The cow-less cow herd

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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, weaning occurs 3 months after calving, and heifers are fattened 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 and 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 without losing weight 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 some 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 cow herd, for which expenditure no beef is produced since the cows do not grow substantively 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.

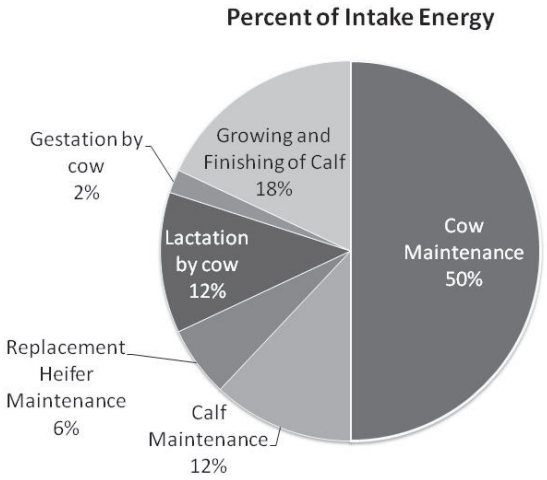

Figure 1. Conceptual illustration of units of intake energy devoted to various physiological functions in a traditional beef production system in the United States.

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

Project description

We have been studying 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 recognize 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 or becoming pregnant too late to continue in the program. However, the AHNC systems could be up to 70% 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 more than doubles 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 (Seidel. 2014), so this fertility gap should continue to narrow. 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 (Arce-Cordero et al., 2016); thus recovering merited price could 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.

There are about 30 million beef cows in the United States. 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 seven billion to a projected nine billion people, plus the increasing standard of living in most developing countries, is predicted to result in a 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 without inecreased greenhouse gas generation.

Project details

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 were with a polled Hereford cleanup bull. These bred heifers and their resulting crossbred calves were used for this research project, although they could have been 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 purchased an additional 57 commercial heifers to breed the next year (one turned out to be a freemartin).

The following list illustrates the system and the various groups of animals:

- Founder Set 1, 54 heifers bought spring, 2013, AI spring, 2013, slaughter late summer 2014
- Founder Set 2, 57 heifers bought spring, 2014, AI spring, 2014, slaughter late summer 2015
- Offspring of Founder Set 1, born 2014, AI spring, 2015. slaughter late summer 2016
- Offspring of Founder Set 2, born 2015, AI spring, 2016, slaughter late summer 2017
- Offspring of offspring of Founder Set 1, born 2016, AI spring 2017, slaughter late summer 2018
- Etc.

Note that as of July, 2016, we have 3 sets of animals: (1) just weaned offspring of offspring of Founder Set 1, (2) their mothers being fattened, and (3) the recently bred offspring of Founder Set 2. This illustrates that at any given time with this system, there will be 2 or 3 sets of animals, each at a different stage of the production cycle. It will take another 2 years until we slaughter the offspring of the offspring of Founder Set 1, which in many ways will be the first equilibrium test of the system.

For this project, we combine a number of proven management practices including crossbreeding, early weaning, fence-line weaning, sexed semen, easy-calving service sires, ovulation synchronization that is progestin-based to hasten puberty (probably only an issue for a few percent of heifers), and having cattle on pasture as much as possible. The first calves produced from the founder sets were Hereford crosses. For the next generation we used sexed semen from a black, polled Simmental bull with easy calving characteristics.

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 operations, 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 was 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. Many 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 are 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 are 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 excellent for carcasses from 2 1/2–year-old parous heifers.

We do have carcass characteristics from slaughtering fattened heifers from Founder Sets 1 and 2. These were purchased as commercial heifers, and birth dates were not available for most of them. The packer determined that 29 of the 85 carcasses were of Grade C maturity (>30 months of age) from dentition and bone ossification status. However, the objective measures of carcass quality were nearly identical between the young maturity and Grade C maturity carcasses: respective marbling scores were 446 +/- 84 and 462 +/-78, and Warner/Bratzler shear force scores (kg) of steaks were 4.9 +/-1.2 and 5.0 +/-0.8.

To what extent can each heifer replace herself?

The most disappointing finding of this project to date is that only about 60% of yearling heifers in fact replaced themselves the following year with a heifer of a suitable age due to about 10% bull calves, death losses, and most importantly, heifers that became pregnant too late in the breeding season to fit the program. The main limiting factor was low pregnancy rates using sexed semen, which are likely to improve as sexed semen technology improves. Starting with founder heifers of unknown age and genetic background also probably did not help, which will be less of an issue in future generations when we will have age and genetic information. Importantly, the steers and late pregnant heifers produced provided substantive ancillary income for the project.

Potential effects on the beef industry and alternative strategies

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.

An alternative strategy, already envisioned decades ago by others, is the single-calf heifer system without sexed semen. Instead of placing stockered heifers into feedlots for fattening, they are inseminated as described above and fattened later, but with no intention of making the system self-sustaining. The early weaned calves can be sold at any point including the option of using the heifers for the next generation of single-calf heifers. With this system, new heifers are procured annually; typically, one would breed ovulation-synchronized heifers once; non-pregnant heifers would continue to be fattened and slaughtered. The 3 million heifers fattened each year represent a huge resource for such a system.

References

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