

Optimal Drought Management Actions for Cattle Operations on the Laguna Pueblo and Zuni Pueblo Indian Reservations

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Introduction

Highlights

- Drought presents significant operational and financial challenges for cattle ranching on the Laguna Pueblo and Zuni Pueblo Indian reservations.
- Purchasing hay to keep all cattle during drought is profitable only when hay prices are low, but is riskier, and can lead to losses as prices rise.
- Selling unsupported cattle becomes the best option for risk-averse ranchers and when hay prices exceed \$150/ton, minimizing financial losses.
- The differences in long-term average returns between drought management options are small for risk-neutral ranchers, suggesting no single best approach for all situations.
- Having a drought management plan, closely monitoring hay prices and drought conditions, and collaborating with tribal and government programs are key strategies for resilience and optimal decision-making.

Agriculture remains a central economic activity on U.S. Native American reservations, particularly in the arid Southwest, where livestock grazing is both a vital subsistence strategy and a deeply rooted cultural tradition (Redsteer et al., 2013). Yet frequent, persistent droughts

threaten the financial sustainability of cattle operations in the region. Drought negatively impacts rangeland quality and water availability, which has negative consequences to cattle production and subsequent 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% when exposed to severe drought conditions (Rodziewicz et al., 2023).

The Laguna Pueblo and Zuni Pueblo Indian reservations are located primarily in New Mexico. For Laguna Pueblo, the tribal government is the largest employer (Grugel, 2012), but they do have an active range management program focused on rangeland health, livestock grazing, non-village agriculture, and irrigation. Rangelands occupy approximately 71% of reservation and leased land. These rangelands are used for grazing 4,000 cattle, owned by approximately 100 members of seven authorized livestock associations (Pueblo of Laguna, 2023).

On the Zuni Pueblo, tourism and raising sheep are the primary economic activities (AAA Native Arts, 2023). It is estimated that around 90% of the population is involved in the production of jewelry, stone carvings, and pottery ware—either part-time or full-time. Agriculture is used mostly to supplement other economic activities (Grugel, 2012). Traditional crops grown by the Zuni include corn, squash, beans, and other vegetables. Many Zunis raise livestock—mainly sheep, but traditionally cattle have been raised as well (AAA Native Arts, 2023).

Additionally, New Mexico is one of the country's driest states, with an average yearly precipitation of 13.38 inches from 2000 to 2019 (National Centers for Environmental Information, 2023). Between April 2022 and May 2023, on average, 77% of the alfalfa hay acreage and 85% of the cattle inventory in New Mexico were affected by moderate to severe drought (U.S. Drought Monitor, 2023). According to the U.S. Drought Monitor (2025a), moderate drought leads to some damage to crops and pastures 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), which may have large 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 these reservations in New Mexico, an estimated reduction of cattle inventory by 3.72% due to a two-year moderate drought led to \$691,000 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 Laguna Pueblo and Zuni Pueblo reservations in New Mexico. Specifically, we discuss the results of a study which evaluated 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 (risk-neutral) or avoid it (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, eight head of cattle could not be supported on the available forage due to drought, 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 years is the most optimal one from a financial perspective.

Table 1. Examined Drought Management Scenarios

Scenario	Share if cattle sold*	Purchase additional hay
1	100%	None
2	75%	25% of cattle
3	50%	50% of cattle
4	25%	75% of cattle

Scenario	Share if cattle sold*	Purchase additional hay
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 New Mexico (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 multiyear 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 New Mexico in 2024 was \$240/ton, which is a slight reduction from the 2020–2024 average of \$250/ton (National Agricultural Statistics Service, 2025).

We collected available weekly steer prices for New Mexico between 2019 and 2023 (Cattle Range, 2023). We then calculated heifer prices and slaughter cattle prices based on the estimated historical relationships between steer, heifer, and slaughter cattle prices. We obtained yearly forage production data for each reservation 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)

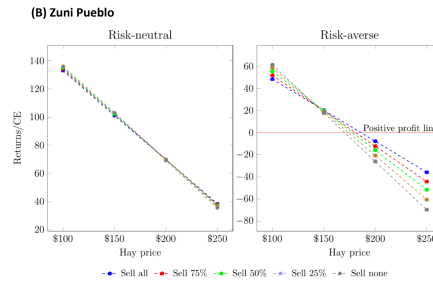
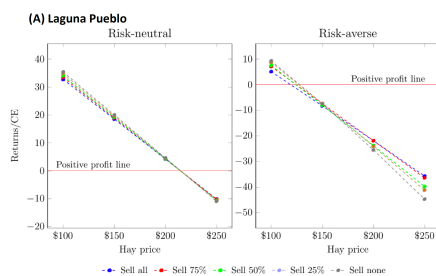
Variable	Mean	St. dev.	CV (%)	Min	Max
Steer prices	171.35	19.59	0.11	144.20	228.87
Heifer prices	149.22	17.06	0.11	125.58	199.31
Slaughter prices	69.53	7.95	0.11	58.51	92.87
Laguna Pueblo forage production ^a	249.42	59.92	24.0%	99.76	395.32
Zuni Pueblo forage production ^a	268.74	52.82	19.7%	92.87	366.48

^a Source: ARS 1986–2021

Study Results

Figure 1 shows the estimated average returns over 10 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) at Ducky Valley (A) and Pyramid Lake (B)



Notes. 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.

Laguna Pueblo

Risk-Neutral Ranchers

For risk-neutral ranchers, the difference in the average returns across the drought management scenarios is relatively small, especially at higher hay prices. The variability of returns (i.e., uncertainty, measured using standard deviation) increases slightly 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 New Mexico, purchasing additional hay to keep all cattle is most profitable (\$35,000). The returns are 8.3% higher than the returns when selling all cattle that cannot be supported (\$33,000). Note that these are average 10-year returns of 1,000 simulations per year, and the actual return observed in any 10-year period may be lower or higher.

When the hay price is \$200/ton, the difference in average returns across the five 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 returns. Also, as hay prices increase above \$200/ton, the option to sell some or all unsupported cattle

becomes economically attractive. However, ranchers experience losses—regardless of the drought action—before hay prices reach \$225/ton. At the highest examined hay price of \$275/ton, selling all unsupported cattle yields the highest but negative return (-\$17,000). It is higher than purchasing additional hay for all cattle (-\$19,000), and higher than selling 50% of the unsupported cattle and purchasing additional hay for the remaining cattle (-\$18,000).

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. At hay prices up to \$150/ton, purchasing hay for the unsupported cattle is most profitable. Selling all unsupported cattle becomes the best option quickly at hay prices above \$150/ton. But risk-averse ranchers start to face losses, on average, at hay prices as low as \$125/ton. Given the 2024 average hay price of \$240/ton in New Mexico, these findings suggest that risk-averse ranchers sell all cattle that cannot be supported during drought to minimize losses.

Zuni Pueblo

Results for ranchers on Laguna Pueblo are generally applicable to ranchers on the Zuni Pueblo, but the overall returns are higher and less sensitive to hay prices.

Risk Neutral Ranchers

The differences in the average net returns are small across the drought scenarios, but risk-neutral ranchers are better off moving away from maintaining the entire herd toward herd reduction when hay prices approach \$200/ton, which is much lower than the hay price observed in New Mexico in 2024. Ranchers can make a profit at the highest hay price of \$275/ton, but the estimated average return for the best-performing scenario of selling all unsupported cattle is only \$23,000.

Risk-Averse Ranchers

For risk-averse ranchers on the Zuni Pueblo, selling all cattle that cannot be supported during drought becomes the best option at hay prices at or above \$150/ton. There is no profit under any of the scenarios examined when hay prices approach \$200/ton.

Conclusions

We examined average returns and their variability for five drought management scenarios for cattle operations on the Laguna Pueblo and Zuni Pueblo reservations. We find that purchasing additional hay to retain all cattle during drought is a riskier option, since it can yield the lowest returns. However, 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 or reduces losses. Considering hay prices in New Mexico in 2024, the differences between average returns across the examined options are relatively small for risk-neutral ranchers. At hay prices above \$150/ton, study results show that selling all cattle that cannot be supported is the best option for risk-averse ranchers. Only risk-neutral ranchers on the Zuni Pueblo generate positive average returns at any hay price level. Risk-averse ranchers on Laguna Pueblo face losses at lower hay prices than ranchers on the Zuni Pueblo.

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 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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