reported sampling of breed germplasm suggests that there are no differences among the major British and Continental breeds for mature weight of cows with the exception of Gelbvieh sired cows, which were significantly lighter. Angus and Simmental sired calves had similar final carcass weights. These results stand in stark contrast to observations made among these breeds 30 years earlier (Cundiff et al., 2007). Although the convergence of breed means might erode complementarity, it does not mean we have witnessed and erosion in heterosis. However, the changes in breed means does impact the decision of which breeds to use for the production of terminal or maternal oriented calves.





[a]Adapted from breed means (Kuehn and Thallman, 2012a) and Across Breed EPD Adjustment factors (Kuehn and Thallman, 2012b).

Simulation research by Tomsen et al. (2001) compared total-system (all purebred plus crossing groups) profitability (income – expenses) for beef production using literature data on 14 breeds of cattle. All systems were simulated for a fixed amount of grazing resource and with slaughter of young animals at a constant level of fat (0.3 inch over the rib). Because there were many crossing systems with 14 breeds, the 10 best for various crossing systems were averaged and compared to the average of the best 3 pure breeds. The average of the best 10 two-breed rotation systems was 32% greater in profitability than the average of the best 3 purebred systems.

The 10 best rota-terminals (two-breed rotation dams) averaged 55% better and the 10 best composites, all composed of four breeds, averaged 51% better for profitability than the average of the best 3 purebred systems. These results illustrate the benefits of correctly utilizing breed strengths, and both individual and maternal heterosis. In terms of utilizing breed strengths, or breed complementarity, there is not greater example than using maternal crosses to produce dams, and terminal crosses to produce sires.

Opportunities in Beef Cattle

A breeding program must first start by defining a breeding objective. A breeding objective represents each animal's genetic value for economic merit. To define a breeding objective requires identifying which traits should be included and their marginal economic values. If done properly, comparison of animals then reflects differences in genetic potential for profit (Tang et al., 2011). An example would be defining an objective that centers on selling all offspring as terminal towards a specified grid (e.g. CAB). This clearly defines the traits of economic importance (growth, lean yield, marbling, and feed intake for example). In the absence of EPD for these traits, indicator traits would be used. The lack of clearly defined breeding objectives represents an initial stumbling block towards improved system efficiency. Another stumbling block is practicing selection based on index values derived with a specified breeding objective in mind that does not match the breeding objective of the user (bull buyer). An example of this would be selecting bulls based on a terminal index (e.g. Angus $B or Simmental TI) but marketing all male calves at weaning and retaining replacement heifers. In this example, the breeding objective of the bull buyer does not align with the selection criterion used to select bulls.

Using specialized sire and dam lines is not a new concept in beef cattle and in fact was fairly prominent in the 1970s. When Continental breeds first made an appearance in the US some four decades ago, these high growth and high yielding cattle were bred to British breed cows that were much more conservative in size and generally tended to have more fat (internally and externally). Challenges that arose included increased calving difficulty and the ability to source replacements in what was essentially a terminal based system. However, breeds have changed since then and data recoding schemes have improved to allow for additional EPD of economic relevance.

The goals of a terminal-based system revolve around the following traits: Early growth rate, calving ease direct (trait of the calf), calf survival, disease susceptibility, feed intake, meat quality, carcass composition, and male fertility. In contrast, the suite of traits of economic importance to a maternal-based system include: female fertility, maternal calving ease, longevity, moderate size, adaptation to production environment, disease susceptibility, milk production (optimal levels), maternal instinct, and temperament (optimal?). The only trait in common between the two is disease susceptibility, and many of the traits between the two are antagonistic. For instance, the genetic correlation between calving ease direct and calving ease maternal is -0.30. The genetic correlation between hot carcass weight and mature cow size is 0.8. If both systems, maternal and terminal, use the same bull battery (duel purpose) there is substantial opportunity cost given the differences in economically relevant traits between the two and the antagonisms that exists between the two. Although all the traits in the two systems above could be merged into one single breeding objective and thus one index, a fewer number of traits under selection allows for faster progress. The pork and poultry industries have this figured out.

So why the disparity in the way the beef industry approaches breeding as opposed to other industries?

Small cowherds produce the majority of calves in the US and this seems unlikely to change. The majority of these herds retain replacement heifers. The problem with this scenario is the lack of efficiency. In smaller herds there are generally not enough replacement heifers each year to make it practical to manage them as a separate group. It also seems a waste of time to wake up during the night to attend a very small group of heifers as they calve for the first time. A more profitable, and maybe more enjoyable, system for small herds would be to purchase bred females (ideally bred for their second calf or even older). In this scenario females would be selected for maternal traits and terminal sires would be used. All offspring would be sold for harvest. This would represent a decrease in labor and an increase in profitability. This system, and the benefits of it, could also be realized by large producers as well. Admittedly the cultural change is a large paradigm shift for the beef industry and unfortunately the cow/calf industry (commercial and seedstock) is not noted for making rapid progress relative to adopting new ideas (e.g. development of selection index theory is 1943 and adoption in beef in the early 2000s).

An opportunity exists for larger commercial and seedstock ranches to produce replacement females for smaller to medium sized commercial herds. The use of sexed semen could prove beneficial. Bull claves in a maternal system, or heifer claves in a terminal system, create a source of inefficiency (although not as large as the use of all-purpose herds). Being able to alter the frequency of the undesired sex would be beneficial. An example of this comes from the dairy industry where replacement heifers are generated using sexed semen. This has actually produced more replacement dairy heifers than needed. Given the excess of dairy females, older, lower producing cows are mated to beef bulls (generally Angus or Limousin) for the production of terminal offspring. This has greatly improved system efficiency. It is interesting that one of the largest impacts to the fed beef sector has come from advances in dairy cattle. Newer technologies are also available, although it is unclear if they will be marketable, in which gene editing is used to create the desired sex.

Obstacles for Implementation

Obviously tradition, as it most often is, represents a tremendous obstacle. If cattle production is the primary source of revenue for a firm, then the opportunities described herein make sense. If, however, cattle production is a byproduct of land ownership and making limited use of land resources not fit for crop production is the objective then this type of cultural shift will be a challenge. However, it could be argued that this simplifies decisions if beef production is not the primary focus for a firm given females will be produced by others and bull selection becomes simpler if only terminal traits are required. The other challenge is akin to the “chicken or the egg” argument. Producers will likely be slow to develop maternal systems until a large market develops for bred females focused on maternal traits. Similarly, all-purpose producers are likely to resist changing to an all-terminal system until a reliable source of bred females becomes available.

Implications

The easiest thing to do is always nothing, and then when profit potential disappears to blame external forces. The benefits of a migration of breeding systems to more defined purposes (maternal and terminal) has multiple benefits to the beef industry and individual producers. It allows for the production of heavy terminal calves from smaller mature cows, thus increasing the efficiency of terminal producers. Calving difficulty should be reduced, as the majority of heifers would reside in maternal herds. It should also increase the uniformity of calves entering feedlots because a more defined breeding objective was in place. Finally it allows for producers, in particular smaller producers, to focus on a narrower set of traits and to excel in doing one thing—producing terminal calves.

Literature Cited

Cundiff, L. V., R. M. Thallman, L. D. Van Vleck, G. L. Bennett and C. A. Morris. 2007. Cattle Breed Evaluation at the U.S. Meat Animal Research Centre and implications for commercial beef farmers. Proceedings of the New Zealand Society of Animal Production 2007, Vol. 67, p 9-17.

Kuehn, L. A. and R. M. Thallman. 2012a. Mean EPDs Reported By Different Breeds. Proc., Beef Improvement Federation 44th Research Symposium and Annual Meeting, Houston, TX. April 18-21, 2012. pp. 147-151.

Kuehn, L. A. and R. M. Thallman. 2012b.Across-Breed EPD Tables for the Year 2012 Adjusted to Breed Differences for Birth Year 2010. Proc., Beef Improvement Federation 44th Research Symposium and Annual Meeting, Houston, TX. April 18-21, 2012. pp. 147-151.

Tang, G., J. Stewart-Smith, G. Plastow, S. Moore, J. Basarab, M. D. MacNeil, and Z. Wang. 2011. Optimizing a beef production system using specialized sire and dam lines. Can. J. Anim. Sci. 91: 353-361.

Tomsen, U. Jon, D. Kirk Darnell, and Merlyn Nielsen. 2001. A comparison of beef cattle crossbreeding systems assuming value-based marketing. Nebraska Beef Report. MP 76-A:3-7.

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LIMIT FEEDING PRODUCTION COWS IN CONFINEMENT

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Introduction

The available forage supply for maintaining beef cow herds continues to be threatened by several factors. High commodity prices encourage the conversion of pasture land into crop ground, cities and towns continue to sprawl out into rural areas creating subdivisions where historically cattle grazed, and drought, fires, hail, and insects continue to periodically deplete forage supplies. When forage supplies cannot be located or are not affordably priced; cattle producers must either sell their cattle or feed the cattle in confinement.

Feeding beef cows in confinement is not a new concept. However, limit feeding them (less than 2% of body weight on a DM basis) an energy dense diet, with the intent of keeping the cows in the production cycle, rather than finishing them out, needs to be thoroughly evaluated. Keeping cows in confinement 12 months out of the year may not be the most economical scenario, but partial confinement when pastures need deferment or forage is not available, may keep at least a core group of cows from being marketed, or provide a means of maintaining a cowherd where pastures is simply limited. Producers will need to know how and what to feed the cows while in confinement to make it feasible. Crop residues, poor quality hays such as those from the conservation reserve program (CRP), and by-products tend to be the most economical ingredients to include in confinement diets.

Nutrient Requirements of the Cow

When producers decide to limit feed cows in confinement there are three concepts that become key to successful feeding. The first concept to understand is the cow’s nutrient requirements. The cow’s nutrient requirements vary with age, size, and stage of production (NRC 1996). Two and three year old cows still have requirements for growth as well as gestation and/or lactation and should be fed separately from mature cows in a limit feeding situation to allow them to consume the feed needed to meet their requirements. More frequent sorting may be necessary when cows are limit fed to prevent very aggressive cows from over-consuming and timid cows from becoming too thin. When lactation starts, the cow’s nutrient needs increase and peak at about 8 weeks of lactation (Figure 1). Producers need to either increase the energy density of the diet or increase the pounds of dry matter fed when lactation starts.

Nutrient Content of the Feedstuffs

Another important consideration is the nutrient content of the commodities used in the limit fed ration. Most producers are familiar with feeding low to medium quality forages to mid-gestation cows. They typically supplement with a protein source to improve forage digestion and the cows are allowed ad libitum access to the forage. The protein allows the cow to adequately digest the forage and if the forage is not restricted, the cow can usually meet her energy requirements. Limit feeding cows while maintaining body condition requires a mindset shift for producers. While the protein needs of the cow do need to be met, the first limiting nutrient, especially for the lactating cow, is energy. Typically, producers are always encouraged to send feed samples to a commercial laboratory for testing. The TDN value listed on commercial laboratory results is not from an analysis but is actually calculated from acid detergent fiber (ADF). In the case of forages, this is fairly similar to the digestibility and is an acceptable measure of forage energy. However, due to the oil content of some by-products, and the interaction of by-products in residue based diets, the University of Nebraska recommends using TDN values for by-products based on animal performance in feeding trials (Table 1). Estimating too much energy for a commodity can result in poorer than expected cattle performance, while underestimating the energy value of a commodity would cause overfeeding, resulting in an increased expense for the confinement period.

Feed Intake of the Nursing Calf

The third important consideration is the feed intake of the calf. Nursing calves can be seen nibbling at forage within the first three weeks of life. By the time they are three months old, research indicates they are eating about 1% of BW in forage (Hollingsworth-Jenkins, et al. 1995). A 300 lb. calf would eat 3 lb. of DM in addition to nursing the cow. If calves are not weaned and in their own pen at this time, additional feed should be added to the bunk for them. Early weaning does not save feed energy but may be a good management practice in the confinement feeding situation. Research conducted at the University of Nebraska indicated that when nursing pairs were fed the same pounds of TDN as their weaned calf and dry cow counterparts, cow and calf performance was similar at the 205 d weaning date (Tables 2,3, and 4). Table 5 depicts the common diets fed to the pairs and their weaned calf and dry cow counterparts. While not resulting in an advantage in feed energy savings, early weaning can be advantageous in other ways. Early weaning would allow the calves to be placed in a separate pen from the cows. Producers would then have the flexibility of feeding the calves a growing or a finishing diet, or even allowing them to graze forages if available. The cows then, without the demands of lactation, could be placed on a lower energy diet.

Management Considerations for Young Calves in Confinement

A common misconception producers often have is that calves nursing cows do not need to drink very much water. In reality, they do need water, and especially so, when the temperatures are warm. A dairy calf study (Quigley, 2001) determined that calves less than 60 d old, consuming 0.8 gal/d of milk replacer, still consumed 0.66 gal/d of free choice water. These researchers also determined the relationship between temperature and free choice water intake was exponential rather than linear. At temperatures above 85° F, nursing calves may drink close to 1 gal/d of free choice water. Free choice water intake also promotes rumen development. Calves that begin eating early tend to thrive and gain weight better than those that don't. Young calves need to be able to reach the water tank and have access to sufficient water. In the UNL confinement feeding trial, calves as young as a couple of days drink water during July calving. Tanks need to be banked high enough that calves can reach the edge and water flow needs to be unrestricted enough that the tank can refill quickly after cows drink. The size of the tank needs to be big enough that on extremely hot days calves can access the water without cows pushing them away. In the research trial it was necessary to put small tubs of water out of reach of the cows but accessible to the calves. Feed access is also an issue as calves begin eating at a fairly young age. In the UNL confinement study, creep feeders were placed at the back of the feedlot pen to allow calves access to alfalfa pellets prior to 90 days of age. Although consumption was low (0.37% BW), it probably served to initiate some rumen function. Calves begin eating at the bunk with cows at an early age and therefore would need to be able to access the feed bunk as well.

Health Considerations for Calves in Confinement

As cattle in an intensively managed system have increased animal to animal contact, there are greater opportunities for pathogen transmission as compared to pasture systems. Neonatal calf diarrhea (scours) is the disease most likely to affect newborn calves during the first few weeks of life. Typically, the average dose-load of pathogen exposure is likely to increase throughout a calving season as calves that are infected initially serve as multipliers and are the foremost source of exposure to young susceptible calves. Consequently, calves born later during the calving season can receive greater dose-loads of pathogens and may also become more infective to other calves. The three primary strategies for preventing outbreaks of calf scours include: 1) removal of pathogens from the herd; 2) improve calf immunity against pathogens; and 3) adapt the production system to minimize opportunities for pathogen exposure and transmission. In the confinement cow study at the University of Nebraska, all pens were cleaned before calving. Then, pairs were grouped by calf age to prevent calves with more than a two week age difference from residing in the same pen.

Pneumonia (bovine respiratory disease or BRD) is also a prevalent source of calf losses early in life. Maternal immunity against infectious agents decreases with time, because by 90 to 120 days of age, a calf will retain less than 2% of the antibodies it initially absorbed from colostrum. The calf's immune system, although functional, is undeveloped in calves that are 90 to 120 days of age. Therefore, they may have increased susceptibility to respiratory disease. Management practices that provide opportunities for infection, such as weaning or commingling, may have a reduced influence on health if done before or after calves are 3 to 4 months of age. Developing sound vaccination protocols against respiratory disease in young (≤ 5 months) calves is important, and future research in this area is essential. Because of the increased opportunity for pathogen transmission, the likelihood of diseases such as scours, respiratory disease, and others occurring is greater for intensive than pasture systems. The importance of newborn calves nursing and receiving adequate colostrum immediately following birth cannot be overemphasized.

In the UNL system, the cow vaccination protocol consisted of two annual vaccinations. Cows were vaccinated with a killed virus product approximately 1 month prior to the start of calving to protect calves against scours. Pathogens vaccinated against included: bovine rotavirus, bovine coronavirus, E. Coli, and clostridium perfringes type C. At the same time, cows received a topical pour-on for the control of external parasites and either a pour-on or injectable solution against internal parasites. After calving and approximately 1 month prior to the start of the breeding season cows were vaccinated with a modified live virus product to protect against persistently infected calves and to prevent abortion. Pathogen strains included in this vaccine were: IBR, BVD types 1 & 2, PI3, BRSV, and multiple leptospirosis strains. At weaning, cows again received a topical pour-on for external parasites.

Calves were vaccinated initially at birth for blackleg, malignant edema, black disease, enterotoxemia, and haemophilus somnus. At birth, navels were sprayed with iodine and bull calves were band castrated. At approximately 90 days of age, calves again received the same vaccination that was given at birth and a modified live virus product to guard against IBR, BVD 1 & 2, PI3, and BRSV. After weaning at approximately 205 days of age, calves remained in the feedlot for growing and finishing, and received additional respiratory and clostridial vaccinations at that time. In both years of the study, at one location or the other, after weaning, some calves were treated for BRD. It is interesting to note that all calves treated responded well and no calves died from respiratory disease after weaning. Various factors contributed to the outbreaks such as weather, stress, and exposure to newly received cattle. These data suggest vaccination protocols for calves in intensively managed systems may need to be more aggressive than those for calves from extensive pasture systems.

Reproduction in Confinement

Cows can be successfully bred in confinement consuming a high energy limit-fed diet (Table 3). The overall conception rate of moderate BCS cows is higher if they are on an increasing plane of nutrition just prior and during the breeding season. This can be done by increasing the DM fed, or increasing the energy density of the diet. Additionally, confinement improves the ease with which synchronization and artificial insemination protocols can be implemented (http://beef.unl.edu/web/cattleproduction/breedingcowsinconfinement). When bulls are confined with cows allow an additional 2 feet of bunk space for every bull and another 15-18 lb of TDN per bull/d depending on the condition of the bulls during breeding.

Defining Confinement Feeding

Feeding in confinement does not necessarily have to be done in a feedlot setting. Although, the advantages of the feedlot often include feed trucks with scales and mixers, concrete bunks, good fences, and access to commodities not always available to ranchers. However, feeding cows in confinement can be achieved by setting up temporary feed bunks or feeding under a hot fence on harvested crop ground, pivot corners, a winter feed ground, or even, as a last resort, a sacrifice pasture. It is important to keep in mind that cattle limit fed a diet on a pasture will continue to consume the forage in the pasture and overgrazing can result if this is the option that has to be implemented. Regardless of location, cows will need a minimum of 2 ft. of bunk or feeding space and calves will need 1.5 ft.

Limit Fed Diet Options for Confined Cows or Pairs

Numerous commodities are acceptable in cow diets and their inclusion will depend on nutrient content, availability, and price. At least in Nebraska, there is large diversity in commodities available, particularly from the eastern to the western ends of the state. As a result, many diets have been formulated for producers. Some diets include ingredients unique to an area, while other ingredients are available in limited quantities in some areas and therefore cannot be included at very high levels. Purchase price and trucking costs also impact commodity inclusion. The following example diets were formulated by UNL extension specialists for research trials or Nebraska producers (Table 6). These diets have been used to maintain body condition on cows and can be adapted for other regions with the help of a nutritionist or extension personnel. Handling characteristics should be considered as well when determining what ingredients to use. Research has indicated a diet containing 80% ground cornstalks and 20% wet distillers grains will result in some sorting. Ground wheat straw or low quality hay may not result in the same degree of sorting. Corn wet distillers grains often results in less sorting than dry distillers. Unfortunately, many producers do not have access to the wet product. Mixing some water with the diet can reduce sorting or including silage or beet pulp can add enough moisture to reduce sorting. Rumensin can be added up to 200 mg/cow to improve efficiency and limestone should be added at 0.3 lb/cow to enhance the Ca:P ratio.

Conclusion

Limit feeding an energy dense diet to cows or pairs in confinement for a segment of the production cycle can be a viable alternative to herd liquidation. Producers choosing to limit feed cows or pairs in confinement must consider the nutrient needs of the cow, changes in nutrient requirements as production phase changes, nutrient content of available feeds, availability and associated costs of available feeds, as well as the increasing feed demands of the growing calf.

Literature Cited

Blasi, D.A., J.S. Drouillard, G.L. Kuhl and R.H. Wessels. 1998. Wheat middlings in roughage based or limit-fed, high concentrate diets for growing calves. Kansas Agric. Exp. Sta. Rep. Progr. Rep. 783:36.

Ham, G., R. Huffman, R. Stock, T. Klopfenstein. 1993. Wet corn gluten feed in beef diets. NE Beef Report MP59-A. p.46.

Hollingsworth-Jenkins, K., T. Klopfenstein, D. Adams, and J. Lamb. 1995. Intake and diet selectivity of cow/calf pairs grazing native Sandhills range. NE Beef Report MP62-A. p.3

Klopfenstein, T. and F. Owens. 1988. Soybean hulls – an energy supplement for ruminants. NE Beef Report MP53. p.34.

Loy, T., T. Klopfenstein, G. Erickson, and C. Macken. 2003. Value of dry distillers grains in high forage diets and effect of supplementation frequency. NE Beef Report. MP 80-A. p. 8.

NRC 1996. Nutrient Requirements of Beef Cattle. National Academy Press.

Nuttelman, B., M. Luebbe, J. Benton, T. Klopfenstein, L Stalker, and G. Erickson. 2009. Energy value of wet distillers grains in high forage diets. NE Beef Report. MP92. p. 28.

Oliveros, B., F. Goedeken, E. Hawkins, and T. Klopfenstein. 1987. Dry or wet corn bran or gluten feed for ruminants. NE Beef Report. MP52. p. 14.

Quigley, J. 2001. Predicting water intake in young calves. CalfNotes #68. http://www.calfnotes.com/pdffiles/CN068.pdf

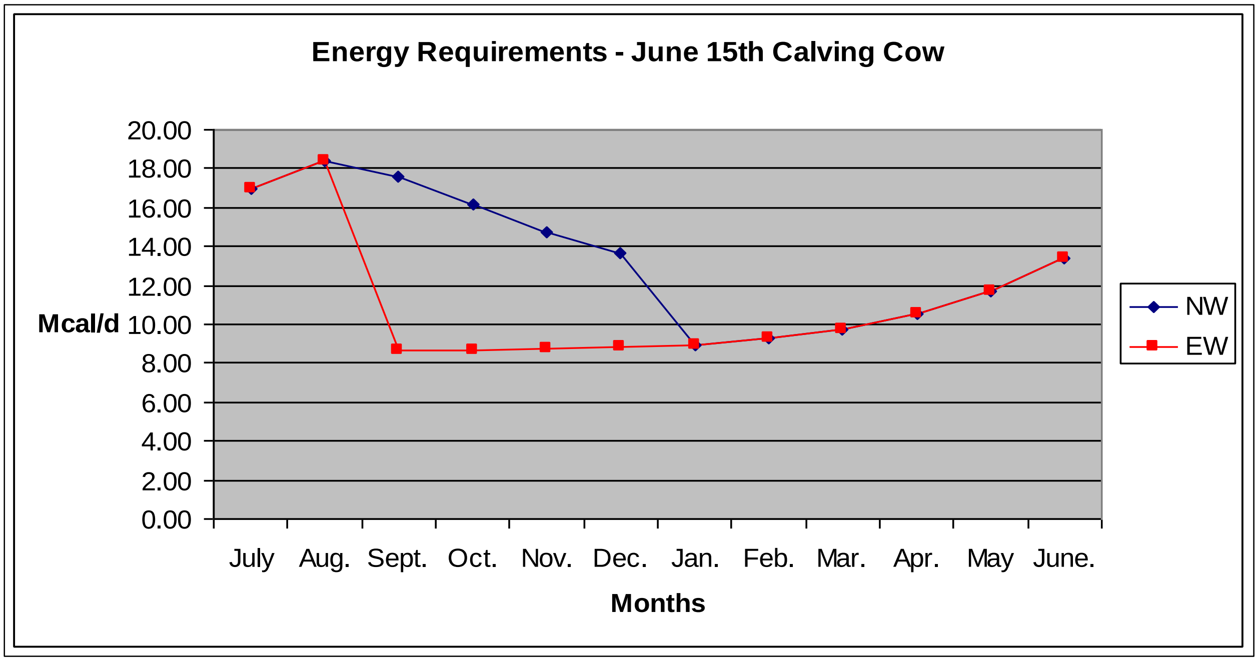

Figure 1. Energy requirement for gestating and lactating cows calving June 15, early weaned calves weaned at 90 days (EW) and normal weaned (NW) at a traditional 205 d weaning

Table 1. Total Digestible Nutrients of common by-products and commodities in forage based diets determined from feeding trials

Ingredient[1]	TDN (% dry matter)
Corn distillers grains, wet, dry, modified	108
Corn condensed solubles	108
Sugar beet pulp	90
Soyhulls	70
Synergy	105
Corn gluten feed	100
Midds	75
Corn	83
Wheat straw/cornstalks	43
Meadow Hay	57

[1] Feeding trials from Blasi et al., 1998; Ham et al., 1993; Klopfenstein and Owens, 1988; Loy et al., 2003; Nuttelman et al., 2009; Oliveros et al., 1987.

Table 2. Daily DMI by weaning treatment and year

	Year 1		Year 2	
Item	EW[1]	NW[2]	EW[1]	NW[2]
Cow	15.0	--	15.5	--
Calf	8.5	--	9.3	--
Cow-calf Pair	--	22.8	--	24.9
Total	23.5	22.8	24.8	24.9

[1]EW = early-weaned at 91 d of age.
[2]NW = normal-weaned at 203 d of age.

Table 3. Performance of cows by location and weaning treatment

	ARDC		PREC			*P*-value		
Item	EW[4]	NW[5]	EW[4]	NW[5]	SEM	Weaning[1]	Location[2]	W x L[3]
Cow BW, lb								
October	1201	1180	1227	1212	114	0.26	0.08	0.85
January	1206	1166	1302	1232	104	0.02	<0.01	0.51
Cow BW change, lb	5	-14	74	20	23	<0.01	<0.01	0.15
Cow BCS[6]								
October	5.5	5.5	5.2	5.2	0.3	1.00	<0.01	0.59
January	5.4	5.3	5.6	5.6	0.4	0.60	0.03	0.60
Cow BCS change[6]	-0.1	-0.2	0.4	0.4	0.2	0.38	<0.01	0.38
Pregnancy, %	89.9	85.4	92.5	95.2	6	0.88	0.25	0.50

[1]Fixed effect of calf age at weaning.
[2]Fixed effect of location.
[3]Calf age at weaning x location interaction.
[4]EW = early-weaned at 91 d of age.
[5]NW = normal-weaned at 203 d of age.
[6]BCS on a 1 (emaciated) to 9 (obese) scale.

Table 4. Performance of calves by location and weaning treatment

	ARDC		PREC			*P*-value		
Item	EW[4]	NW[5]	EW[4]	NW[5]	SEM	Weaning[1]	Location[2]	W x L[3]
Calf BW[6], lb								
October	280	277	288	267	8	0.13	0.92	0.22
January	475[b,c]	510[a]	499[a,b]	461[c]	11	0.90	0.19	<0.01
Calf ADG, lb	1.73[b,c]	2.06[a]	1.86[b]	1.70[c]	0.18	0.09	0.02	<0.01

[1]Fixed effect of calf age at weaning.

[2]Fixed effect of location.

[3]Calf age at weaning x location interaction.

[4]EW = early-weaned at 91 d of age.

[5]NW = normal-weaned at 203 d of age.

[6]Actual weights.

[a-c]Within a row, least squares means without common superscripts differ at $P \leq 0.05$.

Table 5. Ingredient and nutrient composition of diets fed to all cows and calves from October to January by location and year[1]

	Year 1		Year 2	
Ingredient, %	ARDC	PREC	ARDC	PREC
Corn silage	--	--	40.0	40.0
MDGS	56.5	--	36.5	--
WDGS	--	58.0	--	38.0
Cornstalks	40.0	--	20.0	--
Wheat straw	--	40.0	--	20.0
Supplement[2]	3.5	2.0	3.5	2.0
Calculated Composition				
CP, %	19.0	18.8	16.1	15.3
TDN, %	80.0	80.0	78.0	78.4
Ca, %	0.75	0.77	0.58	0.81
P, %	0.50	0.49	0.44	0.41

[1]All values presented on a DM basis.

Table 6. Example Diets of by-products and residues for gestating, lactating, and lactating cows with 60 day old calves

Diet (DM ratio)	Ingredients	Late Gestation Cow	Lactating Cow	Cow with 60 d old calf
		Dry matter intake, lb		
57:43	Distillers grains:straw	15.0	18.0	20.0
30:70	Distillers grains:straw	19.2	23.0	25.6
40:20:40	Distillers grains:straw:silage	15.4	18.5	20.6
20:35:45	Distillers grains:straw:beet pulp	14.6	17.5	19.4

NOTES

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ANNUAL FORAGES TO COMPLEMENT OR REPLACE PASTURE

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Cool- and warm-season annual crops have long been an important forage source for many livestock producers. Their use may be routine for some operations for hay production or to have grazing available at specific times of the year. They are also often used to produce supplemental forage during dry conditions. Currently, relatively low grain prices combined with high cattle prices and a strong demand for pasture has resulted in many producers using cropland for annual forage production.

Cool-season Annuals

Winter Annuals

Rye, winter wheat, and triticale are the three winter cereal grains that are most commonly used for forage. In Nebraska, these primarily provide spring grazing or hay, but may have enough growth for fall or winter grazing depending on the planting date. All three of these grains can either be grazed or hayed, but rye is favored for grazing because of rapid early spring growth. Triticale is well suited for hay or silage with high late spring forage yield. There are winter barley and winter oat varieties available, but field tests have shown that their winter-hardiness is marginal under Nebraska conditions. Additionally, there are some annual ryegrass types and varieties can be planted as winter annuals. Forage yield of annual ryegrasses is typically less than that of the cereal grains, but they regrow rapidly after grazing and are usually higher in quality at similar stages of growth.

Spring-Planted Cool-season Annuals

Oats is the most common spring-planted cereal grain that is used. Although it is most often hayed, grazing can be done when the oats reaches a height of 6 to 8 inches, which typically occurs about the third to fourth week of May. Forage dry matter yield of oats can range from 2.5 to 3.0 tons/acre. Varieties of spring-planted wheat, triticale, barley, and annual ryegrass are available for forage (Table 1). Field peas can be included in seed mixtures of any of the cereal grains resulting in the potential benefit of increased quality and yield.

Table 1. Spring cereal forage harvest date, forage yield, crude protein (CP), and total digestible nutrient (TDN) content, North Platte, NE - 2012.

Entry	Harvest date[1]	Forage yield[2]	CP	TDN
		(tons/acre)	*%*	*%*
'Stallion' oats	21-June	2.56[A]	12.1[B]	58[D]
'Haybet' barley	13-June	2.46[AB]	14.7[A]	67[A]
'Shelby' oats	21-June	2.34[AB]	11.6[B]	57[D]
Spring triticale	21-June	2.16[B]	11.9[B]	62[C]
'Brick' hard red spring wheat	13-June	2.16[B]	14.3[A]	64[B]
LSD $_{0.05}$	- -	0.33	0.6	1.1

[1] All entries harvested at an equal stage of maturity (late-milk to soft dough). [2] Dry matter basis.
[AB] Means followed by unlike letters significantly differ (P < 0.05).

Cool-season Annuals for Fall Forage

All of the spring-planted small grain cereals can be planted with the intention of producing fall forage. Common scenarios for this might be after winter wheat harvest, corn silage, or a second crop after a spring or previous fall planted cereal grain. Planting dates might range from the last half of July until early September. Later planting dates will correspondingly result in less forage yield. Table 2 shows yield and quality results from several August-planted entries grown under irrigated conditions.

Table 2. Fall small grain height at harvest, forage yield, crude protein (CP) and total digestible nutrient (TDN) content, North Platte, NE – 2012[1,2].

Entry	**Height**	**Forage yield[2]**	**CP**	**TDN**
	(inches)	*(tons/acre)*	(%)	(%)
Spring triticale	38	4.48[A]	15.9	61
'Shelby' oats	35	4.07[AB]	14.4	60
'Haybet' barley	30	3.88[B]	14.8	65
'Brick' hard red spring wheat	31	3.17[C]	13.5	59
'Stallion' oats	32	3.08[C]	18.3	62
'Ocala' annual ryegrass	14	1.62[E]	19.1	64
'Fria' annual ryegrass	13	1.47[E]	18.0	60
LSD $_{0.05}$	- -	0.56	- -	- -

[1] All entries planted on August 13 and harvested October 29, 2012.
[2] Dry matter basis.
[ABCDE] Forage yield means followed by unlike letters significantly differ (P < 0.05).

Cover Crops – Forage Cocktails

Cover crop is a term often used to describe the planting of a short-term crop during the off-season of a convention grain crop. These can be used for soil protection, green manure, or for forage. They could be a single species, but often contain a mixture of cool-season cereal grains, warm-season annual grasses, legumes, and brassicas such as turnips or radishes. Planting could be done in the spring, as in the case of using them during the fallow period before fall winter wheat planting in a dryland wheat system. More commonly though, is the use of cover crops following harvest of winter wheat, soybeans, or corn silage. Aerial seeding of some cover crop species into standing corn or soybeans has had mixed results. An example of a cover crop mixture and forage yield results is shown in Table 3.

Forage production from cover crop mixtures or a single species is most successful when irrigation is available. In dryland situations in western and central Nebraska, plantings after winter wheat for example, would ideally have 5 to 7 inches of rainfall for significant growth and production. Soil moisture use by the cover crop might also impact the following year's crop.

Table 3. Total and individual species forage yield of an irrigated cover crop mixture planted into wheat stubble, North Platte, 2009 *.

Variety - Forage	Forage yield	Percent of total yield
	(tons/acre)	*(%)*
Regular Hegari (grain sorghum)	**	**
'Martin' Milo	2.02	69
Oil Seed Radish	0.30	10
'Purple Top' Turnips	0.05	2
'Red Ripper' Cow Peas	0.01	<1
'Indianhead' Lentils	0.01	<1
'Arvika' Forage Peas	0.45	15
Volunteer winter wheat	0.09	3
Total yield	2.92	

* Planting and harvest dates were July 24 and October 8, 2009.

** Regular hegari and milo were combined (not separated when harvested).

Warm-season Annual Grasses

Warm-season annual grasses (summer annuals) are used for summer pasture, green chop, hay, silage, and stockpiled for winter pasture. The summer annual grasses most often used for forage in Nebraska are sudangrass, sorghum-sudangrass hybrids, forage sorghums, foxtail millet, pearl millet, and teff (Table 4). Other species in this group that have been specifically plant for forage are corn and crabgrass. Each of these grasses has unique growth characteristics that require proper management for optimum production. Some of the desirable characteristics of summer annuals are rapid growth (especially in mid-season), excellent drought resistance, and good response to fertilizer and water. They are well adapted to most areas of the state and grow rapidly following planting in late May or June. They provide rapid growth from mid-July through August, and then moderate growth until stopped by fall frost. Planting may also occur up to the latter part of July with moderate yield still being obtained.

Table 4. Range of dry matter yield for warm-season annual forages grown under irrigated conditions.

Forage	**Tons/acre**
Sudangrass	4.1 to 4.8
Sorghum-sudangrass hybrid	4.2 to 5.3
Forage sorghum	4.4 to 5.3
Pearl millet	3.8 to 4.5
Foxtail millet	2.8 to 3.8
Teff	2.6 to 3.8

* Yield ranges include the primary and regrowth harvest for all forages except forage sorghum and foxtail millet.

Complementary Annual Forage Systems

Under irrigation, double cropping cool- and warm-season annuals will maximize potential forage production. There is a wide range of possible combinations that can be planted to best complement other available forage resources (Table 5).

Table 5. Examples of complementary annual forage combinations and periods of available grazing.

Apr	May	Jun	Jul	Aug	Sept	Oct	Nov
Rye		Native range	Sudangrass		Native range		
		Oats	Sorghun-sudangrass hybrid			Oats or cover crop mix	
	Triticale		Native range			Oats or cover crop mix	

Grazing Annual Forages

Proper grazing management of annual forages is critical to effectively utilize these resources. Because of trampling losses and the fact that grazing interrupts plant growth, grazing is not efficient as haying. The grazing of tall and rapidly growing warm-season annual grasses can be particularly challenging. Graze these summer annual grasses in a short, rotational grazing system. Subdivide fields into three or more pastures so that each pasture can be grazed down in 7 to 10 days. Stagger the date of planting each pasture by about 10 to 14 days so that grazing will begin on each pasture when growth is at the appropriate height. This rotation system allows maximum production of nutritious forage. Graze sudangrass and pearl millet when they reach 15 to 20 inches in height and sorghum-sudangrass hybrids when they are 18 to 24 inches tall. Graze down rapidly to 6 to 8 inches of stubble before moving livestock to a fresh pasture, and do not graze regrowth until at least 18 inches of growth accumulates. If growth is more than 36 inches tall, harvest as hay, green chop, or silage since grazing cattle will trample and waste much of the growth. Regrowth will be more rapid following cutting this taller growth than if it is trampled. For spring cool-season annuals such as oats, grazing can begin when plants are 6 to 8 inches tall. In the fall for cereal grains and cover crop mixtures, grazing typically begins in October after those forages have accumulated significant growth.

Whether grazed or harvested for hay, drought stress on many cool- and warm-season annuals increases the risk of nitrate accumulation in the forage. This risk is increased on fields that have had excess nitrogen fertilizer or manure applied. The young plants and leaves of sudangrass, sorghum-sudangrass hybrids, and forage sorghum contain a chemical that breaks down and is released as prussic acid (hydrocyanic acid). Its content in plants can be affected by climate, soil fertility, and plant maturity as well as variety. Its presence should not deter producers from realizing the potential value of these annual forage crops.

NOTES

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PRODUCER PANEL: USING RESOURCES TO CREATE PROFIT CENTERS

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NOTES

Proceedings, The State of Beef Conference
November 4 and 5, 2014 North Platte, Nebraska

PRODUCER PANEL: USING RESOURCES TO CREATE PROFIT CENTERS

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The idea of growing a ranch business with finite resources is not a novel one in my county, but it is often discarded in favor of leveraging the assets Great-Grandad put together against the purchase or lease of more land. The problem is that most young folks starting out don't have access to such assets, or maybe they have to share with a lot of siblings. My husband and I fall into the latter category, and when it became obvious that the "sharing" wasn't going to work, we had to look elsewhere to pursue our vocation. Fortunately we had spent years working hard and building credibility, and we were able to foster a relationship with a benevolent neighbor who was looking to relocate. By the grace of God he was also willing to finance us; and Dad contributed collateral to help us get started. If only everyone deserving could be so lucky; our situation is unique and difficult to replicate.

In any case, by December of 2008 we moved and within 20 months we had doubled our cowherd, initiated a lease on 150 other cows, and established an LLC with the land. We were starting from scratch in terms of machinery and infrastructure, so we made a lot of crappy stuff work for a few years and made improvements as we could afford them. We also switched banks after realizing that our lender didn't share our aggressive growth vision. Our relationship with Ron Rankin at Farm Credit Services now supports our expansion and allows for a lot of room for managed risk and growth.

One of the first things we realized was that with our debt load and insufficient labor force, running a typical cow/calf, cake-hay-and-range, February-calving outfit was not going to work. The ranch was "imbalanced," as the old-timers would say, with insufficient summer grazing to support the 1700 tons of hay it produced. We decided to exploit this resource by taking in heifers on a contract basis to winter, synchronize, and AI. We also purchase heifer calves with known genetics, which we resell as bred heifers at year's end. The heifers run out on pasture and meadow, usually in contemporary groups based on breeding date. We feed hay, and two to five pounds of DDG mixed with a custom mineral, increasing the plane of nutrition as the breeding date approaches. Range cubes are way too expensive relative to distillers to use. Drylotting and finishing-diet type of rations are not part of our program. I am reluctant to use the words *heifer development*, because as my wise friend Jeremy Martin says, *shouldn't it be heifer survival?* They are usually synchronized with MGA/PGF, but we have also used CIDRs. As an ABS rep and AI technician, I do all the armwork and orchestrate the matings; I still breed off heat for at least three sorts because I think the sorting experience helps to instill good manners in the cattle. It doesn't hurt the people to practice some mutual respect either. My goal is to produce a thrifty, fertile, professional future cow that I believe in enough to buy back heifer calves out of in the future. The heifer AI enterprise effectively adds three profit centers to our ranch, because in addition to the income from contracts and bred heifer sales, I also AI 1,500 to 2,000 head off the ranch and sell a little ABS semen.

We were still short on summer grazing a few years ago, so we activated the pivot that came with the ranch and planted millet to graze in August. The first year it did so well that after rotating the heifers through two quarters, we had to have a cousin come swath and bale the rest on shares. Since then we have tweaked our stocking densities relative to water application; we have also installed two used Zimmatics on other dormant wells; rotated rye, triticale, and/or cover crops with millet; tried interseeding with and without spraying RoundUp first, seeding with and without discing first, and chemigation. Believe me when I say that I never anticipated this level of farming to be part of my life, and it certainly adds a few jobs. We also encounter a lot of skepticism when people hear that we *graze our pivots??! Instead of haying them??!* But installation of the irrigation is what got us through the drought, and I'm sure glad I didn't have to pay $55/month/heifer for grass this year. We plan for an additional 100 days of grazing for 300 head heifers with the pivots. When a partial budget shows it to be more profitable to grow and sell hay, or raise alfalfa for a protein source, we will modify our plan.

At first, we thought that running August-calving cows would be a good fit for our ranch, what with the heifer AI enterprise keeping us busy in the spring, and all that extra hay. We were calving 180 to 200 "fall" cows when the chance to lease the 150 April-calvers came along. These were cows that belonged to our financer, the previous owner of the ranch. He had also retained almost 3,000 acres that he offered to lease to us with the cows, on terms that no one in their right mind would refuse. They were Angus cows originating from his carefully managed, maternally superior herd, and we are hoping to renew the sixth year of the cow/land lease this month. The problem, of course, is that having two calving seasons has been too much work for us and complicates our grazing and marketing plans. So this year, in light of the tremendous cattle market and the serendipitous circumstances of some dear college friends, we sold our fall cows to Brian and Hilary Maricle and plan to grow our spring herd up to a respectable size. Heifers produced from the spring cows are mostly made into bred heifers, and steers are backgrounded for 30-150 days before sale, depending on the market and input costs. Cows are TAI'd, graze summer and dormant range, and ideally receive fewer than 70 days of hay around calving, along with DDG/mineral supplementation.

This year we participated in an informal trial where we synchronized and AI'd 143 August-born heifers in June, using MGA/PGF on half and CIDRs on the other half. They weighed about 600 pounds at AI and were extremely immature mentally. Eighty-two percent came into heat; heifers that didn't respond to synch were not exposed to any AI or cleanup bulls. Out of the 117 that were serviced, 50% became pregnant. Fifty-three percent of pregnant heifers came out of the MGA group, and 47% were out of the CIDR group. Out of the pregnant heifers, 78% were called AI bred. Overall they did better than I expected. I appreciate the guidance and help from Dr. Rick Funston and his grad student Hazy Nielson on this endeavor. However, I don't think I have talked Hazy into helping calve them out.

I'm sure it would be easier to do things like everyone else. I don't think it would make as much money, and I know we wouldn't learn as much. I'm grateful to be ranching for a living, and I'm especially thankful for all the help we've had.

PRODUCER PANEL: USING RESOURCES TO CREATE PROFIT CENTERS

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NOTES

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PRODUCER PANEL: USING RESOURCES TO CREATE PROFIT CENTERS

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NOTES

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BEEF PRODUCTION WITHOUT MATURE COWS

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Summary

Mature beef cows must be fed year-round to produce one weaned calf; on average, there is either no net change or a slight decline in the mature cow's value for beef over her lifetime. If the mature-cow herd is eliminated by means of having each first-calf heifer replace herself with a heifer, every animal in the enterprise is growing at all times. With this All Heifer, No Cow (AHNC) model, yearling heifers are bred with sexed semen, weaned early after calving, and slaughtered before 30 months of age to produce a high quality carcass. This greatly reduces the amount of feed needed per pound of beef produced while also decreasing water use and production of greenhouse gases as well as manure.

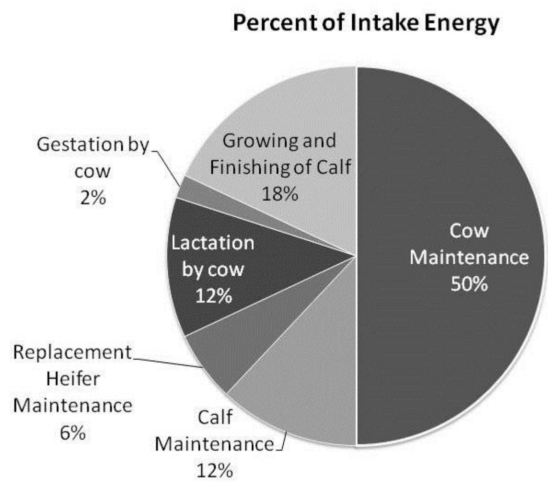
Introduction

Beef cattle production in North America is generally considered to be organized into two segments: the cow/calf enterprise and the feedlot/fattening enterprise, although there often is a stocker phase between these two. Maintaining the cow/calf part of this system includes replacing cows culled due to age, injury, non-pregnancy, poor performance, and having bulls as needed. It is estimated that about 70% of the nutrients consumed for routine beef production are attributed to the cow/calf enterprise and about 30% to the stocker/feedlot part of the system

A cow/calf enterprise produces calves and cull cows and bulls. Typically about 20% of cows are culled annually, and there is considerable cost in raising heifers to replace them. With this system, nutrients go to growth of calves and replacements, pregnancy, lactation, and maintenance (that portion of nutrients needed to keep animals alive independent of growth, lactation, and pregnancy). Calves typically are weaned at about seven months of age and then go to feedlots for fattening or become stockers for several months before going to feedlots, or being bred as replacements. From this overview, it is obvious that the majority of animal-months in the typical cow/calf enterprise are based on older cows, and their total nutritional needs greatly exceed the needs of the calves and replacements for cows that are culled. Integrated over the entire cow/calf enterprise, about 30% of nutrients consumed can be attributed to pregnancy, lactation, and growth, while the other 70% are for maintenance, primarily of the cows. In accounting for all nutrients in beef production life cycle, nearly 50% go for maintenance of the cowherd, for which expenditure no beef is produced since the cows do not grow after they reach three years of age.

Figure 1 illustrates graphically the proportions of intake energy used for various functions in a typical beef production system in the United States. Note the large proportion of energy that is required for the maintenance functions of the mature cow herd.

Figure 1. Conceptual illustration of units of intake energy devoted to various physiological functions in a traditional beef production system in the United States.



Note that the percentages in the above figure will vary somewhat depending on breed, management system, and other factors.

Project

We have begun to study quantifying limits to commercial adoption of an AHNC system. We estimate that the AHNC system eliminates the need for the approximately 50% of nutrients consumed in the total beef enterprise that simply go to maintaining the bodies of older cows for their lifetimes, but recognizes that more nutrients are required for growth because 100% of animals are growing. We will assess the fringe benefits to our proposed system, as well as the additional system costs.

Our idea is simple: breed heifers with sexed semen to produce females so that each heifer replaces herself with a heifer. If the system worked perfectly, it would be entirely self-sustaining – it is not! In addition, all animals in the system are growing at all times and there is no herd of mature cows; all animals are less than 30 months of age. The proposed system is not entirely self-sustaining due to factors that include: deaths of some calves, less than 100% accuracy of sex-selected sperm, and failure of some heifers to become pregnant. However, the AHNC systems could be up to 75-80% self-sustaining, thus requiring only a small percentage of heifers from outside of the system to be added each year.

The overall objective is to determine, in fact, how well this system performs and to what extent economic benefits match the theoretical benefits of producing beef with fewer nutrients, greenhouses gasses, and waste products. The proposed system requires use of sexed semen, early weaning, and fattening heifers to be slaughtered at 28-30 months of age. While each of these components has been researched fairly thoroughly, there has been limited investigation of these together in a system.

The fringe benefits of an AHNC system are substantive; perhaps the main one is that there are no nursing, growing first-calf heifers to breed. Pregnancy rates for first-calf heifers are notoriously low, resulting in culling many of these prime females unless inordinate amounts of high-density feed are supplied. There also are no old cows, which are prone to problems with their feet and legs, mastitis, diseased eyes, and other age-related ailments. Also, all the beef produced is from young, growing animals, whereas with conventional systems about 20% of the beef is from old, culled cows that are severely discounted in market value. Because a minimal number of male calves are produced in this system, there is also an animal welfare benefit due to decreased numbers of calves needing castration. A marked genetic benefit is that generation interval is greatly reduced on the female side, which results in about twice the opportunities to make genetic progress per unit time.

There are additional costs with the AHNC system. All calvings are from heifers, which on average have higher rates of dystocia than cows. However, selection of easy-calving service sires greatly reduces the seriousness of this risk. Also, most calves will be heifers, which average about five pounds lighter at birth than bulls, and therefore have reduced incidence of dystocia. Perhaps the greatest additional cost is lower fertility with sexed than conventional semen. However, sperm sexing procedures are improving rapidly, so this fertility gap should narrow substantively within the next year. As alluded to earlier, due to imperfect sex selection (currently just over 90% accuracy), some inevitable deaths, and a few non-pregnant heifers, some heifers from outside must be added to the system each year. That number may be slightly higher than requirements in conventional beef-production systems for replacing culled cows, but the cost per replacement likely will be lower because replacements are younger, smaller, and productive sooner.

Heifers grow slightly less efficiently than steers, although use of anabolic implants can compensate for this. There also is the possibility of discounts for carcasses of 28- to 30-month-old heifers that may have slightly hardened bones as a result of pregnancy. However, such meat has been thoroughly studied and has excellent eating qualities; thus recovering merited price and grade would be a matter of education.

The extra costs of the proposed system appear to be more than offset by the fringe benefits, but the overriding value is not having to feed and manage a cow herd. Management for the proposed system needs to be at a high level, and to some extent, labor substitutes for feed, possibly resulting in more jobs per unit of beef produced.

Current Opportunity

There are about 29 million beef cows in the United States, the lowest number since the early 1950s (USDA, 2013). That number is very likely to increase as drought conditions improve and grain prices decline from historic highs. There also are hundreds of millions of beef cows in other countries, so the proposed research can have international impact. The combination of increasing world population from the current 7 billion to a projected 9 billion people, plus the increasing standard of living in most developing countries, is predicted to result in an increased demand for meat over the next few decades. With the system to be studied, up to a 30% increase in beef production may be possible without increasing the net amount of feed required, and with concurrent decreased greenhouse gas generation.

We began this project by purchasing 54 commercial Angus-based heifers that were inseminated with female-sexed polled Hereford semen after appropriate synchronization of ovulation with a 14-day CIDR followed by prostaglandin 16 days later and GnRH + AI 66 hours later as recommended by the Beef Reproduction Taskforce. The heifers were checked for pregnancy and have been with a polled Hereford cleanup bull. These bred heifers and their resulting crossbred calves will be available for this research project, although they could be sold as bred heifers, pairs after calving, or calves and cows after weaning. This illustrates one of the major advantages of the proposed system, the ability to enter and exit the program at many life-stage points as feed and cattle prices dictate. However, for this research we plan to study the entire life cycle into the next generation including how the resulting calves perform through calving and slaughter. In order to generate annual income, the system requires a second set of animals. We plan to purchase an additional 60 commercial heifers to breed the next year.

For this project, we combine a number of proven management practices including crossbreeding, creep feeding, early weaning, fence-line weaning, sexed semen, easy-calving service sires, ovulation synchronization that is progestin-based to hasten puberty (probably only as issue for a few percent of heifers), and having cattle on pasture as much as possible. The first calves produced will be Hereford crosses. The next generation likely will involve crossing with a third breed of males.

Even without considering ownership of land, the cow/calf segment of the beef cattle industry is capital intensive, particularly if retaining ownership of calves until slaughter. The proposed system is similarly capital intensive, with the bulk of income from 28- to 30-month-old fattened heifers. With conventional cow/calf operation, income usually is from seven-month-old calves, much sooner than 30-month-old heifers. Starting an AHNC system requires a large capital outlay and one can enter the system in various ways that have different capital requirements, feed and labor resources, etc. Alternate entry points merit evaluation.

For this project, our starting point is purchased 650- to 750-lb Angus-based commercial heifers in spring. These are readily available each year, primarily as stocker heifers that typically go to pasture or feedlots. Most eventually end up as the approximately three million beef heifers that are fattened for slaughter annually in the United States. Spring timing for entry fits our available ranch grass and other resources. Another option is starting the second group four to eight months after the first group for fall calving to garner an earlier income stream and use complementary grazing resources to spring calving cattle.

The initial capital requirements are lowest with the youngest heifers and highest with pairs. However, the time-to-income is considerable with the younger animals, and relatively short if starting with pairs (which might be only those pairs with heifer calves); all of this needs to be balanced with input costs along the way.

Evaluation of resulting carcasses

Heifers will be transitioned to full feed during the two weeks prior to weaning, and then placed on a standard finishing ration formulated to gain about 4 lbs per day. They will be fed 0.5 mg/head/day of melengesterol acetate daily and given an anabolic implant when placed on a finishing diet. The exact ration will depend on ingredient costs and availability, but will be thoroughly documented. Heifers should achieve finish weight after 75 days on feed, but may be fed up to two weeks longer to produce a finished carcass.

The proposed system will not be economically viable unless the carcasses of the 28- to 30-month-old heifers can be marketed for similar value as other fattened cattle. Animal carcasses older than 30 months of age are severely discounted by packers. Because it is difficult to verify age exactly, packers and graders frequently use degree of bone ossification as a surrogate criterion, which is not entirely reliable. Unfortunately, pregnancy hormones hasten bone ossification in first-calf heifers, so carcasses appear older than they are. The data available indicate that eating qualities such as juiciness, tenderness, and flavor are acceptable for carcasses from 2 1/2–year-old parous heifers.

Satisfying the Public Interest

The program envisioned is especially appropriate to increase beef production over the next decade because the recent drought has decimated beef cow herds, and much of the beef from the proposed system would come from calves produced by heifers that otherwise would have been fattened and slaughtered without having a calf. This would be especially beneficial for the current “overcapacity” of feedlots and slaughterhouses; it would create jobs. Use of sexed semen to produce females helps this system even more.

NOTES

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THE USE OF TECHNOLGY TO IMPROVE COWHERD AND FEEDLOT EFFICIENCY

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Overview

The beef industry has made dramatic increases in production efficiencies during the past century. As one considers the adaption of technology, one has to carefully analyze the inputs required to obtain these increases in production. This paper will provide an overview of many of the advancements responsible for improvements in efficiencies we have observed.

Introduction

A classic paper, "Fifty Years of Pharmaceutical Technology and Its Impact on the Beef We Provide to Consumers," was authored by Drs. Preston and Elam in 2004, and outlined the impact of many of the technologies that have led to a direct increase in the technology we use today. Beef cattle production has increased by 50% over the past 30 years alone. This increase can be attributed to advancements in genetics, nutrition, health, and growth enhancement technologies, as well as improved management and information gathering. While many notable improvements come with a cost, several have a much greater return on investment (ROI) than others. One should consider these high ROI technologies as the margin of improvement over cost to be worth the investment.

What questions do we need to ask ourselves as we read papers and think about the presentations from the conference? This paper will outline some of these questions and stimulate a greater interest in adapting the use of technology, no matter how simple it may be, in creating a more profit oriented operation that focuses on improving the efficiency of profitable production.

Genetics

If one were to ask cow calf producers what one improvement has made the most notable advancements in their operations, many would list improved genetics at the top of their list. It is easy to see/quantify the dramatic changes that have taken place since the 1950s and 1960s in the growth potential of the cattle we produce. Likewise, one can look at an increase in slaughter weights and realize the growth potential of today's beef herd is quite large. The Nutrient Requirements for Beef Cattle (NRC) was last updated in 2000. Many feedlots today have pens of cattle where the performance is greater than the maximum values used in calculating the nutrient requirement of a feedlot steer in the 2000 NRC.

The genetic trend for cattle to grow faster and have heavier carcass weights is cause for us to evaluate how we handle this genetic potential. A weaned calf today is very different from 10 years ago. Managing the nutrients needed to maintain growth without hindering marbling development is an important issue that warrants further research.

To recognize the full potential of the genetic improvements the beef sector has made, calving periods need to be tightened. A few feed yards have devoted time in developing and implementing sorting protocols and supporting technology to produce uniform groups of cattle. While sorting technology has shown to be beneficial to identifying outcome groups, this benefit should be initiated prior to weaning by incorporating a tighter calving window. Load lots of similar genetics, age and ranch management could then be purchased or sent to feedlots with little to no need of sorting as they are already similar and will react to management in a similar fashion. Feedlots are redesigning pen space to accommodate load lots which allows for better tracking of data within a contemporary group rather than individuals being dispersed across a feedlot and co-mingled with cattle coming from a multitude of environments or management practices. Genetics and environment are two important factors in making uniform cattle. Control and documentation of these at the ranch with the proper technology is needed.

The incorporation of genetic markers by the purebred industry is resulting in large amounts of data that is not only improving the technology, but resulting in improvements in breeding selections made by breeders. Marker panels are being developed for the commercial sector and progressive feed yards are carefully experimenting and analyzing this technology. Ultimately, sorting will occur based on the genetic capabilities of the animal, which will be an improvement over the phenotypic traits we utilize now that are largely affected by the environment.

Artificial Insemination

Beef producers in a survey conducted by Beef Magazine in 2013, recognized AI as the second most important innovation developed. However, producers' recognition of AI is not related to the utilization/adaptation of the technology. The percentage of operations that utilize AI, reported by the National Animal Health Monitoring System (NAHMS, 2009), was only 7.2%. Over 60% of those that choose not to AI stated labor, time and the overall difficulty of initiating the process were reasons not to AI. As technologies have evolved, a superior support system has developed for many of these new technologies. Artificial insemination companies have done an excellent job training and placing technicians who can cost effectively inseminate cattle with the use of new synchronization protocols.

Cost effect methods can be utilized to effectively synchronize a cowherd and then utilize the vast amount of genetics available to meet herd goals. It is evident the competiveness for securing top commercial bulls is increasing as sale averages set records this past spring. The option to utilize the most suited genetics for an operation matched to an individual cow may be more cost effective than ever through AI. We all are well aware of the level of usage of AI in the swine and dairy industries and how effective it has been in improving their product.

Nutrition

Nutrition is a deal breaker. An improvement of 0.1 lb in feed/gain (F/G) is worth $10 per head at the feedlot, but it is at the end of a feeding period we know if we have made strides in improving feed efficiency as we have no "real time" method of quantifying this valuable component. In an effort to keep costs down, more by-products are being fed which contribute to the complexity of the diet requiring greater technical support. Not always can we focus on a lower F/G, as the cost of many by-products may improve our cost of gain even though our F/G is not improving. In the last couple of years, new methods in feed fabrication have allowed companies to pelletize and cube distillers grains effectively. The University of Nebraska took a leading role in researching the use of calcium oxide in the treatment of cornstalks and has quantified the use of the feedstuff.

The purebred industry has had the ability to focus on many traits, and over the years and recently, it has put a large selection emphasis on improved feed efficiency captured with the GrowSafe system. This technology, when used in conjunction with growth and body composition data, will prove to be a beneficial tool as improved genetics are identified.

As the genetic potential of cattle improves, greater emphasis on matching cattle to proper nutrition will be needed to accurately program cattle to a specific endpoint. While there is a renewed interest in putting more calories in front of calves earlier in life, those that are grown appropriately will maximize growth and have greater hot carcass weights with more pounds to merchandise.

Pharmaceuticals

We are constantly hoping for the “silver bullet” to serve as a cure-all to use. However, we must realize the pharmaceutical industry has empowered us with a great set of tools we can use to improve health and enhance growth while simultaneously improving animal welfare.

Vaccines.

The use of vaccines has gained wide use as an important component to prevent the onset of disease. Just 20 years ago, data from Superior Livestock Auction reported a majority of calves they sold were not vaccinated (Lalman and Mourer, 2012). In 2012, only 1.2% of the calves marketed through Superior were not vaccinated. One can attribute this increase in vaccinated calves to a greater premium, $5.26/cwt in 2012, but it has also been well documented in the Texas Ranch to Rail project (McNeill and McCollum, 2000) sick calves have reduced gains and reduced quality grades. The next generation of vaccines will focus not only on animal health but also on animal welfare. New technologies are being developed to elicit specific immune responses, increasing the success of the vaccine (Meeusen et al., 2007).

Implants.

Considered to be the earliest and most revolutionary “technologies” the industry has developed, it still is considered the most impactful yet today (Preston and Elam, 2004). It has been documented to be an effective tool in increasing production from the ranch to the feedlot (Pritchard, 1999). Estimated returns can range from 30 to 67 dollars per head. (Preston and Elam, 2004). Economists at Iowa State University, Lawrence and Ibarburu (2007), in an extensive analysis, reported the value of implants to cow/calf operations at $34/hd and in the feedlot at $71/hd. The large return on investment, including product and labor, can be captured with little infrastructure.

In a summary of the literature, Lawrence and Ibarburu (2007) reported studies that utilized calfhood implants increased weaning weight from 0.3% to 10.7%. The variation from year to year can be directly tied to the environment. Mathis (2009) reported variation in implanted calf weights over those not implanted over a five year period from 3 lbs to 32 lbs, which equated to value per head difference of $5.84 to $16.53/animal. Studies at South Dakota State University reported little weight gain in calves receiving an implant at branding time during a drought, but in a normal year calves on mature cows were on average 40 lbs heavier at weaning. A premium of $3 to $5/cwt is needed to make up for a 20 lb advantage in weaning weight.

Why do producers choose not use this proven technology? Only 11.9% of all cow calf operations used an implant prior to weaning (NAHMS, 2009), down from 14% reported in NAHMS 1997). Michael King, a research assistant for Kansas State University, analyzed data from 11,350 lots which represented 11.1 million cattle sold through Superior Livestock Video Auctions in 2011 and 2012 where 31% of the calves received an implant. The researcher reported no difference in price of implanted versus non implanted calves (Ishmael, 2014).

Beta-adrenergic agonists.

The newest growth promoting technology to be used in the beef industry is Beta agonists. In 2003 Elanco received labeling for the use of Ractopamine, marketed as Optaflexx, in beef cattle, followed in 2006 with Merck receiving approval to market Zilpaterol under the brand name Zilmax. Both of these compounds are classified as repartitioning agents as they increase muscle hypertrophy and decrease protein degradation, but they do not act upon the same muscle receptors. Zilmax acts upon the beta-2 receptors which elicits a greater response than Optaflexx which acts upon the beta-1 receptor. The benefit to using beta-agonists is well documented with increases in hot carcass weight of up to 30 lbs with improved feed efficiency.

On August 7, 2013 Tyson Fresh Meats announced it would no longer accept cattle fed Zilmax and other packers have followed. Merck has since voluntarily suspended the sales of Zilmax so more research could be conducted on its effect on mobility. Optaflexx is still widely used during the last 28-42 days of the finishing period.

Information Technology

We have seen vast improvements in the farming sector in their ability to effectively incorporate information technology to cropping systems in a cost efficient manner. The beef industry has not yet been as successful in the use of this new and fast moving computer IT. It is important as one evaluates information captured through improved technological advancements the data be put in a usable format. The beef industry has seen extraordinary amounts of data, and we sometimes find ourselves managing this data at the micro level when in reality the macro side will allow us to find trends, identify optimums and be able to focus on eliminating those extreme populations that are not profitable. Quality data is important. One must know what they are looking at and decisions can only be made after comparing to multiple sets or years of data. New skills will be needed to analyze this data which will open the door to a new generation of data gurus.

Looking Forward

Low Stress Handling.

A renewed interest in "low stress" handling has improved feedlot health and is playing a bigger role in ranches. Progressive ranches demand employees adhere to strict rules on handling and provide training opportunities. The "Bud Box" has revolutionized processing facilities and is commonly seen at ranches across the United States. The late Bud Williams' skills have been picked up by many industry leaders who have taken newborn calf care and weaning to a greater level. Tom Noffsinger's approaches to handling calves have greatly reduced morbidity at the yard and improved efficiency. Going forward, the aspect of "low stress" handling will play a greater role than ever before.

Grazing Management Systems.

A greater appreciation and interest in grazing management has started to take place with the help of University Extension Specialists, the Nebraska Grazing Lands Coalition and grazing experts such as Jim Gerrish who operates American Grazing Lands Services LLC. Rotational grazing with periods of rest are being adapted by many across the state with many ranchers in the Sandhills seeing vast improvement in stocking rates and drought resistance when a rest rotation program is implemented. New and innovative fencing technologies that make it easier to move cattle daily are being incorporated by progressive ranches. High density stocking rates referred to as "Mob Grazing" are being used with success across a wide range of environments. New research is needed on when and how to incorporate the powerful tool of grazing meadows into a system that will allow more animal units to be run on a ranch.

Utilizing the Unwanted.

The beef industry has capitalized on adding value to underutilized feedstuffs. The beef cow has added value to over 50% of the land mass of the US which cannot be farmed. The advent of the ethanol industry resulted in distillers grains, which was initially considered a by-product feed, but because of research and utilization by the beef industry, it is now referred to as a co-product where the unit price often supersedes the price of corn.

As corn acreage increases, the opportunities to incorporate residues into a component of the commercial beef cattle sector are imperative for both the grain farmer and the cattle producer. In 2013, UNL Extension faculty hosted a conference on the "Sustainable Use of Crop Residues on Cow/Calf and Yearling Operations."

Key points presented regarding corn stalk residue grazing:

Dr. Klopfenstein
- Crop residues are a great opportunity for Nebraska agriculture
- 6 million acres of irrigated corn produce over 30 million tons of residue
- Estimated all Nebraska beef could utilize up to 4.68 million tons
- Conservative estimate of maximum use would be 15.5% of acres

Dr. Wortmann
- 40 bu. yield produces 1 ton of residue per acre
- Keep 2 ton of residue on field per acre
- Yield improves with 60% of residue removal on irrigated no-till acres

If 50% of the residual from irrigated corn ground was removed to leave two tons per acre, the industry would still have the capacity to triple its use of this commodity. The true value comes in the reduction of cost in running a cow per year. While setting grass aside for winter grazing or haying meadows to feed hay is still done by many and will continue to be a resource, one needs to calculate the use of this underutilized commodity. With the increase in trucking costs, transportation will play a large role in this calculation. To aid producers in making this decision, the "Cornstalk Grazing Calculator" was developed (Stockton and Wilson).

Calving Season.

While labor will become a greater issue as we move forward, and as ranchers make every effort to run more cows with less labor, one needs to look at when calving is taking place. Burke Teichert, renowned ranch management expert, recommends calving season should match up with Mother Nature because fewer feed and labor resources are needed. The National Animal Health Monitoring System surveyed beef cattle operations in 2007-2008 and reported 78.1% of all operations calve before May 1 with 49.3% calving before April 1. Of all calves born alive, 3.6% died before weaning with 2.7% dying in the first 24 hours. The January 2014 beef cow inventory was 29,042,400. If 91.5% of the cow herd calves (NAHMS, 2009) and 2.7% of the calves born alive die in the first 24 hours, this would equate to approximately 717,500 calves. How many of these calves could be saved by calving in a better time of year?

Enterprise Diversity.

How can one diversify when all you have is grass and cows? A short look around will find many ranchers that have embarked on expanding their ranch take on enterprises that involve different segments of the industry. Expanding on the current need for females in the industry by growing and developing bred heifers, rebreeding open cows, running yearlings and putting in embryos are just a few of the opportunities that exist to expand the enterprise. Others are focusing on utilizing unwanted forages through drylotting and/or extensive grazing. Some are even challenging the current mindset and going back to our forefathers by incorporating sheep into a grazing rotation. These ranchers are adding one ewe to every cow without changing the number of cows on their ranches. This increases the output of the ranch by 20%. The amount of red meat produced per acre can increase as much as 30% while improving the plant diversity.

Why pull bulls?

While cull cow prices have "cleaned" the country of problem cows, it has also put a strain on beef cow numbers. What is the value of a cull cow in the fall vs a late bred cow come mid-winter or spring? Bred cow prices have increased by over 50% since 2012. Fall calving cows were selling for $2,750 to $3,100 at Ogallala in August. Selling an open cow now would be when she has the lowest possible value. Seasonally cull cow prices rise by 10 to 15% from the seasonal low (Oct/Nov) to February/March. It will be hard to predict this increase given the historic high prices for cows, but with lower slaughter numbers and continued demand for ground beef, we may see cull cow prices over $140. Breeding open cows gives the owner the option to sell them as culls or breds if market conditions continue to improve.

Summary

Burke Teichert spent 18 years as the general manager of the Rex Ranch. He stated, “It was the Nebraska years that solidified my understanding of management and knowing how to ranch profitably. My coworkers at the Rex Ranch and a group of very good ranchers in the Sandhills became mentors and a sounding board for providing new and good ideas.”

It is these ideas generated here in the heart of cattle country that will make us all more profitable. While some think these ideas are crazy or too far out of the box, others will embrace these ideas and find options that will make their operations more profitable. Profitability is a goal for all of us but increasing cow numbers and bringing young people into the industry should be something we take very seriously given our continued shrinking of the industry.

While technology has proven to be a useful tool within the industry, it will be our innovation in developing production schemes that focus on profit that will keep the industry moving forward.

Literature Cited

Ishmael, W. 2014. Implanting Calves Pre-Weaning Equals Easy Pounds and Easy Money. Beef Magazine. March 2, 2014. http://beefmagazine.com/cow-calf/implanting-calves-pre-weaning-equals-easy-pounds-easy-money

Lalman, D. and G. Mourer. 2012. Effects of Preconditioining on Health, Performance, and Prices of Weaned Calves. ANSI-3529. http://osufacts.okstate.edu

Lawrence, J.D. and M.A. Ibarburu. 2007. Economic Analysis of Pharmaceutical Technologies in Modern Beef Production. Proceedings of the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. Chicago, IL.

Mathis, C. 2009. Implant of Calfhood Growth Promoting Implants on Weaning Weight and Value. Corona Range and Livestock Research Center Newsletter. Volume 4, Issue 1. http://coronasc.nmsu.edu/documents/corona-newsletter-jun-09-opt.pdf

McNeill, J.W. and F.T. McCollum III. 2000. Texas A&M University Ranch to Rail Annual Summary. http://animalscience.tamu.edu/wp-content/uploads/sites/14/2012/04/beef-r2r-992000.pdf

Meeusen, E.T., J. Walker, A. Peters, P. Pastoret, and G. Jungersen. 2007. Current Status of Veterinary Vaccines. 2007. Clin. Microbiol. Rev. 2007; 20(3):489-510. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1932753/

National Animal Health Monitoring System. 1997. Beef 1995-1996. Part II: Reference of Beef Cow-calf Management Practices in the United States.

National Animal Health Monitoring System. 2009. Beef 2007-2008 Part II: Reference of Beef Cow-calf Management Practices in the United Sates, 2007-2008. http://aphis.usda.gov/

Preston, R.L. and T.E. Elam. 2004. Fifty Years of Pharmaceutical Technology and Its Impact on the Beef We Provide to Consumers. An independent review of technical literature. http://www.merck-animal-health-usa.com/binaries/50_Years_of_Technology_and_impact_on_beef_production_tcm96-113484.pdf

Pritchard, R.H. 1999. Implant Strategies for High Quality Grade Beef Production. CAB Partners. http://www.cabpartners.com/articles/news/239/pritchard_implanting.doc.pdf

Stockton, M.C. and R. Wilson. Corn Stalk Grazing Calculator. https://beef.unl.edu/learning/cornstalkgrazingcalc.shtml

NOTES

HEALTH AND BIOSECURITY CONSIDERATIONS FOR EXPANDING COW HERDS

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Introduction

Any time animals are co-mingled there is an increased risk of introducing disease into the herd or group of animals. While this risk cannot be totally eliminated, there are steps that can be taken to reduce the amount of risk and minimize the threat. Biosecurity is the term used to describe a program for the prevention and control of infectious disease. The plan should include practices that reduce the likelihood of introducing a new disease from external sources, and reduce the spread of infectious disease if introduced.

Biosecurity plans can be all encompassing and overwhelming. A good place to start is discussing concerns and needs with your local veterinarian. Development of a plan should commence with a risk assessment in which the problems or agents of concern are identified, their likely effect quantified, and the likelihood of their introduction estimated. Based on this exercise, a prioritized list can be made for the disease agents of most interest. Subsequently, a targeted risk management plan can be developed for those agents of highest priority. As an example, cow calf operations considering expansion of the herd should focus on those diseases that cause reproductive losses or reduced reproductive performance.

Certain biosecurity practices are common and should be incorporated into any plan while others are specific and only incorporated in specific situations. The following are general recommendations that should be considered in developing a plan when contemplating expansion of the herd.

Assess Your Herd First

Before you bring animals into your herd from another source, you should work with your veterinarian to assess the status of your own herd. Is your vaccination protocol adequate and current? There may be additional vaccines you should consider adding for broader protection. Remember that most vaccines require boosters and timing is critical to provide the best protection.

Assess diseases that have been diagnosed in your herd. This will help to know which, if any, vaccines should be administered to animals before entering your herd.

Isolate New Arrivals

New animals should be isolated from the existing herd for at least 30 days. During this time, close observation should be made to detect any type of health problem early. This isolation period also provides adequate time to perform diagnostic testing if warranted and to administer health products such as vaccines, dewormers and external parasite control to the animals before joining the herd. The isolation facility should have no fence line contact with the existing herd. These animals should be observed, fed and handled last.

Appropriate Diagnostic Testing

There are very reliable tests for detection of some diseases while other tests lack the sensitivity and/or specificity to detect disease in individual animals. Diagnostic testing can be time consuming, costly and misleading without an appreciation of what is trying to be accomplished. Understanding the nature of the disease and its transmission can dictate what kind of test, how many tests and which animals to test in order to increase the accuracy and confidence of the results.

A good example of this is testing for persistently infected (PI) BVD animals. Current tests for PI animals are reliable but if appropriate testing in not performed, the risk is still present. Suppose you buy a group of pregnant females and test them for PI BVD. The test results are all negative. You can be pretty confident none of the females are persistently infected. However, you still do not know the status of the fetus the pregnant female is carrying. In this case, these animals would need to be kept separate from the rest of the herd until they have calved and the calves tested.

Source of Purchased Animals

The source of purchased animals dictates to a large degree the amount of risk you are taking. Purchased animals for multiple sources with an unknown history is a high risk proposition whereas purchasing animals from a known single source can mitigate a lot of the risk. Prior to a purchase, consider having your veterinarian contact the seller and his veterinarian to ask about herd health. Every seller of healthy animals should give their veterinarian permission to discuss the herd's health status with potential buyers and their veterinarians. In fact, the seller should welcome this communication.

Conclusion

When considering expansion of the cow herd a biosecurity plan is critically important for protecting your investment. While some general guidelines are presented above; clearly, the biosecurity plan must be individualized for each operation. Taking the time to work with your veterinarian on a plan ahead of time is an important first step.

Literature Cited

Dargatz D. A., Garry F. B., Traub-Dargatz J. L., "An Introduction To Biosecurity Of Cattle Operations", The Veterinary Clinics Food Animal Practice (18), 2002.

Hilton M.W., "8 Biosecurity Tips for the Cowherd", *Beef*, Sep, 2008.

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IMPORTANCE OF EARLY CONCEPTION AND FACTORS INFLUENCING IT

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Introduction

Direct reproductive traits as they are currently measured tend to be low in heritability, making the beef female's environment key to reproductive success. Management and nutrition are factors that can be easily affected and yield significant results. Decisions in crossbreeding, cow size, and calving season can have dramatic impacts on pregnancy rates. Body condition score, adequate energy and protein supplementation, and vitamin and mineral balance also play important roles in insuring reproductive efficiency is optimized. Consideration must be made to total cowherd management and proper nutrition to attain the goal of optimum pregnancy rates.

Management

Importance of Early Conception

Calving date for first calf heifers may impact cow longevity and productivity. Calving late in yr 1 increases the proportion of cows that either calve later next year or do not conceive (Burris and Priode, 1958). Research has indicated heifers having their first calf earlier in the calving season remained in the herd longer compared with heifers that calved later in the calving season (Cushman et al., 2013). Therefore, heifers calving earlier in the calving season have greater potential for longevity and lifetime productivity.

Decreasing the calving period has far reaching implications across the cow-calf enterprise and beyond. Calf age is the single most important factor impacting weaning weight in cow-calf operations so herds with more concentrated calving distributions are expected to have heavier weaning weights compared with herds that do not. Effects of calving early in the calving season potentially extend much further into beef systems, including improved pregnancy percentages and subsequent calving distributions the next calving season, increased cow longevity, lower replacement rate, positive influences on carcass quality and value, reduced labor requirements, increased returns on feed inputs and improved overall sustainability.

Advantage of Crossbreeding

Traits of low heritability, such as reproduction, have the greatest response to heterosis (crossbreeding). It was determined from research at Montana State University (Davis et al., 1994) that crossbred cows have a substantial economic advantage over straight bred animals, primarily through increased longevity and calf weaning weight per cow exposed, which takes into account calf weight as well as cow reproductive performance (Table 1).

Table 1. Advantage of crossbred cows (maternal heterosis) over straight bred cows for economic traits (Davis et al., 1994)

Trait	Maternal heterosis
Longevity	1.2 years (44%)
Calf weight weaned per cow exposed	74 lb (25%)
Net profit per cow exposed	$70

Match Cow Type to Forage Base

Large cow size and high milk production translate into increased nutrient requirements for the cow. Increased milk production and cow size increase both energy and crude protein requirements. Excess milk production and cow size can significantly limit the carrying capacity of any ranch operation or reproduction will be compromised.

Herd Health

A sound herd health program is an essential part of any reproductive management system. Cattle are susceptible to a variety of diseases detrimental to reproduction. All herd health programs should be implemented under the supervision of a qualified, licensed veterinarian. A relationship exists between poor nutrition and increased incidence of herd health problems. Several vitamins and minerals are necessary for immune system function and nutrient deficiencies in these areas can result in an increased susceptibility to disease.

Minimize the Postpartum Interval

Rebreeding performance of the first calf heifer has major economic consequences. This classification of breeding animal is often the most challenging to manage for reproductive efficiency, primarily because this animal is not only subject to the stresses of calving and lactation for the first time, but she is also still growing. Failure to rebreed after birth of the first calf is one of the primary reasons for culling in a beef cattle operation. There is a considerable amount of money invested in this animal and high replacement rates can greatly decrease the profitability of a beef cattle operation. The period from calving until the cow conceives is a very critical period in a cow's production cycle, minimizing this time period is critical for maximizing reproductive and economic efficiency of a beef cattle operation. Cows cycling early in the breeding season have more opportunities to become pregnant during a limited breeding season. Breeding season length will influence uniformity of calves and their value at weaning. In order to have a successful, short breeding season, it is vital that cattle cycle and conceive early in the breeding season. Minimizing the postpartum interval is limited by uterine involution, which is the time needed for repair of the reproductive tract so another pregnancy can be established. Uterine involution generally occurs within 30 days postpartum and does not generally limit cyclicity; however, factors such as malnutrition, disease and calving difficulty will delay normal involution.

Calving Difficulty and Time of Intervention

Bellows (1995) indicated cows that experience calving difficulty will take longer to cycle than cows not experiencing calving difficulty, therefore, it is important to minimize calving difficulty in your breeding herd. Time of intervention, when obstetrical assistance is needed, also affects cyclicity. Dams given early assistance had a reduction in postpartum interval, a higher percentage in heat by the beginning of the breeding season, a trend toward fewer services per conception, an increase in pregnancy rate, and heavier calves at weaning (Table 2). Therefore, early assistance, when needed, is important to assure heifers return to estrus as soon as possible.

Table 2. Effect of time of calving assistance on dam breeding and calf performance

	Time of Assistance	
Item	Early	Late
Postpartum interval, (d)	49	51
In heat at beginning of breeding season (%)	91	82
Services/conception	1.15	1.24
Pregnancy (%)	92	78
Calf average daily gain (lb)	1.74	1.63
Calf weaning weight (lb)	422	387

Calf Effects

Suckling stimulus from the calf has a negative effect on cyclic activity during the postpartum period; however, animals in a positive energy balance and in adequate body condition generally overcome this negative stimulus prior to the breeding season. Calf removal, either temporary or permanent, can increase the number of cows that return to estrus during the breeding season (Williams, 1990). A common practice in some synchronization programs is 48 hr calf removal, which has been shown to induce cyclicity in postpartum cows and first calf heifers. It is important to provide a clean, dry pen with grass hay and water and make sure that pairs mother up before going to pasture.

Induction of Estrus with Hormones

Progestin containing products such as MGA (melengesterol acetate) or CIDR can shorten the postpartum interval provided nutrition and body condition are adequate. Gonadotropin releasing hormone (GnRH) is another hormone used in synchronization programs to induce estrus in some heifers. None of these products are substitutes for good management and heifers need to be at least 40 days postpartum before they will induce cyclicity.

Bull Effects

Bull presence from 30 days after calving to the start of the breeding season has been shown to cause heifers to cycle earlier. Bull exposure requires exposing heifers to surgically altered bulls not capable of breeding. Approximately 1 bull per 20 heifers is required and limited data suggests exposure to androgenized steers or cows will produce similar results.

Nutrition

Body Condition Score

Body condition score (BCS) is correlated with several reproductive events such as postpartum interval, services per conception, calving interval, milk production, weaning weight, calving difficulty, and calf survival; which greatly affect net income in a cow-calf operation (Table 3; Kunkle et al., 1994). The most important factor influencing pregnancy rate in beef cattle is body energy reserves at calving (Wettemann et al., 2003). Body condition at calving is the single most important factor determining when beef heifers and cows will resume cycling after calving. Body condition score at calving also influences response to postpartum nutrient intake. Spitzer et al. (1995) fed primiparous cows differing in body condition (BCS 6 vs. 4; 1 = emaciated, 9 = obese) to gain either 1.87 or .97 lb/d. The percentage of BCS 6 cows in estrus during the first 20 days postpartum increased from 40 to 85% when fed to the higher rate of gain, the cows in BCS 4 only increased estrous response from 33 to 50% during the first 20 d postpartum when fed to gain at the higher rate. Cattle should have an optimum BCS of 5 to 6 at calving through breeding to assure optimal reproductive performance. Body condition score is generally a reflection of nutritional management; however, disease and parasitism can contribute to lower BCS even if apparent nutrient requirements are met.

Table 3. Relationship of body condition score (BCS) to beef cow performance and income

BCS	Pregnancy rate, %	Calving interval, d	Calf ADG, lb	Calf WW, lb	Calf Price, $/100 lb	$/cow Exposed[a]
3	43	414	1.60	374	96	154
4	61	381	1.75	460	86	241
5	86	364	1.85	514	81	358
6	93	364	1.85	514	81	387

[a] Income per calf x pregnancy rate.

Specific Nutrients and Reproduction

Feeding a balanced diet to beef females in the last trimester of pregnancy through the breeding season is critical. Nutritional demands increase greatly in late gestation and even more in early lactation. Reproduction has low priority among partitioning of nutrients and consequently, cows in thin body condition often don't rebreed. Plane of nutrition the last 50 to 60 days before calving has a profound effect on postpartum interval (Table 4; Randel, 1990). The importance of pre- and postpartum protein and energy level on reproductive performance has been consistently demonstrated (Table 4). Positive energy balance postpartum is essential for prompt rebreeding of heifers calving in thin condition (Table 5; Lalman et al., 1997).

Table 4. Effect of pre- or postpartum dietary energy or protein on pregnancy rates in cows and heifers

Nutrient and time	Pregnant, %		Difference, %
	Adequate	Inadequate	
Energy level pre-calving[a]	73	60	13
Energy level post-calving[b]	92	66	26
Protein level pre-calving[c]	80	55	25
Protein level post-calving[d]	90	69	21

[abcd] Combined data from 2, 4, 9 and 10 studies, respectively.

Table 5. Influence of postpartum diet on weight change, body condition score (BCS) change and postpartum interval (PPI)

	Diet			
Item	Low	Maintenance	Maint./ High	High
Post-calving weight, lb	835	822	826	821
BCS at calving	4.27	4.26	4.18	4.10
PPI, d	134	120	115	114
PPI wt. change, lb	12	40	70	77
PPI BCS change	-.32	.37	1.24	1.50

Bearden and Fuquay (1992) summarized the effects of inadequate and excessive nutrients on reproductive efficiency (Table 6).

Table 6. Influence of inadequate and excessive dietary nutrient intake on reproduction in beef cattle

Nutrient Consumption	Reproductive Consequence
Excessive energy intake	Low conception, abortion, dystocia, retained placenta, reduced libido
Inadequate energy intake	Delayed puberty, suppressed estrus and ovulation, suppressed libido and spermatozoa production
Excessive protein intake	Low conception rate
Inadequate protein intake	Suppressed estrus, low conception, fetal reabsorption, premature parturition, weak offspring
Vitamin A deficiency	Impaired spermatogenesis, anestrus, low conception, abortion, weak offspring, retained placenta
Phosphorus deficiency	Anestrus, irregular estrus
Selenium deficiency	Retained placenta
Copper deficiency	Depressed reproduction, impaired immune system, impaired ovarian function
Zinc deficiency	Reduced spermatogenesis

Protein and Energy

Inadequate daily energy intake is a primary cause of reduced cattle performance on forage diets. In many instances with warm-season perennial forages (and possibly with cool-season perennial forages at advanced stages of maturity), there is an inadequate supply of crude protein, which will limit energy intake (Mathis, 2000; Paterson et al., 2001). An example of the relationship between crude protein content of forages and forage intake is presented in Figure 1. Dry matter intake declined rapidly as forage crude protein fell below 7%, a result attributed to a deficiency of nitrogen (protein) in the rumen, which decreased microbial activity. If forage contains less than approximately 7% crude protein, feeding a protein supplement generally improves the energy and protein status of cattle by improving forage intake and digestibility. For example (Figure 1), forage intake was about 1.6% of body weight when crude protein was 5%, while at 7% crude protein, forage intake was 44% higher and consumption was 2.3% of body weight.

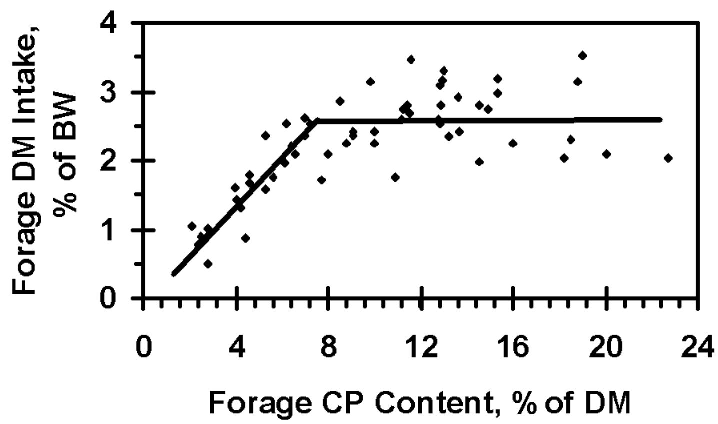

Figure 1. Effect of forage crude protein (CP) on dry matter (DM) intake (Mathis, 2000)

Improved forage intake increases total dietary energy intake, and explains why a protein deficiency is usually corrected first when formulating a supplementation program for animals grazing poor quality forage. As suggested, when the crude protein content of forages drops below about 7%, forage intake declines. However, intake of other forages may decline when forage crude protein drops below 10%. Part of the variation is attributed to differences in nutrient requirements of the cattle, with the remainder of the variation attributed to inherent differences among forages presenting different proportions of nutrients to rumen microbes. Intake response to a single nutrient such as crude protein is not expected to be similar among all forages (Mathis, 2000).

Livestock producers are often concerned excessive dietary nutrients during the last trimester of pregnancy may negatively influence calf birth weights and dystocia. Selk (2000) summarized the effects of providing either adequate or inadequate amounts of dietary energy on calving difficulty, reproductive performance, and calf growth. This summary is presented in Table 7.

Reducing energy pre-partum had virtually no effect on dystocia rates, even though birth weights were altered in some experiments. Of the 9 trials summarized, 7 indicated increased energy intakes during the last trimester of gestation did not increase calving difficulty.

Table 7. Summary of studies on supplemental prepartum energy intake on calving difficulty, subsequent reproductive performance and calf growth

Researcher	Supplementation[a]	Summary of Effects
Christenson et al., 1967	HE vs. LE for 140 d prepartum	HE increased birth wt., dystocia, milk and estrus activity
Dunn et al., 1969	ME vs. LE for 120 d prepartum	ME increased birth wt. and dystocia
Bellows et al., 1972	HE vs. LE for 82 d prepartum	HE increased birth wt. but had no effect on dystocia or weaning wt.
Laster and Gregory, 1973	HE vs. ME vs. LE for 90 d prepartum	HE increased birth wt. but had no effect on dystocia
Laster, 1974	HE vs. ME vs. LE for 90 d prepartum	HE increased birth wt. but had no effect on dystocia
Corah et al., 1975	ME vs. LE for 100 d prepartum	ME increased birth wt., estrus activity, calf vigor and weaning wt. but had no effect on dystocia
Bellows and Short, 1978	HE vs. LE for 90 d prepartum	HE increased birth wt., estrus activity, pregnancy rate and decreased post partum interval but had no effect on dystocia
Anderson et al., 1981	HE vs. LE for 90 d prepartum	HE had no effect on birth wt., milk or weaning wt.
Houghton et al., 1986	ME vs. LE for 100 d prepartum	ME increased birth wt. and weaning wt. but had no effect on dystocia

[a]HE = high energy (over 100% NRC or National Research Council's recommended dietary need); ME = moderate energy (approximately 100% NRC); LE = low energy (under 100% NRC)

In addition, producers are often concerned with levels of crude protein and possible effects on calf birth weight. Selk (2000) summarized studies conducted to specifically measure effects of varying protein intake to the prepartum beef female on calving difficulty (Table 8). Reducing dietary crude protein prepartum does not decrease calving difficulty and may compromise calf health and cow reproductive performance.

Table 8. Summary of studies on feeding supplemental protein during gestation on calving difficulty, subsequent reproductive performance and calf growth

Researcher	Supplementation[a]	Summary of Effects
Wallace and Raleigh, 1967	HP[a] vs. LP for 104 - 137 d prepartum	HP increased cow wt., birth wt. and conception rate but decreased dystocia
Bond and Wiltbank, 1970	HP vs. MP throughout gestation	HP had no effect on birth wt. or calf survivability
Bellows et al., 1978	HP vs. LP for 82 d prepartum	HP increased cow wt., cow ADG, birth wt., dystocia, weaning wt. and decreased conception rate
Anthony et al., 1982	HP vs. LP for 67 d prepartum	HP had no effect on birth wt., dystocia or postpartum interval
Bolze et al.,1985	HP vs. MP vs. LP for 112 d prepartum	HP had no effect on birth wt., dystocia, weaning wt., milk or conception rate but decreased the postpartum interval

[a]HP = high protein (over 100% NRC); MP = moderate protein (approximately 100% NRC); LP = low protein (under 100% NRC)

Excess Protein and Energy

Caution should be used with feeding excessive amounts of nutrients before or after calving. Not only is it costly, but animals with BCS >7 have lower reproductive performance and more calving difficulty than animals in moderate BCS 5 to 6. Excessive protein and energy can both have negative effects on reproduction. Overfeeding protein during the breeding season and early gestation, particularly if the rumen receives an inadequate supply of energy, may be associated with decreased fertility (Elrod and Butler, 1993). This decrease in fertility may result from decreased uterine pH during the luteal phase of the estrous cycle in cattle fed high levels of degradable protein. The combination of high levels of degradable protein and low energy concentrations in early-season grasses may contribute to lower fertility rates in females placed on such pastures near the time of breeding. Negative effects of excess rumen degradable intake protein on reproduction are well documented in dairy literature (Ferguson, 2001).

Effects of supplementing feedstuffs high in undegradable intake protein (UIP) on reproduction are inconclusive and appear to be dependent on energy density of the diet (Hawkins et al., 2000). Research by Kane and others (2004) demonstrated negative effects on reproductive hormones when high (.71 lb/d) levels of UIP were supplemented, but not at low (.25 lb/d) or moderate (.48 lb/d) levels. Heifers fed additional UIP (.55 lb/d) during development reached puberty at a later age and heavier weight and fewer were serviced in the first 21 d of the breeding season. Pregnancy rate was not affected (Lalman et al., 1993). Further research is needed to elucidate potential mechanisms UIP may stimulate or inhibit reproductive processes and under what conditions.

Distillers grains are a co-product from the ethanol industry being utilized in beef cattle diets and are also high (65% of CP content) in UIP.

A 2 yr study was conducted at 2 locations to determine if supplementing beef heifers with dried distillers grains (DDG) as an energy source affected growth or reproduction (Martin et al., 2007a). Spring-born crossbred heifers (n = 316) were blocked by age or sire and age and assigned randomly to DDG or control (dried corn gluten feed, whole corn germ, urea) supplement. Heifers received prairie hay in amounts sufficient for ad libitum intake and 0.59% of BW DDG or 0.78% of BW control supplement (DM basis). Supplements were formulated to be isocaloric, but protein degradability differed. Final BW, ADG, and final BCS were not affected by supplementation. Estimated age and BW at puberty did not differ between treatments, and the proportions of pubertal heifers did not differ at the initiation of the experiment, at the beginning of the 10-d sampling intervals, or before synchronization. Estrus synchronization rate (75.9%), time of estrus, and overall pregnancy rate (89.5%) were not affected by treatment. However, a greater proportion of DDG than control heifers conceived to AI (75.0 vs. 52.9%), resulting in greater AI pregnancy rates for DDG heifers (57.0 vs. 40.1%). Body weight or BCS at pregnancy diagnosis did not differ between DDG and control heifers. Supplementing beef heifers with DDG during development did not affect age at puberty but improved AI conception and pregnancy rates compared with an isocaloric control supplement.

Minerals

Minerals are important for all physiological processes in the beef animal including reproduction, so it is simply a matter of determining when they have to be supplemented in the basal diet.

Salt (NaCl) is the most important mineral a beef animal needs. Normally, sodium and chloride do not appear in feedstuffs in adequate amounts to meet animal requirements and should be provided free choice at all times.

Calcium is generally adequate in forage-based diets, but is often included in commercially available mineral supplements because many phosphorus sources also contain calcium. Much debate and research has been conducted on the effects of phosphorus supplementation on reproductive function. Phosphorus and crude protein content generally parallel each other in pasture or rangeland. Mature forages are generally deficient in phosphorus and impaired reproductive function has been associated with phosphorus deficient diets (Dunn and Moss, 1992; Lemenager et al., 1991). Diets should be evaluated for phosphorus content and supplemented accordingly. Caution should be used to not overfeed phosphorus -- it is costly, of potential environmental concern, and does not positively influence reproduction in beef (Dunn and Moss, 1992) or dairy (Lopez et al., 2004) cattle.

Other macro minerals include magnesium, potassium, chlorine, and sulfur. Need for supplementation, as with the previously mentioned minerals, is dependent on content in the basal diet and water. Both deficiencies and excesses can contribute to suboptimal reproductive function.

Micro or trace minerals include copper, cobalt, iodine, iron, manganese, and zinc. Inadequate consumption of certain trace elements combined with antagonistic effects of other elements can reduce reproductive efficiency (Greene et al., 1998).

Vitamins

Most of the vitamins (C, D, E, and B complex) are either synthesized by rumen microorganisms, synthesized by the body (vitamin C) or are available in common feeds and are not of concern under normal conditions. Vitamin A deficiency, however, does occur naturally in cattle grazing dry winter range or consuming low quality crop residues and forages (Lemenager et al., 1991). The role of vitamin A in reproduction and embryo development has been reviewed by Clagett-Dame and Deluca (2002). Supplementation before and after calving can increase conception rates (Hess, 2000).

Water

Water is more essential to life than any other nutrient. Feed intake is directly related to water intake. Water may also contribute significant macro and micronutrients that may benefit or impair production and reproduction. Contribution of these nutrients from water sources must be considered to accurately design a supplementation program.

Ionophores

Bovatec® and Rumensin® have been shown to influence reproductive performance during the postpartum period. Cows and heifers fed an ionophore exhibit a shorter postpartum interval provided adequate energy is supplied in the diet (Table 9; Randel, 1990). This effect appears to be more evident in less intensely managed herds with a moderate (60 to 85 d) or longer postpartum interval. Scientists have also demonstrated heifers fed an ionophore reach puberty at an earlier age and a lighter weight (Patterson et al., 1992).

Table 9. Effect of ionophore feeding on postpartum interval (PPI) in beef cows and heifers

Study	Ionophore (PPI, d)	Control (PPI, d)	Difference (d)
1	30	42	-12
2	59	69	-10
3	67	72	-5
4	65	86	-21
5	92	138	-46

Fat Supplementation

Inadequate dietary energy intake and poor body condition can negatively affect reproductive function. Supplemental lipids have been used to increase the energy density of the diet and avoid negative associative effects (Coppock and Wilks, 1991) sometimes experienced with cereal grains (Bowman and Sanson, 1996) in high roughage diets.

Supplemental lipids may also have direct positive effects on beef cattle reproduction independent of the energy contribution. Lipid supplementation has been shown to positively affect reproductive function in several important tissues including the hypothalamus, anterior pituitary, ovary, and uterus. The target tissue and reproductive response appears to be dependent upon the types of fatty acids contained in the fat source. Fat supplementation is a common practice in dairy cattle production, primarily to increase the energy density of the diet. Associated positive and negative effects on reproduction have been reported (Grummer and Carroll, 1991; Staples et al., 1998).

Research with supplemental fat has been conducted on cows and replacement heifers. Fats have been fed before and after calving and during the breeding season. Several response variables have been examined, including body weight and BCS, age at puberty, postpartum interval, first service conception rates, pregnancy rates, calving interval, calving difficulty, and calf birth and weaning weight. To determine potential mechanisms of action, scientists have investigated changes in follicular and uterine development, hormonal profiles and changes, brain function, and embryonic development.

The effects of fat supplementation on reproduction in beef heifers and cows has been reviewed (Funston, 2004) and is summarized below.

Fat Supplementation to Replacement Heifers. Studies are limited on the use of fat supplements in replacement heifer diets. In general, heifers in the studies cited were on a positive plane of nutrition and developed to optimum weight and age at breeding. There may have been a positive response to fat supplementation had heifers been nutritionally challenged. It appears from the studies cited, there is limited benefit of fat supplementation in well-developed replacement females and is probably only warranted when supplements are priced comparable to other protein and energy sources.

Fat Supplementation Prepartum. Results from feeding supplemental fat prepartum are inconclusive. However, response to supplementation appears to be dependent on postpartum diet. Beef animals apparently have the ability to store certain fatty acids, supported by studies in which fat supplementation was discontinued at calving but resulted in a positive effect on reproduction. Postpartum diets containing significant levels of fatty acids may mask any beneficial effect of fat supplementation. There appears to be no benefit and in some cases, a negative effect of feeding supplemental fat postpartum, particularly when supplemental fat was also fed prepartum. Fat supplementation has been reported to both suppress and increase $PGF_{2\alpha}$ synthesis. When dietary fat is fed at high levels for extended periods of time, $PGF_{2\alpha}$ synthesis may be increased and compromise early embryo survival. Hess et al. (2005) summarized research on supplementing fat during late gestation and concluded feeding fat to beef cows for approximately 60 d before calving may result in a 6.4% improvement in pregnancy rate in the upcoming breeding season.

Fat Supplementation Postpartum. Supplementing fat postpartum appears to be of limited benefit from studies reported here. Many of the studies reported approximately 5% fat in the diet supplemented with fat. It is not known if more or less fat would have elicited a different response (either positive or negative). If supplementing fat can either increase or decrease $PGF_{2\alpha}$ production, it seems reasonable the amount of fat supplemented might affect which response is elicited. Recent research (Hess et al., 2005) demonstrated a decrease in first service conception rates (50 vs. 29%) when young beef cows were fed high linoleate safflower seeds (5% DMI) postpartum. The same laboratory has also reported (Grant et al., 2002) an increase in $PGF_{2\alpha}$ metabolite (PGFM) when high linoleate safflower seeds are fed postpartum and a decrease in several hormones important for normal reproductive function (Scholljegerdes et al., 2003 and 2004).

Feeding Considerations. The amount of supplemental fat needed to elicit a positive or, in some cases, a negative effect on reproductive function is largely unknown and titration studies are needed in all situations in which supplemental fat has been fed. Dose response studies indicate the amount of added plant oil necessary to maximize positive ovarian effects is not less than 4% (Stanko et al., 1997; Thomas et al., 1997). Staples et al. (1998) indicated 3% added dietary fat (DM basis) has often positively influenced the reproductive status of the dairy cow.

Lower levels of added dietary fat (2%) have also been shown to elicit a positive reproductive response (Bellows et al., 2001) and studies with fishmeal, less than 1% added fat (Burns et al., 2002) produced a positive reproductive response. This indicates both amount and types of fatty acids are important. Feeding of large quantities of fat (> 5% of total DMI) has not been recommended due to potential negative effects on fiber digestibility and reduction in DMI (Coppock and Wilks, 1991). The duration and time (pre or postpartum) of supplement feeding needed to elicit a positive response is not precisely known, many of the studies have supplemented fat at least 30 d. The period of supplementation has varied from different times before breeding in heifer development, pre-calving, post-calving, and/or pre-breeding periods. The young, growing cow appears to be the most likely to respond to supplemental nutrients. An appropriate situation for fat supplementation may be when pasture or range conditions are limiting or are likely to be limiting before and during the breeding season. Feeding supplemental fat to well-developed heifers or cows in adequate body condition on adequate pasture or range resources may not provide any benefit beyond energy contribution to the diet.

Summary of Fat Supplementation. Currently, research is inconclusive on exactly how to supplement fat to improve reproductive performance beyond energy contribution. Most studies have tried to achieve isocaloric and isonitrogenous diets. However, this can be challenging. Some studies only have sufficient animal numbers to detect very large differences in reproductive parameters such as conception and pregnancy rate. Research on feeding supplemental fat has resulted in varied and inconsistent results as it relates to reproductive efficiency including positive, negative, and no apparent effect.

Elucidating mechanisms of action of how supplemental fat can influence reproductive function has been a difficult process. Animal response appears to be dependent on body condition score, age (parity), nutrients available in the basal diet, and type of fat supplement. The complexity of the reproductive system and makeup of fat supplements are often confounded by management conditions and forage quality both in research and in commercial feeding situations. This has contributed to inconsistencies in research findings.

Improvements in reproduction reported in some studies may be a result of added energy in the diet or direct effects of specific fatty acids on reproductive processes. As is the case for any technology or management strategy that improves specific aspects of ovarian physiology and cyclic activity; actual improvements in pregnancy rates, weaned calf crop, or total weight of calf produced are dependent on an array of interactive management practices and environmental conditions. Until these interrelationships are better understood, producers are advised to strive for low cost and balanced rations. If a source of supplemental fat can be added with little or no change in the ration cost, producers would be advised to do so. Research investigating the role of fat supplementation on reproductive responses has been variable. Therefore, adding fat when significantly increasing ration cost would be advised when the risk of low reproduction is greatest. Postpartum fat supplementation appears to be of limited benefit and adding a fat source high in linoleic acid postpartum may actually have a negative effect on reproduction.

Maternal Nutrition and Postnatal Development

Fetal programming is the concept maternal stimuli during fetal development influence the physiology of the fetus and postnatal growth and health (Barker et al., 1993). Limited data exists concerning the influence of late-gestation nutrition of ruminants on reproductive performance of their female progeny. Primiparous heifers restricted to 65% of the NRC recommended energy intake during the final 100 d of pregnancy had calves with lighter birth weights and a reduced weaning percentage compared with heifers fed at NRC recommendations. Age at puberty of heifer calves from energy restricted primiparous dams was increased by 19 d, but pregnancy rate of the heifer calves was not measured (Corah et al., 1975). Energy restriction of ewes for 10 d during late gestation resulted in altered adrenal steroid production in adult female progeny (Bloomfield et al., 2003).

A 3 year study was conducted with heifers (n = 170) whose dams were used in a 2 × 2 factorial arrangement of treatments to determine the effects of late gestation (LG) or early lactation (EL) dam nutrition on subsequent heifer growth and reproduction (Martin et al., 2007b). In LG, cows received 1 lb/d of a 42% CP supplement (PS) or no supplement (NS) while grazing dormant Sandhills range. During EL, cows from each late gestational treatment were fed cool-season grass hay or grazed subirrigated meadow. Cows were managed as a single herd for the remainder of the year. Birth date and birth weight of heifer calves were not affected by dam nutrition. Meadow grazing and PS increased heifer 205-d BW vs. feeding hay and NS, respectively. Weight at prebreeding and pregnancy diagnosis were greater for heifers from PS dams but were unaffected by EL nutrition. There was no effect of LG or EL dam nutrition on age at puberty or the percentage of heifers cycling before breeding. There was no difference in pregnancy rates due to EL treatment. Pregnancy rates were greater for heifers from PS dams, and a greater proportion of heifers from PS dams calved in the first 21 d of the heifers' first calving season. Dam nutrition did not influence heifers' average calving date, calving difficulty, and calf birth weight during the initial calving season. Weight at the beginning of the second breeding season was greater for heifers from PS dams but was not affected by maternal nutrition during EL. Dam nutrition did not affect heifer ADG or G:F ratio. Heifers from PS dams had greater DMI and residual feed intake than heifers from NS cows if their dams were fed hay during EL but not if their dams grazed meadows. Heifers born to PS cows were heavier at weaning, prebreeding, first pregnancy diagnosis, and before their second breeding season. Heifers from cows grazing meadows during EL were heavier at weaning but not postweaning. Despite similar ages at puberty and similar proportions of heifers cycling before the breeding season, a greater proportion of heifers from PS dams calved in the first 21 d of the heifers' first calving season, and pregnancy rates were greater compared with heifers from NS dams. Collectively, these results provide evidence of a fetal programming effect on heifer postweaning BW and fertility.

Summary

There are many considerations to take into account when striving to optimize pregnancy rates and time of conception. Because reproductive traits tend to be low in heritability, the impact of management and nutrition become paramount. Total cowherd management recommendations include:

1. A sound herd health program is essential for optimum reproductive efficiency.
2. Utilize crossbreeding (heterosis) to optimize reproductive efficiency.
3. Make sure heifers are on a balanced ration the last trimester of pregnancy through the breeding season.
4. Heifers should be in optimum body condition (BCS 5 to 6) at calving and through the breeding season.
5. Provide calving assistance in a timely manner when needed.
6. Use an ionophore for increased feed efficiency, coccidiosis control, and the positive effect on reproductive performance.
7. Progestins, GnRH, 48-hour calf removal, and bull exposure are management tools that can induce cyclicity in some heifers.

Several tools can assist in shortening the postpartum interval but none of these will take the place of good total cowherd management. Body condition, level of nutrition, age of cows, milk production, weather, disease, parasites, and other factors will affect the ability to shorten the postpartum interval. The first place to address this problem is with proper nutrition prior to calving and through the breeding season and managing for optimum body condition.

Nutrition has a profound effect on reproductive potential in all living species. Body condition is a useful indicator of nutritional status and when used in conjunction with body weight change can provide a useful method to assess reproductive potential. Energy and protein are the nutrients required in the greatest amounts and should be first priority in developing nutritional programs to optimize reproduction. Minerals and vitamins must be balanced in the diet to optimize reproductive performance. Consider water quantity and quality when balancing diets. Caution should be taken not to overfeed nutrients or reproductive processes may be adversely affected. No magic feed ingredient exists that will compensate for a diet greatly deficient in any of the mentioned nutrients or poor body condition score. Nutritional considerations and impacts on reproduction have primarily focused on postnatal development; however, prenatal nutrition appears to have potential effects on subsequent reproductive performance in beef cattle.

Literature Cited

Barker, D. J. P., C. N. Martyn, C. Osmond, C. N. Hales, and C. H. D. Fall. 1993. Growth in utero and serum cholesterol concentration in adult life. BMJ 307:1524–1527.

Bearden, H.J. and J.W. Fuquay. 1992. Nutritional Management. In: Applied Animal Reproduction. Prentice Hall, Englewood Cliffs, NJ, pp 283-292.

Bellows, R.A. 1995. Managing the first-calf heifer. In: Proc., International Beef Symposium. January 18-20. Great Falls, MT. p 74-85.

Bellows, R.A., E.E. Grings, D.D. Simms, T.W. Geary, and J.W. Bergman. 2001. Effects of feeding supplemental fat during gestation to first-calf beef heifers. Prof. Anim. Sci.17:81-89.

Bloomfield, F. H., M. H. Oliver, C. D. Giannoulias, P. D. Gluckman, J. E. Harding, and J. R. Challis. 2003. Brief undernutrition in late-gestation sheep programs the hypothalamic-pituitaryadrenal axis in adult offspring. Endocrinology 144:2933–2940.

Bowman, J.G.P., and D.W. Sanson. 1996. Starch- or fiber-based energy supplements for grazing ruminants. In: M.B. Judkins and F.T. McCollum III (eds.) Proc. 3rd Grazing Livest. Nutr. Conf. Proc. West. Sec. Amer. Soc. Anim. Sci. 47(Suppl. I): I 18.

Burns, P.D., T.R. Bonnette, T. E. Engle, and J. C. Whittier. 2002. Effects of fishmeal supplementation on fertility and plasma omega-3 fatty acid profiles in primiparous, lactating beef cows. Prof. Anim. Sci. 18:373-379.

Burris, M. J., and B. M. Priode. 1958. Effect of calving date on subsequent calving performance. *Journal of Animal Science* 17:527-533.

Butler, W.R. 1998. Review: Effect of protein nutrition on ovarian and uterine physiology. J. Dairy Sci. 81:2533-2539.

Clagett-Dame, M., and H.F. DeLuca. 2002. The role of vitamin A in mammalian reproduction and embryonic development. Annu. Rev. Nutr. 22:347-381.

Coppock, C.E., and D.L. Wilks. 1991. Supplemental fat in high-energy rations for lactating cows: Effects on intake, digestion, milk yield, and composition. J. Anim. Sci. 69:3826-3837.

Corah, L. R., T. G. Dunn, and C. C. Kalthenbach. 1975. Influence of prepartum nutrition on the reproductive performance of beef females and the performance of their progeny. J. Anim. Sci. 41:819–824.

Cushman, R. A., L. K. Kill, R. N. Funston, E. M. Mousel, and G.A. Perry. 2013. Heifer calving date positively influences calf weaning weights through six parturitions. *J. Anim. Sci.* 91:4486-4491.

Davis, K.C., M.W. Tess, D.D. Kress, D.E. Doornbos, and D.C. Anderson. 1994. Life cycle evaluation of five biological types of beef cattle in a cow-calf range production system: II. Biological and economic performance. J. Anim. Sci. 72:2591-2598.

Dunn, T.G., and G.E. Moss. 1992. Effects of nutrient deficiencies and excesses on reproductive efficiency of livestock. J. Anim. Sci. 70:1580-1593.

Elrod, C.C., and W.R. Butler. 1993. Reduction of fertility and alteration of uterine pH in heifers fed excess ruminally degradable protein. J. Anim. Sci. 71:694-701.

Ferguson, J.D. 2001 Nutrition and reproduction in dairy herds. Intermountain Nutrition Conference Proceedings, Utah State University Publication No. 169:65-82.

Funston, R.N. 2004. Fat supplementation and reproduction in beef females. J. Anim. Sci. 82(E. Suppl.):E154-E161.

Grant, M.H.J., B.W. Hess, J.D. Bottger, D.L. Hixon, E.A. Van Kirk, B.M. Alexander, T.M. Nett, and G.E. Moss. 2002. Influence of supplementation with safflower seeds on prostaglandin F metabolite in serum of postpartum beef cows. Proc. West. Sec. Amer. Soc. Anim. Sci. 53:436-439.

Greene, L.W., A.B. Johnson, J. Paterson, and R. Ansotegui. 1998. Role of trace minerals in cow-calf cycle examined. Feedstuffs Magazine, August 17, 1998. 70:34.

Grummer, R.R., and D.J. Carroll. 1991. Effects of dietary fat on metabolic disorders and reproductive performance of dairy cattle. J. Anim. Sci. 69:3838-3852.

Hawkins, D.E., M.K. Petersen, M.G. Thomas, J.E. Sawyer, and R.C. Waterman. 2000. Can beef heifers and young postpartum cows be physiologically and nutritionally manipulated to optimize reproductive efficiency? Proc. Am. Soc. Anim. Sci. 1999. Available: http://www.asas.org/JAS/symposia/proceedings/0928.pdf.

Hess, B.W. 2000. Vitamin nutrition of cattle consuming forages: Is there a need for supplementation? Cow-Calf Management Guide and Cattle Producer's Library. CL 381:1-3.

Hess, B.W., S. L. Lake, E. J. Scholljegerdes, T. R. Weston, V. Nayigihugu, J. D. C. Molle, and G. E. Moss. 2005. Nutritional controls of beef cow reproduction. J. Anim. Sci. 83(E. Suppl.):E90–E106.

Kane, K.K., D.E. Hawkins, G.D. Pulsipher, D.J. Denniston, C.R. Krehbiel, M.G. Thomas, M.K. Petersen, D.M. Hallford, M.D. Remmenga, A.J. Roberts, and D.H. Keisler. 2004. Effect of increasing levels of undegradable intake protein on metabolic and endocrine factors in estrous cycling beef heifers. J. Anim. Sci. 82:283-291.

Kunkle, W.E., R.S. Sands and D.O. Rae. 1994. Effect of body condition on productivity in beef cattle. M. Fields and R. Sands (Ed.) Factors Affecting Calf Crop. Pp 167-178. CRC Press.

Lalman, D.L., D.H. Keisler, J.E. Williams, E.J. Scholljegerdes, and D.M. Mallett. 1997. Influence of postpartum weight and body condition change on duration of anestrus by undernourished suckled beef heifers. J. Anim. Sci. 75:2003-2008.

Lalman, D.L., M.K. Petersen, R.P. Ansotegui, M.W. Tess, C.K. Clark, and J.S. Wiley. 1993. The effects of ruminally undegradable protein, propionic acid, and monensin on puberty and pregnancy in beef heifers. J. Anim. Sci. 71:2843-2852.

Lemenager, R.P., R.N. Funston, and G.E. Moss. 1991. Manipulating nutrition to enhance (optimize) reproduction. In: F.T. McCollum and M.B. Judkins (eds.) Proc. 2nd Grazing Livest. Nutr. Conf. Pp. 13-31. Oklahoma Agric. Exp. Sta. MP-133. Stillwater, OK.

Lopez, H., F.D. Kanitz, V.R. Moreira, L.D. Satter, and M.C. Wiltbank. 2004. Reproductive performance of dairy cows fed two concentrations of phosphorus. J. Dairy Sci. 87:146-157.

Martin, J.L., Cupp, R.J. Rasby, Z.C. Hall, and R.N. Funston**.** 2007a. Utilization of dried distillers grains for developing beef heifers. *J. Anim. Sci.* 85:2298-2303.

Martin, J.L., K.A. Vonnahme, D.C. Adams, G.P. Lardy, and R.N. Funston. 2007b. Effects of dam nutrition on growth and reproductive performance of heifer calves. J. Anim. Sci. 85: 841-847.

Mathis, C.P. 2000. Protein and Energy Supplementation to Beef Cows Grazing New MexicoRangelands. Available: http://www.childcarefoodsafety.com/pubs/_circulars/Circ564.pdf.

Patterson, D.J., R.C. Perry, G.H. Kiracofe, R.A. Bellows, R.B. Staigmiller, and L.R. Corah. 1992. Management considerations in heifer development and puberty. J. Anim. Sci. 70:4018-4035.

Paterson, J., R. Funston, D. Cash. 2001. Forage quality influences beef cow performance and reproduction. Intermountain Nutrition Conference Proceedings, Utah State University Publication No. 169:101-111.

Randel, R.D. 1990. Nutrition and postpartum rebreeding in cattle. J. Anim. Sci. 68:853-862.

Scholljegerdes, E.J., B.W. Hess, E.A. Van Kirk, and G.E. Moss. 2003. Effects of supplemental high-linoleate safflower seeds on ovarian follicular development and hypophyseal gonadotropins and GnRH receptors. J. Anim. Sci. 81(Suppl. 1):236.

Scholljegerdes, E.J., B.W. Hess, E.A. Van Kirk, and G.E. Moss. 2004. Effects of dietary high-linoleate safflower seeds on IGF-I in the hypothalamus, anterior pituitary gland, serum, liver, and follicular fluid of primiparous beef cattle. Midwestern Section ASAS 2004 Meeting. Abstr. 77.

Selk, G.E. 2000. Nutrition and its' role in calving difficulty. Available: http://www.ansi.okstate.edu/exten/cc-corner/nutritionanddystocia.html

Spitzer, J.C., D.G. Morrison, R.P. Wettemann, and L.C. Faulkner. 1995. Reproductive responses and calf birth and weaning weights as affected by body condition at parturition and postpartum weight gain in primiparous beef cows. J. Anim. Sci. 73:1251-1257.

Stanko, R.L., P. Fajersson, L.A. Carver, and G.L. Williams. 1997. Follicular growth and metabolic changes in beef heifers fed incremental amounts of polyunsaturated fat. J. Anim. Sci. 75(Suppl. 1):223 (Abstr.).

Staples, C.R., J.M. Burke, and W.W. Thatcher. 1998. Influence of supplemental fats on reproductive tissues and performance of lactating cows. J. Dairy Sci. 81:856-871.

Thomas, M.G., B. Bao, and G.L. Williams. 1997. Dietary fats varying in their fatty acid composition differentially influence follicular growth in cows fed isoenergetic diets. J. Anim. Sci. 75:2512-2519.

Wettemann, R.P., C.A. Lents, N.H. Ciccioli, F.J. White, and I. Rubio. 2003. Nutritional- and suckling-mediated anovulation in beef cows. J. Anim. Sci. 81(E. Suppl. 2):E48-E59.

Williams, G.L. 1990. Suckling as a regulator of postpartum rebreeding in cattle: a review. J. Anim. Sci. 68:831-852.

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