

# Agriculture By the Numbers

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NDSU Extension Agribusiness and Applied Economics

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## How Many Dairy Cows can Two Soybean Crush Plants Support in North Dakota?

Jon T. Biermacher, Professor of Practice and Extension Livestock Development Specialist

Over the past 43 years, there has been a significant difference in changes in total dairy cow inventory numbers in North Dakota and South Dakota. According to the U.S. Department of Agriculture (USDA-NASS, 2023), the total number of dairy cows in 1980 was 93,000 in North Dakota and 158,000 in South Dakota (Table 1). Two decades later, North Dakota had a 46% decline and South Dakota a 39% decline in the number of dairy cows. Noteworthy, as of Jan. 1, 2023, South Dakota has rebuilt its dairy cow inventory by 95%, from 96,000 in 2000 to 187,000. During this same period, dairy cow inventory numbers in North Dakota have continued to decline to 14,000 cows in 2023. This is a 72% decline over the past 20 years and an 85% decline over the 43-year period.

**Table 1. Dairy cow inventory in North Dakota and South Dakota across time**

Year	North Dakota	% change since 1980	South Dakota	% change since 1980
1980	93,000	-	158,000	-
2000	50,000	-46%	96,000	-39%
2023	14,000	-85%	187,000	18%

Many states (mostly East and West Coast states) have relocated dairies predominantly to the middle part of the country to states such as Texas and South Dakota. Due to these changes, many stakeholders in the North Dakota agricultural community have expressed interest in finding ways to increase dairy cow numbers. Driving some of this interest is the anticipated new local large-scale production of animal soybean-based feedstuffs like soybean meal and soybean hulls that will be produced by two large-scale soybean crush plants that are being built along the I94 corridor between Bismarck and Fargo.

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# How Many Dairy Cows can Two Soybean Crush Plants Support in North Dakota? — continued from page 1

This study sought to gain an understanding of how much soybean-based feed would be needed for dairy expansion in the state. The objective was to determine the quantity (tons/year) of soybean meal and soybean hulls would be needed to support three expansion scenarios of dairy cows in the state:

- Increasing dairy cow numbers from 14,000 to 50,000
- Increasing cow numbers back to the 1980 number of 93,000
- Increasing cow numbers to 158,000, which is the current 2023 inventory in South Dakota.

Table 2 reports soybean meal and soybean hull requirements for dairy cows and dairy cow expansion scenarios for North Dakota. Daily feed requirements for meal and hulls for lactating cows, dry cow, and heifer development for replacements was obtained from the University of Missouri's Extension Dairy Budgeting Tool (Horner and Milhollin, 2022). This information was used to calculate annual total feed requirements needed for a representative dairy cow that produces an average of 24,000 pounds of milk per year. The analysis used a productive milk production target to place an upper bound estimate on feed requirements. The feed requirements on a pounds-per-head-per-year basis for both feedstuffs were used to calculate the total requirements for the current cow inventory and the three alternative expansion scenarios.

The current inventory of 14,000 head of dairy cows would require 9,483 tons of meal and 10,676 tons of hulls per year. It is expected that the two crush plants will produce approximately 2.2 million tons of meal and 9.9 million tons of hulls per year. Therefore, the existing cow herd in North Dakota (18,000 cows) would only require 0.43% of the meal production and 0.11% of the hull production. On the other hand, for the largest expansion scenario, the current inventory numbers in South Dakota (i.e., 187,000 cows), would require 126,668 tons of soybean meal and 142,598 tons of soybean hulls. This translates into requiring 5.76% and 1.44% of the total state production of soybean meal and soybean hulls, respectively. Of course, it is unlikely that North Dakota would see such expansion in the near future, but over time, moving from 14,000 cows to 50,000 cows is conceivable. In either case, it does appear that production of soybean meal and hulls will be more than adequate to accommodate dairy cow operations in the state with plenty of product left over for expansion of other livestock activities, such as swine and poultry.

For questions, please do not hesitate to write me at [jon.biermacher@ndsu.edu](mailto:jon.biermacher@ndsu.edu).

**Table 2. Soybean meal and soybean hull requirements for dairy cows and dairy cow expansion scenarios for North Dakota**

Variable of interest	Soybean meal	Soybean hulls
<i>Lactating cow*</i>		
Daily feed requirement (lbs/cow/day)	4.12	3.09
Days on feed	307	307
Annual feed requirements (lbs/cow/year)	1,265	949
<i>Dry cow</i>		
Daily feed requirement (lbs/cow/day)	1.55	2.06
Days on feed	58	58
Annual feed requirements (lbs/cow/year)	90	119
<i>Heifer development</i>		
Total annual feed requirements (lbs/cow/year)	0	457
Total feed required (lbs/cow/year)	1,355	1,525
Base-case: Feed required for 14,000 head of dairy cows (year = 2023) (tons/year)	9,483	10,676
Scenario 1: Feed required for 50,000 head of dairy cows (year 2000) (tons/year)	33,869	38,128
Scenario 2: Feed required for 96,000 head of dairy cows (year = 1980) (tons/year)	65,028	73,205
Scenario 3: Feed required for 187,000 dairy cows (South Dakota; year = 2023) (tons/year)	126,668	142,598
Total expected annual soybean-based feedstuff production in North Dakota (tons/year)	2,197,558	9,900,000

\*Calculations are based on milk production of 24,000 pounds per cow per year

## References:

Horner, J., and R. Milhollin. Missouri Dairy Budget Tool. University of Missouri Cooperative Extension Service. Found at: <https://extension.missouri.edu/publications/g676> [Accessed September 29, 2023].

US Department of Agriculture, National Agricultural Statistics Service (USDA-NASS, 2023). Quick Stats Database. Found at: <https://quickstats.nass.usda.gov/> [Accessed September 29, 2023].

# Understanding the Complexities of the U.S. Wheat Market

Frayne Olson, NDSU Extension Crop Economist/Marketing Specialist

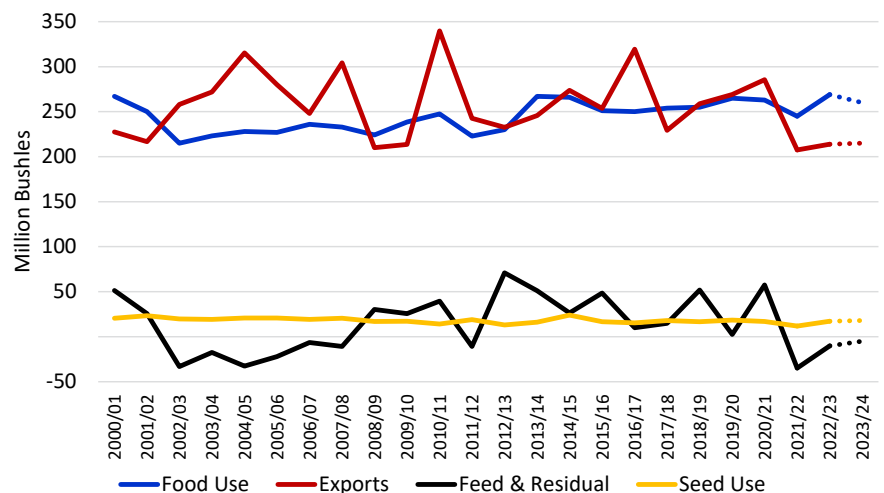
The U.S. wheat market is complex with many interactions and nuances. This makes understanding the dynamics of the spring wheat market and developing a marketing plan tricky.

First, the U.S. has six different classes of wheat: hard red winter, hard red spring, soft red winter, durum, hard white and soft white wheat. In addition, the domestic wheat milling and baking industries have become very sophisticated with their procurement strategies and quality specifications. There is limited substitution between these classes, depending on the type of flour, bread product being made and the quality characteristics of the final product.

The world wheat market is no less complicated. Every major wheat-exporting country uses a slightly different wheat classification and grading system. For example, a U.S. No. 1 Dark Northern Spring wheat has slightly different characteristics than a Canadian No. 1 Canadian Western Spring wheat. While these differences are relatively minor, there are differences. A U.S. No. 1 Hard Red Winter wheat has slightly different characteristics than an Australian Prime Hard wheat.

Forecasting and tracking spring wheat production typically receives more attention than consumption, or use, trends. So, let's focus on the demand side of the wheat market. Figure 1 shows the historic use of spring wheat by category. Domestic food use, the blue line, represents the amount of spring wheat purchased by the wheat milling industry. Most of the flour produced is used for making U.S. bread products, pastries, cookies, cakes and crackers.

**Figure 1 - Historical U.S. Hard Red Spring Wheat Use by Category**



September data from USDA Wheat Yearbook - Table 8

However, some flour is exported. The amount of spring wheat used for flour milling is relatively steady when compared to export levels. Food use for spring wheat varies based on the relative size of the spring wheat crop, price spreads for other wheat classes, the quality characteristics of the U.S. spring wheat crop, and the size and quality of the Canadian spring wheat production.

Spring wheat export levels, the red line, are difficult to forecast. The quantity and quality of the U.S. spring wheat crop, logistics costs, trade policies, and the size and quality of key export competitors, like Canada, all impact the amount and timing of U.S. exports.

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# Understanding the Complexities of the U.S. Wheat Market – continued from page 3

Table 1 shows the annual spring wheat export levels by country for the past six marketing years. Note that the traditional U.S. spring wheat buyers, like the Philippines, Japan, Taiwan, South Korea and Thailand, have been relatively stable over time. However, there has been a steady growth in spring wheat exports to Mexico.

Several key wheat millers in Mexico have begun using larger amounts of U.S. spring wheat. The specific reasons are unknown, but the improved water absorption rates and loaf volumes from spring wheat flour are likely important reasons. A growing population with increasing purchasing power is also a possible explanation. While countries like Japan and South Korea are very quality sensitive buyers, countries like the Philippines, Thailand and Vietnam see the value of U.S. spring wheat but are more price sensitive customers.

While it is difficult to forecast or anticipate export sales, the USDA does track export sales on a weekly basis. If 100,000 metric tons of one commodity is sold in one day to a single destination, an announcement must be made within one business day. These large sales announcements often provide “shock value” and support or temporarily lift grain prices.

Figure 2 shows the accumulated weekly export sales for U.S. spring wheat by marketing year. This figure shows there is not a strong seasonal export pattern because the lines are nearly straight. This means that even though the export sales vary from week to week, there are not time periods where sales levels are consistently higher or lower than average.

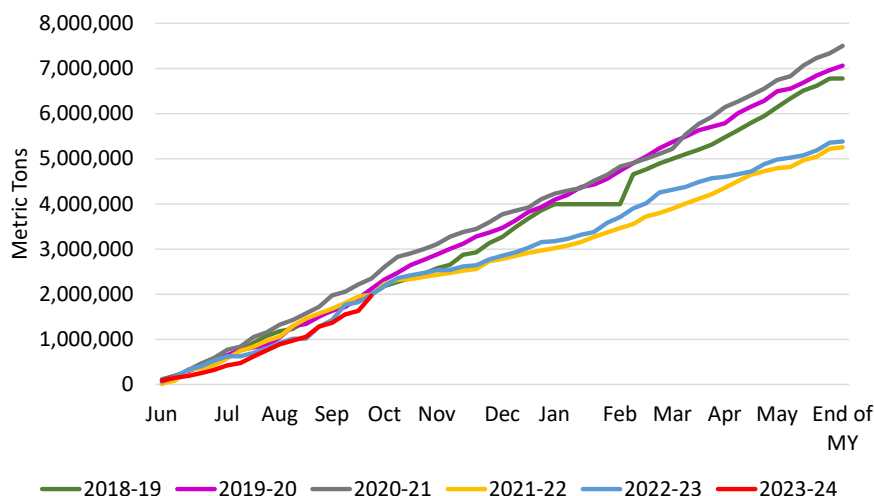
The current 2023-24 export sales have started slower than recent years. But an increase in 2023 spring wheat production is reducing domestic prices. Early samples suggest this year’s spring wheat quality will also be good. The U.S. Wheat Associates Weekly Harvest Report for September 29, 2023,

**Table 1 – Marketing Year Total Spring Wheat Exports, by Country.**

Country	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Philippines	1,247.6	1,760.4	1,732.1	1,856.3	1,447.6	1,133.5
Mexico	128.1	186.4	369.5	506.8	525.3	756.9
Japan	995.9	863.7	987.8	936.0	812.4	605.9
Taiwan	626.0	624.5	658.2	638.7	517.5	488.2
South Korea	399.7	450.2	446.3	431.9	405.8	402.1
Thailand	256.8	360.8	347.1	340.8	233.7	265.6
Vietnam	53.6	164.5	306.4	314.2	75.5	236.0
ROW	1,980.9	2,367.9	2,214.9	1,980.4	1,235.9	1,493.7
Total	5,688.6	6,778.4	7,062.3	7,005.1	5,253.7	5,381.9

USDA – Foreign Agricultural Services Export Sales Custom Query. ROW=Rest of World.

**Figure 2 – Cumulative Weekly Spring Wheat Export Sales**



USDA Weekly Export Sales Reports

shows slightly lower-than-average protein levels, 14.2% versus the five-year average of 14.6%, but slightly higher falling numbers, 406 this year versus the five-year average of 375. The average test weight for 2023 of 61.0 pounds per bushel is slightly below the five-year average of 61.5 pounds per bushel. This should increase the value proposition for U.S. spring wheat and make it more attractive in the global markets.



# 12 ND Counties Now Eligible for Livestock Forage Program (LFP)

Ron Haugen, Farm Management Specialist

As of September 21, 2003, 12 North Dakota counties are eligible for Livestock Forage Program (LFP) payments. Eight counties are eligible for four LFP payments, and four counties are eligible for one LFP payment..

## LFP Program Description

The Livestock Forage Disaster Program (LFP) offers payments to eligible livestock producers with eligible livestock. Producers also must have grazed forage crop acreage.

The payments help producers with grazing losses suffered on native or improved pastureland due to a qualifying drought. This can be land with eligible permanent or planted grazing cover.

LFP also provides for livestock producers on rangeland managed by a federal agency if the agency halts grazing on the land due to a qualifying fire.

For grazing losses due to drought, the Farm Service Agency (FSA) will calculate payments equal to 1, 3, 4 or 5 times the LFP monthly payment rate. The payment rate for drought is equal to 60% of the lesser of the monthly feed cost for all covered livestock or the normal carrying capacity of the eligible grazing land.

## General Program Requirements

The calculation of LFP payments for drought is based on the U.S. Drought Monitor rating for your county. If you suffered losses due to a qualifying drought on eligible grazing or pastureland you own or lease, you may qualify for assistance.

The livestock that would normally graze your land may include:

- Beef and Dairy Cattle
- Beefalo, Buffalo, Bison
- Deer, Elk, Reindeer
- Alpacas, Llamas, Emus
- Equine, Goats, Sheep
- Ostrich

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# 12 ND Counties Now Eligible for Livestock Forage Program (LFP) — continued from page 5

## As a livestock producer, to qualify you must:

- Own, cash lease or share lease, or be a contract grower of livestock during the 60 days before the beginning date of a qualifying drought or fire.
- Provide pastureland or grazing land for livestock, including cash-rented land, as of the date of the qualifying drought or fire.
- File a timely acreage report for your loss claim.

Certify that you have suffered a grazing loss because of qualifying drought or fire.

The qualifying drought or fire must be physically located in an eligible county **or** managed by a federal agency that has stopped you from grazing because of fire.

## Application Process

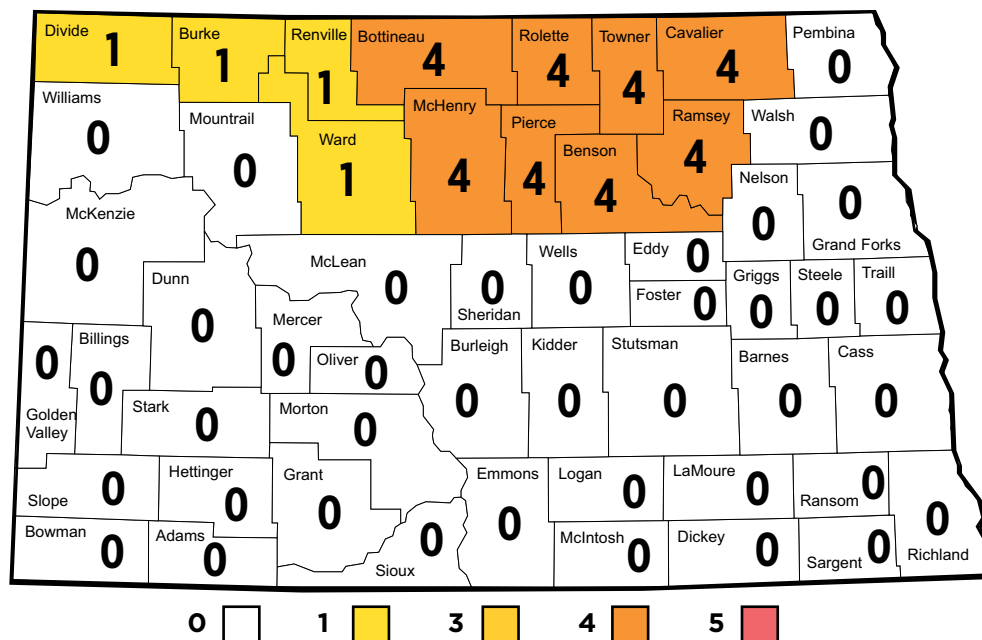
You must apply for payment and submit required supporting documents to your local FSA office within 30 days after the end of the calendar year the grazing loss occurred.

There is a payment limitation of \$125,000 per program year per person or legal entity.

If you have an average adjusted gross income (AGI) of more than \$900,000 that applies, you are not eligible for LFP payments. Legal entities exclude joint ventures and general partnerships.

Other terms and conditions may apply.

## North Dakota LFP Monthly Payments 9/21/23



**To be eligible, a livestock owner or contract grower, as a grazed forage crop producer, must own or lease grazing land or pastureland physically located in a county rated D2 to D4 by the U.S. Drought Monitor.**

**D2 (severe drought)** intensity in any area of the county for at least eight consecutive weeks during the normal grazing period is eligible to receive assistance in an amount equal to **one** monthly payment.

**D3 (extreme drought)** intensity in any area of the county *at any time* during the normal grazing period is eligible to receive assistance in an amount equal to **three** monthly payments.

**D3 (extreme drought)** intensity in any area of the county *for at least four weeks* during the normal grazing period or is rated a **D4 (exceptional drought)** intensity at any time during the normal grazing period is eligible to receive assistance in an amount equal to **four** monthly payments.

**D4 (exceptional drought)** in a county for four weeks (not necessarily four consecutive weeks) during the normal grazing period is eligible to receive assistance in an amount equal to **five** monthly payments.

NDSU has an LFP spreadsheet tool available online for producers to enter their information. The tool also works for South Dakota and Montana producers.

Link to tool:

<https://www.ndsu.edu/agriculture/ag-hub/ag-topics/farm-management>

Contact your local FSA office for more information.



# History Repeats in the Beef Cattle Cycle: 2014 vs. 2023

Tim Petry, Livestock Marketing Specialist

Baseball Hall of Fame New York Yankees catcher Yogi Berra's statement "It's déjà vu all over again" is a great description of the current U.S. beef cattle inventory and price cycles.

Most market classes of beef cattle were at record high levels in 2014 and have reached record highs again in 2023 for many of the same reasons.

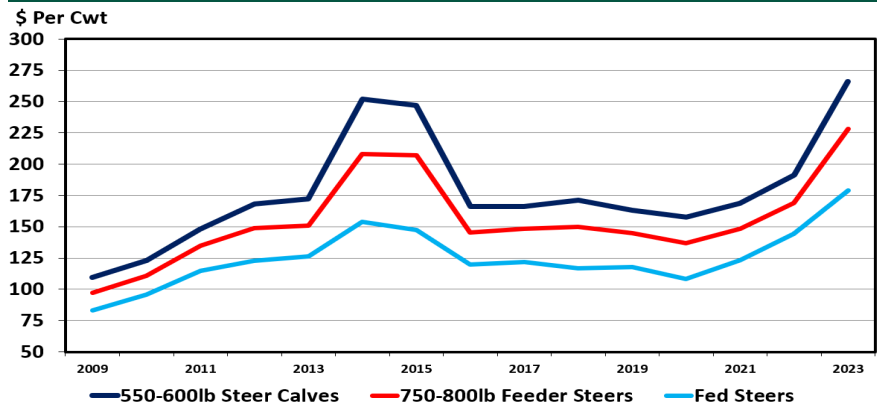
The major reason for record high prices in both years is that the U.S. beef cow herd declined to cyclically low levels due to drought in major U.S. cattle-producing regions.

Four years of drought, from 2010 through 2013, caused forced beef cow liquidation of 2.44 million head: from 31.4 million head to 28.96 million head.

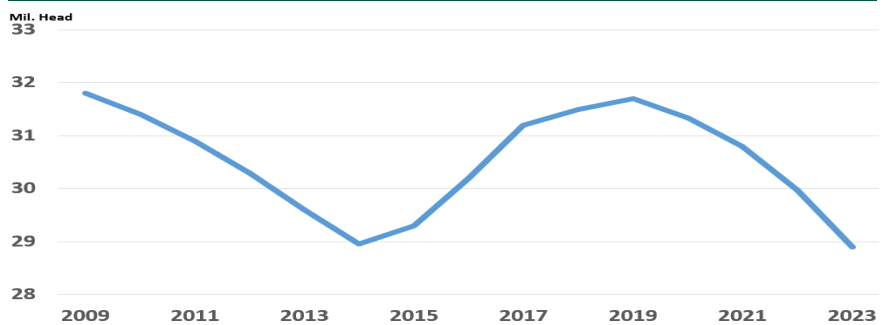
The top 10 states with the largest number of beef cows are usually Texas, Oklahoma, Missouri, Nebraska, South Dakota, Kansas, Montana, Kentucky, North Dakota and Iowa. Each of those states suffered with drought conditions at some point during that time. The Southern Plains were the hardest hit.

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### Average Annual Cattle Prices, North Dakota



### U.S. Beef Cow Inventory — January, Annual



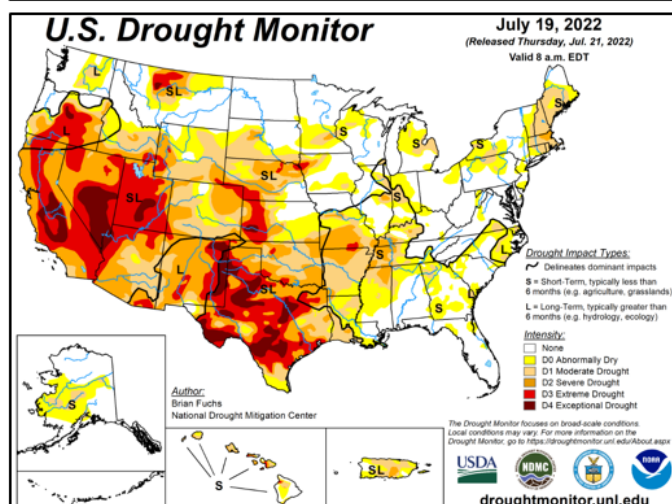
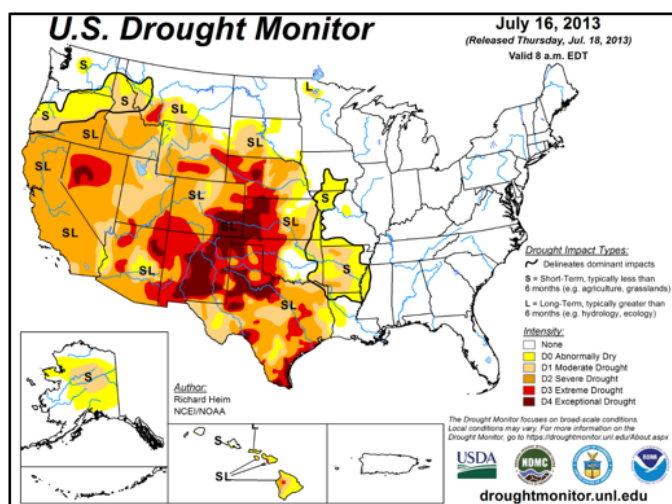
# History Repeats in the Beef Cattle Cycle: 2014 vs. 2023

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For example, Texas, the top beef cow state, experienced forced beef cow liquidation of over 1 million head: from 5.025 million head in 2011 to 3.91 million head in 2014.

Comparing that decline to the recent drought-induced four-year 2019 to 2022 cyclical decline shows similar results. U.S. beef cow numbers declined 2.78 million head to 28.92 million head, which is slightly below the previous 2014 low.

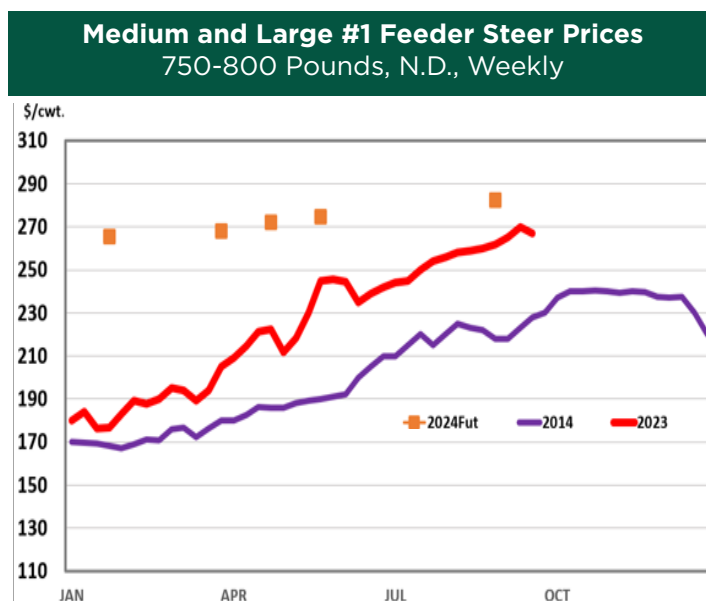
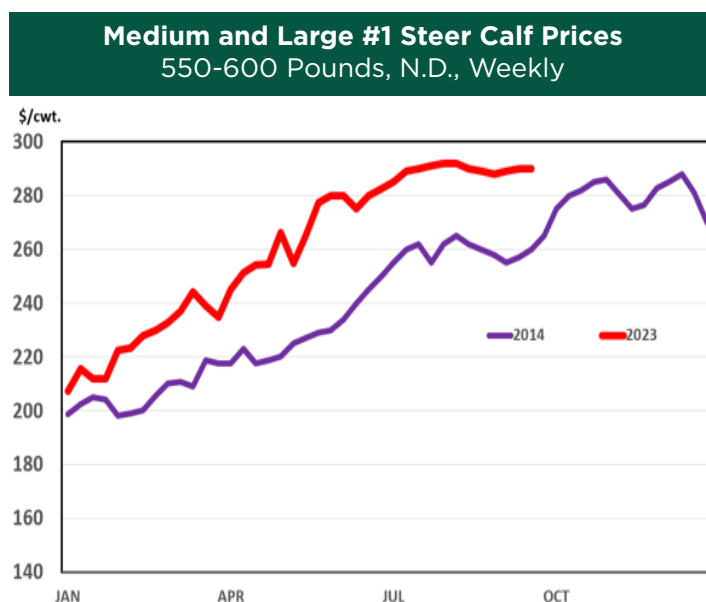
The two time periods compared similar in drought conditions.



Looking at mid-July U.S. Drought Monitors in the years before the record high prices occurred, drought was impacting much of the U.S. cattle-producing area. In 2022, USDA reported that 75% of the U.S. beef cow herd was in drought. While drought conditions do not show up in North Dakota in these two maps, drought was certainly present in the state

during both beef cow liquidation cycles. 2012 and 2021 in particular were bad drought years in North Dakota with forced beef cow liquidations.

Calf and feeder cattle prices in North Dakota have been at record high levels in 2023. Prices started the year at near 2014 levels and have outperformed 2014 throughout the year. Record high prices have been buoyed by record high fed cattle prices, moderating feed (corn) prices and smaller calf crops.



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# History Repeats in the Beef Cattle Cycle: 2014 vs. 2023

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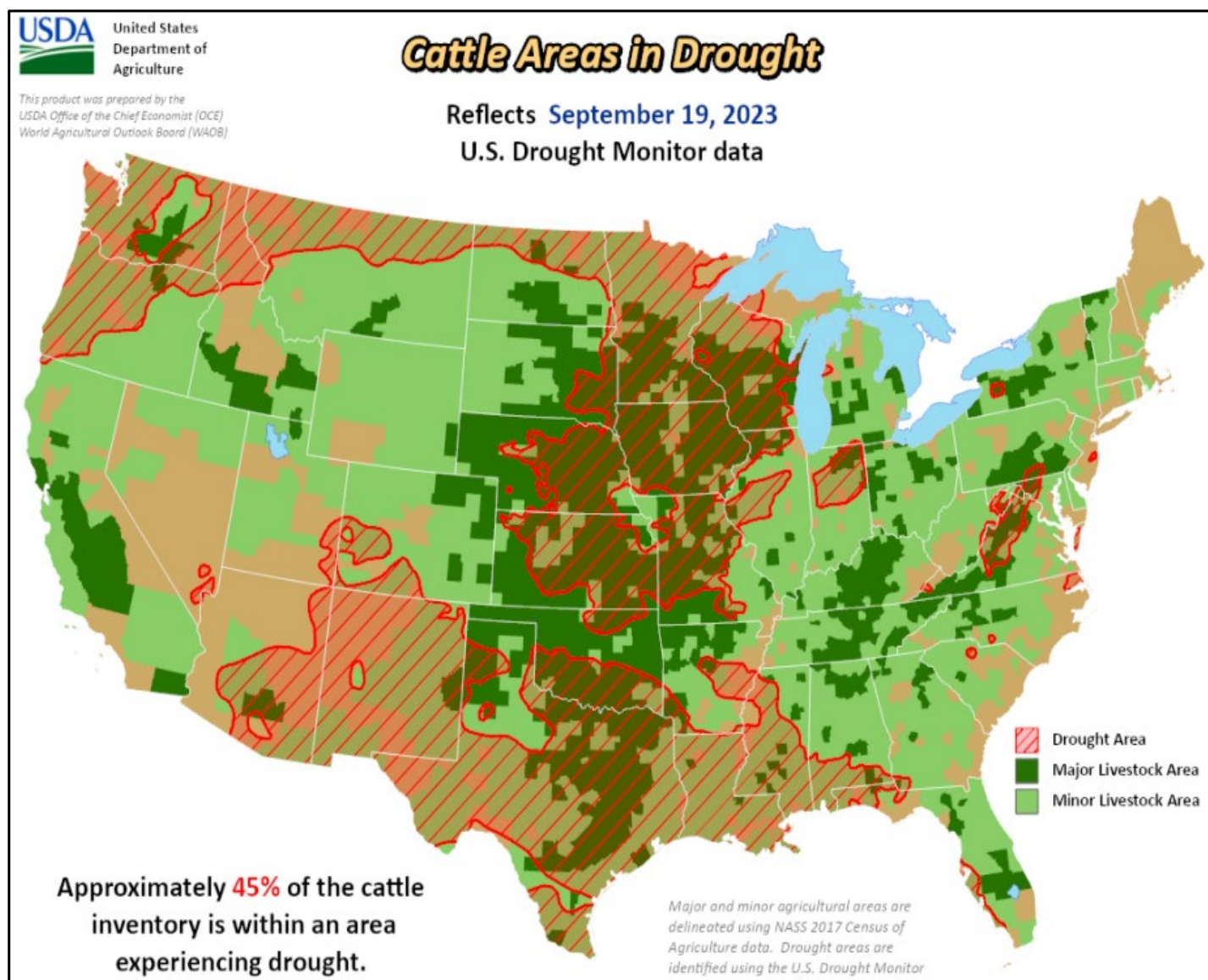
The looming question is what is ahead for cattle prices next year and beyond.

In the last cattle price cycle, after setting record highs in 2014 and the first half of 2015, cattle prices moderated the last half of 2015 and declined sharply in 2016.

Looking ahead, 2023 will be the fifth year of beef herd liquidation. So, the 2024 calf crop will be smaller again. USDA is predicting 2024 beef production to decline 6.6%, which will support 2024 cattle prices.

The highest cattle prices will likely occur when beef cow herd rebuilding is in full swing. Heifer retention, reduced cow slaughter and lower beef production will buoy prices.

The wild card in when herd rebuilding will start in earnest is U.S. pasture and range conditions. Currently, drought persists in major beef cow regions with USDA reporting 45% of the cattle area experiencing drought.



# U.S. Net Farm Income and Net Cash Farm Income Expected to Decline Sharply for 2023

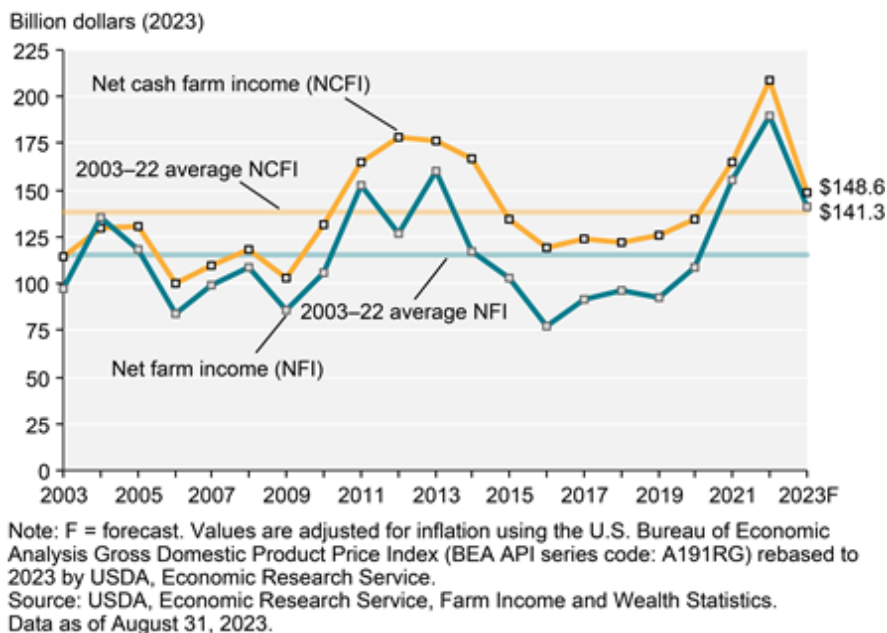
Bryon Parman, Agricultural Finance Specialist



Every year, the USDA Economic Research Service publishes data on U.S. farm financial indicators for previous years as well as a forecast for the upcoming year. Typically, these reports come out in February and late August. With the August report, the current year is a projection since in August, many U.S. crops are still in the fields and with some of it unpriced and final yield totals yet to be confirmed. This also applies to fall cattle sales and spring calf prices. However, spring and summer production costs are known for the most part, yield projections tend to be close to the actual number by August, a large percentage of the crop has been priced, and the fundamentals of current supplies and demand allow for a reasonable projection barring some big global or national unforeseen event.

On the income side of this August's report, cash income from farm-related activities are all projected lower. Cash receipts for crops are projected down 4% compared to 2022 and animal receipts are projected down 4.6%. Federal government direct program payments are also down 19% from a year ago, while farm-related activity income was up 3.6%. In total, gross cash income is expected to fall from \$604.4 billion to \$580.3 billion or approximately -4%. Meanwhile, cash expenses are projected to increase 7.3% from \$402.2 billion to \$431.7 billion. Overall, the projection for net cash farm income is a decline of 26.5% from \$202.2 billion to \$148.6 billion.

## U.S. Net Farm Income and Net Cash Farm Income, Inflation-adjusted, 2003-23F



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# U.S. Net Farm Income and Net Cash Farm Income Expected to Decline Sharply for 2023

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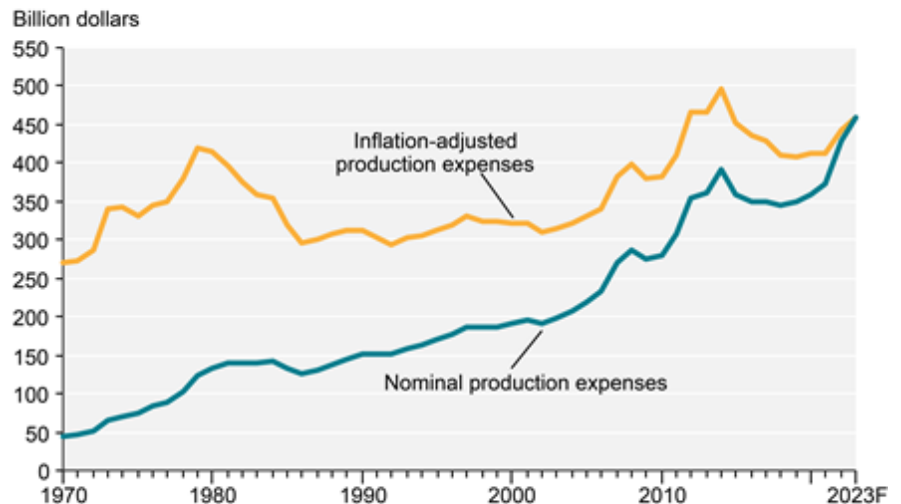
While net farm income is projected to be down 22.8% and net cash farm income is projected down 26.5%, note that 2022 was a record year for both, even adjusted for inflation. In fact, outside of 2022 and 2021, 2023 is projected to be considerably better than any year from 2015 to 2020. As can be seen by the numbers, the main reason for the decline in net cash and net farm income is a slight reduction in gross receipts while costs are notably higher than a year ago.

At the time of planting, fertilizer prices as well as herbicide and pesticide prices were still very high, and used equipment prices remained elevated. Crop prices, however, remained high, allowing for another expected profitable season in 2023. High crop prices also meant high feed costs for livestock producers. However, while nominally 2023 production costs were at a record high, when adjusted for inflation, production costs in 2023 are not projected to be as high as their peak, which occurred in 2013.

Over the summer, fertilizer prices have come down considerably while there appears to be weakness in the used equipment market this fall. Additionally, this fall, propane and natural gas prices look set to be lower than they have been over the last couple of years. However, we have also seen some of the major crop prices, such as corn and wheat, fall as well.

The 2024 projection for net farm income and net cash farm income will not come out until next year, but with the decline in crop prices, if they do not rebound, there will need to be a considerable decline in production costs or net farm incomes and net cash farm income could slide further next year.

## Nominal and Inflation-adjusted U.S. Farm Production Expenses, 1870-2023F



Note: F = forecast. Real values are adjusted for inflation using the U.S. Bureau of Economic Analysis Gross Domestic Product Price Index (BEA API series code: A191RG) rebased to 2023 by USDA, Economic Research Service.  
Source: USDA, Economic Research Service, Farm Income and Wealth Statistics.  
Data as of August 31, 2023.