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# Feeding systems into the future (dealing with high feed costs)

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## Introduction

Based on the title of this presentation you may have been expecting an article about robots, sensors and smart technology to make feeding cattle easier. While advances in those technologies may play a role in the future, the immediate future requires dealing with a new economic reality and cost structure. Feed costs have never been higher than today. Costs will fluxgate in the future with growing conditions, supply and demand but it is very possible that we are entering a new era of higher relative feed costs.

## Reducing feed costs in the feedlot

As feed costs increase and supplies of fed cattle are reduced, incentives to feed cattle to increasingly heavier weights are reduced. Depending on the market and incentives, consider marketing cattle earlier. This will improve feed conversion, especially if marketing the cattle on a live weight basis. Any decision or technology that improves feed conversion has more value with higher feed costs. Be sure and fine tune your implant program, and if you are not using an ionophore or beta agonist you should consider it. For calf feeders, depending on forage and grain price relationships and feed availability, backgrounding is a consideration. Feed costs can also be reduced by improving losses due to feed waste and storage. Investments in commodity sheds for example have much more value when feed costs are high. Taking the time to improve silage storage through proper harvest, packing and coverings can pay big dividends. Reducing feed waste at feeding can be improved with good feed bunk management.

## Reducing feed costs in cow-calf operations

We have a saying that a day grazed is a dollar saved. Today that may quite a bit more. For conventional cow calf herds. The amount of winter feed fed per cow often separates the high cost from low cost operations. Extending the grazing season by utilizing corn stalks grazing, cover crops or stockpiles can reduce the amount of hay fed over the winter. When stored feed is fed there may be opportunity to reduce feed waste by feeding method. For example, rolling out feed each day or feeding a total mixed ration will reduce feed waste the most. If that is not feasible there are differences in feed waste according to the type of feeder used. Also, be sure to store hay in a way that minimizes exposure to moisture and the elements. This includes storing on a rock surface and covering. Be strategic in your feeding and supplementation. This includes testing feeds, sorting cattle by stage of production, age and condition score and feeding according to their needs.

## Resources available

Working closely with your nutritionist is increasingly important as feed costs increase. Also, your local or regional Extension Beef Specialist can help with resources. Here at the Iowa Beef Center (www.iowabeefcenter.org) we have decision tools available including the Feed Energy Index and the Beef Ration and Decision Support program (BRaNDS).

## Fermentation-based proteins

Through biomass fermentation, companies can grow large amounts of high-protein microorganisms like yeast. These microorganisms are then used as sources of food protein and as an ingredient in alternative meat products. In the future, precision fermentation may use microorganisms to produce specific proteins for use as ingredients similar to the production of rennet for cheese making that is widely used today. Not limited to proteins, microorganisms could be used to create particular enzymes, pigments, flavor molecules, vitamins, and more.

## Nutritional equivalence

The goal of most meat-alternatives from a nutritional perspective is to provide a source of protein in the diet. However, protein quality differs between animal and plant sources of protein. High-quality proteins contain all the essential amino acids needed for human growth, in the right amounts, and are highly bioavailable. Recent studies have shown animal-based burgers have greater protein quality than the plant-based Impossible Burger or Beyond Burger (Fanelli et al., 2021). Protein quality, however, may not be important for the average consumer. Survey data suggest consumers' purchasing decisions are more related to their perception of what a product represents than its essential amino acid or micronutrient profile (The Hartman Group, 2019).

## Environmental sustainability

The superior environmental impact of alternative meat products is often cited as a reason for its future adoption. However, the environmental impact of alternative protein production methods is relatively unclear. For example, some life cycle assessments have reported that cultured meat production is more environmentally friendly than beef production (Lynch & Pierrehumbert, 2019). Nonetheless, these studies are challenging to assess because of the fast pace of technology evolution and environmental differences between specific greenhouse gas emissions.

## Consumer perception

Younger US and UK consumers (Millennials and Gen Z) show increased interest in buying alternative meat products (Szejda et al., 2021). However, these two consumer groups also purchase the most traditional meat and poultry. Despite consumer worries about traditional meat consumption's environmental and ethical impact, consumers' view of meat consumption remains strong. In comparison, consumers' main concerns about cultured meat products were price, taste and appeal, unnatural perception (Wilks & Phillips, 2017). As a result, experts agree that US consumers will likely try cultured meat products when available. Still, few would replace traditional meat in their diet.

## Conclusion

Alternative meat products are a rapidly evolving segment of the food industry. There is little doubt that alternative meat sales will continue to rise, given strong investor support and growing consumer interest. However, in the coming years, it's important to remember that consumers worldwide are projected to eat more traditional meat and poultry than ever as well. As the food industry works to double protein availability by 2050 to feed an expanding world population, there is likely room for the growth of both animal and alternative proteins.

# Turning corn into beef

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## Introduction

Economic competitiveness of cattle feeding enterprises depends primarily on local availability of feed resources and feeder cattle availability as well as environmental factors (an abundant supply of potable water and weather conditions amenable for producing both crops and livestock). Local supplies of feedstuffs and feeder cattle generally are available in the northern regions of the U.S. thanks to high quality soils and adequate and timely rainfall. However, climatic conditions (frost late in the spring and early in the fall) shorten the growing degree days needed for long-season crops by preventing timely planting and harvesting of highly productive and efficient crops like corn grain. One solution to this dilemma is to harvest ear corn or corn grain after physiological maturity but before the grain has fully dried in the field. High moisture harvest essentially shortens the length of the growing season needed to produce this highly energy efficient and productive crop. Unfortunately, optimal conditions for harvest, processing, ensiling, and nutritional value of high-moisture (HM) feedstuffs have not been well defined to date.

## Survey

### High-moisture corn (HMC)

Participants (n = 7) from Iowa and South Dakota were included. Average one time yard capacity was 1780 ± 1841 hd (range 499 to 5000 hd). Average inclusion of HMC in finishing diets on a dry matter (DM) basis was 35 ± 12% (range 25 to 54%). The HMC product had been fed on average for 27 ± 13 y and harvest efficiency (acres/h) was 6 ± 5 acres/h.

Custom harvesting services were used by 14.3% of respondents compared to personal equipment (85.7%) for HMC. All HMC was processed prior to ensiling. A hammer-mill was used by 77.8% of those surveyed and a roller-mill was used by 22.2% of respondents. All HMC piles were covered. All HMC sampled was stored in a bunker. Tires were the only covering weight used. Sidewalls were used by 33.3% of participants, whole tires by 50.0% and a combination of both was used by 16.7% of those surveyed. Inoculant application was done by 28.6% of those surveyed. Finally, heating of the ensiled mass was only noted by 33.3% of participants.

### High-moisture ear corn (HMEC)

Participants (n = 9) from Iowa and South Dakota were included. Average one time feedlot capacity was 1754 ± 1605 hd (range 499 to 5000 hd). Average inclusion of HMEC in finishing diets on a dry matter (DM) basis was 38 ± 23% (range 22 to 75%). The HMEC product had been fed on average for 20 ± 16 y and harvest efficiency (acres/h) was 10 ± 7 acres/h.

Custom harvesting services were used by 66.7% of respondents compared to personal harvesting equipment (33.3%) for HMEC. Kernel processing was used by 88.9% of respondents. All HMEC piles were covered. A total of 77.8% of survey participants stored HMEC in a bunker and 22.2% of participants stored HMEC in an silage bag. Tires were the only covering weight used. Sidewalls were used 28.5% of participants, whole tires by 43.0% and a combination of both was used by 28.5% of those surveyed. Inoculant application was done by 44.4% of those surveyed compared to those that do not (33.4%) or did not respond (22.2%). Finally, heating of the ensiled mass was only noted by 22.2% of participants compared to those that did not (66.7%) note heating or did not respond (11.1%).

## Nutrient composition

### High-moisture corn (HMC)

All feed samples were subjected to NIR analysis at a commercial feed laboratory. Samples (n = 111) for HMC were collected from 25 sites in Iowa, Minnesota, North Dakota, and South Dakota. Average DM, CP, NDF, uNDF240, starch, fat, ash, and particle size was 71.5 ± 4.24 %, 8.4 ± 0.57, 7.8 ± 1.22%, 0.52 ± 0.50%, 71.4 ± 1.94, 3.9 ± 0.24, 1.6 ± 0.20%, and 2474 ± 1030 µm.

## High-moisture ear corn (HMEC)

Samples (n = 137) for HMEC were collected from 24 sites in Iowa, Minnesota, North Dakota, and South Dakota. Average DM, CP, NDF, uNDF240, starch, fat, ash, and particle size was 63.9 ± 6.30 %, 7.9 ± 0.66, 17.2 ± 3.04%, 3.85 ± 1.03%, 59.4 ± 4.09, 3.5 ± 0.28, 2.1 ± 0.28%, and 2210 ± 24.3 µm.

## Apparent digestibility of starch

Total tract starch digestibility (TSD) was determined from pens (n = 10) of feedlot steers and heifers from participants that were enrolled in the survey and feed ingredient sampling. Selected pens were required to have been on a finishing diet for a minimum of 4 weeks prior to diet and fecal sampling. Diets were concentrate-based and consisted of HMC, HMEC, corn milling co-products and mineral supplement. Fecal starch (FS) was a predictable function of mean grain particle size (PS) where (FS, % = 0.0054PS – 1.1951; $R^2$ = 0.50; Figure 1). Additionally, TSD was a predictable function of FS (TSD, % = -0.6604FS + 101.82; $R^2$ = 0.92; Figure 2). Hence, particle size can be used as a measure of starch digestibility in the total tract of steers fed a high-moisture corn based finishing diet.

## Conclusion

The HMEC analyzed in this project was on average 82.5% grain and 17.5% roughage. Particle size was more variable in HMC than HMEC, likely a function of varying processing methods. Rate of inoculation use in HMEC compared to HMC is likely a function of harvesting services and equipment.

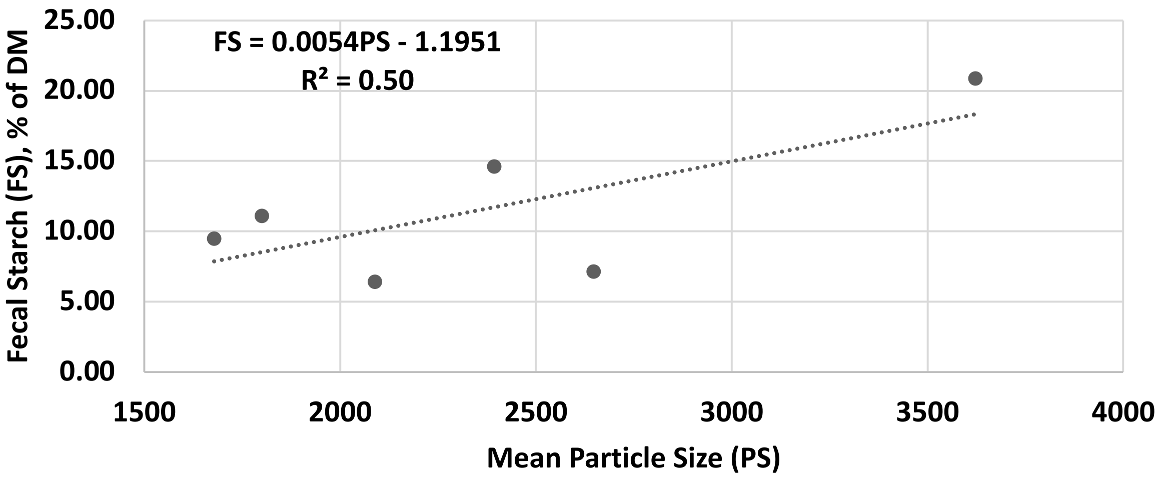


**Figure 1.** Percentage of fecal starch (% of DM) as a function of grain particle size.

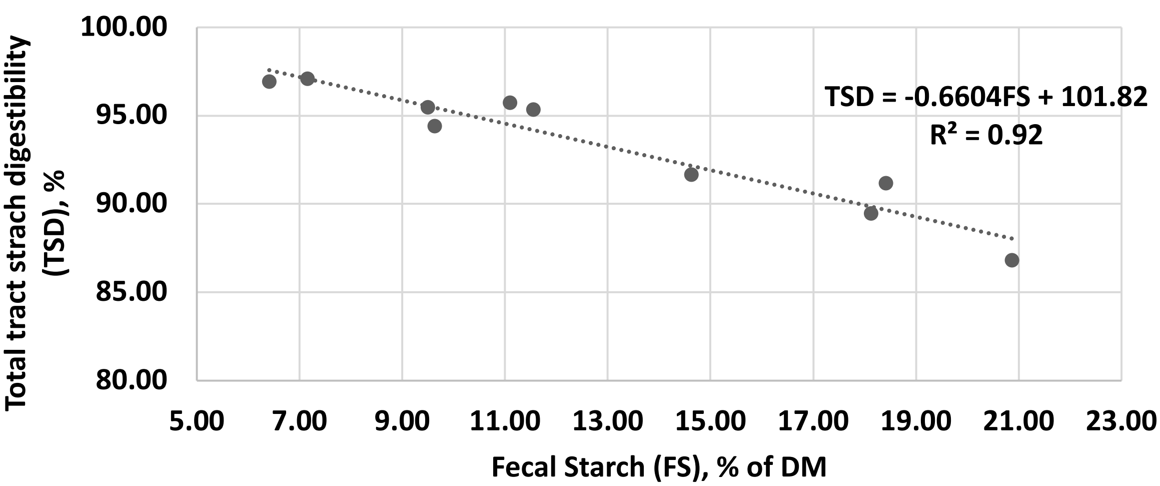


**Figure 2.** Total tract starch digestibility as a function fecal starch content.

# Success on slats: Keys to cattle mobility and structure

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## Introduction

In the Midwest, decreasing available land and poor winter pen conditions have led to more cattle being housed in slatted feeding facilities (Dewell et al., 2018). Advantages of housing cattle in slatted feeding facilities include consistent growth performance during the winter and improved handling of nutrients in manure. Despite the advantages responsible for the popularity of slatted feeding facilities, cattle in these facilities have a greater prevalence of lameness (Schültz et al., 2014). Facility design and management factors (e.g. rubber matting and pen stocking density) affect lameness (Cozzi et al., 2013, Magrin et al., 2019), but structural conformation also can contribute to improved mobility and welfare for cattle in indoor slatted facilities.

Cow-calf operations have long prioritized structural conformation because it impacts longevity within the herd (Onyiro and Brotherstone, 2008). While structural conformation is not a traditional consideration for feedlot cattle, lameness decreased ADG by 5.6% in steers housed in open lots (Kruse et al., 2013). Understanding cattle structure is essential to identify and prevent problems that can occur in feedlot cattle and hurt profitability due to reduced performance. Evaluating cattle structure is focused on assessing the conformation of key joint angles including the shoulder, stifle, hock, and pasterns as they work together to provide comfort and cushion for each stride.

## Research findings

The objective was to determine the effect of final locomotion score of cattle fed in a slatted facility on overall ADG, final BW, and HCW irrespective of differences in rubber flooring using a post hoc analysis. This analysis is applicable to feedlot producers since most operations are currently using rubber matting in their slatted floor facilities. Fall-born Angus × Simmental steers (N = 189; BW = 776 ± 95 lb) were blocked by weight and assigned to 21 pens. Pens were randomly assigned to 1 of 3 treatments: new Animat Pebble matting (PEB2), 15 year-old Animat Pebble matting (OLD2), or no matting/concrete slatting (CON2). Steers were fed a common diet for 153 days. Each pen (16 × 16 ft) contained 9 steers with an average stocking density of 28.4 $ft^2$ per steer. After 153 days on feed, flooring treatment did not affect ($P \geq 0.61$) dry matter intake, final body weight, average daily gain, or hot carcass weight. At the conclusion of the experiment, steers were evaluated by two evaluators for lameness using the Step-Up Locomotion Scoring System (Zinpro, Eden Prairie, MN). A locomotion score of 0 refers to a normal gait while a score of 3 corresponds to little or no weight applied to the affected limb. The maximum locomotion score was used to assess the impact of locomotion score on growth performance during the finishing phase. At the conclusion of the experiment, approximately 18% of steers were scored a 1, 49% of steers were scored a 2, and 33% of steers were scored a 3 (Table 1). Final body weight and hot carcass weight were decreased about 4% in steers receiving a final locomotion score of 3 compared with their contemporaries receiving a 1. A decrease in cattle performance (69 lbs of live weight) due to poor mobility and lameness can reduce saleable value by more than $90 per steer in current prices.

**Table 1.** Effect of final locomotion score on final body weight, average daily gain, and hot carcass weight.

| | Final maximum locomotion score[1] | | | | |
|---|---|---|---|---|---|
| **Item** | **0** | **1** | **2** | **3** | ***P*-value[2]** |
| Number of observations | 0 | 33 | 89 | 60 | |
| Final body weight, lb | - | 1370[a] | 1350[a] | 1309[b] | <0.01 |
| Average daily gain, lb/d | - | 3.9[a] | 3.8[a] | 3.5[b] | <0.01 |
| Hot carcass weight, lb | - | 836[a] | 831[a] | 803[b] | <0.01 |

[1] Means in row with unlike superscripts differ ($P \leq 0.05$)
[2] Main effect of final maximum locomotion score

## Summary and implications

Locomotion scores should be expected to increase with days on feed as cattle spend more time on slatted flooring. Cattle should be evaluated for structural conformation early in the finishing phase to identify animals with severe structural issues. Early identification of lameness or several structural problems would warrant cattle to be removed from slatted floor facility and fed in different pen conditions. Additional losses for early sale of cattle due to lameness issue from decreased marketing price and growth performance should inform future decisions on prevention of realizer cattle. Preventing excessive lameness in slatted floor facilities is key to maximizing profit and cattle welfare for confinement facilities.

## Acknowledgements

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# Evaluating rotations of winter annual and summer annual forages for yield, nutritional value, and economic sustainability as forage resources for beef cattle in northern Iowa

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## Introduction

Interest in grazing cover crops or winter annuals has increased in recent years. Iowa research on grazing winter annuals has been concentrated in southern Iowa, but because of differences in growing conditions, data on growth potential from the northern half of the state is needed. Similar interest has been developing on utilizing summer annuals to fill in the traditional summer slump of Iowa pastures. This project is designed to replicate the current winter annual/summer annual project underway at McNay, Armstrong and Neely-Kinyon research farms, in order to measure and demonstrate the applicability in northern Iowa at the Northeast Research and Demonstration Farm at Nashua.

## Materials and methods

Two years of a winter annual – summer annual forage rotations have been completed. Eight winter annual treatments were established at the Northeast Research and Demonstration Farm on October 30 , 2020, and October 4, 2021 with four replications of each treatment. First year treatments include Elbon cereal rye, Willow Creek forage winter wheat, Flex 719 Brand triticale and Thompson hard red winter wheat, each with and without 50 pounds(lb) nitrogen (N) fertilizer per acre (ac.). This was an exact replication of the trials at the southern Iowa research farms. Second year treatments included KWS Progas cereal rye, Hazlet cereal rye, Triticale, and Thompson hard red winter wheat, each with and without 50lb N. These varieties were based on forage yield recommendations from Albert Lea Seed House. Each were seeded at a target rate of 100 lb of seed per ac. and replicated 4 times in 10'x60' plots. Dry conditions in the fall of 2020 and spring of 2021, delayed germination and growth. Fifty pounds of Nitrogen (N) per acre as urea was spread on half the plots on April 6, 2021 and April 5, 2022, as the forage started to break dormancy and just ahead of predicted rainfall. Plots were mechanically harvested with the 3-foot-wide Carter Harvester on May 26, 2021 and May 31, 2022 and tested for nutrient analysis. The two-year average yield and quality data is in Table 1.

All forage was removed from the plots and four summer annuals were drilled into these same plots on June 9, 2021 and June 21, 2022 at a target rate of 40 lbs/ac . The treatments in 2021 were hybrid brown mid-rib (BMR) pearl millet, Japanese millet, Piper sudangrass and dwarf BMR sorghum-sudangrass and the 2022 treatments were ExCeed BMR hybrid pearl millet, Viking BMR brand hybrid 200 and 232sorghumsudangrass, and Piper sudangrass, each with either 50 or 100 pounds of nitrogen per acre. Fifty pounds of nitrogen per acre as urea was applied to all plots on June 11, 2021, and July 8, 2022 and sprayed with 32 oz/ac Roundup Powermax© on June 13, 2021 and June 20, 2022 to kill winter annual forage regrowth. In 2021, less than 1.5" of rain fell during the month of June (Table 6). An additional 50 lb/ac of nitrogen as urea was applied July 14, 2021 or July 23, 2022 to half the plots. First cutting was harvested on August 3 in both years with the Carter harvester. In 2021, the Japanese millet had a few seed heads showing at harvest but no seed heads were visible on the Pearl millet, sorghum-sudangrass or sudangrass. In 2022, no seed heads were visible at the first harvest in any plot. Two passes on the north and south sides were cut with a discbine and the center 10-14' was left unmowed for a comparison to a single harvest system. All mowers were set to leave at least 8-10" residue height. Mowed forage was baled as wet hay/baleage and removed from plots on Aug. 6 both years. The second harvest was cut September 14, 2021 and September 22, 2022, using the Carter harvester on the earlier harvested plot sections. In the uncut sections, 5 feet 3 inches of row (1/10,000th acre) were hand harvested, weighed and sampled. The remaining forage was mowed as low as possible and removed from the plots. In 2022 a leaf blight limited the yield and quality of the Piper hybrid sudangrass but did not affect the other treatments. Disease damage started to appear in late July and continued to worsen throughout the season and the ISU Plant Diagnostic Clinic reported that the blight was caused by the same pathogen that causes Northern Corn Leaf Blight in corn.

The 2-year average summer annual forage yields and quality are in Tables 2, 3 and 4.

**Table 1.** Cool season forage average yield and quality.

| | 0 lb Nitrogen | | | | 50 lb Nitrogen | | | |
|---|---|---|---|---|---|---|---|---|
| | % DM | Ton/AC | CP, % | TDN OARDC | % DM | Ton/AC | CP, % | TDN OARDC |
| **CEREAL RYE** | | | | | | | | |
| 2021 Elbon | 29.31 | 2.39 | 11.54 | 55.42 | 24.64 | 2.34 | 14.60 | 57.22 |
| 2022 Progas | 28.21 | 3.47 | 9.81 | 61.86 | 26.26 | 3.97 | 12.63 | 63.76 |
| 2022 Hazlett | 27.93 | 3.66 | 11.15 | 62.09 | 24.89 | 4.37 | 12.81 | 63.48 |
| **TRITICALE** | | | | | | | | |
| 2021 Flex 719 | 18.17 | 1.93 | 17.76 | 55.93 | 18.06 | 2.22 | 18.48 | 56.45 |
| 2022 VNS | 22.12 | 3.33 | 14.17 | 63.6 | 20.50 | 3.89 | 11.34 | 62 |
| **HR WINTER WHEAT** | | | | | | | | |
| 2021 Willow Creek Forage Wheat | 20.00 | 1.56 | 19.05 | 57.16 | 17.50 | 1.72 | 21.70 | 57.41 |
| 2021 Thompson HR | 21.91 | 1.81 | 18.02 | 56.44 | 19.83 | 1.98 | 20.69 | 60.13 |
| 2022 Thompson HR | 26.02 | 3.04 | 14.23 | 63.13 | 23.35 | 3.64 | 9.8 | 62.12 |

**Table 2.** First cutting warm season forage yield and quality.

| | 50 lb Nitrogen | | | | 100 lb Nitrogen | | | |
|---|---|---|---|---|---|---|---|---|
| | % DM | Ton/AC | CP, % | TDN OARDC | % DM | Ton/AC | CP, % | TDN OARDC |
| Pearl Millet | | | | | | | | |
| 2021 Pearl Millet | 22.92 | 1.19 | 14.52 | 58.89 | 21.49 | 1.66 | 16.43 | 58.03 |
| 2022 ExCeed BMR | 17.05 | 1.70 | 14.03 | 63.07 | 18.16 | 1.82 | 16.95 | 64.73 |
| Sorghum Sudangrass | | | | | | | | |
| 2021 Sorghum Sudangrass | 19.75 | 2.03 | 12.99 | 58.22 | 18.75 | 2.17 | 16.24 | 58.21 |
| 2022 Viking 200 BMR | 17.41 | 2.54 | 12.83 | 60.41 | 17.48 | 2.90 | 13.1 | 60.96 |
| 2022 Viking 232 BMR | 16.44 | 2.86 | 14.59 | 63.67 | 16.61 | 2.72 | 12.82 | 62.39 |
| Hybrid Sudangrass | | | | | | | | |
| 2021 Piper | 21.73 | 2.25 | 16.45 | 62.57 | 19.25 | 2.02 | 17.10 | 60.96 |
| 2022 Piper | 18.38 | 2.15 | 13.91 | 60.27 | 17.42 | 2.00 | 15.62 | 62.25 |
| Japanese Millet 2021 | 22.03 | 1.11 | 15.70 | 55.47 | 21.25 | 1.61 | 17.79 | 57.87 |

**Table 3.** Second cutting warm season forage yield and quality.

| | 50 lb Nitrogen | | | | 100 lb Nitrogen | | | |
|---|---|---|---|---|---|---|---|---|
| | % DM | Ton/AC | CP, % | TDN OARDC | % DM | Ton/AC | CP, % | TDN OARDC |
| Pearl Millet | | | | | | | | |
| 2021 Pearl Millet | 24.63 | 2.51 | 8.29 | 63.07 | 23.16 | 3.00 | 9.25 | 63.07 |
| 2022 ExCeed BMR | 21.23 | 2.66 | 8.67 | 64.88 | 18.71 | 3.19 | 10.75 | 64.98 |
| Sorghum Sudangrass | | | | | | | | |
| 2021 Sorghum Sudangrass | 22.88 | 2.06 | 9.19 | 63.48 | 21.25 | 2.51 | 11.48 | 63.67 |
| 2022 Viking 200 BMR | 20.46 | 2.48 | 9.96 | 65.08 | 18.23 | 3.46 | 10.19 | 65.18 |
| 2022 Viking 232 BMR | 20.66 | 2.56 | 9.67 | 63.84 | 19.98 | 2.75 | 11.05 | 64.32 |
| Hybrid Sudangrass | | | | | | | | |
| 2021 Piper | 23.50 | 2.42 | 9.94 | 62 | 23.75 | 3.10 | 12.66 | 60.27 |
| 2022 Piper | 22.93 | 1.68 | 12.89 | 63.7 | 20.84 | 1.75 | 14.41 | 64.19 |
| Japanese Millet 2021 | 33.00 | 2.26 | 10.16 | 62.12 | 30.50 | 2.73 | 10.25 | 60.41 |

**Table 4.** Single harvest warm season forage yield and quality.

| | 50 lb Nitrogen | | | | 100 lb Nitrogen | | | |
|---|---|---|---|---|---|---|---|---|
| | % DM | Ton/AC | CP, % | TDN OARDC | % DM | Ton/AC | CP, % | TDN OARDC |
| Pearl Millet | | | | | | | | |
| 2021 Pearl Millet | 31.19 | 2.54 | 10.93 | 49.60 | 32.38 | 5.56 | 9.41 | 49.61 |
| 2022 ExCeed BMR | 23.2 | 3.35 | 8.35 | 65.12 | 22.64 | 3.44 | 9.04 | 65.26 |
| Sorghum Sudangrass | | | | | | | | |
| 2021 Sorghum Sudangrass | 38.93 | 5.44 | 5.73 | 49.61 | 34.60 | 4.93 | 12.24 | 51.06 |
| 2022 Viking 200 BMR | 29.14 | 7.42 | 7.43 | 65.68 | 29.55 | 7.37 | 9.13 | 66.58 |
| 2022 Viking 232 BMR | 29.23 | 6.71 | 5.36 | 65.2 | 31.44 | 7.48 | 6.99 | 64.99 |
| Hybrid Sudangrass | | | | | | | | |
| 2021 Piper | 41.92 | 4.45 | 5.65 | 49.55 | 39.97 | 4.28 | 6.98 | 52.43 |
| 2022 Piper | 32.11 | 2.66 | 10.28 | 63.25 | 30.15 | 2.78 | 9.68 | 62.93 |
| Japanese Millet 2021 | 42.73 | 2.78 | 7.11 | 52.98 | 39.55 | 3.33 | 10.24 | 49.61 |

**Table 5.** Yield comparison of single and double harvests.

| | 50 lb Nitrogen | | 100 lb Nitrogen | |
|---|---|---|---|---|
| | Double harvest | Single harvest | Double harvest | Single harvest |
| Pearl Millet | | | | |
| 2021 Pearl Millet | 3.70 | 2.54 | 4.66 | 5.56 |
| 2022 ExCeed BMR | 4.36 | 3.35 | 5.01 | 3.44 |
| Sorghum Sudangrass | | | | |
| 2021 Sorghum Sudangrass | 4.09 | 5.44 | 4.68 | 4.93 |
| 2022 Viking 200 BMR | 5.02 | 7.42 | 6.36 | 7.37 |
| 2022 Viking 232 BMR | 5.42 | 6.71 | 5.47 | 7.48 |
| Hybrid Sudangrass | | | | |
| 2021 Piper | 4.67 | 4.45 | 5.12 | 4.28 |
| 2022 Piper | 3.83 | 2.66 | 3.75 | 2.78 |
| Japanese Millet 2021 | 3.37 | 2.78 | 4.34 | 3.33 |

**Table 6.** Precipitation (inches) during the 2021 and 2022 growing season at the ISU NE Research Farm, Nashua, IA.

| | Apr | May | June | July | Aug | Sept | Oct | Nov | Total |
|---|---|---|---|---|---|---|---|---|---|
| 2022 | 3.62 | 4.10 | 5.22 | 2.55 | 6.74 | 1.03 | 0.75 | 2.02 | 26.03 |
| 2021 | 0.63 | 3.48 | 1.42 | 2.53 | 10.58 | 1.61 | 4.50 | 2.02 | 26.77 |
| 1976-2021 Avg | 3.61 | 4.50 | 5.38 | 4.53 | 4.80 | 3.51 | 2.71 | 1.75 | 30.79 |

## Results

A winter annual/summer annual forage system can be used to break up the traditional corn/soybean rotation and produce 9-12 tons of forage feed on a dry matter basis. The results indicated the second cutting warm season grasses responded positively to additional nitrogen fertilizer with increased dry matter yields. The sorghum-sudandgrass hybrids had higher yields in the single harvest system while the millets and sudangrass had higher yields in the double harvest system.

## Acknowledgements

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# Dairy on beef performance and biometrics

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## Dairy on beef performance

### Introduction

As dairy/beef cattle become more prevalent on today's dairy operations, the challenge remains to find the best way to raise them. These cattle result from the cross of a dairy cattle dam and a beef cattle sire, usually Holstein x Angus. Dairy farmers breed their lowest genetic potential animals, determined via genomic test, to beef, usually at a rate of 30-50% of the total herd. The remainder of the herd receives conventional or sexed semen as a source of herd replacements. Dairy producers tend to select for cattle that are black faced and have desirable calving ease, without much attention to other performance EPD's. Cattle nutrition is a means of improving the resulting meat product, no matter the genetic background.

### Calf growth phase

One of the main goals of this study is to study the effect of protein and fat levels on cattle growth and finishing. The two milk treatments fed contained 28/14 and 22/20 protein/fat levels. This study looked at not only the effects of nutritional treatments, but also account for other factors that may influence the outcome, such as gender. Carcass ultrasound technology was also used to evaluate live animals for carcass traits, with aims to improve two of the biggest areas of opportunity for producers, carcass length and ribeye dimension.

### Feed efficiency

Once cattle reached 1000 pounds, feed efficiency was evaluated. Feed efficiency can often be overlooked in large feedlots because it is hard to track individual feed intakes in a herd-based setting. This study evaluated feed efficiency for a period of six weeks.

### Carcass quality

The largest goal of this study was to improve the resulting meat quality from dairy/beef animals. While a variety of carcass quality traits were evaluated, important ones of note were quality and yield grading. Dairy animals tend to yield less than their purebred beef counterparts, but have higher marbling, leading to improved quality grades. They however, have lower yield grades.

### Summary

Dairy/beef animals present an area of opportunity for dairy producers looking to capitalize on excess animals and manage heifer inventories. Nutrition is one means of improving meat quality and therefore profitability, regardless of the genetic background of the animals. Both steers and heifers can grow efficiently and grade profitably for producers when managed for their unique characteristics.

## Evaluating the use of morphometric measurements to predict future performance

### Introduction

The practice of breeding dairy females to beef sires has continued to increase over the past 10 years and especially over the past 5 years. One of the concerns with the beef x dairy cross cattle identified by cattle feeders and packers is phenotype variability of feedlot performance and carcass traits of these animals. As they get older and are being fed out, they range in appearance and performance from typical dairy steers to straight beef steers, which can make it difficult to assemble uniform groups of cattle to market. When the calves are very young it is very difficult to predict what body type they will have when they get older with a reasonable degree of accuracy. Many of these calves are sold the first time at less than 10 days old.

### Materials and methods

UW- Madison Division of Extension Livestock Educators and Department of Animal Science Faculty designed and conducted a research project to determine if using morphometric measurements (physical measurements) of the calves' body shortly after birth could predict the phenotype (beef or dairy) of the animal when older. Extension Educators worked with five cooperating farms to measure 206 calves, from four sire breeds, (Angus, Sim-Angus, Simmental, and Limousin). Calves were initially measured within 3 weeks of birth and again at approximately 4 months of age (approximately 350 to 400 pounds). Calf size at the second measurement was chosen because it approximates when calves begin to be grouped for feeder calf sales, and this is the typical time when dairies group hutch raised calves.

Measurements taken were: cannon bone circumference, forearm circumference, hip height, weight, head length and head width. The latter two measurements were based on grower anecdotes "the ones with the short wide heads are the good ones". The calves were also assigned a muscle score when the 4 month measurements were taken using the USDA Feeder Calf Muscle Score Grade method. Cattle from two of the farms were muscle scored again at approximately 650 to 750 pounds and 1,000 to 1,200 pounds.

To evaluate the morphometric measurements at the transition from dairy farms to sale and animal performance 91 out of 206 calves sourced from four farms, and offspring of two different sire breeds (Angus and Sim-Angus), were used. To predict the weight gain and body weight at 120 days of age 97 calves, offspring of three different sires (Angus, Sim-Angus, and Limousin), were used.

## Results and discussion

Hip height and initial weights were 7.67% and 10.7% higher ($P<0.05$) for the Sim-Angus sired calves than the Angus sired calves. However, the ADG and adjusted body weight to 120 days were 14.3% and 9.46% greater ($P < 0.05$) in the Angus sired calves compared to Sim-Angus sired calves. The morphometric measurements improved the model's predictive performance for weight gain (rate of gain) and body weight at 4 months of age. We were not able to follow these calves further through growth and finishing, so we do not know if these differences would continue. In feedlots, Jaborek et.al. (2019) evaluated performance of 20 Angus and 29 Sim-Angus crossbred animals and found no difference in weight gain.

Sire, on average, accounted for 35% of all within-breed variation for the morphometric measurements in the first days of that animals' life and 52% in birth weight. These results demonstrate the importance of selecting sires within a breed to achieve the desired traits of the animals. The trait of birthweight can have both positive and negative implications. Too large of calves increase risk of calving problems and too small of calves are not desirable to buyers when the calves are sold shortly after birth.

There was not enough variation in the muscle scores of the calves in this trial, (greater than 98% were #2 or #3 muscle score) to develop a model to predict muscle score.

In the study above, we were able to use morphometric measurements in beef on dairy crosses to predict their weight gain and body weight at 4 months of age. The morphometric measurements were obtained using tape measurements. However, on a larger scale, taping calves can be labor-intensive and difficult to perform in practice (Bewley et al., 2001; Bezsonov et al., 2021). In this context, new technologies such as using computer collected images to collect morphometric measurements (Cominotte et al., 2020; Oliveira et al., 2021), enabling large-scale phenotyping collection. Ruchay et al. (2020) evaluated the accuracy of depth cameras to measure body biometrics (e.g., wither height, hip height and hip length) in cattle, and reported that the difference normalized between the camera and manual measurements were less than 2 cm. Shi et al. (2019) also reported great potential of computer vision systems to predict ($R2 > 0.82$ and RMSE $< 2.9$ cm compared to manually collected) pigs' body measurements (e.g. body length, body width, body height, hip width, and hip height).

As part of this project, all calves had video data collected using a depth camera (3-D camera) at the time the first two sets of measurements were taken. The camera data is still being analyzed and pooled with camera data from additional calves to determine if a model can be developed to predict phenotype and other important traits.

In conclusion, morphometric measurements at first days of calves' life can be used to predict animals' performance in beef on dairy. Additional work needs to be done to further evaluate traits of importance and methods that would be most efficient.

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## Dairy producer survey to identify use of beef sires on dairy females and post-natal calf care

In 2018 a survey was conducted by UW Madison Division of Extension and Department of Animal Science to collect information about the use of beef sires on dairy females. The survey collected data about how farmers determined which females and how many to breed to beef sires and the criteria they used to select the beef sires. The survey was a cooperative effort with Wisconsin, Michigan State and Iowa State Extensions surveying dairy farms and AI company representatives. The 2018 survey can be found at this link: https://livestock.extension.wisc.edu/files/2021/11/dairy-beef-survey-white-paper-Final-4-4-2019.pdf

In 2021, a follow up survey was conducted in Wisconsin that included similar questions and additional questions on post parturition care of the beef x dairy cross calves. Forty farms returned surveys. A partial summary of the survey pertaining to the beef production aspect of producing beef x dairy cross calves is as follows.

- Herd size ranged from 19 to 7,414 cows with a median herd size of 454 lactating cows and an average herd size of 735 lactating cows.
- Thirty of the 40 farms indicated most of beef x dairy calves were sold within two weeks of age. Five of the farms reported retaining ownership of most of the calves through finish, and four farms reported selling the majority of the calves between 2 months and a year of age.
- Twenty-four farms indicated selling calves though auction markets, 22 via private treaty, four though contract programs and one farm marketed through a meat market that they own.
- Calving ease, conception rate and semen cost were the most important criteria for selecting beef sires. The average semen price paid for beef sires was $10 per straw with a range of $1.40 to $30.00.
- Twenty-one farms indicated the AI representative selected the beef sires, 16 indicated the farm management and two indicated the calf buyer made the beef sire decisions. The survey was not given to AI representatives this time. The previous survey results showed that the AI representatives were using the same criteria as the farmers.

- Thirty-five of 40 farms reported managing beef x dairy calves similarly to dairy heifers at birth and disinfected navels.
- All 40 farms reported having sufficient colostrum for the beef x dairy cross calves and half reported beef x dairy cross calves receiving a second feeding of colostrum. Approximately half also reported testing colostrum quality for the beef x dairy cross calves.
- All farms owning the calves longer than 6 weeks were vaccinating the calves for scours and respiratory disease, and one-third of farms selling at less than 2 weeks were vaccinating (these could be "program calves").

In summary, criteria for selection of beef sires does not appear to have changed since the previous survey in 2018. There appears to be opportunities for improved communication between sellers and buyers. There also appears to be some opportunities for improvement of early calf care on some of the farms.

## Collaborators on the morphometric and survey projects

Matt Akins, Aerica Bjurstrom, Erin Borchert, Taigo Bresolin, Amanda Cauffman, João Dórea, Carolyn Ihde, Tina Kohlman, Matt Lippert, Dan Marzu, Guilherme Menezes, Megan Nelson, Guilherme Rosa, Heather Schlesser, Ryan Sterry, and Sandy Stuttgen.

# Impacts of poor nutrition during late gestation on the cow-calf system

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## Introduction

Nutrient requirements increase dramatically in the late gestation beef female to allow for proper growth and function of the uteroplacenta, fetus, and mammary gland. Even in well-managed herds, it is possible for cows and heifers to be nutrient restricted during this time due to challenges of low forage quality or availability and environmental stress brought on by cold (spring-calving) or heat (fall-calving). For heifers, the added nutrient requirements of growth and establishment of a functional uterus and mammary gland for the first time pose an even greater challenge during their first pregnancy. A growing body of research demonstrates that nutrient restriction during pregnancy can have long-lasting effects on calves resulting from impaired development before and after birth. This is not surprising, as calves depend on their dams for all nutrients before birth, and the majority of nutrients pre-weaning. Late gestational nutrient restriction research generally associates decreased nutrient delivery during gestation with programming fetal growth and development, resulting in poor postnatal outcomes. However, the effects gestational nutrient partitioning may have on programming the mammary gland to decrease milk yield and therefore postnatal nutrient delivery is far less understood. It is also generally unknown how poor nutrition during one pregnancy impacts cows during their next pregnancy and lactation.

## Experimental model

To determine the effects of late gestational nutrient restriction in primiparous females, fall-calving Hereford-SimAngus heifers bred to a single sire were used in this study. Heifers were allocated by fetal sex and expected calving date to receive either 100% (control; n = 12) or 70% (nutrient restricted; n = 13) of NASEM metabolizable energy and metabolizable protein requirements for maintenance, pregnancy, and growth from day 160 of gestation to calving. Heifers were individually-fed using Calan gates, which allowed animals to eat individual diets while group-housed in pens. Diets were based on low-quality chopped sorghum sudan hay (1.7 ME Mcal/kg, 6.7% CP, 72% NDF) from day 160 to day 265 of gestation and chopped tall fescue hay (1.9 ME Mcal/kg, 7.2% CP, 65% NDF) for the remainder of gestation and lactation. Based on expected individual intakes, heifers were supplemented with whole corn, dried distillers grains, and soyhull pellets to meet targeted nutritional planes.

After calving, treatments were terminated and all cows were fed to meet energy and protein requirements for maintenance, lactation, and growth. Females continued to be fed individually in Calan gates to ensure individual nutrient intakes remained similar and to prevent calves from having access to feed other than milk. At 5 months post-calving, cow-calf pairs were co-mingled and group-fed hay and supplement until calves were weaned at 8 months of age. Post-weaning, calves were backgrounded in drylots for 2 months and then placed into the feedlot for finishing. Cattle were slaughtered at a similar number of days on feed.

## Outcomes

Major findings of late gestational nutrient restriction on dam and calf production are shown in Table 1. Nutrient restricted females lost body weight and condition and had less nutrients in maternal circulation during late pregnancy. Post-calving, nutrient restricted dams weighed 64 kg less and were 2.0 lower body condition score. Nutrient restricted dams had lower maternal heart rates during pregnancy and less contralateral placental growth (uterine horn opposite of the fetus and CL), yet total uterine blood flow and placental weight were maintained and ensured calf birth weights similar to control calves. It should be noted that when we conducted a similar study using the same experimental model, calf birth weight was reduced by 15% and placental weight by 17%, but uterine blood flow remained unaffected. In combination, these results demonstrated that late gestational nutrient restriction is inconsistent in reducing fetal growth, which appears to be driven more by placental size than uterine blood flow.

**Table 1.** Effects of late gestational nutrient restriction on maternal and calf outcomes

| Nutrient restricted heifers | Calves born to nutrient restricted heifers |
|---|---|
| ↓ Body weight at calving | = Birth weight |
| ↓ Body condition score at calving | = Gestation length |
| ↓ Heart rate during pregnancy | ≠ Altered placental development |
| = Uterine blood flow | ↓ Calf vigor |
| ↑ Abnormal presentation at birth | ↑ Stress at birth |
| ↓ Colostrum production | = Achieved passive transfer of immunity |
| ↓ Milk production | ↓ Pre-weaning growth |
| ↓ Mammary blood flow | = Carcass weight and quality grade |
| ↓ Body condition score at weaning | ↓ Yield grade (numerically lower) |

Fetal presentation at calving was normal for all control births, while 23.1% (3 of 13) of nutrient restricted dams had calf malpresentations. While calf birth weight and gestation length were unaffected in this study, nutrient restricted dams had less vigorous calves that were slower to stand and 40% less colostrum yield. Colostrum of nutrient restricted females was more concentrated with IgG, and calf 48-h serum IgG indicated that calves of both treatments had successful passive transfer of immunity. Colostrum of nutrient restricted females had less total lactose, but similar total protein and fat compared with control females. There was no neonatal calf death loss due to treatment in the current study; however, this was likely because females were managed intensively for research purposes and monitored continuously during calving season to ensure data collection.

Even when females were fed to meet their energy and protein requirements during lactation, late gestational nutrient restriction reduced milk yield by 15% and decreased milk protein concentration during the first 150 days of lactation. Lower milk production was partially explained by a 19% reduction in blood flow supplying the mammary gland during this time. Less total lactose, protein, and fat provided by the milk resulted in calf body weight diverging by 42 days of age, and calves born to nutrient restricted remained smaller through weaning when they weighed 27 kg less than control calves (Figure 1). In agreement with pre-weaning body weight, shoulder height in calves born to NR dams was shorter from d 63 of age through weaning and calf ribeye area was smaller on d 42 and 126 of age than for control calves. Interestingly, calf metabolic status pre-weaning was not as severely altered as expected considering milk nutrient and calf growth differences.

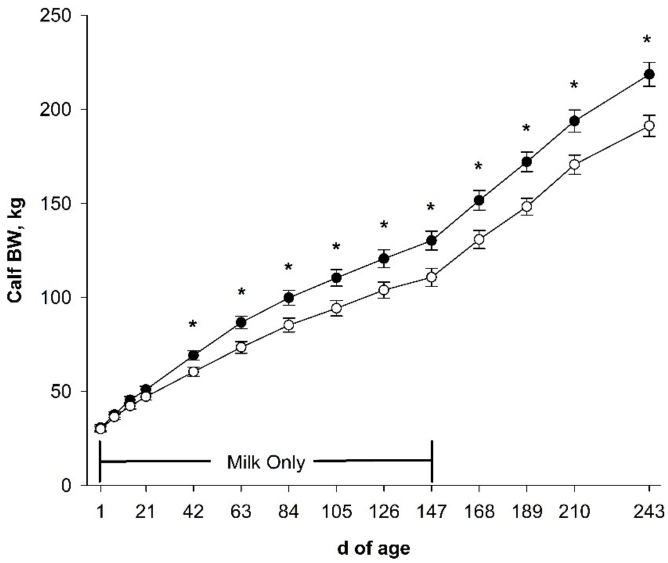


**Figure 1.** Effect of late gestational nutritional plane on calf body weight (BW) from birth until weaning. Solid circles (•) represent calves born to control dams and open circles (○) represent calves born to nutrient restricted dams. *Treatment means differ ($P \leq 0.05$).

By day 21 of lactation, metabolic status of previously nutrient restricted dams had returned to concentrations similar to control dams. During lactation, previously nutrient restricted females gained maternal weight faster and increased body condition, but had still not fully recovered to that of control females. Females in both treatments were similarly successful in rebreeding for a 2nd calf and comparable to industry averages for conception rate. At weaning, previously nutrient restricted dams weighed 17 kg less and were 0.7 lower body condition score.

At harvest, calves born to nutrient restricted dams had lower dressing percentage, but improved yield grade and backfat thickness. Final feedlot body weight, hot carcass weight, ribeye area, and quality grade were not affected by maternal treatment.

## Outcomes in the second pregnancy and lactation

Females were managed together and followed through weaning of their 2$^{nd}$ calf to determine if there were carryover effects during the subsequent parity. Previously nutrient restricted dams still weighed roughly 45 kg less and were 0.6 lower in body condition score when measured at multiple points during late gestation and lactation. Uterine blood flow, placental size, and calf birth weight were unaffected by nutrient restriction during the first pregnancy. Colostrum yield, nutrient composition, and IgG concentrations had recovered and were similar between treatments. Milk yield and nutrient composition also recovered; however, the reduction in milk protein concentration in previously nutrient restricted dams still remained. Reduced mammary blood flow persisted in the 2$^{nd}$ lactation and was 18% less for previously nutrient restricted dams. During the second parity, differences in lactational performance were not severe enough to alter calf pre-weaning growth as weaning weight was similar between treatments.

## Implications

Although late gestational nutrient restriction may not always reduce birth weight, our results illustrate that colostrum and milk production was impaired resulting in divergent pre-weaning growth. Calves born to nutrient restricted dams had lighter weaning weights, which would ultimately affect cow-calf profitability. While no calves died in the research setting, it is more likely that calf malpresentations at birth, reduced calf vigor, and altered colostrum composition could lead to decreased calf survival in nutrient restricted heifers in a production setting. Additionally, persisting effects in the 2$^{nd}$ parity on maternal size, fleshing ability, and mammary blood flow demonstrate the possibility of long-term programming effects on the dam, which could have implications for cow longevity in the herd. These results reinforce the importance of providing adequate nutrients to pregnant beef cattle, especially first-calf heifers that are still growing.

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# Drought Impacts Come Home to Roost in 2023

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## Beef markets changing in 2023

Beef markets will change dramatically in 2023 with cattle prices continuing to trend higher. Continuing drought since late 2020 provoked sharp liquidation of the beef cow herd over the past two years. In 2022, total female cattle (cow plus heifer) slaughter totaled over 51 percent of all cattle slaughter, a level of female slaughter not seen since 1986. Beef cow herd culling was at a record level in 2022. Drought-forced liquidation cows and replacement heifers and early marketing of feeder cattle pushed 2022 beef production to record levels. The increase in beef production is temporary and not sustainable as it is based on inventory liquidation.

## Declining beef production ahead

Beef production is expected to decrease sharply in 2023 although the exact amount depends on continuing drought conditions. If drought persists this year, more herd liquidation will result in beef production higher than otherwise but still down year over year. If drought conditions improve, attempts to begin herd rebuilding will result in a more dramatic decrease in beef production with increased heifer retention and reduced cow culling.

## Beef demand holding steady thus far

Beef demand has remained relatively strong through all the shocks and challenges of the past three years. This is evidenced in 2022 by stable wholesale and retail prices in the face of record beef production. The potential for weaker beef demand remains a concern with consumers facing continuing challenges of inflation and recession fears. Declining beef production likely implies that beef prices will rise further albeit with more demand rationing and consumers adjusting purchasing decisions. Tight supplies of beef means that some consumers will likely significantly reduce beef consumption or trade down to lower value products in the coming year.

## Beef trade remains favorable

Part of the strong beef demand has been a favorable beef trade environment. Beef exports pushed to another record level in 2022 with continued, though slowing increases in beef exports to China/Hong Kong. The Asian markets of Japan, South Korea, China/HK and Taiwan account for over 70 percent of U.S. beef exports followed by Mexico and Canada. Beef exports will likely slow in 2023 with tighter supplies, higher prices, and a continued strong dollar adding more headwinds to exports. The U.S. imports beef, largely to support the ground beef market, and that may accelerate some in 2023. Sharply reduced lean beef supplies in the U.S., due to declining cow slaughter; higher beef prices; recovery in Australian beef production; and a strong dollar are all likely to contribute to modest increases in beef imports going forward.

## Higher cattle prices ahead

Cattle prices have trended higher from the lows in 2020 and that trend will continue in 2023. Cow-calf producers will increasingly be in the industry driver seat as tight cattle supplies are more fully manifest in markets. Drought liquidation thus far ensures that the beef industry is smaller than needed and rebuilding incentives will be strong once drought conditions improve. This will likely spike cattle prices higher with increased heifer retention and reduced cow culling. It is not clear now when that will happen. Unless drought conditions improve by this spring, it is unlikely that the rebuilding push will happen in 2023, although it could start by year end. All the margin sectors above the cow-calf level will face the squeeze of higher input prices (the stocker, feeder and fed cattle) that they purchase pushing higher faster than the output prices (feeder and fed cattle) prices adjust higher. The squeeze will be even harder with demand limitations slowing price adjustments are the retail level. Retail, packer and feedlot margins in particular will all be squeezed for the foreseeable future.

## Cost management challenges will continue

Producers at all levels will continue to face high input and production costs which will reduce and slow the profit expectations of higher cattle prices. Feed costs will remain elevated, particularly feedlot cost of gain, at least through the 2023 harvest. Forage and hay price and prospects depend entirely on drought condition for the coming growing season. Cattle producers will see increased profitability ahead, but high input prices will slow and somewhat mute the development of better returns in the industry.