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Keys to profitability in the ranch business

Burke Teichert

When discussing ranch profitability, I am often challenged that it's not possible. My counter is that it should be and can be profitable if you learn how to do it. There are probably more keys than I am going to discuss here; but, if you pay good attention to these on your farm or ranch, you can be nicely profitable. You will find that you usually need to change "what" you do rather than "how" you do something to improve profitability.

The starting point for any successful business is a 'shared vision" which describes what the stakeholders want to become. It must be led by management with input from all team members. The team must include the manager and any full-time employees, and it may be desirable to include part time employees, other family members and even people with whom you have business relationships such as bankers, accountants, feed and equipment dealers, buyers of your products, etc.

The shared vision should include long-term goals in at least three categories: financial goals which should roughly define how you plan to be profitable, landscape goals which should define what you want your ranch to look like and how the ecosystem should function, and quality of life goals which should describe what gives you fulfillment and satisfaction in all aspects of your life.

With a vision and goals defined you should understand that agriculture is a science and ranching is a business and, in that agri-business, you need to manage four areas: production, economics & finance, people and marketing. You will tend to focus on one of these at a time. However, you can't manage any of them well without recognizing that each affects the others. Therefore, to some extent, you are managing all simultaneously. If you aren't aware of that, too much focus on one area could result in negative results in another.

For good financial management, you should also understand that there are three ways (and only three ways) to improve profit. You will be tempted to say that there are more ways than that. I can assure that all will fit under one or more of the three, and understanding where they fit will greatly help you improve profitability. They are:

- Increase turnover
- Reduce overheads
- Improve gross margin which is total enterprise returns minus direct costs

Now, being aware of the four areas to manage and three ways to improve profit, there are "Five Essentials of Successful Ranch Management." These are attitudes or approaches or tools that will help you evaluate your ideas and tackle the tasks of managing. The five essentials are:

The approach must be both integrative and holistic. This means you "integrate" facts, ideas, information, practices, etc. from as many sources as realistically possible and then you use all of that to make holistic or systems decisions. This is done recognizing that making one change yields several results some of which are positive and some of which may be negative. You need to insure that unintended consequences are minimized and that the balance of positive and negative weighs heavily in favor of the positive.

Strive for continuous improvement of the key resources—land, livestock and people. I will later discuss improvement of land and livestock. People, including yourself, need constant opportunities to learn and grow in their commitment and value to the team.

Use of good planning and decision making tools. These usually include good accounting information for each enterprise with a good separation of overheads and direct costs. You also need a few good production records.

War on cost. This is necessary because of competition. We must be able to place a product in the marketplace at a price that is attractive to the customer and profitable to us. If one producer can produce something at a lower cost than another, he gets to stay in business longer.

Emphasis on marketing. I think many ranchers sell their main commodity (maybe steer calves) fairly well. However, I am quite sure that we often leave $50-200 per head on the table with many of the other livestock we sell.

With a basic introduction of:

- A shared vision
- Four areas to manage
- Three ways to improve profit
- Five Essentials of Successful Ranch Management

We must now understand that it is profit per acre or whole ranch profit that we are trying to improve **NOT** profit or production per cow. "Profit per cow" can be terribly distorting of whole ranch profit. If profit per cow is higher with large cows, you could probably run enough more smaller cows with a little less profit per cow and make more total ranch profit.

Major determinants of profit

There are several major determinants of profit that can have huge effects on profits—some by themselves and almost all in combination with the others:

- Enterprise mix and choices
- Overheads (including people)
- Stocking rate
    - Cow size and milk production
    - Grazing and pasture management
- Fed feed vs, grazed feed
- Calving season
- Realized herd fertility
- Wise input use for optimum production
- Marketing

Major determinants

Enterprise mix and choices

Our selection of enterprises or a combination of enterprises can and usually does have a tremendous impact on profitability. Enterprises need to fit the resources. The following choices need to be considered in cattle operations:

- Cow-calf
- Stocker
- Seedstock
- Cash crops
- Sheep and/or goats
- Poultry
- Combinations or the above

Overheads

Reducing overheads is one of the three ways to improve profits. Overheads are land and the facilities that are attached to the land—fences, livestock working facilities, buildings, houses, etc.--and people along with the tools and equipment to do their jobs. Overheads are usually the low hanging fruit on unprofitable operations. We just have a lot of stuff that we don't need. Intellectually we can make decisions on paper quite easily to reduce overheads, but it can be terribly difficult emotionally. We simply become attached to having our favorite overheads.

Stocking rate

Stocking rate is greatly affected by:

- Cow size and milk production. As cow size and milk production increase, stocking rate must decrease or we must produce or buy in more feed. Smaller cows giving less milk will produce more lbs. of weaned calf per acre than larger cows. Cows sized to fit their natural environment can be more productive on fewer inputs.

- Grazing and pasture management is one of the big hitters for increasing profitability. Carrying capacity (supply) must always precede stocking rate (demand) or you will certainly overgraze. By using adaptive, multi-paddock grazing many ranchers in many parts of the US and world have made large increases in stocking rates while improving soils and pasture productivity. I know many that have doubled and are heading toward triple the average area stocking rate.

Fed feed vs grazed feed

In our business most of the costs are overheads. This leaves feed as most of the direct costs.

- Any time you put a machine between the mouth of the cow and her feed source, that feed has just cost more. Cows have four legs and a mouth and should be expected to do most of the work of feeding themselves. There is tremendous economic power in replacing fed feed with grazed feed.
- Strategic supplementation of protein (right amount at the right time) can make it possible for a number of poor quality feedstuffs to keep gestating cows in adequate condition for calving and rebreeding.

Calving season

There are many advantages to calving in sync with nature. This is usually late spring; but different timing may fit some locations. You want to calve in good weather and reduce fed feed. Calving in sync with nature should reduce the cost of feed, labor and facilities. Remember that feed requirements nearly double after calving. Cows should do most of the work—not you.

Realized herd fertility

Realized herd fertility is the combined result of a pregnancy plus survival until the animal is sold. The sale may occur as a weaned calf or as a cull cow or anything in between.

- Longevity is highly dependent on fertility. There are some traits of soundness for which we cull some cows; but most of them are culled because they are open or dry.
- Fertility is highly dependent on adaptation to the environment which is a combination of the natural environment and what we as managers add to it. Well adapted cows have higher "realized" fertility—better conception rates, less embryonic loss, better calf health and less loss throughout their lives.
- High herd fertility creates more market options to be discussed later.
- You can select for fertility as opposed to feeding for fertility. Well-fed animals will breed very well. However, nature does not always feed them well. Adapted animals will breed when not so well fed.

Wise input use for optimum production

When we think holistically, we see how interconnected various causes and effects really are. As we make changes to some of the "determinants of profit," we make it easier to optimize the use of direct inputs.

- Match cow-size and milking ability to naturally available resources.
- Change the calving season to be more closely in sync with nature.
- Increase grazing days and reduce feeding days.
- Carefully use "strategic supplementation."
- Be careful in adopting new technologies. Just because you can do something, doesn't mean you should. Too often there is not a good cost-benefit ratio.
- Practice "minimal development" of replacement heifers. Heifers should be developed like "dry wintered" stocker cattle—mostly on grass or prairie hay with minimal supplementation. Keep costs low.
- Buy small replacement cows that fit your environment, OR
- Raise replacement heifers from bulls and cows that fit your environment.

Marketing

- Production and marketing must work together.
- Use a short calving season and a long breeding season.
- Cut inputs then cull the right cow.

- Opens
- Dries
- Wild
- Requires individual attention or help
- Poor calf
- Ugly (your definition)

- Select the right bull. Don't undo what cow culling is trying to accomplish.
    - Mature size—moderate or small
    - Milk—most ranches have and want too much
    - Cow Fertility
    - Bull care requirements. Do you have to feed to keep them in good condition? If so, do you want their daughters as replacements?
- Find opportunity to market bred cows.
- Two ideas after cutting inputs:
    - Each year, shorten the breeding season on yearling heifers until it is 24-30 days. Expose most of the heifers. The pregnant heifers will make good cows. The opens will make good feeders. Nature and the bulls make better selections than we do. See market opportunities.
    - For cows use a short calving season and a long breeding season. You might wonder how that works. It requires discipline to cull the late calving cows, but bred cows usually sell for more than open cows. As you get the calving season shorter and shorter, herd fertility will be increasing and you have most cows calving in a very short period of time. In addition you will have very few open cows. See marketing opportunities.

If you consider the 4 thing we have to manage, the 3 ways to improve and the 5 Essentials along with the major determinants of profit, it is easy to see the great amount of interconnectedness that ties them all together into a single system. So, for profitable decision making, become a "systems thinker."

Summary

- Reduce overheads
- Market well
- Improve three key ratios
    - Acres per cow
    - Cows per person
    - Fed feed vs grazed feed

By doing this, you are spreading overheads over a lot of production and increasing production and market prices. While doing this, you insure that expenditures on direct costs are fully cost justified.

In addition to understanding the economics and finance of what has been presented, four skills are required on a daily basis:

Good grazing

It is important to learn: 1) the biological and ecological principles, 2) the practices that embrace the principles and fit your resource and goals, and 3) the mechanics of doing good grazing—fencing, stock water, etc.

Low stress livestock handling

You must recognize that it is much more than just quiet and slow (sometimes it's not so slow). You must also learn the principles of animal handling.

Animal breeding

Culling the right females and selecting the right bulls so that cattle fit you environment better and better as you go along.

Observation

Observation is very important in learning what is going on in the soil, plant, animal interconnectedness and to teach ourselves how to improve next time.

Controlling costs by reducing feed waste

A. DiCostanzo, professor, Beef Cattle Nutrition and Management and Extension Animal Scientist, University of Minnesota, St. Paul

Introduction

Cattle producers manage a various resources on a daily basis. These resources can be classified as land (pasture or crop), labor or human, livestock, facilities, equipment and harvested or procured feed. Within the context of remaining financially sustainable, profitable cattle producers manage resources within well-defined limits defined by gross return and costs.

In a cow-calf operation, feed resources must be managed so that nutrient requirements of a brood cow are met with no additional excess. Excess nutrients in a brood cow lead to weight gain, which, given no need to regain weight or prepare for a period of nutrient supply deficit, contributes nothing to additional production output. Therefore, feed needs in a cow-calf operation are defined mostly by maintenance requirements.

In the feedlot, feed resources must be managed so that weight gain offsets cost of feed and other resources invested in the finishing process. Most of us refer to this as feed conversion efficiency or feed-to-gain ratio. Although most of us think of it as feed consumed divided by gain, few of us think of it as feed disappearance divided by gain. Astute feedlot owners and managers make sure that feed consumption and feed disappearance are nearly the same concept.

The following sections are dedicated to stimulate the reader to think of methods of controlling costs by reducing feed waste. Some examples of situations leading to feed waste will be presented along with ensuing discussion on return on investments to reduce waste realized by preserving feed resources.

Hay feeding

Most cattle producers in the U.S. feed hay to cattle in the form of a round bale for the simplicity of handling and management. Depending on herd size, facilities and equipment, producers deliver hay to last for at least one day. Options for managing feed intake by producers with small herds and no access to equipment are few. When relying on bale feeders, the minimum feeding unit is a bale. Because a single mature cow accounts for disappearance (intake and waste) of up to 40 lb DM, when single bales (weighing 1,000 lb) are placed on feeding sites, producers need approximately 25 cows to use an entire bale in a single day. Alternatives to bale feeder feeding are rolling the bale out on the pen surface, or investing in feeding delivery equipment and concrete or wooden bunks to manage intake at increments on par with the number of cows in the group.

As expected, feeding forage on the pen surface and delivering forage at amounts greater than needed for a single day leads to greater forage wastage. Relative to hay waste of 5% in a hay ring feeder, cows fed loose hay on the pen surface wasted from 11% when offered a 1-day supply to 31% when offered a 4-day supply (Smith et al., 1974). Similarly, forage DM waste was 24% (Year 1) to 34% (Year 2) when calves were permitted to graze windrowed forage, whereas offering forage from the same source as the dried hay in a ring feeder led to forage DM waste of 12% to 13% DM for years 1 and 2, respectively (Volesky et al. 2002). Results from this study were confounded by moisture concentration of forage and forage placement.

The extent of waste management by using feeding structures varies widely. Cows given free-choice access to hay delivered in a manner to prevent the feeder from being empty in a 24-h period wasted more hay from trailer- and cradle-type feeders than cows given access to hay delivered in a ring or cone feeder (cone over a ring) (Buskirk et al., 2003). Measures of cow behavior, particularly, negative interactive behaviors, apparently arising from hay feeder design were correlated with hay waste. Cradle design feeders led to more aggressive behavior at the feeder, caused cows to access the feeder in a manner inconsistent with the manufacturer's projections, and caused greater feeder occupancy (Buskirk et al., 2003).

Feeding long or ground hay to beef cows in a feeder (hay ring or feed bunk) or on the pen surface did not affect ($P > 0.33$) hay intake expressed as lb/d or proportion of cow BW (Jaderborg et al., 2011; Table 1). Hay waste was greater ($P < 0.01$) when hay was fed on the pen surface rather than in a feed bunk or hay ring. Intake of mineral supplement was affected by hay processing. Cows fed processed hay (on the pen surface or in a bunk) consumed more ($P < 0.01$) mineral supplement than those fed long or whole hay (on the pen surface or in a hay ring feeder). A trend for greater ($P = 0.08$) mineral supplement intake by cows fed on the pen surface was observed. Similarly, a trend ($P = 0.058$) for an interaction between feeder type and processing was observed for mineral supplement intake because cows fed long hay in a ring feeder consumed the least amount of mineral supplement. Yet, cows fed ground hay in a bunk or on the pen surface consumed the greatest amount of mineral supplement; consumption of mineral supplement by cows fed long hay on the pen surface was intermediate.

Total DMI averaged 2% of the cow's BW and was not affected by hay feeding method or processing. Estimates of waste resulting from placing hay in a feed bunk or hay ring feeder were similar to those reported previously. Estimates of waste from placing processed or unprocessed hay on the pen surface were also similar to those reported previously.

Thus, feed inventory required when using a hay ring feeder or a feed bunk would need to be nearly 5% greater than the expected intake or it would need to provide an additional 1.35 lb DM/cow daily. The feed inventory required if a feeder is not used would need to include an extra 5 lb DM/cow daily over the expected DM intake or be about 19% greater than the expected daily DM intake of the cow.

Hay feeder or hay processing was no expected to impact mineral supplement intake. Cow eating behavior and eating rate may have been affected by hay processing, which may have resulting in greater mineral supplement intake by increasing the hay intake rate. Dairy cows fed alfalfa hay chopped to a theoretical length of 15 mm ate at a faster rate (11% more lb/min) than those fed the same hay chopped to a theoretical length of 30 mm (Nasrollahi et al., 2014). Absence of a feeder likely resulted in increased trampling and led to the greater hay waste measured when hay was placed on the pen surface. This likely prompted cows to spend more time at the mineral supplement feeder to compensate for the perceived lack of "good feed" at the site where the hay was fed.

Alternatively, limiting access to the hay feeder is an option to reduce waste that is particularly appropriate for small herds owned by operators who have off-farm jobs. In a recent study, lactating beef cows (with calves) were permitted limited access to hay ring feeders for 4 or 8 hours or given 24-hour access (Cunningham et al., 2005). Cows given access for 4, 8 or 24 hours consumed 20.1, 28.2 or 29.3 lb of DM daily and wasted 2.4, 4.0 or 6.4 lb of DM daily, respectively. In this study, total disappearance (intake + waste) but not waste alone increased linearly with access time. In a similar study, cows in their last trimester of gestation were given access to hay in ring-type feeders for 6, 9 or 24 hours (Miller et al., 2007). There was a linear trend for cows given longer access time to consume more hay, but a quadratic trend for cows to waste more hay. The latter was because less hay was wasted when cows were given access to hay for 9 hours, than for 6 or 24 hours. Estimates of hay waste for cows offered access for 9, 6, and 24 hours were 8.5% vs 16.1% and 16.4% of DM offered, respectively. Cows given access to hay feeder rings for 24 hours consumed and wasted more ($P < 0.05$) hay than those given 6 or 14-hour access (Jaderborg et al., 2011). Cows given access to hay for 6 hours consumed and wasted less ($P < 0.05$) hay than those given access for 14 hours. Average BW was not affected by access time to hay feeders; therefore, on all treatments, the energy consumed from hay was sufficient to maintain BW and fetal growth.

Table 1. Hay, mineral supplement and total DM intake and waste by cows fed whole or processed hay in structures (ring feeder or feed bunk) or on the pen surface (Experiment 1)

Item	Placement		Processing			P-values		
	Pen surface	Structure	Whole	Processed	SE[1]	Placement	Processing	Placement x Processing
Hay								
Intake, lb/day	24.9	26.2	25.8	25.4	1.1	0.33	0.70	0.50
Intake, % BW	1.9	2	1.9	1.9	0.1	0.33	0.70	0.40
Waste, % 2	19.1	4.6	13.6	10.1	2.2	<0.01	0.26	0.60
Mineral supplement								
Intake, lb/day	1.5	1.3	1.1	1.7	0.1	0.08	<0.01	0.06
Total								
Intake, lb/day	26.5	27.6	26.9	26.9	1.1	0.42	0.97	0.40
Intake, % BW	2	2.1	2	2	0.1	0.42	0.98	0.40
Waste, % [2]	18.1	4.4	13	9.5	2	<0.01	0.22	0.6

[1] Standard error.
[2] Waste expressed as a proportion of intake

Cattle limit-fed a high-energy diet had greater diet dry matter digestibility (Klinger et al., 2007) than those fed a high-forage diet ad libitum. In the experiment by Jaderborg et al. (2011), DE concentration derived from ME reflected the finding that cows given access for 14 hours digested hay at expected values while those fed for ad libitum access had 6.1% less energy digestibility. Cows given access to hay for 6 hours had 9.4% greater energy digestibility.

Feed storage

Feed losses result from a variety of conditions or situations occurring in feed storage and diet mixing areas. In many situations, feedlot layout evolved over several years; this evolution may result in feedlot facilities that are not optimally located or managed. Therefore, certain conditions leading to feed loss during storage or transfer may arise.

TMR mixer loading area

Although feed storage areas may be protected from wind or precipitation, feed center areas may not. Figure 1 depicts theoretical air flow over solid windbreaks. Wind protection from a windbreak extends 10’ for every 1’ of height. Also, for every 1’ in windbreak height, a 4’ long snow drift is expected to develop (Harner et al., 2011). These guidelines are applicable to solid windbreaks. Placement of windbreaks to reduce wind loss in the TMR mixer loading area must involve consideration of other structures already in place, which may affect wind flow and effectiveness of windbreaks.

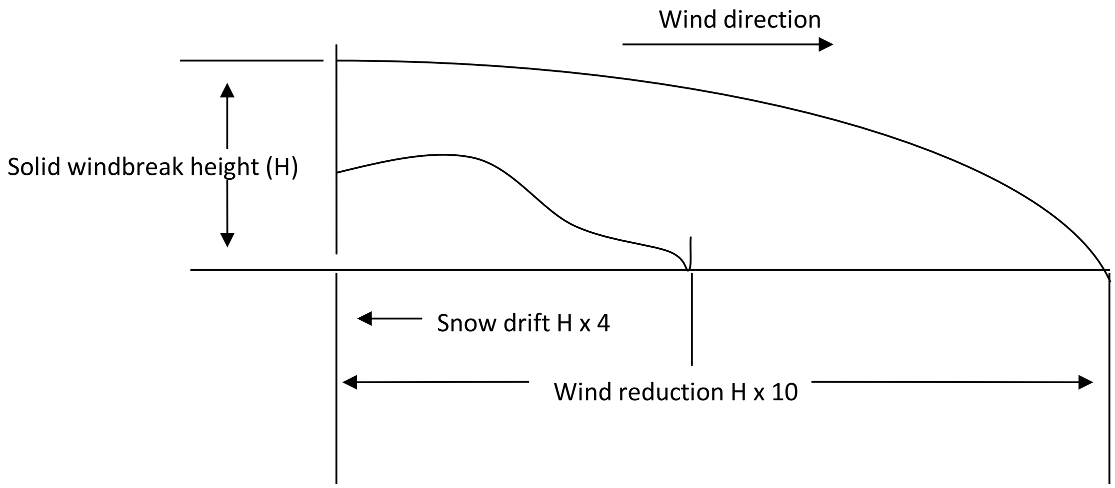

Figure 1. Typical wind and snow patterns resulting from windbreak placement. Adapted (Harner et al., 2011).

During ingredient loading of TMR mixers, especially dry or lower density ingredients, wind can reduce amount of product that reaches the TMR mixer. Theoretical calculations of wind erosion (Figure 1) led to exponential losses resulting from winds increasing from 5 to 25 mph (Harner et al., 2011).

Windbreaks for the TMR mixer loading areas must take into consideration the height at which ingredients are loaded, ingredient characteristics (particle size and moisture concentration), wind direction, and existing structures. Thus, on open areas, a windbreak positioned as close to the TMR mixer, must rise at least 4' higher than the top edge of the mixer to be effective. Liquid supplements are not exempt from effects of wind. Using flexible hoses long enough to reach below the top edge of the TMR will reduce wind loss and guarantee correct product application site.

Feed storage

Using simple approaches to provide surfaces or walls for feedstuff storage is both economical, and protects large investments in feed. Storing commodities on concrete or pavement pads eliminates mixing soil or gravel with these. Old road barriers or precast concrete barriers can be used as an economical solution to contain feedstuffs into piles, preventing mixing feedstuffs during storage or feed preparation, and reducing wind effect losses.

One of the easiest ways to reduce feed loss is to consider ingredient placement relative to TMR mixer loading area. Dry roughages and fermented feeds should be stored closest to the TMR mixer loading area because bulkiness (dry roughages) and to prevent excessive losses during transport to the TMR mixer loading area.

For feedstuffs stored over 250' away from the TMR mixer loading area, hauling heavier loads in the TMR mixer or truck rather than a skidsteer or payloader bucket at a time improves efficiency; this simple action will decrease feeding time and will reduce compounded feed loss effect. Using an estimated 850-lb load of cracked corn in a skidsteer bucket and estimated loss during transport of 1% results in $1.23 loss for every trip made. Applying this calculation to a skidsteer bucket loaded with 250 lb hay, and using a 5% transport loss led to transport loss of $0.75/trip. In addition, shrink may increasing from trampling feedstuffs that are transported from a distance away by frequent trips (skidsteer or payloader bucket) as equipment moves back and forth near the feed pile. This action also can add organic matter to gravel driveways and deteriorate their condition.

Environmental exposure losses must also be considered. Feedstuffs stored with no cover permit direct sunlight or moisture (from precipitation) exposure, which can change dry matter content. Drying due to sun exposure increases dry matter content, leading to inadvertent increases in dry matter offerings. Similarly, moisture added from precipitation reduces dry matter content, and increases nutrient leaching. Mold growth is commonly observed in feedstuffs stored out in the open, because nitrogen, energy and oxygen: conditions supportive of mold growth Nelson (1992) are present in feed and feed piles.

Commodity sheds are an investment to reduce environmental exposure from the sun, rain and snow. When building commodity sheds, it is important to use plastic as vapor barriers in the floor to eliminate moisture. The open face of commodity sheds should be faced south to avoid moisture and other debris from reaching stored feeds.

It is also important to slope pads away from buildings to prevent water pooling inside of bays. Number and size of storage bays and size should take into consideration current and future storage demands. A bay that is at least 12' wide or wider should be considered so semi-trailers can easily back up into them. A larger number of smaller bays with the same cubic feet storage capacity as would be provided by a smaller number of larger bays is more desirable. This will permit complete cleanout of one small bay before fresh feed is delivered into a single larger bay preventing spoilage of feed remaining in areas of the large bay inaccessible to payloaders or skidsteers.

Left without repair, holes caused by wildlife or equipment in plastic silo bags can result in spoilage of a minimum of 15% to the entire contents of the bag Muck and Holmes (2006). Considering the costs of concrete, tin and lumber structures often seems prohibitive to many operators. Yet, when compared to ground alfalfa stored outside (Table 2), for which losses were measured at 10% to 20% of stored mass, losses from ground alfalfa stored inside a 3-sided building were only 5% to 10% (Kertz, 1998). At a price of $120/ton, these results would translate to savings of $9/ton. Using feed piles quickly (fewer than 7 days), and emptying storage bays completely before placing new product in them is important to prevent spoilage and dry matter losses.

Table 2. Approximate feed loss (shrink) due to storage and handling (% as-fed)

Ingredient	Open, uncovered piles	Covered, three-sided	Closed bulk
Alfalfa, chopped	10-20	5-10	-
Beet pulp, dried	12-20	5-10	3-5
Distillers, dry	15-22	7-10	3-6
Distillers, wet	15-40	15-40	-
Dry grains, typical	5-8	4-7	2-4

Adapted from Kertz (1998)

Feed predation

Rodents and birds attracted to feed storage and preparation areas are a threat to financial losses or cattle (and human) health. Observations resulting from a study conducted by Besser et al. (1968) demonstrated that a single starling was responsible for the disappearance of up to 2.8 lb of diet delivered in the feed bunk over a wintering period in Colorado. In the same time period, consumption by redwing black birds was measured at 0.13 lb/bird.

At an estimated 250,000 starlings and 300,000 redwing black birds ranged over a 1,600-square mile area in Colorado, in which there were 250 feedlots (West, 1968). Utilizing estimates of consumption above, the economic losses represented 370 ton (as-is).

In dealing with feed predation by most birds such as starlings, scheduling feed delivery time when birds return to their roosting area at dusk (Besser et al.,1968) was recommended as a strategy to reduce predation. Greenquist et al. (2004) observed that delivering a steam flaked corn-based diet 30 min before dusk to be consumed overnight, instead of once in the morning ad libitum to feedlot heifers, resulted in a reduction of 3.4 lb DMI/hd daily. In this study, DMI reduction could have also resulted from improved feed conversion efficiency and reduced feed predation by birds.

Disappearance of various diets by starlings ranged from 66% to 86% of original delivery in a study (Depenbusch et al., 2011) where only birds and not cattle were permitted access to feed bunks for 9 h (from 7:30 am to 4:30 pm). Diets formulated with steam flaked corn were more susceptible to predation than those formulated with dry rolled corn. In addition, starch concentration of residual feed left in the bunk after bird predation was less than 30% to 60% of the original starch concentration depending on diet. Crude fiber of residual feed was greater than that of feed placed in the bunk.

Feed consumption by other, larger wildlife may seem small; a single deer was measured by remote sensor video weights to consume 0.5 lb/d (Cooper et al., 2006). When considering size of deer, raccoon, wild boar and other wildlife populations around livestock operations, the total amount of feed predation by wildlife can become excessive (Table 3). Birds, rodents and other wild animals consume feed, increasing feed costs, but can also infect cattle with diseases such as *E. col*i O157:H7, *Salmonella* spp, *M. avium* subsp. *paratuberculosis*, coccidiosis, chlamydiosis (USDA 2000). Up to 8.3% of free ranging raccoons, rats and skunks carried *M. avium* subsp. *Paratuberculosis* (Corn et al. 2005).

Control of bird populations in US feedlots may represent an area of opportunity for improving overall efficiency. Only 35% of feedlots surveyed indicated that a bird control protocol was in place (USDA, 2013). Shooting at birds was the most commonly used form of bird control while chemical control was only cited by 9% of feedlots surveyed.

Dimethyl anthranilate (methyl N-methylanthranilate; DMA) and methyl anthranilate are GRAS substances (FDA) that may be used as bird repellents. Bird populations were reduced to nearly 10% to 20% of original populations, and consumption of feed from feed bunks was reduced nearly 90% when 0.20% to 0.28% DMA was sprayed onto lipophilic starch and included in pellets of cattle feed (Mason et al., 1985). Similarly, when mixed using farm equipment to yield a concentration of 1% DMA in milled feed, bird populations and consumption of feed by birds, mostly starlings, declined dramatically (Glahn et al., 1989). Concentrations of DMA in mixed feed remained relatively constant demonstrating stability of the compound. At current prices, undiluted fogging applications at a rate of 7 oz/acre cost $10/acre and should be repeated at 3 to 4 wk intervals.

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Five common grazing mistakes

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When it comes to optimizing grazing systems, most recognize that it is a mix of art and science. There is no "one size fits all" system or plan that is best, but there are some common mistakes which often reduce the output, and ultimately, the profitability of operations.

1. Not understanding the plant's needs

"Overgrazing May Not be Apparent". Overgrazing that is a result of overstocking is easy to see. However, even when there is plenty of foliage, overgrazing can occur because animals may selectively graze only certain plant species. Over time this can cause them to die, or at a minimum, be less productive. This is one of the main arguments for rotational grazing, as it can be used to reduce overgrazing of desirable species and increase grazing of less desirable species. Observing the makeup of plant species in your pastures and watching how they change over time can tell you a lot about your management and whether or not you are meeting the plant's needs.

2. Not being flexible

"Success is Dependent on Effort." Management is the most important investment you can make. An important component to proper pasture management is understanding and managing for the "green leaf paradox". The green leaf is the primary source of food for both the animal and the plant. Thus we need to give the plant the time it needs to "fatten up" in between periods of grazing. Overgrazing is generally not a consequence of grazing a plant too short once, it is usually due to regrazing the same plant before it has had time to replenish its stores of carbohydrates. The word generally is used here because some plants (such as orchardgrass) do store a significant amounts of their reserves in the lower stem and thus grazing these plants too short even infrequently can cause stand loss. Listen to the plants when they tell you they need rest. The amount of recovery time varies based on the growing conditions. If the plants have not recovered enough (reached the desired regrazing height) by the time you are ready to start back into a paddock, consider putting the cattle into your winter feeding area and using stored feed or going into a planned sacrifice pasture that you were considering renovating anyway. This type of management will pay back in the long run and likely result in you feeding less stored feed overall. Have a set rotation is easy but it is not effective.

3. Not investing in the pasture

"Test, Don't Guess". Test hay fields every year and pastures every three years. To make it more manageable, sample a third of your pastures each year. Do you have problem areas in your field where you have more weed pressure, less legumes, or productivity just seems lacking? Consider sampling this area separately. It is also a good idea to not include loafing areas in your composite samples (i.e. stay away from areas under trees, gates and waters).

"Soil pH is a Number that Deserves Respect". The pH of the soil is very important as it affects availability of the nutrients in the soil. Liming can easily payoff in terms of productivity if your soil is acidic. It is also important if you want to take advantage of legumes, because they are sensitive and will not do well in acidic conditions. Shoot for a minimum pH of 6.0 for grass pastures and a 6.3 for grass-legume mixes.

"Where Cattle Go, the Nutrients Flow". Phosphorus and potassium can become low over time, especially in fields that are hayed, but also due to relocation to areas where cattle congregate. Strategic management, such as unrolling hay or providing supplement on certain areas of the pasture can help even out nutrient distribution in pastures.

"You Can't Get Something for Nothing". When it comes to renovation, planning is important. Talk to your local extension/agronomy experts to ensure you have a good plan for establishment. For instance, since limestone reacts slowly to increase pH, it is best to apply it at least three months before establishing a forage stand. Having a good plan for killing the current plants and suppressing weeds are the next steps. Then, it is time to select the seed.

4. Not making use of technology

“Forage Varieties can be Compared to Bulls”. When it comes to seed selection you are making a long term investment in the genetics of your forage so make sure you use the best varieties possible. “Good Seed Selection Doesn’t Guarantee Success but a Bad One Guarantees Failure”. Be sure to use certified seed so that you don’t waste your money planting seeds that have low germination rates or come with weed seed.

“When You’ve Finished Changing, You’re Finished.” Just because you have never done it, does mean it is not a better option. Continual experimentation and tweaking is the only way to make improvements. High tensile electric, portable electric fencing, and temporary pipe are probably one the most readily assessable and powerful tools in your grazer tool box. They allow you to have endless options when it comes to grazing management. Are their areas of your pastures that are often under or overutilized? Using portable fencing is a great way to test out potential changes in pasture design to see if you can improve forage utilization.

5. Not taking advantage of opportunities

“An Investment in Knowledge Pays the Best Interest.” Knowledge provides the opportunity to make wiser choices and can ultimately lead to more profit. However, to reap the benefits of knowledge you must act on that knowledge. So go home and put those new ideas into action.

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Managing depreciation

Burke Teichert

In the business of ranching we have a lot of "stuff" that depreciates:

- Cattle
  - Bulls and cows
- Fixed Facilities
  - Buildings, fences, cattle working facilities, wells, water lines, stock tanks, etc.
- Vehicles and tractors
- Trailers and Equipment
- Large tools

We have some of this because it was once low cost and we got in the habit. We have some of it because we like it or it makes the work a little easier (perhaps not more profitable). And, we have some of it because we really need it.

A wise uncle in his 90's once pointed out that everything we own, owns us. How right he is. If we have any self-respect, we will spend money to maintain it and keep it functional and looking nice. I know too many ranches where they still maintain buildings no longer in practical use.

Having profitability as a goal, we ranchers should prefer to own things that appreciate rather than things that depreciate. If it rusts, rots or depreciates; we want to own as little of it as possible. Naturally we still have to get the work done, but knowing what we really need to get it done is really important.

Buildings, equipment and tools are on that list of "stuff" that depreciates. Yes, we need to get our work accomplished in an efficient and timely manner. However, we need to be very careful in what is really "required" to get it done. Reducing depreciable assets is one of the surest ways to reduce depreciation. It is not easy, but worth the mental effort to figure it out. I know of several ranches that were transformed from annual money losers to annual profit makers. The first big step was reducing the depreciable asset list. Then they started to look at opportunities to lease equipment for some jobs, hire custom operators for other work and work with equipment dealers to work their way to the ideal equipment list through 3 for 2 trades or other programed trading strategies to reduce long term depreciation of equipment.

Some of the larger operators trade their high use equipment fairly often—perhaps every 1-3 years. These trades are made during the slow time of year. The dealer can have the new tractor in place in time for busy season and often has the trade-in sold (probably to a smaller operator) before he gets it back from the rancher. Thus he was able to sell it without ever having to put it in his inventory. This kind of trading provides the dealer some room to work on a better deal for both ranching parties.

Land, livestock and people are assets that should appreciate, but they don't always do that.

Land should never depreciate in true value unless it is terribly abused. Well managed land should appreciate faster than the local market inflation. Good management of grazing and farming practices that will improve long-term soil health, reduce erosion and improve water quality will definitely make land value appreciate faster than the local market.

Livestock on most ranches depreciate in value, but we need to look at that more carefully. It is the value of the whole herd or the livestock inventory that we are working with. If you are doing things correctly, the herd value should appreciate faster than the cattle market over time. Not on the accountant's books, but at the market place, a new-born heifer calf will appreciate in value until it is about 4 years old. It will then stay about constant for another year or two; and then, at about 6 years old, it will begin to depreciate. I know several breeders who have a high heifer replacement rate and sell most of their cows before they are six years old. This works very well if you can keep the heifer development cost low. If you can't, perhaps you should not be raising heifers. The depreciation on cows purchased for replacements is a very cheap substitute for heifer development costs. I know, you can't buy cows as good as you can raise them; but I have done the arithmetic many times. It always favors buying replacement cows even thought they aren't as good. So, if you are going to raise heifers, you need to raise enough to sell bred cows for a good premium in order to be competitive. If you sell bred cows before they get very old for a nice premium, there is no depreciation.

People are not owned, but we own part of their time. If you can encourage, facilitate and reward their empowerment and, by your example, help them become life-long learners; their value to themselves and to the ranch will greatly improve. They will become more efficient in their work and bring more and better ideas to the managerial decision making process.

As we look at the major determinants of profit, we can see a number of ways to better manage depreciation. Here are the major determinants:

- Enterprise structure – cattle, sheep, wildlife, etc.
- Overheads (including people)
- Stocking rate
    - Cow size and milk production
    - Grazing and pasture management
- Fed feed vs. grazed feed
- Calving season
- Realized herd fertility
- Wise input use for optimum production
- Marketing

Sometimes we can stack a new enterprise on top of another—sheep with cattle—with little increase in overheads. Reducing overheads or spreading them over more units of production is an obvious way of managing depreciation. Increasing the stocking rate through smaller cow size and milking ability or with better grazing management can also spread depreciation across more units of production. Changing the calving season and reducing fed feed and other costs associated with winter calving can reduce the need for facilities, equipment and labor. That all reduces depreciation.

We need to be careful in the use of direct inputs—those that go directly to the cow or heifer. It is easy to "get sold" something that will improve performance (maybe) but cost more than the added performance is worth. I like to feel like I can get back two additional dollars for every one dollar I spend. Why, because our ability to estimate is not as good as we would like; and, if I overestimate the added performance, I am in trouble. Also, what if the price of the input goes up and cattle prices don't. After a time, cattle could very well become dependent on the input for adequate performance. If it's worth it, buy it; and it will spread depreciation. If it's not worth it, don't be talked into it.

I have a good friend in Montana that reduced acres per cow from 30 to 16 with good grazing practices over a number of years. Over that same period of time he spent about $50 per acre on fencing (some of which was portable electric fencing) and stock water development. He told me he had bought another ranch for $50 per acre and doesn't have to pay property tax on this one because it is located on top of the one he already owned. He also didn't have to add full time labor, a pickup, a tractor, a horse—just some fence and water work. They do require a little more of their own time or a little more day labor when they brand, pregnancy check and ship. That's pretty good management of depreciation.

Another friend in Missouri has improved stocking rate from 5-6 acres per cow to just under 2 acres per cow. In the meantime he sold all his haying equipment and purchases a little hay to stretch his winter stockpile of grazable feed. There is no depreciation on equipment that you do not own.

If you can reduce overheads, market well and improve three key ratios, you will be making great progress in managing depreciation. The ratios are:

- Acres per cow
- Cows per person
- Fed feed vs. grazed feed

I hope you can see how improving those ratios will either reduce depreciation or spread it across more units of production and more dollars of revenue.

Feed cost comparison basics (cowboy math)

Dan Loy, Extension Beef Specialist and Director, Iowa Beef Center at Iowa State University

The math involved in comparing available feeds can be simple or complex depending on the question and decision. But before you sharpen the pencil you should do some homework to make sure you are making the right comparisons. Here are a few steps to think about in the process.

Know the needs of the cattle and the value of your feeds and forages. Being strategic in using your feeds of different quality can minimize the need for supplementation.

Identify feedstuffs. Look out of the box. Today the first step in beef ration development is to identify the feedstuffs that should be considered. Surprisingly, often the best bargains are the feeds that are most local, especially those only you and a few neighbors know about or have access to.

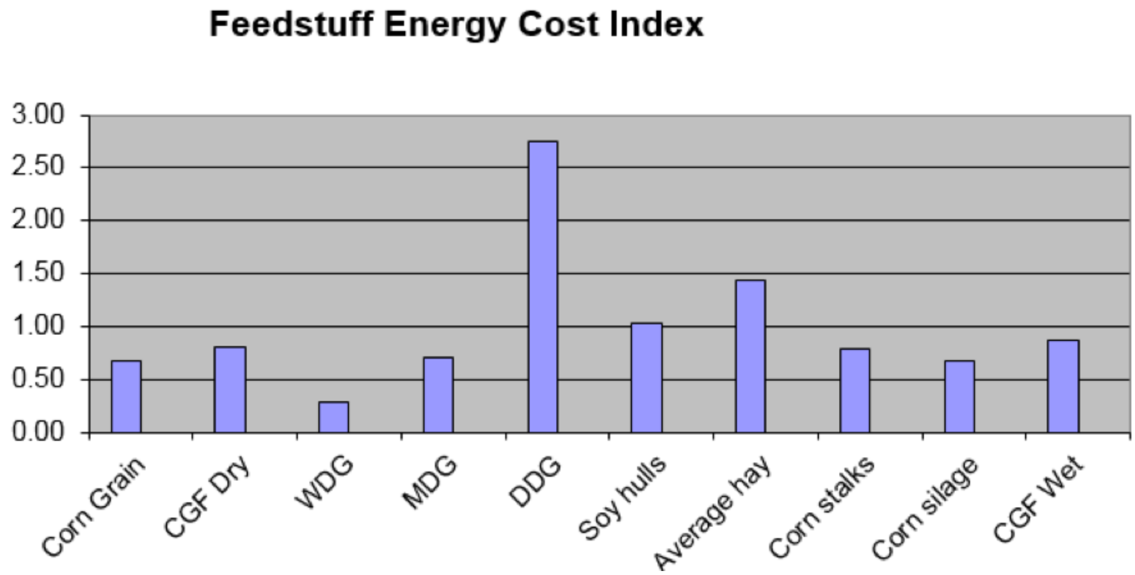
Check out these very local opportunities first. Some examples of these types of feeds that may be available are corn screenings from the local elevator, slightly damaged or off-grade corn from your cash corn neighbor, husklage from the local seed corn processing plant, or byproducts from local food and feed processors. Give your cattle the opportunity to be “locavores” if there is an economic opportunity.

The next feeds to consider are those that are limited in their market by moisture levels and transportation costs. In Iowa, these include modified distillers grains, wet distillers’ grains, wet corn gluten feed and condensed distillers solubles (syrup).

Finally, consider dry commodities that may be available. These feeds can be great bargains, but those bargains can disappear quickly because they are global commodities. Examples include dry distillers’ grains, soy hulls, corn gluten pellets, wheat midds and whole cottonseed.

Compare these feed per unit of nutrient. For example, if you need protein and the high price of distillers grains have you considering soybean meal you can calculate the cost per unit of protein. Be sure and consider the dry matter of the ingredients. As an example if soybean meal is $330 per ton, 90% dry matter and 48% protein then the cost per unit of protein is ($330/2000/.9/.48 = $.38 per pound of protein. If DDG is $175 per ton and 30% protein then cost per unit of protein is $175/2000/.9/.3 = $.32 per pound of protein. At these prices DDG is still a better value.

The chart below is generated by the feedstuff energy cost index program, a free download from the Iowa Beef Center (see references for link). The example here was from average prices published on January 12, 2019. The prices were taken from the National Ethanol Report, the Missouri byproduct feed price listing and the Iowa Hay Report. Of course, you should use your own delivered prices and account for storage and feeding losses, but this example shows that dried distillers grains are no longer a competitive source of energy. Corn silage at $40 wet distillers grains at $55 per ton are good values. Hay priced at $150 per ton are among the highest energy cost feeds available.



Balance rations. One of the major challenges of the new reality for feedstuff selection is that the most economical feeds will likely be quite variable in nutrient composition and/or need significant supplementation to meet the requirements of many classes of cattle. This requires producers to have a good relationship with suppliers. Routine feed testing and monitoring, along with complete ration balancing, is more important as feed costs increase. If you are want to tackle the ration balancing on your own, consider a computer program such as the BRaNDS program from IBC. Many of you will look to professional assistance from a nutritionist for help.

Lock in feed supplies and prices. Many ethanol producers offer forward contracts for MDG and WDG supplies and prices. If these feeds work out to be the most economical of the available feeds, this may be an option to consider. Also, with the volatility in feed, feeder and fed cattle prices, some protection of margins may be prudent when the opportunity arises. Check out our new crush margin app to help identify these pricing opportunities.

In today's economic environment, successful cattle producers are the ones who are flexible and adaptable in feed procurement. Once the feeds are sourced, however, efficiency and consistent management continue to be of utmost importance.

Resources

National Ethanol Report – https://www.ams.usda.gov/mnreports/sj_gr113.txt

Missouri Byproduct Feed Price Listing – http://agebb.missouri.edu/dairy/byprod/bplist.asp

Feedstuff Energy Index Program (free download) –
http://www.iowabeefcenter.org/Software/FeedEnergyIndexNE.xls

Crush Margin – http://www.iowabeefcenter.org/apps.html

Iowa cow-calf production: Exploring different management systems

Denise Schwab, Extension Beef Field Specialist, Iowa State University Extension and Outreach

Iowa is home to 4.2 percent of the United State's beef cattle inventory, the seventh-largest number of any state in the country. As of January 1, 2018, Iowa had the tenth largest beef cow herd with 970,000 cows. Land use in Iowa has changed dramatically since 1997, with approximately two million less acres in cropland pasture and associated losses in hay production (88 percent loss), while beef cow numbers in the state have declined only 14 percent.

Iowa has abundant feed resources including forages, grains, and grain by-products. The current emphasis on improving water quality has added an incentive to increase both annual and perennial forages across the landscape, further supporting the beef industry. Beef cow-calf production has been successful in many different types of environments and with different types of resources.

Although there are variations within each system and overlap between systems, this project characterized three systems. The traditional or conventional system consists of pasture grazing during the growing season and winter feeding of harvested or purchased feed in either a lot or open area. The second is an extensive grazing system which aims to have cows grazing at least 75 percent of the year with little supplemental harvested or purchased feeds. The last system is a limited grazing system where the majority of feed is harvested or purchased and cows are confined in a building or drylot for a majority of the time. In some cases there is limited grazing of small pastures or crop residue with this system for less than 25 percent of the year.

This project worked with 28 cooperating producers to assess emerging beef cow management technologies, summarize production and environmental data, develop decision aids and educational tools to assist Iowa cow-calf operators, and improve sustainability within all major cow-calf production systems in Iowa. Cooperating producers were categorized into one of the three management systems. Data collected included production cost records, forage quality, soil samples, and soil loss based on land use and conservation practices. Cooperator case studies were developed to demonstrate successful practices in each production system. Example budgets and decision tools to assist new or expanding operations evaluated which system best fit their individual resources.

On average, limited grazing herds had the highest cost of production in this project, followed by traditional herds, and extensive grazed herds had the lowest cost. However, there was much variation regardless of system type. All three systems have the potential to be low cost operations provided managers pay attention to feed and ownership costs.

A summary of feed resources utilized by the cooperators suggest that a diverse mix of feedstuff and pastures are available. Each producer has the ability to utilize the wide range of available feeds by nutrient testing, supplementing as appropriate, and capitalizing on available resources. While pasture availability may be limited in some regions of the state, the cost per cow-calf pair is competitive with other regions of the U.S. due to productivity.

Each operation poses unique animal health issues. The principles of animal health practices are similar regardless of production system but there may be differences in disease risk based on system and associated management practices.

Cow-calf enterprises can have a positive impact on the environment when well managed. Incorporating rotational or permanent pastures into crop rotations increases organic matter and reduces soil erosion. Feed production can impact the environment either positively or negatively. When corn silage is chopped, the addition of cover crops in the rotation reduces soil erosion. Long term pastures increase soil organic matter and recycle phosphorus and potassium from manure. Manure provides phosphorus and potassium for forage or crop production, however nitrogen contribution can vary based on handling and system.

Opportunities to add value exist for beef cow systems. More intensive systems lend themselves to advancements in technology such as embryo transfer, while also providing the ability to market grass fed beef direct to consumers.

Some keys to success are critical in all systems, such as optimum reproduction, feed cost management, risk management, use of good genetics, adoption of appropriate technologies, and optimum marketing of calves and cows. Financial management, debt management, and access to capital are also keys to business sustainability across all systems. Within systems, extensively grazed systems benefit from improved pasture management, parasite control, and minimizing machinery expenses. Traditional systems must reduce winter feed costs, improve pasture management, and utilize corn residue and cover crop grazing. Limited grazing system must manage year-round feed costs, watch for health issues, take advantage of manure value, and control facility and machinery costs.

The full manual will be available for purchase from the Iowa State University Extension Store (www.store.extension.iastate.edu) in the spring of 2019.

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Holstein and beef steer performance by self-feeding

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Abstract

The purpose of this report is to draw attention to the performance of steers finished by self-feeding a high-corn diet. In one comparison, Holstein steers were finished either by self-feeding or fenceline feeding a corn silage-containing diet. Self-fed finished Holstein steers were as efficient as fenceline-fed Holstein steers. Angus steers were finished by self-feeding but their diet contained 23.8% neutral detergent fiber (aNDF) and 50.9% non-fiber carbohydrate (NFC), whereas Holstein steers were self-fed a diet containing 18.5% aNDF and 58.6% NFC. In the absence of feeding Tylan, only 3 of 24 steers had evidence of liver abscesses. Commercial closeout results were obtained for 25 groups of Holstein steers and results were averaged. Their initial weight was 487 lb, harvest weight was 1437 lb, days on feed were 326 d, daily dry matter intake (DMI) was 20.4 lb/hd, average daily gain was 2.95 lb/hd, and diet DM disappearance per pound of weight gained was 6.97. Within management regimen, the coefficients of variation for these intake and gain variables was typically less than 4%, indicating consistency of steer performance. Under commercial conditions, the substitution of Component-IS for Synovex Feedlot One resulted in improved ADG and feed conversion efficiency. Optimization of self-fed diet composition and grain processing could yield improvements in efficiency for this method of finishing cattle. A 10% reduction in yardage is proposed for self-feeding versus daily feeding in fenceline bunks.

Introduction

A self-feeder consists of a diet reservoir and a feed trough that receives the gravity-induced outflow of feed from the reservoir. The self-feeder can have a chassis with wheels or can be on skids for portability. Self-feeders are also called "steer stuffers" by some folks. The rate of diet outflow into the pan is limited by a restrictor plate that has adjustable settings. The volume of the self-feeder reservoir, the number of cattle being served, and the daily consumption by these cattle determine the elapsed interval between filling the reservoir. It is reasonable for this interval to be one week. To avoid spoilage of diet in the reservoir and to ensure gravity flow, the diet must be a free-flowing diet and not subject to spoilage or bridging in the reservoir. For these reasons, only air-dry feed ingredients that are not sticky can be used in formulating a diet for this feeding method. The implication is that ingredients with moisture concentrations greater than 15% are not suitable for this feeding method. As the name implies, a self-feeder is a piece of equipment that allows cattle to consume feed in a free-choice manner. Licking is the means by which steers induce feed particle flow beneath the restrictor plate. Manufacturers will recommend a linear allowance of feed trough per head, depending upon size of cattle being fed. An allowance of 4-6 inches per head is reasonable. Since diet is freely available, competition for diet is not an issue. Therefore, steers of widely different sizes can be fed in the same pen. On the other hand, introduction of new steers into a group may violate quarantine practice, always involves a re-establishment of the pecking order, and prohibits one from developing a closeout summary of cattle and financial performance.

Use of self-feeders minimizes labor for feeding because daily feeding chores are unnecessary. Likewise, there is no need for a fence-line feed bunk nor is a total mixed ration (TMR) wagon for feed mixing and delivery needed. Yet, the self-fed diet must be mixed prior to delivery to cattle, though this mixing could be via on- or off-farm equipment. The minimization of feeding chore labor allows this feeding method to appeal to those who have off-farm employment or restricted access to labor. The implication of this feeding method for yardage expense will be addressed later in this paper.

The Holstein steer has been the preferred animal to be finished by the self-feeding method. Commercial implementation of self-feeders for Holstein steers was pioneered by Dr. Herb Rebhan. Dr. Herb Rebhan joined Doughboy Industries in 1959. In 1960, he began research that led to the development of a whole corn-pelleted supplement diet that was marketed as Tend-R-Leen (Forma Feed, 2019) beginning in 1963. Tend-R-Leen is a program that maximizes dietary starch input, enables the use of self-feeders by Holstein steers, and avoids hay inclusion (Schaefer et al, 2017, p. 146).

Very little public research has been conducted and reported for the self-feeding method when it has been applied to finishing confined, not grazing, cattle. Engel et al. (2013) used weaned Angus steers and heifers to compare a bunk-fed TMR of corn, wheat midds and tub-ground grass hay to self-fed corn-wheat midds or corn-wheat midds-barley diets with free-choice hay. The authors used wheat midds because they aimed to provide fiber to the self-fed cattle so as to prevent acidosis. Hay waste from the large round bales fed in ring feeders was mentioned but not quantified. Provision of free-choice hay in a round bale feeder is a common method of providing forage to self-fed cattle, yet the loss of hay from these feeders undermines accurate determination of feed conversion efficiencies.

The aims for this paper were to 1) report feed conversion efficiencies for Holstein and Angus steers fed via self-feeding under Arlington Beef Center research conditions, 2) summarize commercial closeout results for Holstein steers finished via self-feeding, and 3) to bring visibility to this feeding method in the beef cattle feedlot nutrition literature. Lastly, it was of interest to consider whether this feeding method merits further consideration as a cattle finishing method given the sustained shortage of labor in agricultural enterprises.

Materials and methods

Trial 1

The purpose of this trial was to evaluate whether feeding an antibody against interleukin-10 (aIL-10) would aid in preventing liver abscesses in Holstein steers. Interleukin-10 is a cell signaling molecule that tones down responsiveness of the immune system. Therefore, aIL-10 was hypothesized to allow the immune system to be more active in preventing invading rumen wall organisms from causing liver abscesses. Following their use in a grazing trial in summer 2016, 75 steers were stratified by weight and randomly allocated to one of three treatments which were as follows: Control diet which did not include tylosin, Tylan diet (positive control) which included a daily dosage of 90 mg tylosin/hd throughout the trial, and aIL-10 which involved the feeding of whole liquid egg that contained aIL-10 in the egg yolks. The dosage of aIL-10 was 750 µg/hd daily for d 1-14. This dosage of whole liquid egg was mixed daily into the batch of diet prepared for each pen. Each of the three treatments involved 4 pens of steers – 3 pens of 6 hd/pen and 1 pen of 7 hd/pen. Pen was the experimental unit for statistical analyses.

All steers were adapted to a 15% corn silage:85% corn and supplement diet and subsequently were switched to the Control self-feeder diet shown in Table 1 on a dry matter (DM) basis. During the few days after the diet switch, fecal consistency of these steers was consistent with the expectation that mild acidosis was occurring. All steers received the Control diet for 7 d prior to initiation of the trial. The diet was fed once daily in fenceline bunks. Steers received Vision 7, were dewormed, and received Revalor-XS implants on d 1. During d 1-14, treatments were administered to their respective pens and bunks were read so that daily allotments of diet met the appetite of the steers with very little residual feed carried forward to the next day. On d 14, two steers were removed from the trial for reasons unrelated to the treatments, and the remaining 73 steers were hauled to an open lot with bedded pack pole shed. Each treatment group of steers was penned as a single group and each of the three pens with approximately 25 hd per pen had access to a 3.5 ton Apache self-feeder.

Table 1. Composition of diets (dry matter basis) fed in Trial 1 during days 1-14 in fenceline bunk and during days 15-167 in Apache self-feeders.

Ingredient	Negative Control	Tylan	aIL-10 [a]
	DM basis	*DM basis*	*DM basis*
Corn, whole		34.8	
Corn, cracked		29.3	
Corn gluten feed		17.6	
Wheat, hard red spring		2.50	
Oats, whole		5.00	
Distillers grain		6.37	
Urea		0.32	
Calcium carbonate		1.82	
Max-Fat tallow		0.79	
Wheat midds		0.91	
Salt		0.20	
Trace mineral premix [b]		0.05	
Vitamin A [c]		0.04	
Vitamin D [d]		0.01	
Vitamin E [e]		0.09	
Rumensin premix [f]		0.26	
Negative Control, corn	0.03	-	-
Tylan with corn [g]	-	0.03	-
Whole liquid egg with corn [h]	-	-	0.03

Nutritional attribute	Negative Control	Tylan	aIL-10
Dry matter, % (n) [i]		87.6 (31)	
Crude protein, % (n)		13.3 (31)	
aNDF [j], % (n)		18.5 (31)	
NDF Digestibility, % of aNDF (n)		90.2 (3)	
Non-fiber carbohydrate, % (n)		58.6 (31)	
Starch, % (n)		47.5 (13)	
Starch Digestibility, % of starch (n)		88.4 (3)	
Non-starch NFC, % (n)		15.5 (3)	
Fat, % (n)		3.75 (31)	
Calcium, % (n)		0.70 (31)	
Phosphorus, % (n)		0.56 (31)	
Potassium, % (n)		0.71 (31)	
Magnesium, % (n)		0.17 (31)	
NE maintenance [k], Mcal/lb (n)		0.94 (31)	
NE gain [k], Mcal/lb (n)		0.64 (31)	

[a] Antibody against interleukin-10 which was present in chicken egg yolks after hens had been vaccinated with an 8-amino acid peptide sequence which copied bovine interleukin-10.

[b] Trace mineral premix contained iron, 1.0%; manganese, 4%; zinc, 6%; cobalt, 200 ppm; copper, 6000 ppm; iodine, 1000 ppm; and selenium, 200 ppm.

[c] Vitamin A premix contained 3 million IU/lb. This inclusion rate provided 1100 IU/lb diet DM.

[d] Vitamin D premix contained 1 million IU/lb. This inclusion rate provided 140 IU/lb diet DM.

[e] Vitamin E premix contained 20,00 IU/lb. This inclusion rate provided 19 IU/lb diet DM.

[f] Rumensin premix contained 5 g monensin/lb as-fed. Inclusion rate provided 27 g/ton diet DM. At dry matter intake (DMI) of 25 lb/hd*d, this inclusion rate provided 337 mg monensin/hd*d.
[g] Tylan 10 was mixed with ground corn so that 0.5 lb/hd of this premix mixed into diet daily provided 90 mg tylosin/hd*d.
[h] Whole liquid egg at dose of 750 µg interleukin-10 antibody/steer daily was blended into diet fed to each of four pens during days 1-14.
[i] Number of sample determinations in mean is shown in parentheses.
[j] Neutral detergent fiber following incubation with amylase.
[k] Net energy value estimated using equations from 2001 Dairy NRC.

The Arlington Station Feed Mill mixed the basal as-fed diet shown in Table 2, with or without Tylan supplement, and delivered it at approximately weekly intervals. Tallow was added to reduce dustiness of the diet. Wheat was included because it was available as a relatively inexpensive energy source. The hull fraction of oats was considered an attribute of the diet for rumination. Whole corn was included to serve as a less rapidly digestible starch source. Feed was maintained in the Apache self-feeders at all times. While being self-fed, steers had 68 square feet of pen space/hd, and were bedded every 4 d with oat hulls, sawdust or corn stalks. No forage was provided. The Apache self-feeder feed troughs provided 7.4 inches of linear frontage per steer. Feed troughs were 10 inches deep and 10 inches wide and these dimensions were insufficient for finishing Holstein steers since some feed was spilled by the steers. Diet samples were collected at the Feed Mill as batches were mixed. Samples were composited by month and by treatment and then sent to the UW Marshfield Soil and Forage Lab for analyses, all of which were by wet chemical methods. Steers were weighed on d 0 (11/28/2016), 1 and 167. On d 167, steers were loaded and hauled 120 mi to JBS Packerland, Green Bay, WI. Off-truck weight of the 73 hd was obtained from JBS Packerland as well as camera-based carcass data for 71 steers. On the day of harvest, we observed livers for number and severity of abscesses, and rumens were observed on the serosal surface for red spots presumably due to inflammation and injury to the rumen wall.

Table 2. Base formula for Holstein self-feeder (as-fed basis) diet fed in Trial 1.

Ingredient	Amount
	per 2000 lbs
Corn, whole	700
Corn, cracked	590
Corn gluten feed, not pelleted	350
Wheat, hard red spring	50
Oats, whole	100
Max-Fat tallow	10
Supplement, pelleted, with DDG and midds, with or without Tylan	200

Trial 2

The purposes of this trial were 1) to compare performance of Holstein steers when fed a finishing diet composed of ensiled shelled corn with 20% versus 28% moisture, and 2) to compare Holstein steers finished via fenceline bunk feeding versus self-feeding (Trial 1). Seventy-two Holstein steers were used for this trial, and they were derived from the same group of summer-grazed steers as used for Trial 1, but these were the heavier subset. Steers were stratified by weight into five weight blocks, allocated to pens of 6 hd/pen and 8 hd/pen. The diet DM formula is shown in Table 3. The 28% moisture corn was one hybrid, 108-d relative maturity variety Renk 791SSTX. The 20% moisture corn consisted of 11 varieties. Three of the larger pens and two of the smaller pens were randomly allocated to each of the corn moisture treatments, for a total of 5 experimental units (pen) and 36 hd per treatment. The two heaviest weight blocks were harvested on d 139 and the three lightest blocks on d 167. Off-truck weight of the 72 hd was obtained from JBS Packerland as well as camera-based carcass data for 72 steers.

Table 3. Composition of finishing diets (dry matter basis) fed to Holstein steers in Trial 2 to compare cracked corn with kernel moisture of either 20 or 28%.

	Corn Moisture Percentage	
Ingredient	**20**	**28**
Corn silage	12	
Corn, cracked	76.1	76.1
DDG	6.8	
Urea	1.0	
Limestone	1.9	
Potassium chloride	0.15	
Salt	0.20	
Trace mineral premix[a]	0.05	
Vitamin A[a]	0.035	
Vitamin D[a]	0.013	
Vitamin E[a]	0.09	
Rumensin premix[a]	0.26	
Tylan premix	0.035	
Max-Fat tallow	0.10	
Molasses, liquid	0.25	
Corn, coarse ground	1.0	

[a] Source and dosage of this ingredient was the same as shown in Table 1 footnote.

Steers were adapted to the 12% corn silage finishing diet and had received it for 4 d prior to d 0 and 1 of this trial. Vision 7 and dewormer were administered on d 0 and Revalor-IS was implanted into all steers on d 1. Bunks were read at 7 AM and diets were mixed and fed at 8 AM. Ration allotments were chosen to allow for only residual crumbs of diet at the 7 AM bunk readings. Corn stalks were used as bedding and the bedding interval was 4 d. Weights of the cattle used for reporting data were collected on d 0 (11/22/2016), 1, day prior to harvest and day of harvest. On the day of harvest, steers were hauled 120 mi to JBS Packerland, Green Bay, WI.

Trial 3

The purpose of this trial was to collect a feed conversion value for Angus steers finished via self-feeding. These 72 steers originated from a single straightbred Angus herd in Wisconsin. Prior to Trial 3, they were used in a project to evaluate energy value of high quality alfalfa haylages. Initial weights were obtained on May 2 and 3, 2017. Thereafter, the steers were stepped down over 30 d to a 15% corn silage diet. On May 31, Revalor-S was administered and steers were relocated to the nearby pole shed and Apache self-feeders that had been used for Trial 1. Corn stalks were used as bedding and the bedding interval was 4 d.

The Arlington Station Feed Mill mixed the diet shown in Table 4. This diet was intentionally formulated to have a greater fiber content because it is the bias of one author (DS) that native breed feedlot cattle are more prone to acidosis and founder than Holstein steers when fed high starch diets. Self-feeder diet samples were collected at the Feed Mill as batches were mixed. Samples were composited by month and then sent to the UW Marshfield Soil and Forage Lab for analyses, all of which were by wet chemical methods. Steers were weighed on d 0, 1 and 132. One steer was removed on d 77 and his proportion of DMI was removed from the feed conversion calculation. Thus, this was a "deads out" calculation. On day 132, steers were hauled 180 mi to Tyson Foods, Joslin, IL. Off-truck weight of the 71 hd was obtained from Tyson as well as camera-based carcass data for 71 steers.

Table 4. Diet formulas for Angus steers finished on self-feeders (Trial 3). Cattle were adapted to 15% corn silage diet and then shifted onto this diet on day 30. Harvest occurred on d 132.

	Formula	
	DM basis	**As-fed basis**
Ingredient		
Corn, whole	18.4	18.5
Corn, cracked	12.4	12.5
Corn gluten feed	15.1	15
Wheat midds	29.8	30
Oats, whole	9.9	10
Molasses, liquid	2.0	2
Max-Fat tallow	2.2	2
Supplement, pelleted	10.2	10
Nutritional attribute (n=3)		
Dry matter, %	86.7	
Crude protein, %	13.4	
aNDF, %	23.8	
Non-fiber carbohydrate, %	50.9	
Fat, %	5.2	
NE maintenance, Mcal/lb	0.92	
NE gain, Mcal/lb	0.62	

Statistical analyses

Trials 1 and 2 were analyzed using the Proc Mixed procedure of SAS Software 9.4. The model was y = treatment block treatment* block, and block was designated to be a random effect. Lsmeans were separated by the pdiff procedure. Means were declared to be different when $P < 0.05$. Since all steers were managed as one group in Trial 3 and there were no treatment comparisons, statistical analysis was not possible for these results.

Results

Trial 1

Nutritional attributes of the basal diet are shown in Table 1. The DM content of this diet indicates that it is sufficiently dry so that it will not support mold growth. Values for crude protein (CP), fat, calcium, phosphorus, potassium and magnesium are as expected for finishing cattle diets (NASEM, 2016). NDF was determined since the fiber fraction of this diet, as opposed to the starch fraction, is less rapidly fermented in the rumen. However, the 48-hr NDF digestibility (90.2) indicates that NDF in this diet was extensively digested. Principal NDF sources were corn gluten feed, oats and distillers grain. The NFC and starch fractions were 58.6% and 47.5%, indicating a high level of readily digestible carbohydrate, but the starch digestibility of 88.4% indicates that the starch has a low rate of digestion (Blasel et al., 2006). The equations of the Dairy NRC (2001) were used to calculate the net energy for maintenance (NEm) and gain (NEg) values. The NEg calculation is based on digestible NFC, digestible CP, digestible fat, and digestible NDF contents of a diet. The NEg value here (0.64 Mcal/lb) should be noted. Comparisons to this value will be made later in this paper.

Results for Trial 1 are presented in Table 5. Steers consuming the Tylan diet had higher daily dry matter intake (DMI), but there were no other treatment effects on average daily gain (ADG), feed conversion efficiency (DMI/ADG), incidences of liver abscesses or rumen wall inflammation sites nor carcass yield and quality variables ($P >$ 0.06). Tylan was not necessary to control liver abscess incidence because liver abscess scores were not elevated in the Control treatment. Three of 24 livers in the Control treatment had a liver abscess score of 2. There was no evidence of founder or hairy heel warts in these cattle. Remarkably, these steers had access to wooden posts and fence boards, but did not chew them. Since there were no notable differences among treatments, the performance of the group of 73 steers will the perspective carried forward in this paper. Quality grades on the group were highly desirable with a Choice and Prime percentage of 91.8%. Lastly, the initial and final body weights were determined in the morning. These should be considered to be full body weights (FBW) since no weight shrinkage would be involved in these weighing conditions.

Table 5. Growth and carcass performance of Holstein steers that received diets containing no Tylan (Control), interleukin-10 antibody (aIL-10) or Tylan (Tylan) during Trial 1 which had a duration of 167 days.

	Treatment[a]				
Variable	**Control**	**aIL-10**	**Tylan**	**SEM**	***P* value**
Initial BW, lb	825b	829ab	833a	20.4	0.014
Final BW, lb	1509	1521	1512	28.3	0.95
DMI, lb/hd*d	24.7b	24.3c	25.0a	0.04	<0.001
ADG, lb/hd*d	4.09	4.14	4.06	0.16	0.94
DMI/ADG	6.15	6.08	6.49	0.39	0.74
Liver abscess score[b]	1.12	1.17	1.12	0.07	0.89
Rumen serosa score[c]	1.34	1.00	1.05	0.17	0.38
Carcass, lb	867	865	869	16.1	0.98
Rib-eye, sq in	11.8	12.0	11.8	0.26	0.71
Yield grade	2.74	2.78	2.81	0.05	0.67
Marbling	552	512	520	9.8	0.06
Standard, %	0	0	4		
Select, %	8	12	0		
Choice, %	75	76	92		
Prime, %	17	12	4		

[a] During days 15-167, steers were fed as three groups (Control, aIL-10, and Tylan) via Apache self-feeders. Diet containing Tylan was fed during days 1-167, while diet containing aIL-10 was fed only during days 1-14.

[b] Liver abscess scoring metric was as follows: 1 = no lesions, 2 = liver with 1 or 2 very small abscesses or abscess scars, also known as A-score; 3 = liver with 2-4 well organized abscesses, generally less than 1 inch in diameter, A; and 4 = liver with one or more large, active abscesses or many small abscesses, A+

[c] Serosal surface metrics were as follows: 1 = normal white serosa color with no red spots; 2 = entire rumen wall with 1 or 2 small red spots; 3 = 2-4 red spots; and 4 = rumen wall with one or more large clusters of red spots, or many small red spots.

Trial 2

Owens et al. (1997) reviewed the effects of corn moisture on starch digestibility and feedlot cattle performance. They concluded that feed conversion efficiency improves when moisture content of ground or rolled corn increases and they predicted maximization of ADG at 30-31% corn moisture.

Corn starch granules are encased in a protein (zein) matrix. This matrix limits the accessibility of starch granules to the degradative enzymes of rumen bacteria. Corn varieties of lower (8-9%) crude protein content are associated with better starch digestibility than those with more elevated crude protein content. In addition, zein fractions have a role in affecting starch granule release from the protein matrix. Lower proportions of zein present in the delta zein fraction are associated with improved starch digestibility (Blasel et al., 2006). The corn compositional analysis shown in Table 6 reveals that there is a much lower proportion of zein present in the beta, gamma and delta fractions for the 28% moisture corn. Therefore, the compositional analysis of the 28% corn suggests that the diet composed of this corn should support better steer growth rates due to improved starch digestibility and more megacalories available for growth.

Table 6. Nutritional attributes of corn treatments and finishing diets for Trial 2. All tabulated values, except dry matter (DM) and moisture, are reported on DM basis unless indicated otherwise.

Attribute	20% Corn[a]	28% Corn[a]	20% Corn Diet[b]	28% Corn Diet[b]
DM, %	80.2	73.1	73.7	67.6
Moisture, %	19.8	26.9		
Crude Protein, %	8.32	8.73	12.5	12.4
Starch, %	76.0	81.9	68.4	68.5
Starch digestibility, % of starch	85.9	85.1		
Total zein, %	3.33	3.46		
Total zein, % of CP	40.02	39.63		
Alpha-zein, % of CP	33.65	38.95		
Beta, Gamma, and Delta Zein, % of CP	6.37	0.69		
aNDF, %			13.7	12.0
Non-fiber carbohydrate, %			64.4	66.5
Fat, %			4.2	4.1
Calcium, %			0.52	0.48
Phosphorus, %			0.49	0.49
Potassium, %			0.70	0.67
Magnesium, %			0.08	0.07
Sulfur, %			0.09	0.08
NE maintenance, Mcal/lb			1.00	1.01
NE gain, Mcal/lb			0.69	0.70

[a] Composition analysis is based on one sample.
[b] Composition analysis is based on five monthly composite samples

The diet fed in Trial 2 possessed a greater starch content (68%) and lower NDF content (13%) than the diet fed in Trial 1(47.5% starch and 18.5% NDF). These compositional differences resulted in calculated NEg values of 0.69 and 0.70 Mcal/lb for 20% and 28% treatments.

The astute reader will notice that the calcium to phosphorus ratio is near 1:1 in the Trial 2 diet (Table 6). These results indicate that some assumption with regard to calcium concentration in diet formulation was incorrect. Nevertheless, there were no instances of urinary calculi (aka water belly) in these steers.

Growth performance and carcass variables for Trial 2 steers are shown in Table 7. Feed intake, ADG and feed conversion efficiency tended to be improved due to the 28% corn diet, but did not qualify as significant effects. The ADG of the treatment groups was greater than 3.8 lb/d, yet it must be noted that these are FBW. The quality grades of the 20% and 28% treatment groups were highly desirable with Choice and Prime percentages of 94% and 97%, respectively. There was no evidence of founder or hairy heel warts in these cattle. Since effects due to corn moisture percentage were not detected, the performance of the group of 72 steers will be the perspective going forward.

Table 7. Growth and carcass performance of Holstein steers that received diets containing high-moisture corn with either 20% or 28% kernel moisture (Trial 2). Two pens from each treatment were harvested on d 139 and three pens from each treatment were harvested on d 167.

	Corn Moisture Percentage[1]			
Variable	**20**	**28**	**SEM**	**P value**
Initial BW, lb	882	884	15.2	0.53
Final BW, lb	1479	1510	19.2	0.23
DMI, lb/hd*d	25.3	25.6	0.37	0.09
ADG, lb/hd*d	3.83	4.04	0.11	0.20
DMI/ADG	6.62	6.35	0.15	0.24
Carcass, lb	842	863	13.8	0.14
Rib-eye, sq in	11.4	11.5	0.23	0.61
Yield grade	3.23b	3.31a	0.02	0.02
Marbling	540	551	11.1	0.18
Select, %	6	3		
Choice, %	78	91		
Prime, %	17	6		

[1] Diets containing one of the two corn treatments were fed in fenceline bunks once daily. Steers for this trial were chosen from the same population as those used in Trial 1.

Trial 3

The performance of the Angus steers is shown in Table 8. The ADG of 3.92 lb/hd*d is similar to the overall ADG noted for Trials 1 and 2. Consider that the aNDF content of this diet is 23.8%, the NEg is 0.62 Mcal, and Trial 3 performance includes the diet adaptation phase, which was not included in the steer performance variables of Trials 1 and 2. Although this diet had a lower energy density, 5-10% of steers in this trial displayed the slight upward hoof curvature which is characteristic of founder resulting from acidosis. The quality grade results are as follows: Select, 4%; Low Choice, 51%; Upper two-thirds Choice, 41%; and Prime, 4%. In summary, these steers grew well and were finished appropriately, but their hoof health suggested that this diet was near the upper limit of their tolerance for an energy-dense, self-fed diet.

Table 8. Comparison among Holstein steers finished by fenceline bunk- versus self-feeding and native black-hided steers finished by self-feeding.

Variable	Trial 1	Trial 2	Trial 3
Breed type	Holstein	Holstein	Angus
Feeding method	Self-feeder	Fenceline	Self-feeder
Steers, n	73	72	71
Initial BW, lb	826	883	844
Implant	Revalor-XS	Revalor-IS	Revalor-S
Final BW, lb	1513	1495	1361
Transportation shrink, %	4.9	2.5	3.4
Harvest BW, lb	1439	1457	1315
Dress, %	60.1	58.0	61.7
Carcass, lb	867	852	811
Ribeye area, sq. in.	11.9	11.5	13.0
Fat thickness, in.	0.31[b]	0.28[a]	0.57
Yield grade	3.3[c]	3.3	3.2
Marbling[d]	528	546	483
Empty body fat, %	29.1	28.9	30.8
Diet NEg, Mcal/lb DM	0.64	0.69	0.62
aNDF, %	18.5	13	23.8
Non-fiber carbohydrate, %	58.6	65.5	50.9
Starch, %	47.5	68	-
DMI, lb/hd*d	24.7	25.4	26.4
ADG, lb/hd*d	4.11	3.93	3.92
DMI/ADG[e]	6.00	6.49	6.72
SBW ADG[f], lb/h*d	3.87	3.91	3.83
DMI/SBW[e] ADG	6.38	6.50	6.89

[a] Fat thickness and percentage of kidney, pelvic and heart fat (KPH) were not provided directly in JBS Packerland yield grade report. Assumption was made that KPH was 2.5%.

[b] Fat thickness and percentage of KPH were not provided directly in JBS Packerland data. Yield grade was reported as “adjusted preliminary yield grade”. Assumption was made that KPH was not included in preliminary yield grade calculation, i.e., KPH = 0.

[c] If fat thickness is assumed to be 0.31 inches and KPH is assumed to be 2.5%, then “adjusted preliminary yield grade” of 2.78 becomes yield grade of 3.28.

[d] Marbling scores are as follows: 300-399, slight; 400-499, small; 500-599, modest; 600-699, moderate; 700-799, slightly abundant

[e] Feed conversion efficiency was calculated as DMI divided by respective body weight gain.

[f] Shrinkage of 4% was applied to initial BW and the respective transportation shrinkage was applied to final BW.

Summary of trials

The comparison of self-feeding versus fenceline bunk feeding is captured in Table 8. Although the implant regimens are not identical between Trials 1 and 2, the calculation of empty body fat percentage (Guiroy et al., 2002) suggests that Trial 1 and 2 steer groups were harvested at very nearly the same body composition. Therefore, comparison of feed conversion efficiency seems valid. To justify comparison of results shown in Table 8 with those shown in feedlot closeout reports, cattle weights in Table 8 were converted from FBW basis to shrunk body weight (SBW) basis. Payweights can be assumed to be SBW whenever cattle transport is involved prior to weighing. Initial BW was multiplied by 0.96 to calculate initial SBW. Final BW was shrunk by the transportation shrinkage percentage (Table 8) to calculate final SBW. Transportation shrink percentage was able to be calculated because steers were weighed immediately before transport to the packing plant and after unloading at the packing plant. It is interesting to note that the transportation shrink percentage for Trial 1 self-fed steers is 4.9% while the same value for Trial 2 fenceline bunk-fed steers is 2.5%. Determination of initial and final SBW was intended to allow comparison of ADG and feed conversion efficiencies (Table 8) to these variables in closeout reports which are on a "payweight to payweight" basis.

The self-fed steers (Trial 1) received a diet that had a lower NEg value than that for TMR fenceline-fed steers (Trial 2) because the self-fed diet had a higher NDF content and lower NFC and starch concentrations. In the absence of a statistical basis for comparison, it appears that there is no difference between the two feeding methods in terms of DMI, SBW ADG, or SBW feed conversion efficiency.

Trial 3 was conducted mainly for the purpose of obtaining a feed conversion efficiency value for native steers. The SBW feed conversion efficiency value of 6.89 is greater than for the Holstein steers because the corn grain step-up phase has been included, and the NE content of the Trial 3 diet was lower due to less starch and greater NDF content. The empty body fat percentage is greater than for the Holsteins which also contributes to less efficient weight gain. Yet, it remains to be determined if Angus steers can avoid acidosis if self-fed a diet equivalent to that fed to Holstein steers in Trial 1.

Commercial closeout results

Results for groups of Holstein steers finished by self-feeding were sought to complement the results of the above research trials. Ultimately, several Iowa cattle feeders graciously provided their closeout results for numerous groups of Holstein steers. The diets used in finishing these steers can be generally described as follows. One type of diet consisted of (as-fed basis) 67% cracked corn, 15% dried distillers grain, 12% pelleted corn gluten feed, and 6% balancer pellet, which provided supplemental minerals, vitamins and Rumensin. A second type of diet consisted of 65% cracked corn, 30% distillers grain, and 5% balancer pellet. Tylan, Optaflexx, molasses, probiotics and other non-nutritional additives were not included in either diet type. Vaccination programs varied among cattle feeding operations, ranging from 5-way respiratory and 7-way clostridial booster vaccinations upon arrival at the feedlot, to no vaccinations in the finishing phase. Long-stem or chopped hay was fed during the first 3 to 10 days after arrival. Diet was available for consumption at all times. Feed intakes and feed conversion efficiency calculations are based on "deads in", that is, feed consumed by steers that died or were culled could not be subtracted from total feed consumption. Each operation aimed to provide 40 square feet of pen space per steer and baled corn stalks were used as bedding in bedded pack sheds. Bedding was provided 2 to 3 times per week. All operations used natural ventilation and had access to ambient environmental conditions. All steers were harvested at JBS Packerland in Green Bay, WI. Bodyweights are SBW due to trucking prior to weighing. Percentage of Choice and Prime carcasses was reported by JBS Packerland at the time of payment.

Table 9 shows the closeout results for 5 groups of Holstein steers that were fed a corn-based diet via self-feeders. All groups were fed by the same cattle feeding operation, but not at the same location. The group size averaged 338 hd and average payweights at arrival and at the packing plant were 581 lb and 1445 lb, respectively, which implies that the average BW during the feeding period was 1013 lb. Since average DMI was 21.08 lb/hd*d, DMI was 2.08% of BW. Averages for ADG, feed conversion efficiency, and percentage Choice and Prime were 2.80 lb/hd*d, 7.54, and 79.8%. Note the consistency of results for a variable across groups. Standard deviations were calculated across the 5 groups and then divided by the mean, to assess coefficients of variation. Coefficients of variation for DMI, ADG, and DMI/ADG were 2%, 3.7%, and 4.6%, respectively. These coefficients are very low which is evidence for the consistency of steer performance.

Table 9. Commercial closeout results for Holstein steers fed a corn-based diet via self-feeders. Diet was indicated to be 87.5% DM and the only ingestible long particles were from corn stalk bedding that was provided twice weekly.

	Group				
	1	2	3	4	5
Head, n	294	390	114	360	534
Implants[a]	E+FO	E+IS	E+FO	E+FO	E+FO
Housing	Bedded Confinement	Outside lots with sheds	Outside lots with sheds	Outside lots with sheds	Outside lots with sheds
Initial wt, lb	565	593	594	610	541
Harvest wt, lb	1461	1458	1426	1440	1442
Duration, d	323.5	293	305	307	315
DMI, lb/hd*d	20.7	21.0	21.8	20.9	21.0
ADG, lb/hd*d	2.77	2.95	2.73	2.7	2.86
DMI/ADG	7.48	7.11	8.00	7.76	7.34
Death & Culls, %	4.85	2.74	5.0	2.7	2.9
Choice & Prime, %	-	78.33	81.25	79.75	80.01

[a] All steers received Component EC at 60 d of age during nursery phase. Additional implant protocols were as follows: E+FO, Encore administered at 350 lbs during calf growing phase, followed by Synovex Feedlot One at 180 d pre-harvest; E+IS, Encore administered at 350 lbs followed by Component IS at 90 d pre-harvest

An interesting alternative to use of a self-feeder is to provide the same diet in a fenceline bunk. In this case, rain and snow may fall onto the feed. However, personal communication with the cattle feeders indicated that Holstein steers preferred to eat the diet after it was moistened by rainfall, and fresh diet placed on top of a feed surface layer of snowfall was not a deterrent to diet consumption. Results for groups 6 to 11 fed in this manner are shown in Table 10. All groups were fed by the same cattle feeding operation, but not at the same location. The group size averaged 249 hd and average payweights at arrival and at the packing plant were 597 lb and 1404 lb, respectively. The average BW during the feeding period was 1001 lb, and average DMI was 20.83 lb/hd*d. Thus, DMI was identical to that for self-feeder groups (Table 9) at 2.08% of BW. Averages for ADG, feed conversion efficiency, and percentage Choice and Prime were 2.65 lb/hd*d, 7.85, and 81.8%. Growth rate and feed conversion efficiency for bunk-fed groups tended to be less favorable but percentage Choice and Prime tended to be better than for self-feeder groups.

Table 10. Commercial closeout results for Holstein steers fed a corn-based diet via fenceline bunks. Diet was indicated to be 87.5% DM and the only ingestible long particles were from corn stalk bedding that was provided twice weekly.

	Group					
	6	7	8	9	10	11
Head, n	214	281	118	185	479	215
Implants[a]	E+FO	E+FO	E+FO	E+FO	E+FO	E+FO
Housing	Outside lots with sheds	Outside lots with sheds	Outside lots with sheds	Bedded Confinement	Outside lots with sheds	Outside lots with sheds
Initial wt, lb	638	573	589	547	539	696
Harvest wt, lb	1420	1405	1418	1412	1370	1401
Duration, d	292	322	293	312	330	277
DMI, lb/hd*d	21.1	20.2	21.4	21.4	19.8	21.1
ADG, lb/hd*d	2.68	2.58	2.83	2.77	2.52	2.55
DMI/ADG	7.87	7.83	7.55	7.71	7.88	8.28
Death & Culls, %	4.89	6.6	1.7	7.5	6.1	4.0
Choice & Prime, %	80.80	83.29	86.55	81.78	76.9	81.66

[a] All steers received Component EC at 60 d of age during nursery phase. Additional implant protocols were (E+FO) Encore administered at 350 lbs during calf growing phase, followed by Feedlot One at 180 d pre-harvest.

Groups 12 to 14 (Table 11) were fed by the same cattle feeding operation as groups 1 to 11, but these recent groups received an implant protocol that included Encore implanted at steer weights of 400 lb and then a follow-up implant of Component IS at 80 days before harvest. These groups were lighter at arrival and heavier at the packing plant with SBW of 414 lb and 1481 lb, respectively. The average BW for these groups was 948 lb. Therefore, the average DMI of 20.7 lb/hd*d was 2.18% of BW. The greater DMI percentage could be due to the faster ADG of these groups, 3.07 lb/hd*d. These groups had a better Choice and Prime percentage of 95.1%, and remarkably better feed conversion efficiency of 6.74. As before, the coefficients of variation for the performance and quality grade variables were very low. Important differences between the two implant regimens are that the latter (Table 11) regimen involves an implant procedure at 1200 lb rather than 900 lb, and the latter regimen has less implant expense.

Table 11. Commercial close-out results for Holstein steers fed a grain diet via self-feeders or fenceline bunks with a modified implant protocol. Diet was indicated to be 87.5% DM and the only ingestible long particles were from corn stalk bedding that was provided twice weekly.

	Group		
	12	13	14
Head, n	364	289	385
Feeding method	Bunks	Self-feeder	Self-feeder
Implants[a]	E+IS	E+IS	E+IS
Housing	Bedded Confinement	Bedded Confinement	Outside lots with sheds
Initial wt, lb	373	362	507
Harvest wt, lb	1455	1467	1522
Duration, d	356	356	330
DMI, lb/hd*d	19.8	20.9	21.4
ADG, lb/hd*d	3.04	3.10	3.08
DMI/ADG	6.52	6.74	6.96
Death & Culls, %	9	4.9	3.75
Choice & Prime, %	93.61	95.86	95.96

[a] All steers receive Component EC as 60 d of age during nursery phase. Additional implant protocol: E+IS, Encore administered at 400 lbs, followed by Component IS at 80 d pre-harvest. Component-IS has the same hormonal composition as Revalor-IS (16 mg estradiol and 80 mg trenbolone acetate) but with a tylosin coating rather than chlortetracycline.

Groups 15 to 19 (Table 12) were fed in the past 3 years by a single cattle feeding operation at a constant location. These groups had the lightest starting SBW, therefore improved feed conversion efficiency is expected. These groups were 320 lb at arrival and 1433 lb at the packing plant. The average BW for these groups was 877 lb. Therefore, the average DMI of 19.3 lb/hd*d was 2.20% of BW. The greater DMI percentage could be due to the faster ADG of these groups, which was 3.07 lb/hd*d, as for Table 11 groups. Perhaps due to the lighter starting weight, their feed conversion efficiency of 6.28 was very good. The coefficients of variation for DMI, ADG and DMI/ADG were 3.6%, 2.2% and 2.6%, respectively, which indicate consistent performance across groups.

Table 12. Commercial close-out results for Holstein steers fed a corn-based diet via self-feeders and bunks with outside lots and sheds. Diet was indicated to be 87.5% DM and the only ingestible long particles were from corn stalk bedding that was provided 2 to 3 times weekly.

	Group				
	15	16	17	18	19
Head, n	140	111	120	140	135
Implants[a]	C+E	C+E	C+E	C+E	C+E
Initial wt, lb	348	329	335	310	280
Harvest wt, lb	1425	1435	1446	1441	1417
Duration, d	352	360	353	365	383
DMI, lb/hd*d	19.2	20.2	19.5	19.1	18.3
ADGb, lb/hd*d	3.06	3.08	3.15	3.10	2.97
DMI/ADG[b]	6.29	6.56	6.20	6.17	6.18

[a] Compudose was implanted at arrival and Encore was implanted 160 d later.
[b] These variables include an assumed death and culled calf loss of 3.5%.

Closeouts for groups of steers from three cattle feeding operations are shown in Table 13. In general, all groups follow the program shown in Tables 9 to 12 in that the arrival and harvest weights average 543 lb and 1466 lb, the duration averages 308 d, and ADG and feed conversion efficiency are 2.99 lb/hd*d and 6.93, respectively. Group 21 is noteworthy due to having the greatest ADG (3.41 lb/hd*d) of the 23 closeout reports and among the best feed conversion efficiency (6.25).

Table 13. Commercial close-out results from three cattle feeding operations for Holstein steers fed a corn-based diet via self-feeders. Diet was indicated to be 87.5% DM and the only ingestible long particles were from corn stalk bedding.

	Group			
	20	**21**	**22**	**23**
Head, n	104	103	152	
Implants[a]	C+RevIS	S+FO	E+RevIS	C+FO
Initial wt, lb	440	458	682	590
Harvest wt, lb	1409	1437	1495	1524
Duration, d	322	283	303	322
ADG, lb/hd*d	2.97	3.41	2.66	2.90
DMI/ADGb	6.72	6.25	7.62	7.13
Death & Culled, %	2.9	2.9	1.3	

[a] The implant protocols were as follows: C+RevIS, Compudose initially followed by Revalor-IS; S+FO, Synovex-S followed by Synovex Feedlot One; E+RevIS, Encore followed by Revalor-IS; and C+FO, Compuduse followed by Synovex Feedlot One.

Table 14 displays growth performance results for two large groups of Holstein steers. Group 25 was fed in a manner akin to the corn-pellet feeding program developed by Dr. Herb Rebhan. As for previous groups, harvest weight, DMI, ADG and feed conversion efficiency are similar, though Group 25 has ADG and feed conversion efficiency values among the best observed. Owens et al. (1997) stated that ADG numerically was greater with the wettest rolled corn and whole corn. The commonly spoken recommendation for this corn-pellet type of diet has been that fines in the feed trough should be avoided because they induce bloat and acidosis. Quality grade data were not available for these groups.

Table 14. Commercial close-out results from a Wisconsin feed company for Holstein steers fed a corn-based diet via self-feeders. Rumensin and Tylan were added to the diet.

	Group	
	24 [a]	**25 [b]**
Head, n	867	923
Implants [c]	RevG+RevIS	RevG+RevIS
Initial wt, lb	478	462
Harvest wt, lb	1397	1384
DMI, lb/hd*d	20.3	20.0
ADG, lb/hd*d	3.02	3.19
DMI/ADG [b]	6.72	6.27

[a] Diet ingredient composition was corn, 75%; dry gluten, 20%; and balancer pellets, 5%.
[b] Diet ingredient composition was corn, 90%; and balancer pellets, 10%.
[c] The implant protocol was Revalor-G followed by Revalor-IS.

Discussion

Comparison of results from Trial 1 and 2 with the commercial closeouts reveal an important difference. Relative to closeout results, the Trial 1 and 2 Holstein steers started on feed at 850 lb rather than as 487 lb calves (average of groups 1-25). Their prior use was for a grazing research trial (Nieman et al., 2019) in which their ADG was 1.25-1.8 lb/hd*d. The growth of Trial 1 and 2 steers probably includes the effect of compensatory growth which would be reflected in increased DMI and ADG. Consequently, Trial 1 and 2 steers versus groups 1-25 had daily DMI of 25 lb/hd rather than 20.4 lb/hd, and their SBW ADG was 3.89 rather than 2.95 lb/hd*d, respectively.

The coefficient of variation analysis within a management regimen indicates that Holstein steer performance is very consistent. Therefore, it seems that the sources of variation in the management regimen should be identified and quantified. Knowledge of the important sources of variation would mitigate the risk of having a low-performing group. Implant program is apparently an important source of variation. Groups 1 and 3-5 (Table 9) and groups 12-14 (Table 11) had coefficients of variation not greater than 3.8%, which indicates consistency within each management regimen. Then, changing implant protocol from Synovex Feedlot One to Component-IS as the second finishing phase implant increased ADG from 2.76 to 3.07 lb/hd*d, and decreased DMI per ADG from 7.64 to 6.74. Pen stocking density may also be an important source of variation. Trial 1 self-fed steers had a pen stocking density of 68 versus 40 square feet/hd for groups 1-22.

Yardage cost consideration

Yardage is the daily cost associated with a cattle feeding operation. It includes fixed costs such as buildings and equipment, and variable costs such as bedding, manure removal, and fuel for tractors. A summary of yardage expenses was assembled with input from 17 Holstein cattle feeding operations in Wisconsin (Halfman et al., 2015). The average yardage cost was $0.70 (not counting unpaid labor and management) per head daily. However, the summarized input was from cattle feeders who fed silage-containing diets in fenceline feed bunks. The summary did not include cattle feeders who used self-feeders for finishing Holstein steers.

Should there be an adjustment to this yardage cost estimate based on the use of self-feeding as a cattle finishing method? At first thought, it seems that machinery-related costs will be less with self-feeding. Our contemplation of this notion led us to not change the yardage cost based on the machinery component. Manure removal and diet mixing still require equipment, though the daily need for diet delivery is not needed so some savings exist here. Fenceline bunks and self-feeders have similar per head costs, and fenceline bunks could be the method for providing forage during adaptation of cattle to the self-fed diet. Collection of the closeout results revealed that farmers can use fenceline bunks for self-feeding without the added expense of stand-alone self-feeders. Labor is a potential source of savings for self-feeding because feed delivery is less frequent – perhaps weekly via self-feeders or every 2 d if fenceline feeding of the corn-based concentrate diet occurs. However, self-feeding still requires that Holstein steers be visually checked. Twice daily observations are needed after arrival of the cattle and daily observations to observe respiratory health, hoof health, mobility, pen dryness, etc are needed after the first month. The essentiality of managerial input is still present with self-feeding, but the intensity of the input is less. After contemplating the components of yardage in view of an average yardage expense for fenceline feeding a silage-containing diet, assumed to be $0.70 per head daily, we consider that the diminished labor component could warrant a self-feeding yardage expense of $0.63, which is a 10% reduction in yardage expense. A detailed comparison of the two feeding methods would be useful though uniqueness of these two feeding methods when implemented by cattle feeders also undermine the ability to generalize the yardage expense.

Conclusions, implications and the future

The very low incidence of liver abscesses suggests that tylosin feeding for liver abscess control is not needed. Given good feeding management, the comparison of Trial 1 and 2 groups suggests that feed conversion efficiency by self-feeding is equal to, if not better than, fenceline bunk feeding. However, more replication of this comparison is needed before drawing a more certain conclusion.

Research on self-feeding as a method for finishing Holstein steers has received insufficient attention. It would be interesting to study the effect of corn particle size on rumen pH, particulate passage rate, and the escape of dietary starch in manure. Likewise, the effect of NDF and non-fiber carbohydrate concentration in the self-fed diet should be investigated. Corn sources should be characterized in terms of their zein fractions. Pen density as it affects steer comfort is another potentially important source of variation. Lastly, is there a physiological or metabolic adaptation that enables Holstein steers to tolerate self-fed, high-corn diets? Could Holsteins have a more favorable endogenous salivation rate?

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The value of reproductive efficiency

Burke Teichert

This is an interesting topic. Certainly Reproduction in cattle has a high value. However, if your reproduction rate, which I like to call "realized fertility," is high; the value may not seem to be so great because it might take a lot of input to improve it very much. In reality, we are not trying to improve the pregnancy percentage. We are trying to reduce the percentage of open cows. If you want to improve pregnancy from 94% to 96%, you need to ask how much more you might have to spend on 100 cows to get two more pregnant. If your pregnancy rate is 80%, you have a lot more room for a reduction in the number of open cows.

In my previous talks I presented some fundamentals of "Profitable Ranch Management" which I will quickly review. Good managers work on each of these areas:

- Production
- Economics/Finance
- Marketing
- People

It's important to think of these in a systems context understanding that they all affect each other. Sometimes there are even antagonisms in "Production." My observation from discussions with many ranchers is that, as we have put upward pressure on growth and milk production, we have suffered a reduction in reproductive efficiency.

There are three ways to improve profit:

- Increase turnover, which improving reproductive efficiency definitely does. You simply have more to sell from the same ranch or herd when a higher percent of cows get pregnant.
- Reduce overheads.
- Improve Gross Margin. Gross margin is the resulting of subtracting direct cost, most of which are feed, from the total livestock revenues. If you get better reproduction by spending lots of money on feed and supplements, you may be "reducing" reproductive efficiency and thus gross margin also. Be careful with how you spend money on feed.

If you can work on animal breeding to adapt your cattle to the environment, this can often improve reproduction in a cost effective way. Good grazing management and aligning the calving season to be more in sync with nature can also maintain or improve pregnancy rates with significant reduction in costs—both overheads and direct.

For years I have pointed to the importance of "Five Essentials for Successful Ranch Management" which are:

1. The approach must be both integrative and holistic
1. Continuous improvement of the key resources – Land, Livestock, People
2. Use of good planning and Decision making tools
3. War on cost
4. Emphasis on marketing

Managing reproduction well certainly adheres to the "essential" of continuous improvement of livestock. It also fits under the "essential" of war on cost. When perfectly understood, it fits under the others as well.

Then there are major determinants of profit:

- Enterprise structure – cattle, sheep, wildlife, etc.
- Overheads (including people)
- Stocking rate
    - Cow size and milk production
    - Grazing and pasture management
- Fed feed vs. grazed feed
- Calving season
- Realized herd fertility
- Wise input use for optimum production
- Marketing

When we think about each of these, we can see that changing the calving season, replacing fed feed with grazed feed and improving the stocking rate with good grazing and modifying cow size can all have a very positive effect on the gross margin of the enterprise. At the same time, we need to be very careful with our cow culling and bull selection to insure that our cattle fit the new management or new environment. If we can remove cows from our herds that don't fit the environment (don't maintain condition, don't get pregnant, get sick or lame, etc.) and replace them with cows that do, over time pregnancy rates, herd health and calf survivability will all improve.

I have done some work comparing revenue possibilities of two herds with different levels of reproductive efficiency. The first model herds are terminal herds where all the calves are sold and replacement cows are purchased to maintain cow numbers at a constant level. One had a 96% weaned calf crop percentage (weaned calves/number of pregnant cows at beginning of calving) and 95% pregnancy rate at weaning time. The other herd had a weaned calf crop percentage of 92% and a pregnancy rate of 85%. I assumed weaning weights of calves to be the same for both herds and that all dries would be sold after calving and opens would be sold after pregnancy checking. I assumed that the high fertility herd would need to sell 10% in addition to opens and dries to remove undesirable and old pregnant cows. In the low fertility herd, I assumed selling 5% in addition to the opens and dries thinking that the opens and dries would include a lot of the undesirable and old cows.

The better herd had a revenue advantage of $102 per cow. The differences in pregnancy and calf survival seem large, but national data suggest that these kinds of differences exist.

I then compared two maternal herds where most of the heifer calves were kept and exposed to bulls at one year of age with the opens being sold as feeders and any pregnant cows or heifers in excess of the need to maintain a constant inventory were sold as pregnant cows.

Table 1. Herd assumptions.

	Weaning %	Pregnancy rate
Better herd		
Cow	96	96
H2 (two yr old)	93	93
H1 (yearling)		85
Poorer herd		
Cow	92	88
H2 (two yr old)	90	85
H1 (yearling)		75

It was again assumed that all dries would be sold at the end of calving season and the opens would be sold at pregnancy check time. The difference was $80 per animal unit in favor of the more fertile herd. Those kinds of differences add up.

Summary

- Since we are striving for profit per acre, we must make sure that we balance growth and milk with fertility. Pushing hard on growth and milk will reduce fertility unless additional feed is fed. This is seldom cost effective.
- Many things can have an effect on fertility. Most of them are related to our management and the environment. Because of its economic importance, which compounds over time, it seems that the best approach to achieving a high level of realized herd fertility is to make the cattle fit the environment.
    - On low to moderate inputs, fertility is more highly heritable than often thought.
    - You want to cull heifers and cows that don't conceive early in the breeding season. You will have to define "early" by the current length of your calving season. You may need to take several years to cull as deeply as you want.
    - Only use bulls that were born in the first 25 days of calving and show evidence of fertility in their closely related females.
- A very good alternative is to buy bred cows as replacements and breed them to terminal cross sires and sell all the calves. It would be nicer still if you could find a source cows that have been bred for fertility in an environment like yours.

Spreading overhead cost in the cow herd

Amanda Cauffman, Agricultural Educator, Grant County, University of Wisconsin-Extension

Overhead cost is a significant concern for cow-calf enterprises as there are significant expenses that need to be covered by the productivity of the beef cow herd. The productivity and profitability of the cow-calf enterprise can be greatly impacted by management decisions. By implementing adequate and accurate record keeping we can more easily evaluate the enterprise, measure the impacts of management changes, look for areas of improvement, and justify purchases.

Financial records

Financial records are divided into two categories, direct costs and overhead costs. Direct costs are expenses that are impacted by the number of cows present in the enterprise. As cow numbers increase so does the direct costs. Direct costs are easy to monitor and would include such things as feed, veterinarian care and supplies, fuel, oil, and marketing costs. Overhead costs are not impacted by the increase or decrease of cows in the herd and they are not always the easiest to track. Overhead costs include such things as equipment, land costs, depreciation, interest, repairs, taxes, and insurance. In a diverse operation we need to be able to assign a percentage of the cost to each enterprise.

Comparison of cost of production

To gain a better understanding of how overhead costs impact cow-calf enterprises we pulled information from the University of Minnesota's Center of Farm Financial Management's FINBIN and were able to evaluate direct and overhead costs from 45 farms located in Southeast and East Central Minnesota in 2017. The data compares the bottom 20% of farms for profitability, the top 20% of farms for profitability, and the average.

The revenue for this information was calculated by the sale of calf and cull cow sales. The information showed the bottom 20% of farms sold calves on average for $25 per cwt less than the top 20% of cow-calf enterprises. This may be due to lack of backgrounding, uniformity, or group size. The bottom 20% also had more cull cow sales and retained more replacement heifers.

Table 1. Background information for data set.

Measure	Average	Low 20%	High 20%
Herd size	66	**30**	68
Average weight sold (lbs)	626	611	621
Number of calves sold per cow	0.75	0.79	0.95
Cull income per cow ($)	100.85	115.93	76.01
Avg price/cwt ($)	142.63	**118.29**	143.90

The information revealed that having fewer cows in the herd impacted the effect the overhead cost had on the enterprise. The fewer the cows meant less calves that were produced to spread out the overhead costs. The direct costs had little impact on the profitability of the farms with feed costs being relatively even but saw an increase in the cost of repairs and fuel for the bottom 20% of farms. The increase in the cost of repairs may be an area where the farms can better themselves in caring for facilities and equipment.

The overhead cost is where we saw the greatest impact on cow-calf enterprise profitability with the greatest difference being in the equipment and building depreciation category and the interest category. This may be due to having more equipment than what the enterprise truly needs or can sustain. It could also signify too new of equipment. The high interest category may be due to having loans at the bank for equipment, land, or buildings all of which would impact overhead costs.

Table 1. Summary of the gross return, direct, overhead, labor, and management costs.

Measure	Average	Low 20%	High 20%
Gross return	770.00	685.00	925.00
Direct costs	551.95	564.67	560.30
Overhead costs	148.12	295.52	146.40
Return over direct and overhead	69.93	-175.19	218.30
Labor and management	95.03	197.27	110.37
Net return to labor and management	-25.10	-372.46	107.93

Performance records

The performance records can better help us understand overhead costs by identifying strengths and weaknesses with our management practices. It helps us identify any “problem” cows or cows that are not going to efficiently produce calves to help spread out the overhead costs. Performance records start at birth and we need to be able to keep adequate records regarding which cow had which calf, calving dates (which is correlated to cow fertility), calving weights or calving issues, and health records. We additionally need to record weaning weights and monitor which cows are high in production and which are marginal. The marginal cows may need to be managed differently or eliminated.

We can also use benchmarking to predict profitability. Pregnancy percentage (number of cows bred divided by number of cows exposed) predicts issues with fertility or bull power. Calving percentage (Number of calves born alive divided by number of cows bred) indicates issues with fetal loss or dystocia. These measurements allow us to evaluate our management and how it affects herd health and productivity.

Enclosing

Cow-calf enterprises do not handle overhead costs well, that is why we must strive to be better than average by making educated, calculated decisions. It is important to keep in mind that we can’t manage what we do not measure.

References

University of Minnesota Center for Farm Financial Management FINBIN

Identifying and selecting efficient cattle

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Introduction

Feed efficiency has become a very popular topic among cattle producers and researchers. However, this is not a new concept. Researchers have been studying feed efficiency for 40 years. However, changing dynamics in agriculture have brought more feed efficiency research to the forefront. The combination of decreasing acres available for crop production, an increasing world population, increased utilization of grain for fuel, increased input costs (fuel, transportation, and fertilizer) and an increase in feed costs (grain and forage) are some of the key factors that highlight the changing dynamics of agriculture. Historically, feed costs have represented 50-70% of the cost of production for beef enterprises. As corn prices approached and exceeded $7 per bushel, feed costs were nearly 80% of the costs in many feedlot operations.

Measures of efficiency

Feed Conversion Ratio (FCR): Feed conversion ratio is the ratio of dry matter intake to live-weight gain. A typical range of feed conversion ratios is 4.5 -7.5 with a lower number being more desirable as it would indicate that a steer required less feed per pound of gain. Feed conversion ratio is a good measure for monitoring or describing feedlot cattle performance; however, it is not a great measure to select for. Feed conversion ratio is correlated to growth rate. Selecting for improved FCR would result in an increase in genetic merit for growth which would lead to increased mature cow size which would ultimately increase the feed costs for the cow herd.

Residual Feed Intake (RFI): Residual feed intake is an alternative measure of efficiency. It is the difference between actual intake and predicted intake based on an animal's body weight, weight gain, and composition. A negative value for RFI is good as it would indicate that a steer consumed less feed than was predicted for his weight, gain, and composition. An advantage of RFI is that it is independent of growth and mature size. Because it is independent of growth, research has investigated selection based off of RFI.

Residual Gain (RG): Residual gain is the difference between actual gain and predicted gain based on an animal's body weight, intake, and composition. A positive value for RG is good as it would indicate that a steer gained more than was predicted for his weight, intake, and composition. This measure is correlated to growth; thus, it may be better suited for identifying superior feedlot cattle and not as good for selecting replacement females.

Current status of the industry

Although feed efficiency has been studied for decades and feedlot profitability is clearly impacted by feed efficiency, the beef industry is well behind the competition. Feedlot cattle typically have FCR at or above 6:1, swine are < 3.5:1, poultry are < 2:1, and catfish are nearly 1:1. In fact, poultry have improved feed efficiency by 250% in the last 50 years. However, the beef industry has made minimal to no improvement during the last 30 years. Why are cattle less efficient? Unfortunately, beef cattle will never be as efficient as monogastric animals. Ruminant animals consume a higher fiber diet and through rumen fermentation energy is lost as methane. Also, because of their larger size, cattle have a much higher maintenance requirement. However, this does not explain why we have made little to no improvement. The answer to that is simple; we have not selected for feed efficiency until recently. Identifying superior individual cattle requires feed intake records for individual animals. This requires expensive and/or labor-intensive facilities.

Technological advances facilitate efficiency research

Major technological advances in feed intake measurement now allow cattle to be maintained in a pen environment yet have individual intake recorded. Technology, such as the GrowSafe® system, utilizes radio frequency ID tags and a bunk that is on scales. Only one animal at a time is able to eat. An antenna in the bunk reads the radio frequency ID tag and records the weight of the feed in the bunk when the animal puts its head in the bunk and when it removes its head from the bunk. Several universities and private businesses now have technology similar to this to record individual feed intake. The use of ultrasound allows repeated measurements of 12th rib backfat, rump fat, marbling and ribeye area. When calculating RFI and RG, composition is often included as it accounts for some of the variation in intake and/or gain.

Cowherd efficiency

Much of the research thus far has focused on identifying cattle that are efficient in feedlots on high energy (grain) diets. However, identifying efficient females to retain in the herd may deserve as much or more attention. Approximately 70% of feed resources utilized in the beef industry are for the cowherd and about 70% of that feed is for maintenance. This means that nearly half of all of the feed used in the beef industry is just to maintain the cowherd. Several definitions have been proposed for cow efficiency. Beef cow efficiency measures often include pounds of calf weaned and intake. Reproductive success and longevity obviously can have a dramatic impact on the bottom line of a cow-calf operation. More work is needed to evaluate the effects of selecting for various feed efficiency measure on reproductive success, cow productivity and longevity.

Selecting for feed efficiency

A variety of philosophies currently exist regarding the best approach to selecting for feed efficiency. Breed associations are taking different approaches. Private companies are investing in genetic improvement of feed efficiency. Seedstock producers are evaluating feed efficiency and marketing bulls accordingly. Single trait selection has never been a good idea. The same is true with regards to selecting for feed intake or feed efficiency. There is a growing consensus among geneticists and breed associations that incorporating feed intake into multi-trait terminal focused selection indexes is the best approach to select for feed efficiency in feedlot cattle. Further feed intake (and especially grazing intake) records are needed on replacement females and mature cows to be able to further understand relationships of feed intake and feed efficiency with other cowherd traits.

Summary

Limited feed supplies and high feed prices have increased producer awareness of feed efficiency recently. Feed efficiency has been studied for decades yet minimal progress has been made in the beef industry. Recent advances in technology now allow for individual feed intakes to be recorded on cattle fed in large groups. Research has largely focused on identifying superior cattle during the finishing phase when cattle are fed grain-based, high-energy diets. However, the cowherd consumes a lower energy, forage based diet. Additional research focused on collecting forage and grazing intake in replacement heifers and mature cows is needed. Depending on the breed and Seedstock producer, a range of opportunities exist for genetic improvement in feed efficiency. There is a trend towards incorporating feed intake into multi-trait terminally focused selection indexes. Further research is needed to understand the impacts of selecting for feed efficiency on cowherd reproduction, productivity, and longevity.

Effects of trace mineral supplementation of steers with or without hormone implants on growth and carcass characteristics

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Summary and implications

The utilization of hormone implants and the supplementation of trace minerals have become well adopted management strategies in the feedlot industry. When hormone implants increase rates of growth in feedlot cattle this could increase the demand for trace minerals to support those rapid rates of growth. In experiment 1, an aggressive implant strategy dramatically increased growth rates and hot carcass weight, without having negative effects on marbling score. It was also observed, regardless of hormone implant, that trace mineral supplementation tended to increase overall ADG and steers supplemented at industry consultants recommended concentrations had a 33 lb increase in hot carcass weight compared to cattle that received no trace mineral supplementation. Focusing on varying supplemental Cu concentrations, experiment 2 determined that growth performance in response to hormonal implants is differentially affected by dietary Cu supplementation. Overall live ADG was improved by 24.7% due to implant in cattle not receiving supplemental Cu while only a 15.3% improvement in ADG was observed in cattle receiving industry recommendations of Cu (20 mg Cu/kg DM) in accordance with a survey of consulting nutritionist (Samuelson et al., 2016). Additionally, implants impacted liver mineral concentrations of Cu, Mn, and Zn. These studies suggest that hormone implants remain a good return on investment although additional work is warranted to determine the optimal concentration of individual minerals to support the optimum growth of finishing beef steers.

Introduction

Growth rates of feedlot beef cattle have dramatically increased as the result of advancements in genetics and management technologies. Hormone implants are a well adopted management strategy used to increase growth rates and increase hot carcass weight; however, it is unknown what the trace mineral requirements are for rapidly growing beef steers.

Therefore, these experiments study the concentration of supplemental trace minerals to evaluate the performance benefits to cattle receiving a high potency hormone implant program or steers not receiving a hormone implant. The first objective was to determine if supplementing a trace mineral program at differing concentrations impacted performance and biological factors in non-implanted and implanted cattle. As a follow up, the second experiment focused on the effect of supplemental Cu on the performance of implanted and non-implanted cattle. In both studies, it was hypothesized that implanted cattle experiencing greater growth than non-implanted cattle would require increased trace mineral supplementation to accommodate growth.

Materials and methods

Experiment 1

Seventy-two Angus-cross black hided steers (856 ± 37.8 lb) were used in a 2 × 3 factorial arrangement. Upon arrival steers were fed a 40% cracked corn, 30% hay, 25% modified distillers grains (MDGS), and 5% supplement diet for 7 days. Steers were transitioned over 21 days to a corn-based finishing diet, described in Table 1. Steers were housed 6 per pen in pens equipped with GrowSafe feeding bunks for individual feed intake determination.

Consecutive-day initial body weights (BW) were collected, and half of the steers were implanted (IMP) with Component TE-IS (Elanco) while half remained non-implanted (NoIMP). Steers began trace mineral supplementation treatments on day 0. Trace mineral treatments included: 1) CON that received no additional trace mineral supplementation, 2) REC that received supplementation at the national recommendations (NASEM, 2016) for Cu (10 mg/kg), Zn (30 mg/kg), Mn (20 mg/kg), Se (0.10 mg/kg), Co (0.15 mg/kg), and I (0.50 mg/kg) from inorganic sources, and 3) IND which received supplementation at the mode value from the Samuelson et al. (2016) feedlot consulting nutritionist survey for Cu (20 mg/kg), Zn (100 mg/kg), Mn (50 mg/kg), Se (0.30 mg/kg), Co (0.20 mg/kg), and I (0.50 mg/kg) from inorganic sources. This resulted in six total treatments with 12 steers per treatment combination.

Interim BW were collected on days 28, 56, 70, 84, 123, and 124. Implanted steers were re-implanted on day 56 with Component TE-200. All steers were shipped to a commercial packing plant (Iowa Premium Beef) on d 124 and were harvested on d 125 and individual carcass data were collected.

Liver biopsies were collected from 3 steers per pen on d -7, 70, and a sample was taken at slaughter (d 125) for trace mineral analysis. Blood samples were also collected on d -1, 70, and 124 for plasma glucose and urea nitrogen concentrations.

Data were analyzed as a 2 × 3 factorial using the MIXED procedure of SAS 9.4 (SAS Inst. Inc., Cary, NC). Animals were assigned to treatments using a completely randomized block design. Fixed effects included block, growth stimulating implant (GS), trace mineral supplementation (TM), and GS × TM. The experimental unit for all data was steer (n = 12 per treatment for performance and carcass data except NoIMP/REC where n = 11; for blood and liver data n = 6 for all treatments except IMP/IND where n = 5). Average daily gain, DMI and F:G were summarized by implant period. Liver mineral from d -7 and plasma glucose and PUN from d -1 served as covariates in analysis for respective parameters to all subsequent sampling dates. Data from one steer were not included in the statistical analysis due to poor overall performance (from NoIMP/REC treatment). Data reported are LSMEANS with SEM. Significance was determined at $P \leq 0.05$ and tendencies determined when $0.05 < P \leq 0.10$.

Experiment 2

Sixty Angus-cross black hided steers (1052 ± 71.0 lb) were housed in partially-covered pens with concrete bunks and automatic waterers. Steers utilized in the present trial were previously enrolled in another trial, in which the Cu antagonists S and Mo were fed to develop distinct liver Cu concentrations. At the start of the present study steers were blocked by initial liver Cu concentration and stratified to pens (6 steers per pen; n = 10 pens total) by BW. Pens were randomly assigned to dietary treatments. Cattle were fed a common dry rolled corn based TMR supplemented with NASEM (2016) recommendations of all minerals except for Cu, described in Table 1.

Experimental treatments were arranged as a 2 × 2 factorial, with 2 dietary Cu treatments: 1) control (CON) common TMR with no supplemental Cu, and 2) industry Cu supplementation (IND) common TMR supplemented with 20 mg Cu/kg DM from CuSO4. Two implant strategies (IMP) were utilized: 1) no implantation (NoIMP) or implanted with a Component TE-200 (TE-200; 20 mg E2 + 200 mg TBA; Elanco Animal Health, Greenfield, IN). Implant treatments were distributed equally among pens (3 steers per treatment per pen). All steers were previously implanted with a Component TE-IS (16 mg E2 + 80 mg TBA; Elanco Animal Health, Greenfield, IN) 107 days prior to the initiation of the present trial. The industry treatment was chosen to be representative of the mode industry consultant recommendation for Cu (Samuelson et al., 2016) in contrast to NASEM (2016) recommendations of 10 mg Cu/kg DM. The common diet analyzed to contain 4.5 mg Cu/kg DM and the IND diet analyzed to contain 21.6 mg Cu/kg DM.

Body weight was recorded on consecutive days to start (d -1, 0) and end (d 73 and 74) the trial, and interim weights were recorded on d 13, 28, and 55. For calculations of BW and ADG a 4% pencil shrink was applied to all live BW. Liver biopsies were conducted on d -23, 14, and 62 on 4 steers per pen (2 implanted and 2 non-implanted) and blood samples were collected on d 0, 14, and 73 from the same steers (n = 40 total, 10 per treatment). Cattle were shipped to a commercial abattoir (Iowa Premium Beef, Tama, IA) on d 74, harvested on d 75 and HCW were recorded. Carcasses were chilled for 48-hours and carcass data were collected including REA, back fat (BF), KPH, marbling score, and YG. Dressing percent was calculated as HCW divided by shrunk final BW and multiplied by 100.

Data were analyzed as a 2 × 2 factorial using the Mixed procedure of SAS 9.4 (SAS Inst. Inc., Cary, NC) with the fixed effects of Cu, Implant, and Cu × Implant. The experimental unit was steer (n = 15 per treatment for growth and carcass data; n = 10 per treatment for liver and blood data). Initial liver Cu (day -109) and BW (day -107) from the previous trial were used as covariates in liver Cu and performance analysis, respectively. Blood parameters were analyzed as repeated measures. In addition, plasma Zn data were log transformed to normalize the data, and back transformed means and standard errors are reported. Cook's D was used to evaluate data for outliers, and two data points for the IND-TE-200 treatment were removed from plasma Cu and Zn analysis. Data reported are least square means with standard error of the means. Statistical significance was determined at $P \leq 0.05$, with tendencies defined as $0.05 < P \leq 0.13$.

Results

Experiment 1

Day 56 BW tended to be ($P = 0.10$) and d 0 - 56 ADG was ($P = 0.05$) affected by the GS x TM interaction, where within implant treatment, BW and ADG for steers receiving REC or IND were greater than CON, all IMP treatments out-performed NoIMP, but TM had no effect within NoIMP steers. Day 0 – 56 DMI and F:G was improved in implanted steers compared with non-implanted steers ($P \leq 0.01$).

Implant effect data are presented in Table 2. There were no GS x TM interactions for d 56 – 124 performance, DMI, overall performance, or carcass-adjusted live animal performance ($P \geq 0.13$). Day 56 – 124 ADG, DMI, final BW, and overall ADG, DMI, and F:G were improved in IMP steers compared with NoIMP steers ($P \leq 0.03$). Carcass-adjusted final BW and ADG in IMP steers were greater than NoIMP steers ($P < 0.01$).

Trace mineral effect data are presented in Table 3. Trace mineral supplementation increased d 56-124 DMI and overall DMI ($P \leq 0.01$) and tended to increase overall live ADG ($P = 0.07$). Steers in the IND treatment had greater final BW than CON steers, with REC being intermediate, while IND had greater carcass adjusted overall ADG than both REC and CON steers ($P < 0.01$).

There were no GS x TM interactions for liver Cu, Zn, Mn, Se, or Co concentrations ($P \geq 0.11$ on d 70 or 124. Steers that did not receive implants had greater liver Cu and Mn concentrations on d 70 ($P \leq 0.05$) and lesser liver Zn concentrations ($P = 0.01$) on d 125, compared with IMP steers. On d 70 steers in the IND treatment had greater liver Cu concentrations than REC and CON ($P < 0.01$). There was a TM effect ($P \leq 0.01$) on d 70 liver Mn and Se where IND steers had greater liver Mn and Se concentrations than CON ($P \leq 0.01$), with REC intermediate. There was also a TM effect ($P = 0.02$) on d 70 for liver Co concentrations where REC steers had greater liver Co concentrations than CON, with IND intermediate. On d 124 IND steers had greater liver Cu concentrations than CON, with REC intermediate ($P < 0.01$). Steers receiving REC had greater liver Zn concentrations than CON with IND being intermediate on d 124. IND and REC had greater liver Mn and Co concentrations than CON on d 124 ($P \leq 0.01$). Steers receiving IND had greater liver Se concentrations than REC and REC steers had greater liver Se than CON steers on d 124 ($P < 0.01$).

Implants increased HCW by 10.5% compared to non-implanted steers ($P < 0.01$; Figure 1A). Trace mineral supplementation also affected HCW, where IND steers had greater HCW than REC and CON steers (Figure 1B). Remaining carcass data are not shown. There were no GS × TM interactions, or effects of GS or TM for dressing percent, KPH, backfat, or marbling score ($P \geq 0.13$). There was a GS × TM effect ($P = 0.02$) for ribeye area with IMP/CON being greater than IMP/IND, with IMP/REC intermediate; NoIMP had smaller ribeye area, regardless of TM supplementation. There was also a GS × TM effect for yield grade with NoIMP/IND steers having a greater yield grade than IMP/CON with all other treatments intermediate ($P = 0.02$). There was no GS × TM effect on quality grade distribution ($P \geq 0.48$). There was also no effect of GS or TM on quality grade distribution of steers ($P \geq 0.18$).

Experiment 2

In a 74-d finishing trial, live final BW of TE-200 steers was greater than NoIMP steers by an average of 53 lb ($P \leq 0.001$; Table 4). Because TE-200 and NoIMP steers were housed in pens together, individual animal DMI data are not available in the present trial. However, overall DMI between CON (25.6 lb/d) and IND (26.0 lb/d) did not differ ($P = 0.51$). A tendency for an IMP × Cu interaction was detected for overall live ADG ($P = 0.13$). Additionally, a 24.7% increase in overall live ADG was observed in CON steers when implanted, while IND supplemented steers had a 15.3% ADG increase due to implant.

There were no IMP × Cu interactions for HCW, REA, BF, KPH, YG, or DP ($P \geq 0.21$; Table 4). Additionally, carcass characteristics were unaffected by Cu treatment ($P \geq 0.16$) and KPH, YG, and DP were unaffected by implant treatment ($P \geq 0.30$). However, BF tended to increase due to implant treatment ($P = 0.12$). Implant also increased HCW and REA of steers ($P \leq 0.01$). Additionally, a tendency for an IMP × Cu interaction ($P = 0.12$) was observed influenced by the lesser marbling score of CON-TE-200 steers while IND-TE-200 marbling remained no different than NoIMP steers.

No IMP × Cu interactions were observed for liver mineral concentrations. Although liver Cu concentrations of steers in CON and IND treatments measured on d 14 or 62 remained quite distinct (P = 0.001; Table 3) both treatments maintained adequate liver Cu status in accordance to reference ranges established by Kincaid (2000) as: deficient (< 33 mg Cu/ kg DM), marginal (33 to 125 mg Cu/kg DM), and adequate (125 to 600 mg Cu/kg DM). Prior to the start of the trial CON steers had a combined average liver Cu concentration of 97 mg Cu/kg DM while IND steers averaged 188 mg Cu/kg DM. Additionally, during deficiency plasma Cu would be expected to fall below 0.50 mg/L (Kincaid, 2000). Plasma Cu concentrations for all steers were considered adequate as values did not fall below 0.87 mg/L. Further, steers fed the IND treatment had on average 91 and 250 mg/kg DM greater liver Cu concentrations than CON steers at the beginning and end of the trial, respectively.

Further, IMP affected liver mineral concentrations (Table 5). Liver Cu concentrations tended to be greater in implanted cattle ($P = 0.13$) 14 days after implantation. Additionally, a decrease in liver Mn on d 14 after implant (P = 0.001) was observed in implanted cattle. Liver Mn tended to remain lesser ($P = 0.08$) in implanted steers and was lesser in CON steers compared to IND steers ($P = 0.002$) near the end of the present trial (d 62). Liver Zn also tended to be lessened by implant on day 14 ($P = 0.07$) but was unaffected by implant on d 62 ($P = 0.69$). However, liver Zn was not affected by Cu treatment ($P \geq 0.16$). Plasma Zn concentrations (Figure 2) across the present trial were lesser on d 13 and 73 due to implant (IMP × Day; $P = 0.001$). No IMP × Cu × Day ($P = 0.22$) or IMP × Cu ($P = 0.42$) interactions were observed in the plasma data, but Cu tended to decrease plasma Zn ($P = 0.13$).

Conclusions

In the first study, regardless of implant status, trace mineral supplementation resulted in a growth response and increased HCW. Further, through the second study growth performance in response to potent hormonal implants was differentially affected by dietary Cu concentrations. It is important to note that national recommendations are concentrations shown to prevent symptoms of mineral deficiency and should support growth of cattle (NASEM, 2016), but these may not necessarily be the concentrations needed to optimize performance or profit. Given the responses observed in these experiments some trace minerals may be more beneficial towards optimizing performance. Especially with the greater than expected implant response in the first study and the differential implant response due to Cu treatment observed in the second study, further research is needed to investigate which mineral(s) have synergistic relationships with cattle growth and further refine what concentrations are needed to optimize growth of feedlot cattle.

Acknowledgments

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Table 1. Ingredient and nutrient composition of control diet.

Ingredient	% of diet dry matter [1,2]
Cracked corn	62.0
MDGS [3]	25.0
Bromegrass hay	8.0
DDGS [4]	3.0765
Limestone	1.5
Salt	0.31
Vitamin A & E premix [5]	0.1
Rumensin 90	0.0135

[1] Experiment 1 dietary trace mineral treatments included: CON (no supplemental trace mineral), REC (2016 recommendations of 10 Cu, 30 Zn, 20 Mn, 0.10 Se, 0.15 Co, and 0.50 I; mg/kg), and IND (feedlot consultant recommendations from Samuelson et al. (2016) of 20 Cu, 100 Zn, 50 Mn, 0.30 Se, 0.20 Co, and 0.50 I; mg/kg). Sources of trace mineral included copper sulfate, zinc sulfate, manganese sulfate, calcium iodate, sodium selenite, and cobalt carbonate. The CON treatment analyzed as 2.0 Cu, 53.8 Fe, 7.8 Mn, 16.8 Zn, and 0.22 Se, 0.05 Co; mg/kg). Nutrient analysis of diet revealed 16.0% CP, 18.0% NDF, 5.6% ether extract, and 0.33% S.

[2] Experiment 2 dietary trace mineral treatments included: CON (no supplemental Cu) and IND (Samuelson et al., 2016; 20 mg/kg Cu) with all other trace minerals included at NASEM (2016) recommendations. The CON treatment analyzed as 4.5 Cu and 61 Zn; mg/kg while IND treatment analyzed as 21.6 Cu and 58 Zn; mg/kg. Nutrient analysis of diet revealed 15.3% CP, 18.0% NDF, 5.8% ether extract, and 0.28% S.

[3] Modified distillers grains with solubles.

[4] Dried distillers grains with solubles.

[5] Premix provided 2,200 IU vitamin A and 25 IU vitamin E/kg diet.

Table 2. Main effect of implant status on live animal performance of non-implanted or implanted[1] beef steers fed varying concentrations [2] of supplemental trace minerals (Exp 1).

Live animal performance [3]	NoIMP n = 36	IMP n = 35	SEM	*P* - value
DMI, lb/d				
d 0-56	21.36	22.62	0.345	0.01
d 56 - 124	20.32	24.04	0.353	0.0001
Overall d 0 - 124	20.84	23.33	0.313	0.0001
BW, lb				
d 0	854	856	4.14	0.82
d 124	1231	1359	12.9	0.0001
ADG, lb/d				
d 56 – 124	2.62	3.50	0.122	0.0001
Overall d 0 - 124	2.98	4.04	0.083	0.0001
F:G				
d 0 – 56	6.44	5.02	0.124	0.0001
d 56 - 124	8.14	7.14	0.304	0.03
Overall F:G	7.13	5.85	0.157	0.0001

[1] Growth stimulated implanted steers (IMP) received Component TE-IS (16 mg estradiol + 80 mg TBA) on d 0 and were reimplanted with Component TE-200 (20 mg estradiol + 200 mg TBA) on d 56, while NoIMP received no implants.

[2] Supplemental trace mineral treatments: CON (no additional supplemental trace minerals), NRC (2016 NRC recommendations: 10 Cu, 30 Zn, 20 Mn, 0.10 Se, 0.15 Co, and 0.50 I; mg/kg), and IND (feedlot consultant recommendations from Samuelson et al. (2016) of 20 Cu, 100 Zn, 50 Mn, 0.30 Se, 0.20 Co, and 0.50 I; mg/kg) all from inorganic sources.

[3] No GS × TM; $P \geq 0.13$.

Table 3. Main effect of trace minerals on live animal performance of non-implanted or implanted[1] beef steers fed varying concentrations[2] of supplemental trace minerals (Exp 1).

Live animal performance [3]	CON n =24	REC n = 23	IND n = 24	SEM	*P* - value
DMI, lb/d					
d 0-56	21.28	22.33	22.36	0.423	0.13
d 56 - 124	20.75[b]	22.58[a]	23.20[a]	0.433	0.0004
Overall d 0 - 124	21.02[b]	22.46[a]	22.78[a]	0.383	0.004
BW, lb					
d 0	857	856	853	5.07	0.79
d 124	1287	1289	1309	15.7	0.56
ADG, lb/d					
d 56 – 124	2.96	3.04	3.18	0.149	0.59
Overall d 0 - 124	3.34	3.51	3.68	0.102	0.07
F:G					
d 0 – 56	5.92	5.80	5.48	0.152	0.12
d 56 - 124	7.44	7.88	7.60	0.372	0.74
Overall F:G	6.58	6.55	6.34	0.192	0.67

[a,b,c] Within rows, means without a common superscript differ ($P \leq 0.05$).

[1] Growth stimulated implanted steers (IMP) received Component TE-IS (16 mg estradiol + 80 mg TBA) on d 0 and were reimplanted with Component TE-200 (20 mg estradiol + 200 mg TBA) on d 56, while NoIMP received no implants.

[2] Supplemental trace mineral treatments: CON (no additional supplemental trace minerals), REC (2016 NASEM recommendations: 10 Cu, 30 Zn, 20 Mn, 0.10 Se, 0.15 Co, and 0.50 I; mg/kg), and IND (feedlot consultant recommendations from Samuelson et al. (2016) of 20 Cu, 100 Zn, 50 Mn, 0.30 Se, 0.20 Co, and 0.50 I; mg/kg). Sources of trace mineral included copper sulfate, zinc sulfate, manganese sulfate, calcium iodate, sodium selenite, and cobalt carbonate.

[3] No GS × TM; $P \geq 0.13$.

[4] Adjusted overall live performance parameters were carcass adjusted with a common 64.66% dress.

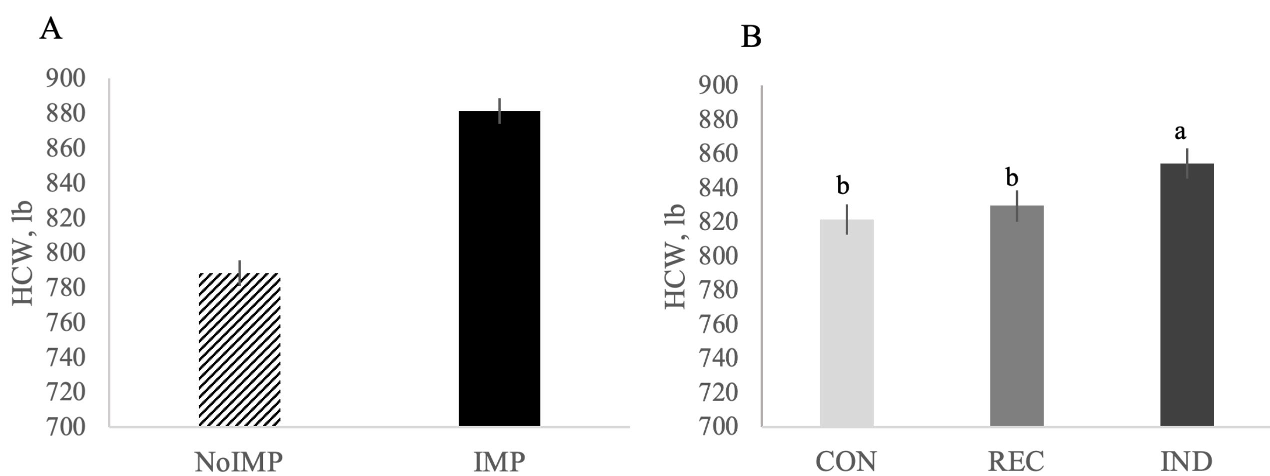

Figure 1. Exp 1: Main effects of implant (panel A; $P < 0.0001$) and trace mineral supplementation (panel B; $P = 0.03$) on HCW of beef steers. a,b indicates means differ ($P \leq 0.05$). Growth stimulated implanted steers (IMP) received Component TE-IS (16 mg estradiol + 80 mg TBA) on d 0 and were reimplanted with Component TE-200 (20 mg estradiol + 200 mg TBA) on d 56, while NoIMP steer were not implanted. Supplemental trace mineral treatments: CON (no additional supplemental trace minerals), NRC (2016 NRC recommendations: 10 Cu, 30 Zn, 20 Mn, 0.10 Se, 0.15 Co, and 0.50 I; mg/kg), and IND (feedlot consultant recommendations from Samuelson et al. (2016) of 20 Cu, 100 Zn, 50 Mn, 0.30 Se, 0.20 Co, and 0.50 I; mg/kg) all from inorganic sources.

Table 4. Effect of implant strategy [1] and copper supplementation [2] on growth and carcass characteristics (Exp 2).

	NoIMP		TE-200			*P*-value		
	CON	IND	CON	IND	SEM	IMP[3]	Cu	IMP × Cu
Steers (n)	15	15	15	15				
Live performance [4,5]								
d 0 BW, lb	1047	1059	1055	1047	12.3	-	0.90	-
d 73 BW, lb	1312	1334	1385	1367	15.6	0.001	0.91	0.19
Overall ADG, lb	3.57	3.74	4.45	4.32	0.255	0.001	0.87	0.13
CA performance [4,5,6]								
d 74 BW, lb	1315	1340	1382	1363	17.3	0.01	0.87	0.21
Overall ADG, lb	3.57	3.74	4.36	4.22	0.116	0.001	0.94	0.18
Carcass characteristics [4,5]								
HCW, lb	844	860	887	875	11.1	0.01	0.87	0.21
Ribeye area, in^2	13.1	13.3	13.9	13.9	0.24	0.004	0.56	0.63
Back fat, in	0.68	0.69	0.77	0.74	0.044	0.12	0.86	0.69
KPH	2.4	2.5	2.5	2.6	0.06	0.30	0.16	0.62
Marbling [7]	534	511	459	510	23.6	0.11	0.55	0.12
YG	3.71	3.72	3.83	3.73	0.144	0.67	0.77	0.70
DP, %	64.3	64.4	64.0	64.0	0.32	0.30	0.88	0.95

[1] Implant treatment (IMP) consisted of either a Component TE-200 implant (TE-200; 20 mg estradiol + 200 mg TBA; Elanco Animal Health, Greenfield, IN) on day 0 of the trial or no hormone implant (NoIMP).
[2] The CON treatment received no supplemental Cu whereas the IND treatment received 20 mg Cu/kg DM from CuSO4 per feedlot consultant recommendations (Samuelson et al., 2016).
[3] IMP represents all steers in the TE-200 treatment for implant regardless of Cu treatment.
[4] A 4% pencil shrink was applied to all live BW prior to analysis.
[5] Beginning weight from prior trial was used as covariate in analysis.
[6] Carcass adjusted (CA) overall performance was determined with the average DP of the group (64.20%).
[7] Marbling scores: slight=300, small=400, modest=500, moderate=600, slightly abundant=700, moderately abundant=800.

Table 5. Effect of implant strategy [1] and copper supplementation [2] on liver and plasma mineral parameters (Exp 2).

	NoIMP		TE-200		SEM	*P*-value		
	CON	IND	CON	IND		IMP[3]	Cu	IMP × Cu
Steer (n)	15	15	15	15				
Liver Cu, mg/kg DM [4]								
d -23 (initial)	92	197	101	178	3.6	-	0.001	-
d 14	117	202	138	207	4.0	0.13	0.001	0.27
d 62	95	344	89	339	4.4	0.62	0.001	0.75
Liver Zn, mg/kg DM								
d 14	126	131	119	121	2.0	0.07	0.37	0.77
d 62	114	117	111	117	1.5	0.69	0.16	0.76
Liver Mn, mg/kg DM								
d 14	9.6	9.7	8.2	8.6	0.13	0.001	0.43	0.55
d 62	8.9	9.7	8.1	9.5	0.13	0.08	0.002	0.30

[1] Cattle within the implant treatment received Component TE-200 (TE-200; 20 mg estradiol + 200 mg TBA; Elanco Animal Health, Greenfield, IN) on day 0 of the trial. Non-implanted (NoIMP) cattle did not receive an implant.
[2] Cu supplementation treatments included CON with no supplemental Cu and IND providing 20 mg/kg DM of supplemental Cu from Cu sulfate in the diet as recommended by industry consultants per Samuelson et al. (2016).
[3] IMP represents all steers in the TE-200 implant treatment regardless of Cu supplementation treatment.
[4] Liver Cu from the beginning trial (d -23) was used as covariate in analysis.
Data analyzed as repeated measures, no interactions with day ($P \leq 0.15$).

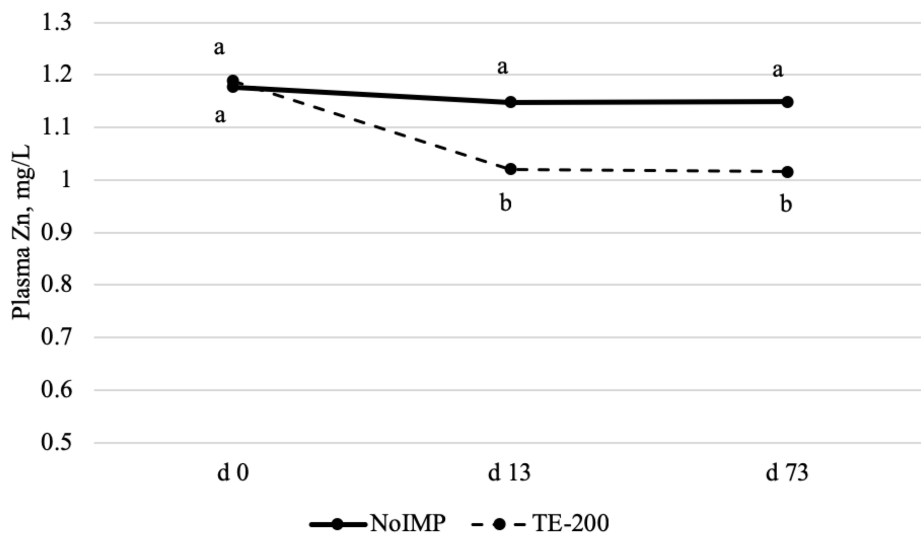

Figure 2. Exp 2: Effect of implant (TE-200) or no implant (NoIMP) and day on plasma Zn concentrations (IMP × Day $P = 0.001$; SEM = 0.075). Cattle receiving the TE-200 treatment were implanted with Component TE-200 (20 mg estradiol + 200 mg TBA; Elanco Animal Health, Greenfield, IN) on day 0 of trial. Unlike superscripts indicate means differ ($P \leq 0.05$).

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Samuelson, K. L., M. E. Hubbert, M. L. Galyean, and C. A. Löest. 2016. Nutritional recommendations of feedlot consulting nutritionists: The 2015 New Mexico State and Texas Tech University survey. J. Anim. Sci. 94:2648.

Direct marketing beef in the Driftless Region

Teresa Wiemerslage, Local Foods Field Specialist, Iowa State University Extension and Outreach

Many cattlemen are trying to direct market beef as a way to diversity their income. This presentation will talk about the various direct marketing channels and the challenges and opportunities associated with each method. Attendees will also hear examples of farms and cooperatives who are making direct marketing work for them.

Resources

How to Direct Market your beef
https://www.sare.org/Learning-Center/Books/How-to-Direct-Market-Your-Beef

Direct Marketing Beef: Pros and Cons, Do's and Don'ts
http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1052&context=rangebeefcowsymp

Beef Marketing Alternatives
http://acrcd.org/Portals/0/Beef%20marketing%20alternative_NCAT%20ATTRA.pdf

Beef and Pork Whole Animal Buying Guide
https://store.extension.iastate.edu/product/13056

Livestock Price and Yield Calculator
http://smallfarms.cornell.edu/2017/04/03/meat-price-calculator/

Marketing and regulations

Iowa: Marketing Local Foods in Iowa - Red Meat
https://store.extension.iastate.edu/product/15325

Minnesota: Marketing Local Food
https://www.misa.umn.edu/publications/localregionalfoodsystems/marketinglocalfood

Wisconsin: Local Food Marketing Guide
https://datcp.wi.gov/Documents/DAD/LocalMarketingFoodGuide_1_16.pdf

Iowa Fresh Food
www.iowafreshfood.com

Minnesota Grown
https://minnesotagrown.com

Something Special from Wisconsin
http://somethingspecialwi.com

Driftless Region examples

Wisconsin Grass-fed Beef Cooperative
https://www.wisconsingrassfed.coop

Meat CSA program: Prairie's Edge Farm
https://www.prairiesedgeiowa.com

Beef-to-School in Northeast Iowa
https://store.extension.iastate.edu/product/15098

Effects of extended dry lot housing of beef cows

W. Travis Meteer, Beef Extension Educator, University of Illinois

Increasing land values, less pasture availability, and other factors continue to limit herd expansion for cattle producers in the Midwest. As a result of these limitations, cattle producers have been looking to alternative cow productions strategies. Among these alternatives are semi-confinement or extended dry lot housing of beef cows.

These are not new productions strategies. During times of drought and limited forage availability, many producers have deployed semi-confinement or extended dry lot housing of beef cows. Also, many Midwestern cattlemen utilize semi-confined and confined areas for winter feeding and housing of cows during forage dormancy.

There are some known factors that cattlemen should consider when extending the dry lot period for beef cows. Unlike a pasture setting where cows harvest their own feed, dry lot housing requires feed be delivered to the cow. As a result, increased labor and resources are necessary to deliver feed to cows. Obviously, stored forages and supplements to provide a balanced ration are needed. This means hay, silages, grains, crop residues, and by-product feeds will need to be secured and stored on farm.

It is also paramount that herd health protocols intensify. Preventative health measures need to be deployed to combat challenges such as scours, mastitis, lameness, and other health concerns that increase when animals are more confined.

Manure management and bedding of animals needs to be considered. Lack of management and appropriate storage facilities for animal waste will increase health challenge to the animal. These same deficiencies may very well result in situations that compromise stewardship of natural resources and could cause concern from an environmental standpoint. Thus, it is imperative that cattlemen considering these alternative housing strategies have proper manure management plans and the capacity to handle more manure production.

At the University of Illinois, investigation into extended dry lot housing effects on cows and calves has been taking place. In the spring of 2017, a demonstration was conducted at the University of Illinois, Orr Beef Research Center, located in west-central Illinois. This demonstration monitored cows that remained in the dry lot where they had been housed for wintering and compared them to cows rotational grazing cool season pastures. The monitoring period was 5/19/17 to 8/8/17 (82 days). Dry lot cows were limit-fed a corn silage based ration. Calves had ad libitum access to the TMR cow diet for creep in an adjacent pen. In both groups, cows lost weight during the period (Pasture cows lost 91 lbs. and Dry lot cows lost 134 lbs.). Pasture calves gained 2.3 ADG with no creep feed offered. Dry lot calves gained 2.9 ADG and had free access to the TMR as creep. Cows had similar milk production and conception rates.

In 2018, the demonstration was scaled up into a trial containing two experiments. Experiment 1 looked at the effect of housing beef cows on dry lots vs. pasture on cow performance and reproduction. In this experiment, 108 Sim-Angus lactating, spring-calving cows were utilized. Treatments were dry lot (DL) or pasture (PAST). DL cows remained in the dry lot after the wintering period, while PAST cows were kicked out to pasture where they were rotationally grazed. The cows in the dry lot were limit-fed a ration consisting of corn silage, dried distillers grains, corn stalks, corn, and soybean hulls to meet their protein and energy requirements. At the end of the comparison (day 87), DL cows (1452 lbs.) had greater BW ($P = 0.05$) than PAST cows (1382 lbs.). It should be noted that in 2018, the performance of pasture cows may have been hindered by drought conditions. The BCS, milk yield, and reproductive rates did not differ ($P \geq 0.12$). Housing cows in dry lots compared to pasture increased BW, but did not affect BCS, milk production, and reproduction. (Cooney, et. al., 2019)

In experiment 2, effect of housing cow-calf pairs in dry lots vs. pasture on calf performance and calf behavior was investigated. The cows and management strategies mentioned in the previous paragraph represent the mothers of the calves in this experiment. One hundred and eight Sim-Angus calves were utilized. Calves had ad libitum access to same diet as the cows in an adjacent pen. Calves on pasture were rotationally grazed with free-choice mineral. After weaning (177 ± 11.5 d of age) all calves were fed a diet consisting of corn silage, wet distiller grains, dry rolled corn and grass hay during the receiving phase (42 d). At the age 87, 142, 177, 198 and 219 ± 11.5 d, BW was measured. Hair coat score (HCS) and dirt score (DS) were measured on d 0 and d 90. Calf behavior was observed after feedlot arrival. Average daily gain, DMI and feed efficiency were also analyzed.

Dry-lot calves had greater BW and ADG prior to weaning. Calves from PAST had lower DS and greater HCS at weaning. Upon feedlot arrival, more DL calves were walking and had increased vocalizations. Calves from PAST had greater ADG, DMI as a percent of BW, and gain:feed than DL calves during the receiving phase. Calves raised in a dry lot had greater BW and ADG prior to weaning, but PAST calves had less behavioral signs of stress and greater growth performance in feedlot. (Neira, et. al., 2019)

In summary, recent research at the University of Illinois shows that extended dry lot housing of beef cows can serve as a short-term alternative to housing cows in a pasture setting. In 2018, cow performance was greater for cows housed in a dry lot. However, cows on pasture were subject to drought conditions. Calf performance prior to weaning was greater for those raised in a dry lot setting. However, pasture raised calves had less behavioral signs of stress and greater growth performance in feedlot. If producers decide to deploy an extended dry lot period for beef cows, they need to be aware of these differences along with the increased need for labor, herd health, feed, and manure management.

References

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Beef cattle market situation and outlook: 2019 and beyond

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This past year saw the beginnings of a transition from a demand-driven environment where stronger-than-expected beef demand led to stronger-than-expected calf and yearling prices, to a supply-driven environment, with lower fat cattle prices but continued strong feeder and calf prices. Looking ahead, continued large supply with stable to weakening demand paints a darker picture for 2019 and 2020.

After another year of large supplies, U.S. beef production will continue to grow in 2019. Trade concerns and record exports dominated the demand-side discussion in 2018 and will likely continue in 2019. Fat cattle saw the biggest decrease in prices, while calf and feeder cattle prices stayed remarkably strong. This year, 2019, will see packers gain greater leverage over feeders as packing capacity is tested; meanwhile feeders will gain greater leverage over cow/calf producers due to limited pen availability and large supplies of feeder cattle and calves.

Corn production

Corn prices are low due to large production; however, stocks are lower than last year. USDA projections in the World Agriculture Supply and Demand Estimates indicate 2018 U.S. corn supply decreased just under 1 percent from 2017. National yield was up to 178.9 bushels per acre; although the USDA would likely have reduced this estimate in the January 2019 WASDE release. World supplies are down slightly for 2018/19.

U.S. corn demand is up slightly, due to increased feed and residual and exports. Ethanol production for September to November was on track to use 5.4 billion bushels rather than the USDA estimated 5.6 billion bushels. Corn exports for the current marketing year were strong, but there has been no new trade data at the time of this writing, so it is unknown if that strength has continued. Corn price will likely follow the typical seasonal pattern and trade up until the end of April.

Corn acreage in 2019 will likely increase. If the trade war with China ends soon we may see a lower than expected switch between soybean and corn acres; however, market prices currently favor corn production.

Herd size and cycles

U.S. beef cow inventories will be higher in 2019 and given female slaughter and retention rates, the beef cow inventory will likely be around 32 million head, up 0. over 2018 and 10 percent over 2014 (this cycle's inventory low). Heifer slaughter, at just under 36 percent of fed cattle slaughter, and cow cull rates of nearly 10 percent indicate that the beef cow herd will stabilize in 2019. The 2018 U.S. calf crop was about 8.5 percent larger than in 2014, and 2019 is expected to be flat with 2018. Given the time it takes for herd expansion to work through the cattle and beef supply chain, the industry can expect larger calf, feeder cattle and beef supplies in 2019 and 2020.

Assuming a typical cattle cycle, one would expect the cow herd to decrease after 2020. To date, though this is not obvious. Prices have remained profitable for cow/calf producers. Until those prices drop there isn't much incentive for liquidation.

Protein production

The current cattle cycle had its lowest herd inventory in 2014 and lowest beef production in 2015. Increased cattle on feed and slaughter in 2019 will bring large production that continues to increase through 2020. Beef production will likely increase 1.9 percent in 2019, to 27.4 billion pounds, and an additional 1 percent in 2020, continuing our reliance on exports to absorb additional supplies. Although 2019 will see continued beef production growth, the rate of growth has slowed since 2016.

Pork and poultry production was also up in 2018. Total red meat and poultry production was up 7.5 percent over the average 2013-2017 time frame and with continued growth will be up another 1.4 percent in 2019.

Domestic demand and trade

Given expected beef production in 2019, expected lower beef imports, and higher exports, U.S. per capita consumption will be 57.1 pounds per capita, up 0.3 percent over 2018. Beef imports held steady in 2018, up just 0.4 percent over 2017 but will likely be lower in 2019 due to increased U.S. cow slaughter and a moderated Australian beef production. U.S. beef exports were up 11 percent in 2018, driven mostly by increased demand from South Korea and Japan. Beef exports will continue to increase in 2019, but at a slower rate.

Pork exports grew 5 percent in 2018, even with reduced exports to Mexico and China. The USMCA has yet to be signed and the 20 percent tariff of pork going to Mexico will continue until it is signed. The tariff on pork going to China has increased to 78 percent. African Swine Fever and its impact on the Chinese pork supply may cause China to import U.S. pork in 2019.

World economic growth is expected to be lower in 2019. This reduced growth may impact beef exports due to the high priced/higher value nature of U.S. beef. Additionally, the uncertain global trade situation will continue to slow world growth as well as impact U.S. exports. To date, the U.S. is not a part of the new CPTPP trade agreement and does not have a bilateral agreement with Japan. Without an agreement the U.S. will lose competitiveness in the market.

Although beef has not been directly impacted by tariffs, indirect tariff impacts will continue to grow. Tariffs will continue to make products in the U.S. more expensive, thereby reducing the domestic consumer's spending power. Given the ample supply of pork and poultry in the market, U.S. beef will likely see a weakening demand, which will only be amplified if the U.S. goes into recession.

Things to watch in 2019

World macroeconomic conditions are beginning to slow. Although still positive, the World Bank recently revised their outlook for global economic growth to be only 2.9 percent in 2019, as compared to 3 percent in 2018. Additionally, given the real GDP decline in growth in the U.S. between second quarter of 2018 and third quarter, coupled with the volatility in the equity market and the continue partial government shutdown, the economic forecast for the U.S. is looking dimmer, with many analysts predicting a recession.

Hopefully by the time of the 2019 Driftless Region Beef Conference, the U.S. government will be up and running again. If not, the continued loss of the USDA reports will be weighing heavily on the market. Those USDA reports provide information that is a starting place for analysis. They provide information that helps to inform long-term investment and management decisions. Apart from the loss of the Cattle on Feed report, the semi-annual Cattle report provides information on the state of the U.S. cattle herd and allows market participants to make informed decisions.

All three major proteins will continue to expand production in 2019, providing the U.S. with 102.5 billion pounds of product. Information on changes in supply or exports is vital to the industry. Stronger global demand is critical to maintain per-capita consumption near or at forecasted levels; and having the USDA provide trade data allows participants to be on somewhat equal footing.

Risks to beef demand are the greatest concern for 2019. To date, domestic and international demand has remained strong. Anything that disrupts that demand, whether it is a trade war or recession, will bring lower prices.

Barring any loss of exports or recession, expect fat cattle prices to be stable to down slightly in 2019. Feeder cattle and calf prices will experience the greatest decline in prices, especially in fall when the larger calf crop goes to market.

2019 will force producers to examine the core values of operating a business. Many factors to consider include managing cash flow needs, as well as knowing and managing input costs. The increased reliance on global trade will heighten volatility and hence increase the need to protect personal equity and manage risk. Knowing your break-even prices and understanding how much loss your business can withstand are essential to risk management.

Poorer margins are likely for 2019, however the efficient producer who maximizes production while managing costs has some opportunity for small profits in 2019.