

Optimal Drought Management Actions for Cattle Operations on Navajo Nation

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Introduction

Highlights

- Drought significantly threatens cattle operations on the Navajo Nation by reducing forage, water availability, and ranch income.
- Profitable drought responses depend on hay prices and risk tolerance, with hay purchases favored only at low prices.
- Risk-neutral ranchers face small long-term return differences across strategies, allowing more flexibility in decision-making.
- Proactive drought planning and market monitoring improve outcomes, including timely herd adjustments and careful postdrought rebuilding.

Agriculture remains an important economic activity on U.S. Native American Indian reservations. Native Americans in the arid Southwest rely on livestock grazing for subsistence, and it's an inseparable part of their culture and a traditional source of livelihood as well (Redsteer et al., 2013). Yet frequent, prolonged droughts increasingly threaten the financial viability of cattle operations in this region. Drought conditions degrade rangeland quality and reduce water availability, leading to lower cattle productivity and diminished economic returns (Hamilton et al., 2016; Wold et al., 2023). Recent research indicates that ranch income decreases by as much as 11% when an additional share of pastureland is exposed to abnormally dry conditions and by up to 15% for severe drought conditions (Rodziewicz et al., 2023).

On the Navajo Nation, 3.5% of the population is employed in the agriculture, forestry, fishing/hunting, and mining sectors, which is almost double the U.S. national average of 1.8% (U.S. Census Bureau, 2022). Crop sales on the Navajo Nation represent 79.1% of all agricultural sales, and livestock sales represent the remaining 20.9% (National Agricultural Statistics Service [NASS], 2020). In terms of livestock inventory, cattle and calves represent the second most important group (71,374 head), behind sheep and lamb (194,034 head). A major agricultural producer on the Navajo Nation is the Navajo-owned "Navajo Agricultural Products Industry" (NAPI), which operates an estimated 110,000 acres of cultivated land, of which 74,000 acres are under pivot irrigation. The major crops include alfalfa, feed corn, small grains, dry beans, and potatoes, and the products are labeled with the "Navajo Pride" stamp (Marchant, 2019).



The Navajo Nation is primarily located in Arizona, one of the driest states in the U.S. Arizona's average yearly precipitation was 11.24 inches between 2000 and 2019 (National Centers for Environmental Information, 2023). Between April 2022 and May 2023, on average, 59% of alfalfa hay acreage and 50% of cattle inventory in Arizona were affected by moderate to severe drought (U.S. Drought Monitor, 2023). According to the U.S. Drought Monitor (2025a), moderate drought causes some crop and pasture damage and results in low stream, reservoir, and well levels. Reduced grazing quality, feed, and water supply have negative implications for animal health, reproduction, and overall production systems (Nardone et al., 2010), potentially with significant economic impacts. For example, livestock producers in the Hualapai Tribe lost \$1.6 million between 2001 and 2007 due to a 50% loss in grazing efficiency and a resulting 30% herd reduction (Knutson et al., 2007). On the Navajo Nation, an estimated reduction of cattle inventory by 2,400 head (3.72%) due to

a two-year moderate drought led to \$3.5 million in losses to cattle operations (Drugova et al., 2022).



In this fact sheet, we examine the drought management options available to cattle operations on the Navajo Nation, the largest Native American reservation in the U.S. Specifically, we discuss the results of a study evaluating the economic outcomes of two common drought response strategies: herd reduction and supplemental hay purchases. We also provide recommendations for ranchers regarding optimal strategies, i.e., those which would maximize profits, for two rancher types, differentiated by their willingness to accept (risk-neutral) or avoid risk (risk-averse). A third potential drought response strategy, leasing additional grazing land, was not included in the analysis, as this option isn't normally possible. The vast majority of Native American reservation lands are held in trust by the U.S. government, and thus, land-leasing agreements must go through a lengthy approval process at the U.S. Department of the Interior. The one exception is reservations with approved HEARTH Act regulations, which allow tribal governments to approve land-leasing agreements directly (see [HEARTH Act Leasing](#)).

Study Approach and Data

In the study, net returns were calculated over 10 years for the selected drought management scenarios listed in Table 1. For example, in Scenario 2, due to drought, available forage could not support all eight head of cattle, so the rancher sells six head and purchases additional hay for the remaining two head. The scenario that yields the highest net returns over the 10-year period is the most optimal one from a financial perspective.

Table 1. Examined Drought Management Scenarios

Scenario	Share of cattle sold*	Purchase additional hay
1	100%	None

Scenario	Share of cattle sold*	Purchase additional hay
2	75%	25% of cattle
3	50%	50% of cattle
4	25%	75% of cattle
5	0%	100% of cattle

Note. *Calculated for all cattle not supported on available forage.

To calculate net returns, we used data from available cost-of-production studies in the region (Utah State University [USU] Extension, 2024). We simulated cattle prices and forage production using historical data to use variable cattle prices and forage production in the analysis. The remaining variables were held constant, including starting herd size, cattle production ratios, cull rate, cattle forage and feed needs, and fixed costs. We simulated forage production in the first year only, and we defined drought as simulated forage production below the historical average. In the following years, we assumed normal forage production and allowed ranchers to repurchase cattle. We also assumed that the drought occurred in one year only. Additional analysis would be needed to determine the most profitable actions in periods of persistent (multi-year) drought. Research shows that herd rebuilding may take from 3–6 years after a multi-year drought, while rangeland recovery takes 1–3 years for moderate drought and 3–5 years for severe drought (Countryman et al., 2016; Peel, 2023; U.S. Drought Monitor, 2025b).

We did not simulate hay prices; rather, we calculated net returns for each hay price between \$100 and \$275/ton at \$25 increments to examine the impact of variable hay prices on the optimal management scenario. Note that the average hay price in Arizona in 2024 was \$181/ton, which is a reduction from the 2020–2024 average of \$230/ton (NASS, 2025). We collected available weekly steer prices for Arizona between 2019 and 2023 (Cattle Range, 2023). We then calculated heifer and slaughter cattle prices based on estimated historical relationships between steer, heifer, and slaughter cattle prices. We obtained yearly forage production data for the Navajo Nation from 1986–2021 (Agricultural Research Service [ARS], 2023). Table 2 reports the summary statistics for the cattle prices and forage data used in the simulation.

Table 2. Summary Statistics for Cattle Prices (\$/cwt) and Forage Production (lb/acre)

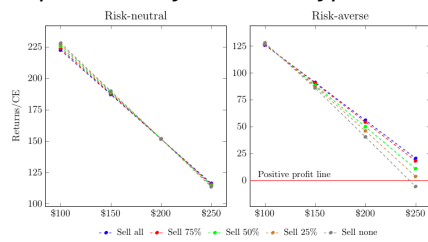
Variable	Mean	St. dev.	CV (%)	Min	Max
Steer prices	170.24	19.48	0.11	137.17	227.13
Heifer prices	148.26	16.96	0.11	119.45	197.79
Slaughter prices	76.00	8.70	0.11	61.23	101.39
Forage production ^a	135.95	32.96	24.2%	67.11	217.52

^aSource: [ARS](#), 1986-2021

Study Results

Figure 1 shows the estimated average returns over ten years for risk-neutral ranchers and certainty equivalents (CE) for risk-averse ranchers. Certainty equivalent is the return that a risk-averse rancher would accept to avoid the risk, and thus it is lower than the average return. Examined drought management scenarios are differentiated by circle color, which plots the average return or certainty equivalent in \$1,000 (y-axis) for the drought option at a given hay price (x-axis). The highest plotted circle per hay price represents the most profitable option at that hay price.

Figure 1. Average Returns and Certainty Equivalents by Rancher Type



(\$1,000)

Note. Hay prices are \$/ton. CE is certainty equivalent. Per Table 1, “Sell all” is Scenario 1, “Sell 75%” is Scenario 2, “Sell 50%” is Scenario 3, “Sell 25%” is Scenario 4, and “Sell none” is Scenario 5.

Risk-Neutral Ranchers

For risk-neutral ranchers, the difference in average returns across the drought management scenarios is relatively small, but it matters more as hay prices increase and average returns decrease. The variability of returns (i.e., uncertainty, measured using standard deviation) increases

as the rancher moves from selling all unsupported cattle (Scenario 1) to purchasing additional hay only (Scenario 5) at any hay price.



At the lowest examined hay price of \$100/ton, which is much lower than recent hay prices in Arizona, purchasing additional hay to keep all cattle is most profitable (\$228,000). The returns are 2.5% higher than returns when selling all cattle that cannot be supported during drought (\$223,000). Note that these are average 10-year returns of 1,000 simulations per year, and the actual return observed in any given 10-year period may be lower or higher.

When the hay price is \$200/ton, the difference in average returns across the five drought management scenarios is virtually \$0. There are likely differences in returns in the short term, but they disappear in the long term (10 years), assuming the drought lasts only one year. But purchasing hay only (Scenario 5) is the riskiest, with the possibility of observing the lowest return. Also, as hay price increases above \$200/ton, the option to sell some or all unsupported cattle becomes economically attractive. At the highest examined hay price of \$275/ton, selling all unsupported cattle yields the highest return (\$98,000). It is 4.5% higher than purchasing additional hay for all cattle (\$94,000), and 2.2% higher than selling 50% of the unsupported cattle and purchasing additional hay for the remaining cattle (\$96,000).

Risk-Averse Ranchers

Risk-averse ranchers avoid risk, and incorporating risk aversion into calculations leads to significantly lower average certainty equivalents when compared to the average returns for risk-neutral ranchers, as shown in Figure 1. Similarly, as in the case of risk-neutral ranchers, the differences in returns are relatively small at lower hay prices, but they increase rapidly at hay prices above \$150/ton. At or above this hay price level, selling all cattle that cannot be supported due to drought is the most profitable option. Given the 2024 average hay price of \$181/ton in Arizona, these findings suggest that risk-averse ranchers

sell all cattle that cannot be supported during drought to maximize profits.

Conclusions

We examined average returns and their variability for five drought management scenarios for cattle operations on the Navajo Nation. We find that purchasing additional hay to retain all cattle during drought is riskier, since it can yield the lowest returns. But on average, it is the most profitable option if hay prices are low. As hay prices increase, selling some cattle and purchasing less (additional) hay becomes more profitable. Considering hay prices in Arizona in 2024, the differences between average returns across the examined options are minimal in favor of purchasing hay and keeping all cattle, but not large enough to outweigh the uncertainty associated with that option. At hay prices at or above \$150/ton, the analysis shows that selling all cattle that cannot be supported during drought is the best option for risk-averse ranchers.

These results are consistent with expectations that, as hay prices increase, it becomes more expensive to maintain cattle and, thus, better from a financial perspective to reduce the herd. But the differences in average returns across drought actions are small for a risk-neutral rancher, suggesting that there is no clear right or wrong approach. On the other hand, risk-averse ranchers benefit greatly from herd reductions at higher hay prices. We assumed that cattle ranchers have a drought management plan in place and monitor the weather conditions so that they can act promptly.

Recommendations

- Monitor current and forecasted regional drought conditions ([U.S. Drought Monitor](#)).
- Monitor forage and hay prices closely. When hay prices increase, selling unsupported cattle is usually the better option.
- Have a drought plan in place. Set clear triggers for herd reduction or supplemental feeding based on forage and water availability.
- *Risk-neutral ranchers* can maintain more cattle through hay purchases when prices are low.
- *Risk-averse ranchers* should reduce their herds early during drought to avoid financial losses.
- Rebuild herds cautiously after drought once forage recovers and market prices are favorable.
- Build resilience by storing hay in good years, exploring insurance programs, and maintaining accurate cost-of-production returns records to improve future drought-response decision-making.

- Collaborate with tribal and government programs to improve range management and drought response capacity.

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