ANALYZING THE EFFICACY OF LIVESTOCK FORAGE DISASTER PROGRAM PAYMENT THRESHOLDS

A Thesis

by

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ABSTRACT

The Agricultural Act of 2014 (2014 Farm Bill) permanently funded a number of supplemental disaster assistance programs, including the Livestock Forage Disaster Program (LFP). LFP provides assistance to livestock owners and certain contract growers that have suffered a loss of grazed forage due to qualifying drought during the normal grazing period for the county.

This study compares the additional costs incurred by a producer in the presence of drought and subsequent compensation through LFP payments. It utilizes one of the Agricultural & Food Policy Center's (AFPC) representative ranches (and the associated costs of production) to analyze the extent to which the various LFP payment thresholds are calibrated to the actual costs of production incurred during a drought. This analysis is conducted by evaluating net present value, net cash farm income, and ending cash in response to four drought management scenarios: feeding in response to a one-year drought, and feeding, culling, or relocating in response to a three-year drought.

Compensation received from LFP in the case of drought mitigates some of the additional costs incurred, but it does not make a producer whole. In the case of a one-year drought, LFP is fairly well calibrated. LFP payment rates are designed to cover 60% of feed costs, and that is what was found in that scenario. However, the remaining additional costs had a long-term impact on cash flow. As drought persists and alternative management strategies are utilized, LFP compensates for a smaller share of the costs incurred due to drought.

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Contributors

This work was supervised by a thesis committee consisting of Dr. Joe Outlaw, Dr. David Anderson, and Dr. Bart Fischer of the Department of Agricultural Economics and Dr. Tryon Wickersham of the Department of Animal Science.

The data analyzed was provided by the Agricultural and Food Policy Center (AFPC) at Texas A&M University and the Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri. The analyses were conducted in Simetar, with assistance provided by Dr. Henry Bryant, Dr. Aleksandre Maisashvili, and Mr. Brian Herbst.

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CHAPTER I

INTRODUCTION

Agricultural production has always been dependent on many factors, weather being foremost among them. Livestock production is particularly vulnerable to regional weather patterns and events, with drought being one of the most common. In responding to these events, producers face many management decisions that greatly affect their bottom line.

The Agricultural Act of 2014 (commonly referred to as the 2014 Farm Bill) permanently funded several disaster assistance programs following a period of prolonged drought. One of these programs, the Livestock Forage Disaster Program (LFP) provides assistance to livestock owners and certain contract growers that have suffered a loss of forage due to qualifying drought during the normal grazing period for the county. Producers are eligible for monthly payments based upon severity and length of drought. Due to persistent drought in the Southern and Central Plains from 2011 to 2013, Congress expanded the upper limit of the payment threshold to 5 months.

Currently, the LFP payment rate is calculated using 60% of monthly feed costs, and producers are limited to receiving up to 5 months of payments per year. Historically, drought and its effects can persist long past 5 months, leading to significant increases in operational costs and reduction in revenue. Following a drought, producers spend a significant amount of time building their operation back to pre-drought levels. No analysis has been undertaken to compare payment rates to actual costs incurred during a persistent drought; this project rectifies that.

Objectives

The primary objective of this research is to analyze the extent to which the current LFP payment rates are calibrated to the actual costs of production that ranchers face during drought. A secondary objective is to evaluate the financial impact LFP has on a ranch under alternative drought management responses.

Justification

There are an infinite number of decisions made when managing a cattle ranch. Specifically, during times of drought, management decisions are critical to the continued operation of the business. Congress implemented LFP to help ranchers impacted by drought, but the extent to which LFP addresses the losses incurred in the presence of drought is not clear. Although there are several different paths that a ranching operation could take in the case of a drought, this study focuses on three popular scenarios. Costs of maintaining the operation during each of these scenarios will be compared to LFP payments to provide an assessment of how the payment thresholds affect a producer's bottom line. The outcome will inform policymakers as they contemplate changes to LFP in the upcoming farm bill debate.

CHAPTER II

LITERATURE REVIEW

Livestock production is dependent on several factors, including feed cost and availability, weather, and disease, among others. Weather and associated natural disasters can have a large impact on the overall profitability of an operation. For example, if forage availability is reduced by a drought or wildfire, stocking rates and feed costs are directly affected, impacting the overall profitability and survivability of the operation. While a few studies have addressed the economic costs of drought, to date, there has been little research regarding the effectiveness of LFP or other drought assistance in the United States.

Agricultural Drought

Agricultural drought comes from a long period of below-average precipitation combined with above-average temperatures. Specifically, agricultural drought is a period during which soil moisture is lacking and insufficient to support crops or other forage (Dracup et al., 1980). High temperatures worsen already dry conditions and deplete moisture in the soil, groundwater reserves, and reservoir levels (Wallander et al., 2017). Surface water is reduced, leading to decreased forage availability and watering for livestock. As a result, decreased revenues from livestock and changes in production cost lower net farm income (Kuwayama et al., 2019). As Wallander states, "[producers] in different regions tailor their crop choices, production systems, and decisions on inputs largely based on average weather conditions in their area—which makes them vulnerable when those conditions change."

The National Oceanic and Atmospheric Administration (NOAA) maintains a nationwide drought monitor, categorizing areas into 5 different drought levels (Table 2.1):

Table 2.1 NOAA NDIS Drought Conditions

Drought Level	Effects
D0-Abnormally Dry	• Short-term dryness slowing planting, growth of crops or pastures. • Some lingering water deficits • Pastures or crops not fully recovered
D1-Moderate Drought	• Some damage to crops, pastures • Streams, reservoirs, or wells low, some water shortages developing or imminent • Voluntary water-use restrictions requested
D2-Severe Drought	• Crop or pasture loss likely • Water shortages common • Water restrictions imposed
D3-Extreme Drought	• Major crop/pasture losses • Widespread water shortages or restrictions
D4-Exceptional Drought	• Exceptional and widespread crop/pasture losses • Shortages of water in reservoirs, streams, and wells creating water emergencies

The National Drought Mitigation Center at the University of Nebraska-Lincoln compiles a weekly map illustrating drought levels across the country (Kuwayama et al., 2019). Starting in 2011, much of the country was in some form of drought, according to the historical drought monitor, with major livestock production states such as Texas, Kansas, and Oklahoma in stages D3-D4 for several consecutive months. Forage availability was limited, and water was scarce for livestock. This drought lasted until the end of 2013, around the same time that the 2014 Farm Bill was being finalized by Congress.

Drought Management Strategies

When a producer encounters drought on their operation, there are several potential strategies for dealing with it. Depending on the region, producer, and several other factors, there are an infinite number or combination of strategies used to respond to drought. To narrow the scope of this research, three strategies were selected based on previous research (Carpenter and Hart 2001; Van de Koppel and Rietkerk 2000; Díaz-Solís et al. 2009; Bidwell and Redfearn 2020; Rasby 2009; and McCollum 1999):

- **Purchasing supplemental feed**—During short periods of drought, producers may choose to purchase feed to supplement scarce forage. This feed may be in the form of forage (alfalfa or grass hay), protein (dried distillers' grains or cubes), or both. The amount of feed needed will depend on the severity of the drought, the body condition of the herd, and the dietary nutrients being supplemented (Carpenter and Hart, 2001). There are a few drawbacks to this scenario. The longer the drought persists, the more severe it becomes; thus, purchasing feed becomes significantly more expensive as the forage does not replenish and eventually ceases to exist, perhaps with irreparable damage to soil conditions (Van de Koppel and Rietkerk, 2000). Additionally, feed conversion becomes less efficient when more than 3 pounds of high energy supplements are used (Carpenter and Hart, 2001). On average, a 1,000-pound cow needs to consume "20 to 30 pounds of dry forage per day or 2 to 3 percent of her body weight" (Carpenter and Hart, 2001). This strategy is normally used until it rains, or the producer decides to adopt one of the following strategies.
- **Reducing stocking rates**—Díaz-Solís et al. (2009) discussed adaptive stocking rates and their effectiveness on cow-calf production systems during periods of drought. Their findings reaffirmed what Bidwell and Redfearn (2020) emphasize: "During drought, stocking rates **must** be reduced on all types of forage." As stated above, over-utilization of pastureland could cause irreversible damage to the rangeland (Van de Koppel and Rietkerk, 2000). When reducing the stocking rates, Carpenter and Hart (2001) posit that open cows should be first culled, followed by lactating females in poor body condition, as they likely won't calve again.

- **Relocation**—Rasby (2009) and McCollum (1999) give an overview of considerations when relocating all or part of a herd in response to a localized drought. During prolonged drought, this strategy calls for moving cattle to a pasture outside of the drought area to ride out the drought. Several considerations need to be made when using this strategy: the construction of a pasture lease or rental agreement, restrictions if crossing state or county lines, and biosecurity measures if cattle are moved to a feedlot. If relocating to another pasture owned by someone other than the principal operator or rancher, a rental rate will need to be paid, as well as any other agreed upon fees and rates within the pasture lease agreement. While feed is not purchased in this strategy, there are other associated costs. McCollum (1999) states that if a cow consumed 25 pounds of forage per day, hay would have to cost less than $32/ton to be competitive with pasture rental rates at $12/cow/month. If cattle are fed in confinement, as in a feedlot, less total feed would be required as less energy is spent and the feed is more energy dense than forage; however, these cattle would not be eligible for LFP payments, as cattle fed in confinement are ineligible for LFP.

Livestock Forage Disaster Program

The Food, Conservation, and Energy Act of 2008 (2008 Farm Bill) established several programs to help livestock producers address risks related to natural disasters: the Livestock Forage Disaster Program (LFP), the Livestock Indemnity Program (LIP), and the Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish Program (ELAP). Prior to 2008, versions of these provisions were available as ad hoc disaster assistance; the 2008 Farm Bill codified these programs, albeit on a temporary basis and without permanent funding (MacLachlan et al., 2018). Following major drought in much of the country from 2011 to 2013, these programs were permanently authorized and funded in the 2014 Farm Bill. While all of these programs play an important role, LFP is the focus of this study.

LFP provides assistance for livestock producers facing a major loss of forage and pastureland due to drought or fire. Livestock owners and contract growers who have covered livestock and also produce grazed forage crops (native and improved pastureland with permanent vegetative cover or certain crops planted specifically for grazing) that have suffered a loss of grazed forage due to a qualifying drought during the normal grazing period for the county are eligible for payments (FSA, 2019). LFP payment rates – described in detail below – are based on monthly feed costs incurred by producers, and the number of monthly payments a producer is eligible to receive is based on county drought ratings from the U.S. Drought Monitor and the length of time the county has been in drought. Specifically, Congress stipulated that producers with eligible livestock that have been in counties in:

- D2 drought for at least eight consecutive weeks are eligible for one monthly payment,
- D3 drought at any time are eligible for three monthly payments,
- D3 drought for at least four weeks or in D4 at any time are eligible for four monthly payments, and
- D4 drought for four weeks, including non-consecutive weeks, are eligible for up to five monthly payments.

However, a producer may not receive LFP payments if the land is used for haying or grazing under the Conservation Reserve Program.

Eligible livestock must receive the majority of their nutrition from grazing forage grasses and include alpacas, beef cattle, buffalo/bison, beefalo, dairy cattle, deer, elk, emus, equine, goats, llamas, reindeer, and sheep. Additionally, a producer that has livestock grazing on rangeland managed by a Federal agency where grazing at normal rates is prohibited due to wildfire also qualifies for payments. Livestock must have been owned prior to the start of the drought or sold because of it and cannot have been used for anything other than commercial production nor have been in a feedlot when the drought started. Under the 2014 Farm Bill, producers were retroactively eligible for payments for losses incurred after September 30, 2011 (FSA, 2019).

LFP Payment Rates & Limitations

LFP is funded through USDA's Credit Commodity Corporation (CCC), and there is no limit to the funding, as "the Secretary shall use such sums as are necessary" to implement the program (2014 Farm Bill). One month's payment for losses due to drought is 60% of either monthly feed costs of livestock owned or of the normal carrying capacity of the land, whichever is less. Normal carrying capacity is the capacity "that would be expected from the grazing land or pastureland for livestock during the normal grazing period in the county, in the absence of a drought or fire that diminishes the production of the grazing land or pastureland" (FSA, 2019). This is determined by the stocking rate and number of grazing days (in the absence of drought) established under the Noninsured Crop Disaster Assistance Program (NAP). Topography, climate, altitude, and land mix factor into the calculation of carrying capacity. The type of pastureland also factors into the calculation, designated in each county by state technical committees. Notably, livestock sold due to drought in the two years before the current production year are eligible for 80% of the monthly payment rate. For losses due to fire on publicly managed lands, the payment rate is 50% of the monthly feed cost for all of the livestock covered by the producer's federal lease. Monthly feed costs are calculated by:

$$\boldsymbol{Monthly\ feed\ cost = 30\ days\ x\ feed\ grain\ equivalent\ x\ corn\ price\ per\ pound}$$

Feed grain equivalent is equal to 15.7 pounds of corn per day for an adult beef cow; for all other livestock, that number is determined by USDA to represent the average number of pounds of corn needed per day to feed the livestock. Corn price per pound is determined by dividing (1) the higher of the national average corn price per bushel for the 12-month period immediately preceding March 1 of the year for which the disaster assistance is calculated or for the 24-month period immediately preceding that March 1 by (2) 56. For context, the monthly payment rate for adult beef cattle in 2020 was $31.89 per head.

Producers cannot receive LFP payments for more than five months for the "same kind, type, and weight range of livestock" (FSA, 2019). Payments for losses due to fire start on the day that the federal agency excludes the producer from using the lands for grazing and end on the last day of the lease. For losses due to fire, producers cannot receive payments for more than 180 calendar days.

The Agriculture Improvement Act of 2018 (2018 Farm Bill) maintained an annual payment limit for LFP at $125,000 per person or legal entity, disregarding any other program, for 2019 and subsequent years. The number of payment limits for joint ventures and general partnerships parallel the number of members within the entity. Additionally, the average adjusted gross income (AGI) means test applies to LFP payments. A person or legal entity with an AGI that exceeds $900,000 on average over the past three years is ineligible for LFP payments in the given year.

Despite having been created almost 15 years ago, there has been little to no analysis on LFP. How "whole" do LFP payments make producers experiencing differing levels of drought? Do the payment limitations or rates need to be adjusted to better meet the financial needs of livestock producers operating in the midst of severe drought? Given the current presence of drought in the western United States that rivals the severity of that seen in 2012, the potential adjustment of LFP thresholds will be a relevant and pertinent topic in 2023 Farm Bill discussions. Analysis of current program payments and parameters will inform policymakers as they negotiate the upcoming farm bill.

Stochastic Simulation

As noted at the beginning of this chapter, livestock producers face a number of risks, primarily based on factors that are outside of their control. Consequently, any projection of revenues and costs – including an analysis of alternatives from status quo – must account for risk so producers and policymakers alike can make informed decisions. For example, while a model can include deterministic, expected prices, examining probabilistic outcomes over the entire distribution of expected prices would give a much clearer picture of the risks facing a particular operation.

Stochastic simulation is tailor made for incorporating random variables – for example, the price of cull cows, cull bulls, calves, corn, soybean meal, and hay. Using Monte Carlo simulation, variables are simulated 500 times across various scenarios to generate a number of different outcomes based on the probabilities associated with each underlying random variable. Once the model is simulated, a probability distribution of key output variables (KOVs) is developed (Richardson, 2008).

CHAPTER III

DATA & METHODOLOGY

This study utilized the data to describe a representative ranch in King County, Texas, maintained by the Agricultural and Food Policy Center (AFPC) in the Department of Agricultural Economics at Texas A&M University. Several financial variables were analyzed for the nine scenarios, highlighted in Table 3.1: baseline during a normal year, feeding through a one-year drought, and feeding, culling, and relocating through a 3-year drought, all with and without LFP payments. To analyze the impact of LFP payments, descriptive and financial data from the ranch was used to create income statements, cash flow statements, and balance sheets under each scenario. Each scenario without LFP payments was compared to its counterpart with LFP payments, and to the baseline scenario (Scenario 1).

Table 3.1 Description of Scenarios

Scenario	1	2	3	4	5	6	7	8	9
Drought Length (Years)	0	1	1	3	3	3	3	3	3
Management Response	N/A	Feed	Feed	Feed	Feed	Cull	Cull	Relocate	Relocate
LFP Payments	No	No	Yes	No	Yes	No	Yes	No	Yes

Model Ranch

AFPC maintains 94 representative crop, livestock, and dairy farms in 30 different states, ten of which are cow-calf operations. Information used to simulate the economic activity on these operations is developed through a consensus-building interview process with a panel of producers. Projected prices and input inflation rates are provided by the Food and Agricultural Policy Research Institute (FAPRI) at the University of Missouri. Financial statements are provided to the panels for their respective operations, and they are asked to verify the accuracy of the simulated results for each year and for a five-year projection (Outlaw et al., 2021). The

King County ranch (TXRB400, shown in Figure 3.1) was chosen, in part, because cattle are the primary enterprise on the operation. Additionally, the ranch is in the heart of the area affected by the 2011-2013 drought and was eligible for 5 months of LFP payments on native grass in 2022 due to prolonged D4 drought (Figure 3.2).

Figure 3.1 AFPC Representative Ranch Location

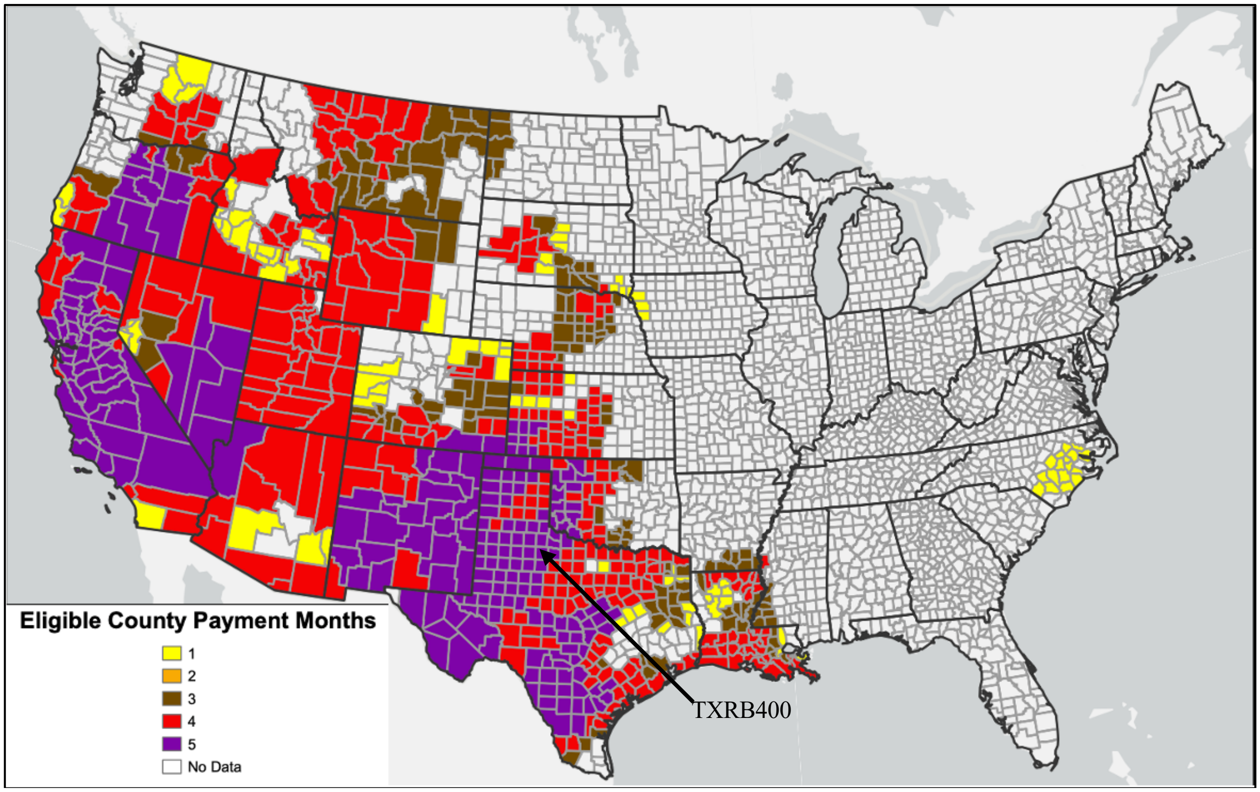

Figure 3.2 Livestock Forage Program Native Pasture Payment Months by County – 2022

For each scenario, net cash farm income (NCFI) (ranch profitability) and ending cash (liquidity) were projected for five years starting with 2022. Net present value (NPV) was also calculated with 2022 as the base year.

Data

To build the financial statements, costs and descriptive data for the ranch were obtained from AFPC. The following inputs were used from the representative ranch:

- Pastureland acres owned and rented
- Herd dynamics: inventory of mature cows and bulls, replacement heifers, and yearling heifers along with calving rates, death loss, and cull percentages
- Purchased feedstuffs: amount fed and type of feedstuff per head per day

- Variable costs per head: vet and medicine, marketing, checkoff, salt and mineral, and hauling
- Fixed or overhead costs: rent, real estate taxes, accounting and legal, repairs, maintenance, supplies, trucks, equipment, liability insurance, fuel and lube, phone, utilities, internet, horse costs, environmental maintenance, and labor
- Land, equipment, and operating loan information: amount borrowed, length of loan, interest rate, and first year of loan
- Local price wedge and interest basis: discount or premium from national price received or paid for the ranch
- Family living withdrawals
- Annual machinery purchases

Additionally, projected prices, input price indices, and inflation rates were provided by FAPRI. This model ranch also generates off-farm income in the form of hunting receipts, but these were excluded from the analysis as they do not influence cattle receipts. As such, the rental rate for leased land was reduced from $9/acre to $5/acre, as the extra $4 in rent was from hunting on those acres. Additionally, the ranch is a corporation that is taxed at a flat rate of 21% of taxable income (net income less machinery depreciation and other tax deductions).

Price histories and projected prices for calves, cull cows, hay, corn, and soybean meal were obtained from FAPRI, and risk was added for 2022-2026 projected prices using Simetar, an Excel add-in. The natural log of each price was taken, and the differences of the logs between each year calculated. A Dickey-Fuller test was conducted on historical prices to determine how many differences of the natural log to calculate and used to calculate parameter estimates of various distributions. The CDFDEV function in Simetar indicated the goodness-of-fit of each distribution. The prices were determined to be normally distributed. Using a multivariate normal distribution, the differences in the natural logs were then simulated. The simulated values represented the risk associated with prices and were drawn from the 500 iterations created through simulation. The formula for this is shown below.

$$\ln \widehat{Y} = \ln(FAPRI\ price_t) + correlated\ yield\ deviate$$

Price wedges for local heifer, steer, yearling heifer, cull cow, bull, hay, and soybean meal prices were added to each stochastic national price to determine the local prices used throughout the financial statements.

USDA calculates the LFP payment rate each year, but they do not publish projected payment rates for future years. Consequently, to forecast LFP payments, the model estimates stochastic corn prices. In this study, LFP payments follow the calculations outlined in Chapter II with one simplifying exception: instead of using a 12- or 24-month price average to calculate the corn price, the model simply uses 1- or 2-year average projected stochastic corn prices, as yearly price averages were available from FAPRI. To calculate LFP payments, the number of head of adult cattle was multiplied by the "Adult Cows and Bulls" rate, and the number of head of replacements and yearlings was multiplied by the "Non-Adult, 500 pounds or more" rate, which was 75% of the "Adult Cows and Bulls" rate. Replacements and yearlings did not qualify as adults as they had not yet produced any calves, and payments for heifer and steer calves were not calculated as they were unweaned and not yet considered grazing animals. When cattle were sold due to drought in 1 or 2 of the production years prior to the current program year, 80% of the LFP payment rate was used to calculate payments, as dictated by the 2018 Farm Bill. An annual payment limit of $250,000 was assumed due to spousal doubling allowances in the farm bill, per AFPC notes on the ranch.

Model Development and Scenarios

Herd dynamics were calculated based on the ranch's history. The ranch was assumed to own 400 mature cows in 2022 for each scenario. Calving percentage was assumed to be 50% heifers and 50% bulls. A 10% culling rate was assumed; in each scenario, these cattle were not eligible for LFP payments as they would have been culled in a normal year and were not sold due to drought. The ranch feeds soybean meal and hay; the amount fed and to what categories of cattle was provided by AFPC. Since a localized drought was assumed, soybean meal and hay price responses were not included. Additionally, the price of replacement cattle when rebuilding the herd was not adjusted to reflect a market response to higher demand after drought. After the baseline income statement, cash flow statement, and balance sheet were constructed, the scenarios were then analyzed.

One of the primary management responses being evaluated in this research is purchasing additional feed in response to drought. Drought intensity is not being analyzed in this study; the ranch is already in D4 drought and eligible for the maximum 5 months of payments. For this ranch, the biggest question is how long the drought will persist. Consequently, to analyze purchasing additional feed, one must determine the amount of feed purchased in each scenario. The longer the drought persists (i.e. as existing forage is depleted), the rate of feed purchased will increase. To account for that dynamic, the model incorporates a feed multiplier. Based on personal communication with ranchers (Tom Wilton, in-person conversation with author, April 16, 2022) and notes from the representative ranch, a feed multiplier of 2 was used for scenarios 2 and 3 (feeding through a one-year drought without and with LFP payments, respectively). Normally, cattle are only fed for 180 days during the winter; in the case of a one-year drought, cattle would be fed year-round. In other words, the multiplier accounts for the ranch feeding double the number of days. A multiplier of 3 was used for scenarios 4 and 5 (feeding through a 3-year drought without and with LFP payments, respectively). This multiplier followed a similar logic – cattle are being fed twice as many days, and the prolonged nature of the drought results in even more depletion of forage. The herd dynamics would remain constant, with only the amount fed and resulting cost changing. Scenarios 2 and 3 only had the feed multiplier applied in 2022, the year of assumed drought; after that, feeding rates return to normal. Scenarios 4 and 5 increased the amount fed in 2022, 2023, and 2024 (assumed three years of drought). All other variables in the baseline were unaffected by this change. Furthermore, during non-drought years, only replacements are fed hay and only mature cows are fed soybean meal. In the feeding scenarios, this was expanded so that mature cows, herd bulls, replacements, and yearlings were all fed soybean meal and hay at the same rates to replace the forage that makes up their diet in years without drought.

Another management scenario analyzed in this study is culling in response to prolonged drought. As mentioned above, adapting stocking rates allows for better management of rangeland and forage and lowers the need for purchasing additional feed. In the culling scenarios without and with LFP payments (scenarios 6 and 7, respectively), the drought started in 2022, but the ranch would not cull until 2023, as the drought may be short lived, and the ranch would not cull good genetics if unnecessary. This research assumes that all pasture was exhausted in 2022 before the producer responded to the drought by culling or relocating cattle in 2023 (i.e. no additional feeding was assumed in 2022). As discussed in Chapter II, open, older cows would be the first to be culled due to drought to maintain good herd genetics. The model was designed so that mature cows would be sold first, ensuring that young replacement and yearling heifers would stay in the herd as long as possible. In 2023, 25% of the herd, or 100 mature cows, are culled. In 2024, another 25% of the herd is culled, resulting in only 50% of the original herd size on the ranch at the beginning of 2025. Since 2025 is a non-drought year, the ranch starts to rebuild the herd, purchasing 100 head of mature cows. In 2026, another 100 mature cows are purchased, and the herd is back to its original size by the beginning of 2027. It was assumed culled cattle were taken off the ranch halfway through the year, so the average number of cattle at the beginning of the year and at the end of the year was used to calculate feed and variable costs.

The final drought management strategy analyzed is relocation to an area outside of the drought region. Scenarios 8 and 9 (relocation without and with LFP payments, respectively) maintain the same herd size as the baseline scenario with no additional culling beyond the normal 10% rate; however, a percentage of the cattle are moved to a location in east Texas outside of the drought. The cattle are still owned by the ranch but are being managed in another location by another rancher. This location was chosen because it hosted cattle from the representative ranch during the 2013 drought. Each year, starting in 2023, 25% of the herd is relocated until the drought ends in 2025. In 2025, 25% of the herd, or 100 head of mature cows, is moved back to the original ranch; the remaining relocated 100 mature cows are moved back to the original ranch in 2026. Hauling and management costs are incorporated, and all other variables mirror the baseline scenario. Hauling costs were based on May 2022 diesel prices and inflated based on FAPRI indices. Management custom rates – the amount the ranch paid someone else to keep and care for the relocated cattle – were based on 2020 Texas Agricultural Custom Rates (Klose, 2020) (Table 3.2). The per-head management rate included pasture rent, variable costs, labor, and feed at the new location (inflated using FAPRI indices), which equated to roughly $2.15 per head per day in 2022. Even after the drought ends in 2024, these costs are still incorporated as cattle are gradually moved back to the original ranch.

Table 3.2 Hauling and Management Custom Rates.

	2022	2023	2024	2025	2026
Hauling Rate ($/loaded mile)	$5.95	$6.01	$5.35	$4.84	$4.44
Management Custom Rate ($/head/month)	$64.58	$67.23	$68.02	$67.82	$67.47

Importantly, USDA has stringent rules for LFP eligibility when cattle are being temporarily managed by someone else in an alternate location. For purposes of this analysis, the ranch is assumed to have met the necessary contracting requirements to maintain eligibility in scenario 9.

For each scenario, NPV, NCFI, and ending cash were simulated to analyze the impact of LFP payments on the ranch's bottom line.

CHAPTER IV

RESULTS

This analysis used the model summarized in Chapter III to evaluate three key output variables (KOVs) (net cash farm income (NCFI), ending cash, and net present value (NPV)) across nine scenarios. The Excel Add-in, Simetar, was used to incorporate risk and generate stochastic prices for heifer calves, steer calves, yearling heifers, cull cows, bulls, hay, corn, and soybean meal. These prices were used to calculate market receipts, the amount spent on feed, and LFP rates. Chapter IV provides the results of the nine scenarios that were evaluated in this study. The distributions of each KOV were used for comparison across scenarios and years. The following scenarios were analyzed for the representative ranch:

- Scenario 1) Baseline (not in drought),
- Scenario 2) Feeding in response to a one-year drought without LFP,
- Scenario 3) Feeding in response to a one-year drought with LFP,
- Scenario 4) Feeding in response to a three-year drought without LFP,
- Scenario 5) Feeding in response to a three-year drought with LFP,
- Scenario 6) Culling in response to a three-year drought without LFP,
- Scenario 7) Culling in response to a three-year drought with LFP,
- Scenario 8) Relocating in response to a three-year drought without LFP, and
- Scenario 9) Relocating in response to a three-year drought with LFP.

Cumulative distribution functions (CDFs) illustrate the risk in potential NPV, NCFI, and ending cash. They include the 500 simulated iterations of each scenario of the model for 2022-2026. The dollar amount is shown on the x-axis and the associated probability values are on the y-axis. Tables comparing NPV, NCFI, and ending cash across each scenario with and without

LFP payments to the baseline are also included. LFP payments were only triggered in the years of drought; for example, in scenario 3, LFP payments are only received in 2022, whereas in scenarios 5, 7, and 9, LFP payments are received in 2022, 2023, and 2024.

Expected NPV across all scenarios is shown in Figure 4.1. There is a significant difference in NPV when LFP payments are added. For scenarios 5 and 7 – feeding through a three-year drought and culling – LFP raises the ranch's expected NPV above zero, although it still falls short compared to the baseline. LFP payments in the one-year feeding and relocating scenarios bring the NPV closest to the baseline.

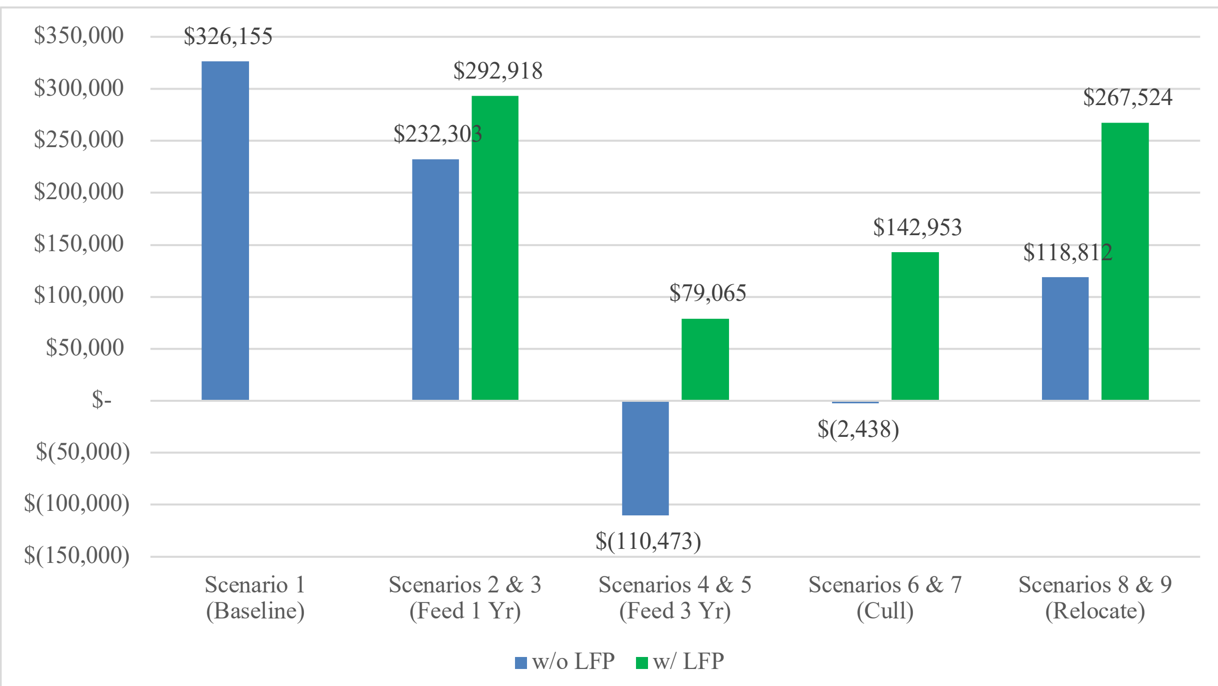

Figure 4.1 Expected Net Present Value

Scenario 1 – Baseline

Table 4.1 shows the projected means for NPV, NCFI, and ending cash for the years 2022-2026. This scenario has no additional costs due to drought, and no additional payments from LFP. The baseline NPV – using a discount factor of 5% – is $326,155. Net cash farm income (profitability) and ending cash (liquidity) in the absence of drought or other shocks steadily increases over the projection period.

Table 4.1 Scenario 1 (Baseline) Projected Means.

Year	NPV	NCFI	Ending Cash
2022	$326,155	$ 81,251	$ 818
2023		$102,302	$ 15,624
2024		$125,635	$ 46,065
2025		$148,458	$ 91,545
2026		$161,556	$144,175

Figure 4.2 is the CDF for the scenario 1 (baseline) NPV. In this status quo scenario – that is the point of reference in this study – there is a 50 percent chance that NPV falls below (and above) $308,000. NPV for the baseline scenario never falls below zero.

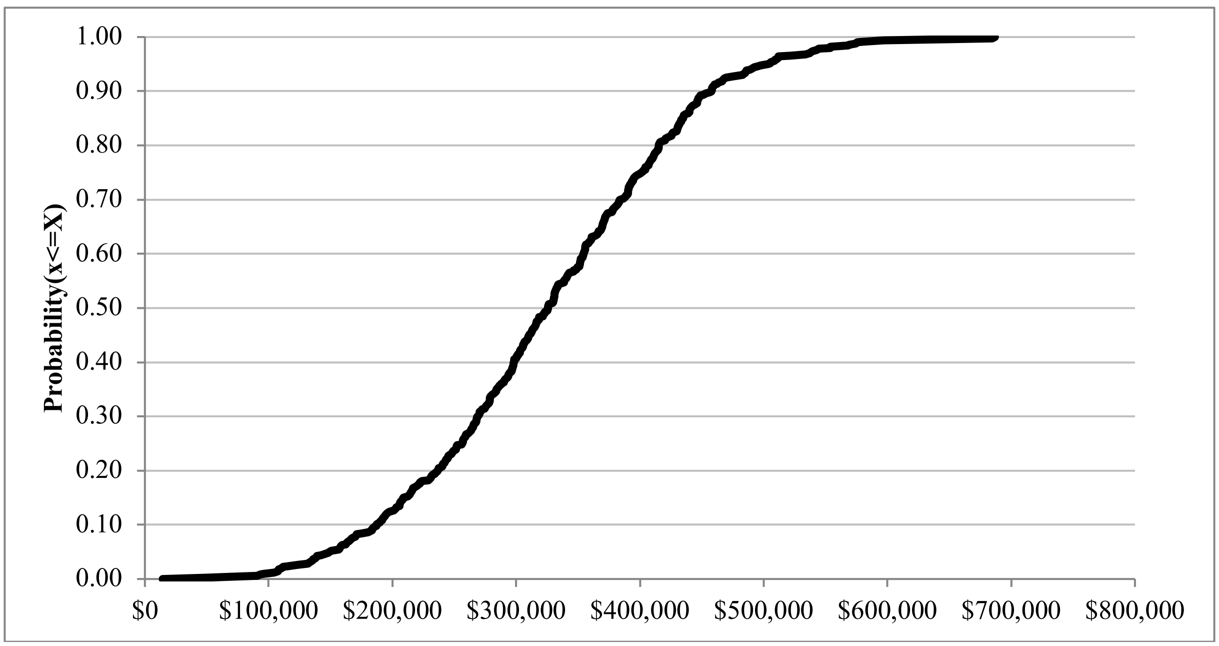

Figure 4.2 Baseline Net Present Value CDF

Figures 4.3 and 4.4 are the CDFs for NCFI and ending cash, respectively from 2022-2026. As the years go on, each projected yearly average increases. Figure 4.3 illustrates that almost all of the time, the ranch is firmly in the black – out of 500 draws, there is a negligible chance (less than 2%) that NCFI will be negative in any year from 2022 to 2026.

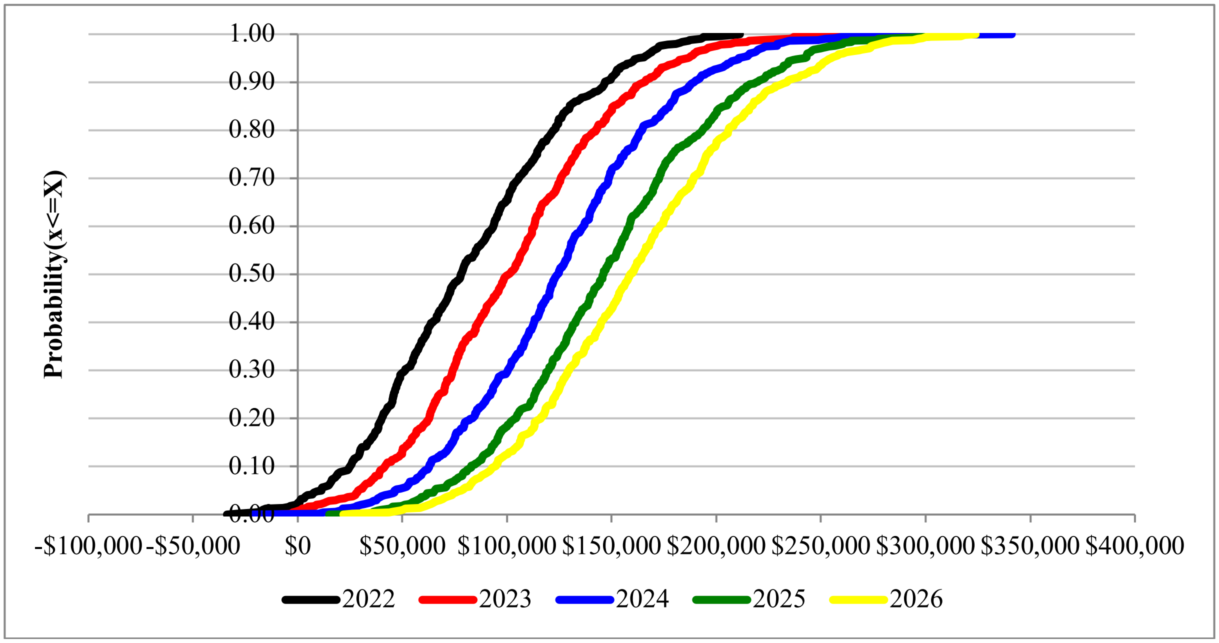

Figure 4.3 Baseline NCFI CDF

While NCFI is generally positive, the ranch still faces cash flow pressure. For example, cash outflows exceed inflows in about 50% of the draws for 2022 (Figure 4.4). Each year, expected ending cash increases, but so does the variability. This is to be expected the farther out ending cash is projected as it is dependent on the previous year's cash reserves.

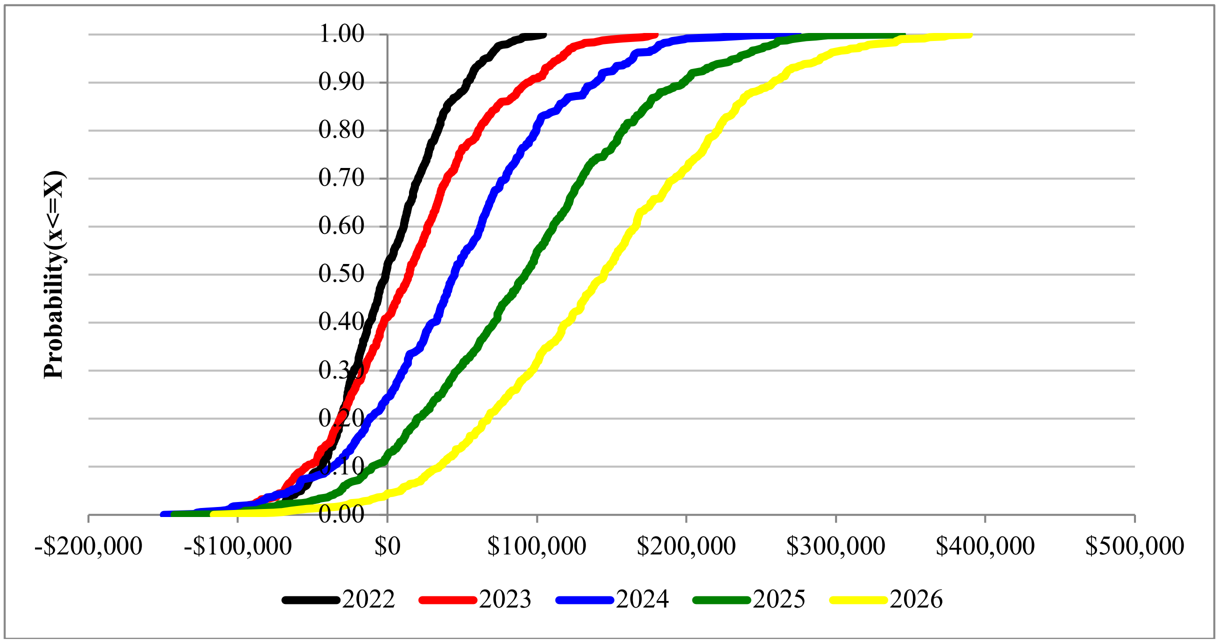

Figure 4.4 Baseline Ending Cash CDF

Scenarios 2 & 3 – Feeding in Response to a One-Year Drought

In scenarios 2 and 3, the representative ranch increased feed in response to a one-year drought in 2022. Herd size was maintained, and total amount fed increased by a multiplier of 2. Herd bulls, replacements, and yearling heifers were added into the feed mix. Figures 4.5 and 4.6 depict the difference in expected NCFI and ending cash between the Baseline and scenarios 2 and 3. Due to increased feed costs, expected NCFI drops sharply in 2022 (recall in scenario 2 there are no LFP payments to make up the difference). In scenario 3, the LFP payments make up for about 60% of the NCFI lost to drought. Interestingly, in this particular scenario, the LFP payment rate appears to be perfectly correlated to feed costs incurred. For example, the 60% LFP payment factor stipulated in the farm bill covers 60% of the NCFI shortfall caused by drought. Because the drought is assumed to end after one year, NCFI in 2022 is the only year impacted. In other words, after the drought ends, NCFI for scenarios 2 and 3 closely follows the baseline in years 2023-2026.

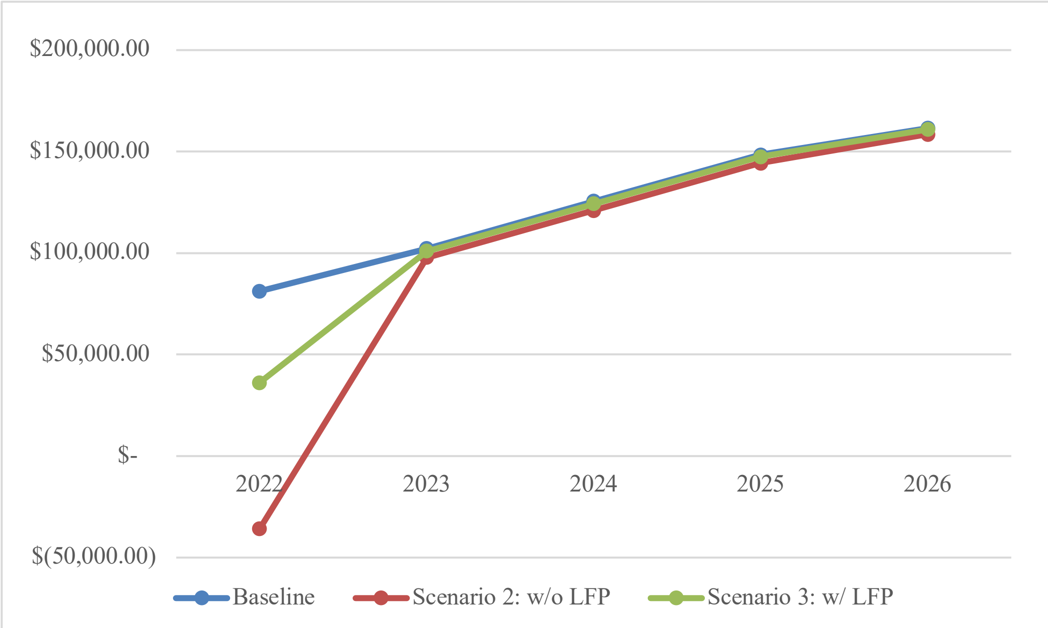

Figure 4.5 Projected Expected Net Cash Farm Income for Baseline and Scenarios 2 and 3

The ending cash amounts in Figure 4.6 tell a different story. While the cash shortfall occurs in 2022, it has an ongoing impact that is not captured by NCFI. Naturally, the shortfall in scenario 2 is much larger and it persists over the 2022-2026 period. Figure 4.6 demonstrates that, even with LFP, it can take the ranch awhile to recover from even a one-year drought after incurring the cost of purchasing additional feed.

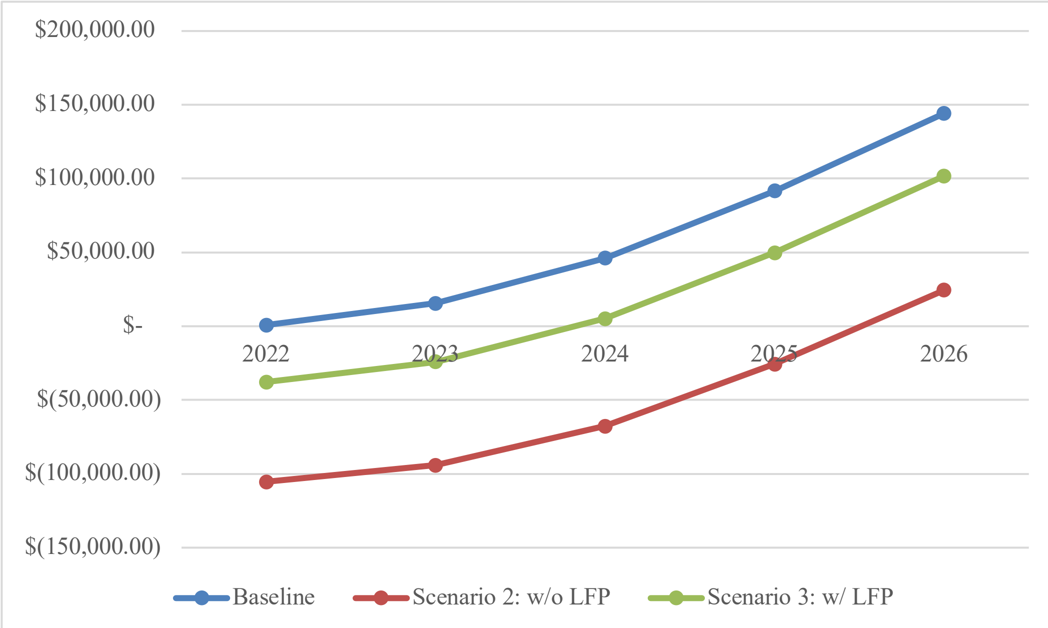

Figure 4.6 Projected Expected Ending Cash for Baseline and Scenarios 2 and 3

Figures 4.7, 4.8, and 4.9 represent the CDFs for NPV, NCFI, and ending cash, respectively. The NPV for scenario 2 illustrates the effect of increased feeding with no compensation from LFP; there is a 1.2% chance that NPV will fall below $0. In the year that feed is increased due to drought (2022), NCFI in scenario 2 is significantly less than NCFI in scenario 3. In 75% of the iterations, NCFI without LFP payments is negative. When LFP payments are added in, that percentage falls to 23%, which is still a significant chance that the ranch loses money, despite the fact that the expected NCFI is $36,000, as noted earlier. However, after the drought ends, NCFI tracks closer to the Baseline scenario.

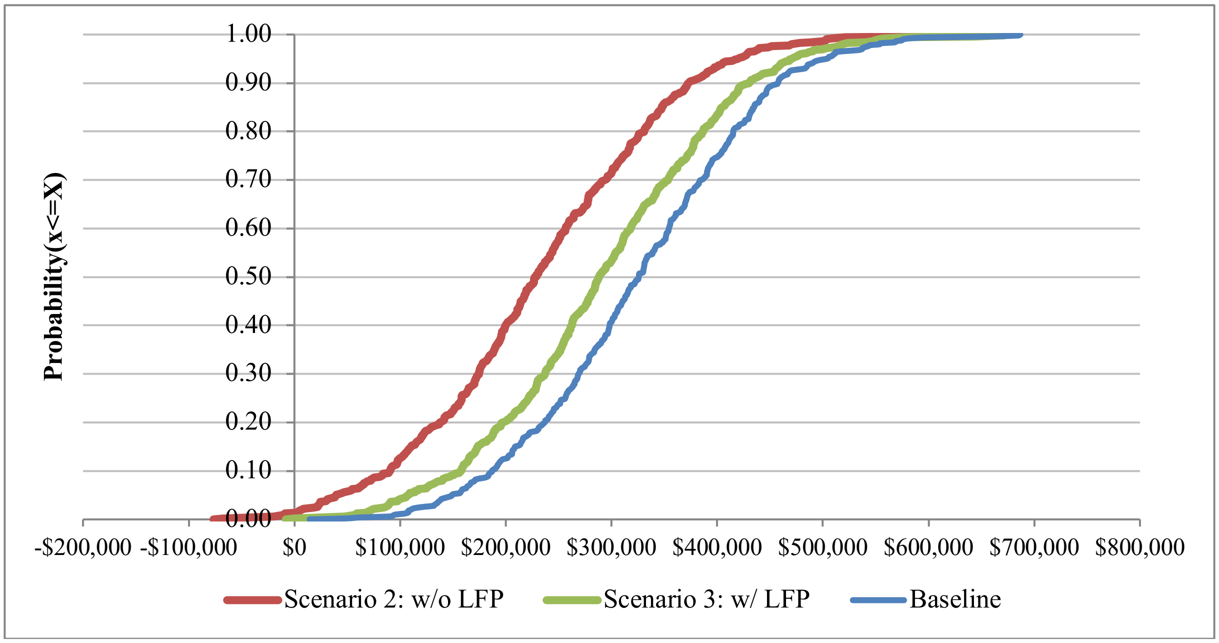

Figure 4.7 Scenarios 2 and 3 Net Present Value CDF

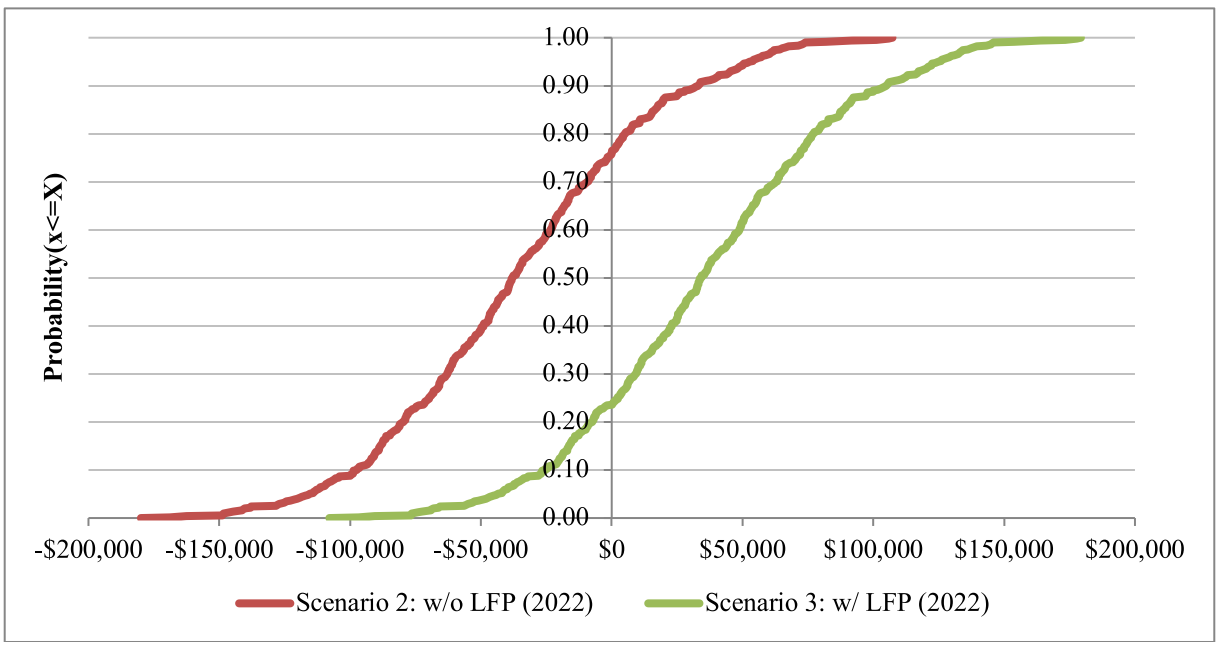

Figure 4.8 Scenarios 2 and 3 Net Cash Farm Income CDF

The CDFs for ending cash illustrate the range in variability as time goes on and that drought has long-lasting impacts. Again, the longer the projection, the wider the variability.

Ending cash with no LFP payments is lower than ending cash with LFP payments in 2022; in fact, 99% of the time, ending cash in scenario 2 (without LFP) is negative. LFP payments slightly improve the chance that ending cash is positive in 2022 to 19%. In a one-year drought with additional feeding and no LFP, there's still a 60% chance of having negative ending cash in 2025, after the drought has ended. LFP payments improve ending cash in 2025, but there is still a 30% chance of having negative ending cash the year after the drought has ended.

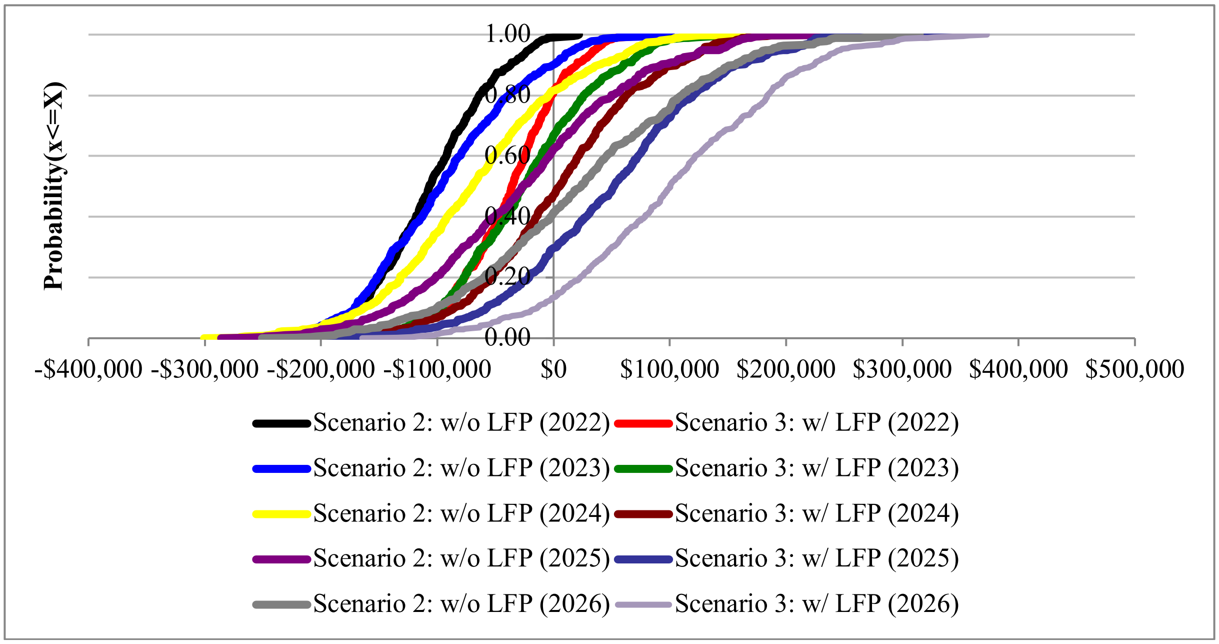

Figure 4.9 Scenarios 2 and 3 Ending Cash CDF

Scenarios 4 & 5 – Feeding in Response to a Three-Year Drought

Scenarios 4 and 5 are similar to scenarios 2 and 3 in that the response to drought was increasing the amount fed. However, the drought was assumed to persist for three years (2022-2024) and a feed multiplier of 3 was used for all years of drought. All other parameters are identical to scenarios 2 and 3. Figure 4.10 compares expected NCFI for the Baseline and scenarios 4 and 5. During the three years of drought (2022-2024), the ranch's expected NCFI both with and without LFP payments is significantly lower than during a normal year. Even with

LFP payments in scenario 5, expected NCFI remains negative in 2022 and 2023. Once the drought is over and the ranch is no longer incurring additional feed costs, expected NCFI returns almost to baseline levels, though it does not completely recover due to carryover debt.

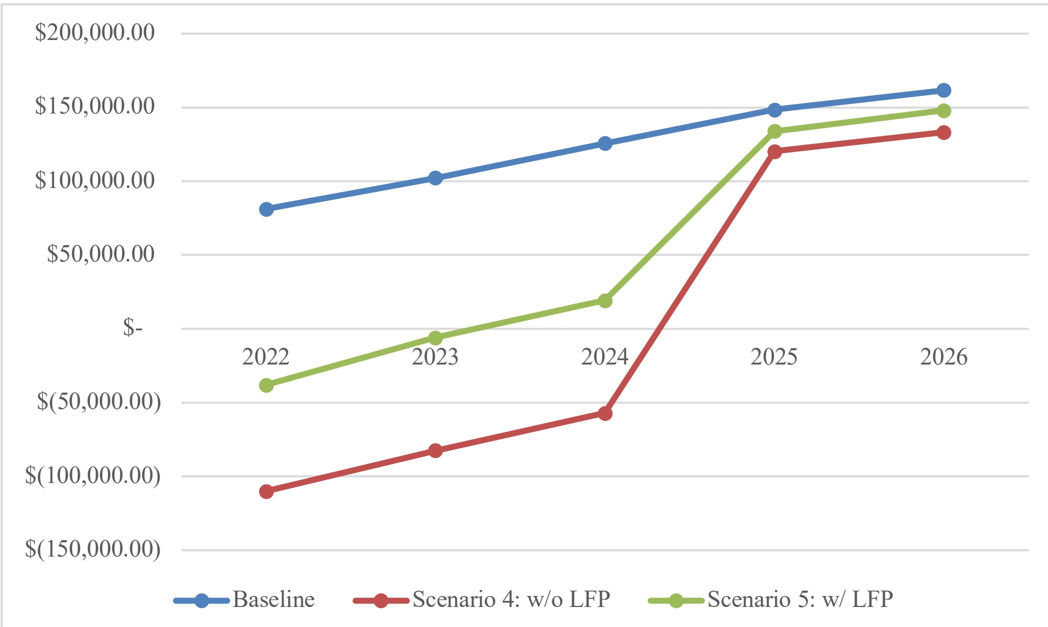

Figure 4.10 Projected Expected Net Cash Farm Income for Baseline and Scenarios 4 and 5

Figure 4.11 illustrates that the deficit in ending cash is harder to recover from. During the three years of drought, ending cash drops into the red, and never raises above $0, even after the drought has ended. Additionally, ending cash increases at a much slower rate than it fell during drought, meaning that it will take well beyond three years to rebuild ending cash and that the ranch will continue to have to borrow against an operating note to finance cash flow shortfalls.

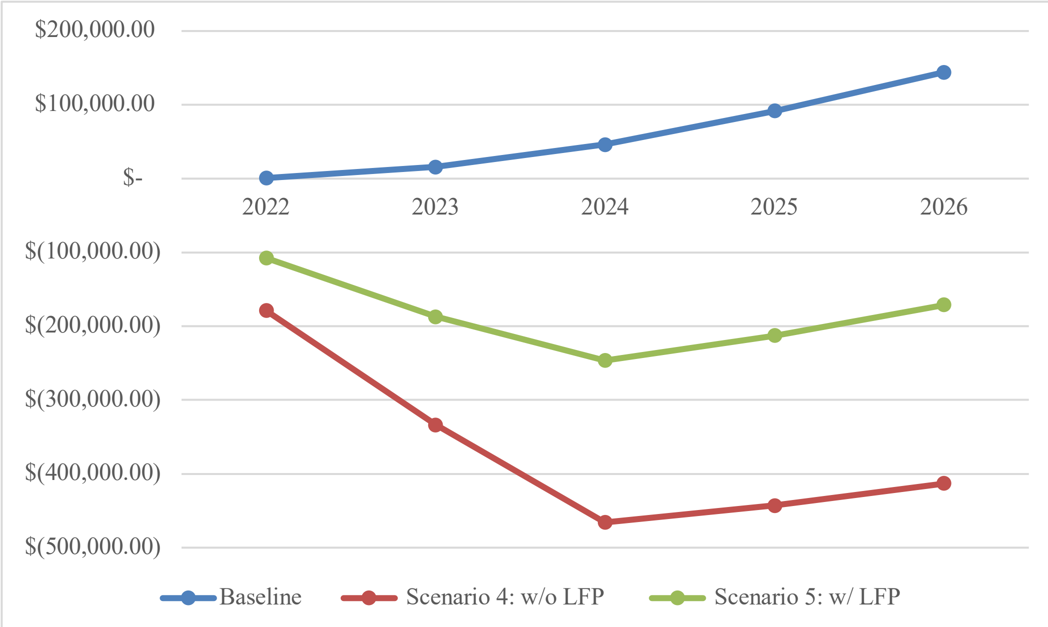

Figure 4.11 Projected Expected Ending Cash for Baseline and Scenarios 4 and 5

Figures 4.12, 4.13, and 4.14 depict the CDFs associated with NPV, NCFI, and ending cash, respectively. As discussed earlier, the scenario 1 (baseline) NPV has very little chance of being negative. Without LFP payments, NPV in scenario 4 has an 80% chance of being negative. With LFP payments in scenario 5, that probability falls to 25%, but it is still a significantly higher probability than with the baseline NPV, which is expected to never fall below $0. As noted in Figure 4.13, NCFI has a high probability of being negative without LFP through all three years of drought. Even with LFP payments through the first two years, NCFI still has a high chance of falling below $0. Once the drought ends, NCFI in 2025 and 2026 are largely expected to be positive (consistent with Figure 4.10). In those years, there is no significant difference between scenarios 4 and 5 as LFP payments are not received in non-drought years in scenario 5.

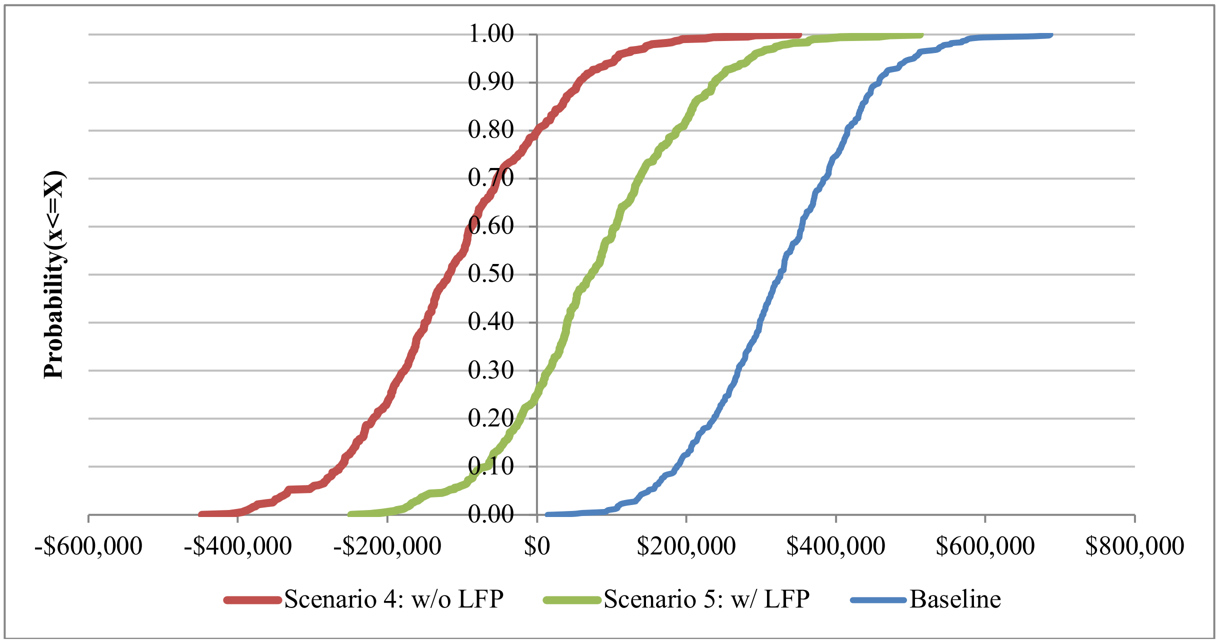

Figure 4.12 Scenarios 4 and 5 Net Present Value CDF

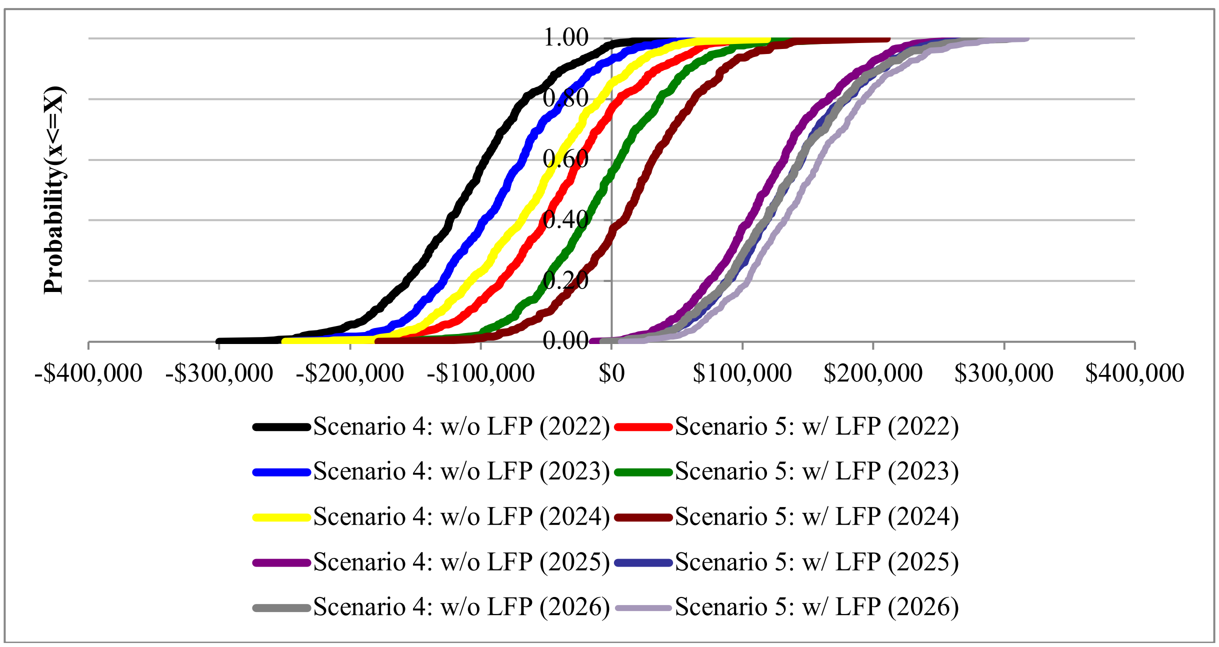

Figure 4.13 Scenarios 4 and 5 Net Cash Farm Income CDF

On the other hand, there is a very small chance of ending cash being positive in scenarios 4 and 5 (Figure 4.14). Notably, ending cash decreased with each year of drought, and while in 2025 and 2026 the probability of higher ending cash increased, there was only a 2% and 9%

chance of inflows exceeding outflows with LFP payments, respectively. Without LFP payments, none of the 500 iterations are positive in 2026, two years after the drought has ended. This ranch faces cash flow problems under status quo, so it stands to reason that those problems would be compounded by drought.

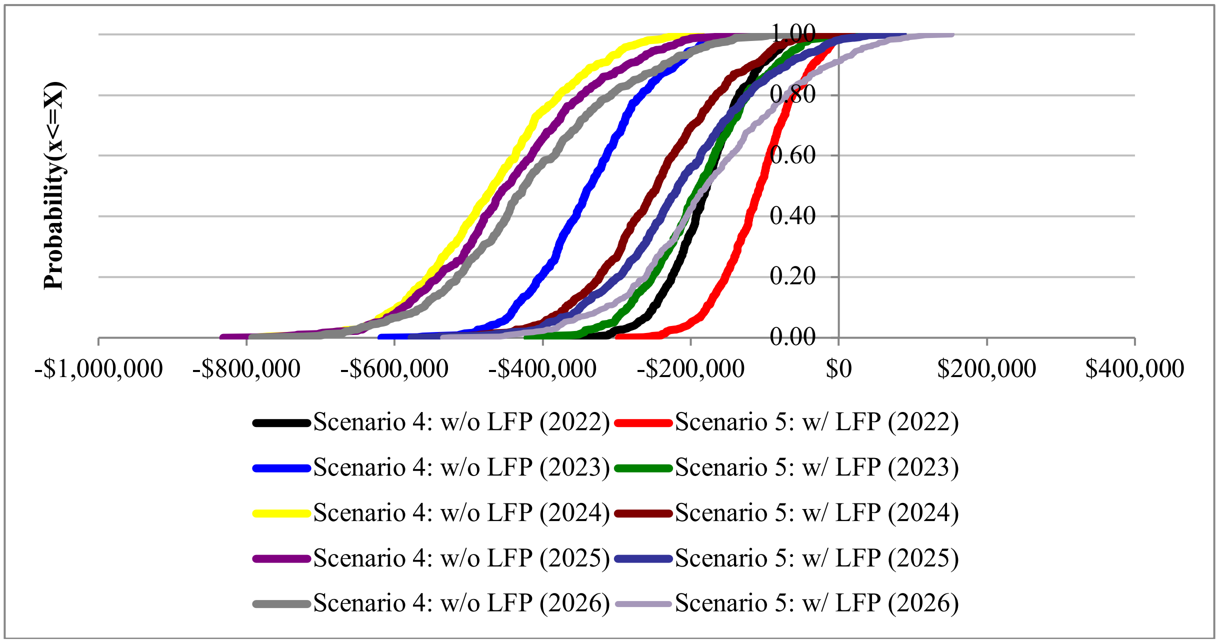

Figure 4.14 Scenarios 4 and 5 Ending Cash CDF

Scenarios 6 & 7 – Culling in Response to a Three-Year Drought

Scenarios 6 and 7, culling without and with LFP payments, respectively, also take place in the presence of a three-year drought (2022-2024). The herd is culled by 25% each year until 2024 and rebuilt by 25% per year in 2025 and 2026. LFP payments at the monthly rate are received during the drought and for livestock mitigated due to drought in the one or two years prior to the current year. When the drought is over, the only LFP payments received are for mitigated livestock at 80% of the monthly payment rate. As seen in Figures 4.15 and 4.16, expected NCFI and ending cash for the representative ranch from 2022-2024 are well above that of the baseline year since 25% of the herd is being sold in 2023 and 2024, and LFP payments are received in scenario 7. However, once the herd is in the rebuilding phase, both expected NCFI and ending cash drop sharply. The ranch's expected NCFI drops below $0 in 2025 for both scenarios, increasing slightly in 2026 due to increased livestock receipts (albeit still in the red). Ending cash shows no improvement in either scenario once rebuilding starts. LFP payments allow for ending cash to remain positive until 2026, when payments are only received for cattle mitigated due to drought in 2024.

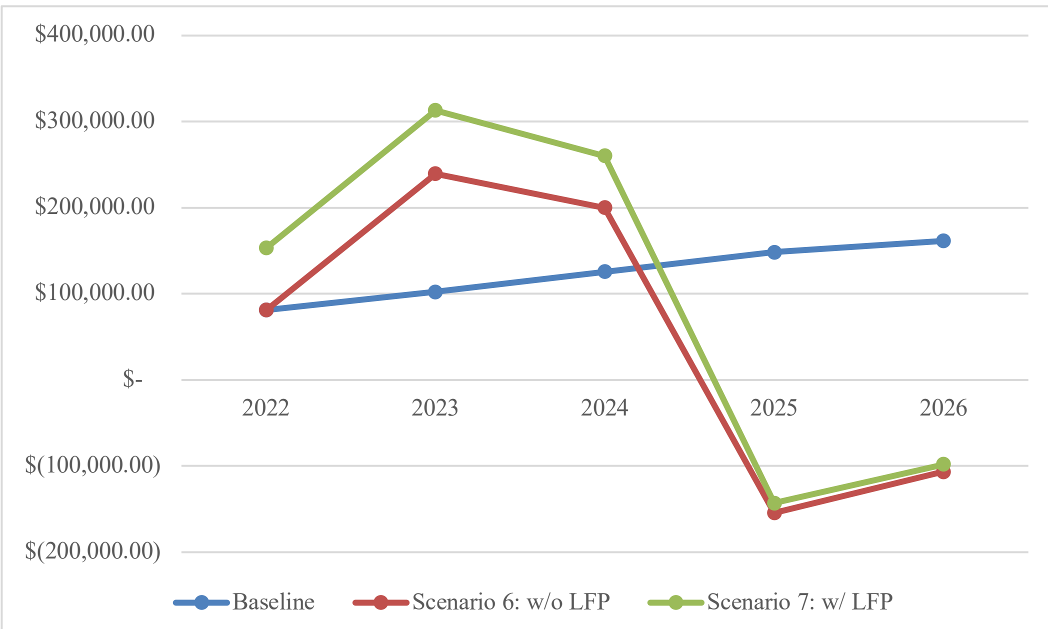

Figure 4.15 Projected Expected Net Cash Farm Income for Baseline and Scenarios 6 and 7

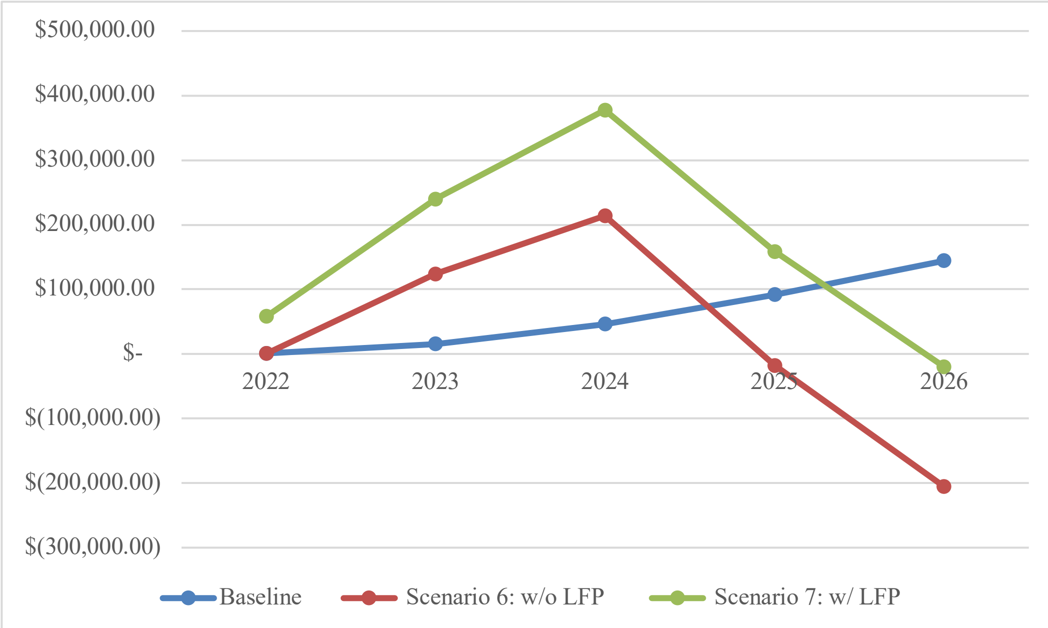

Figure 4.16 Projected Expected Ending Cash for Baseline and Scenarios 6 and 7

Figures 4.17, 4.18, and 4.19 illustrate the CDFs for NPV, NCFI, and ending cash, respectively, for scenarios 6 and 7. As has been the case with the previous scenarios, the NPV for scenarios 6 and 7 is significantly less than the baseline (scenario 1). Without LFP payments, there is only a 52% chance of NPV remaining positive in scenario 6; that percentage falls to 10% once LFP payments are included. NCFI for both scenarios will very likely remain positive through 2024, but once cattle are bought to rebuild the herd, that probability inverts, even with LFP payments from previously mitigated livestock.

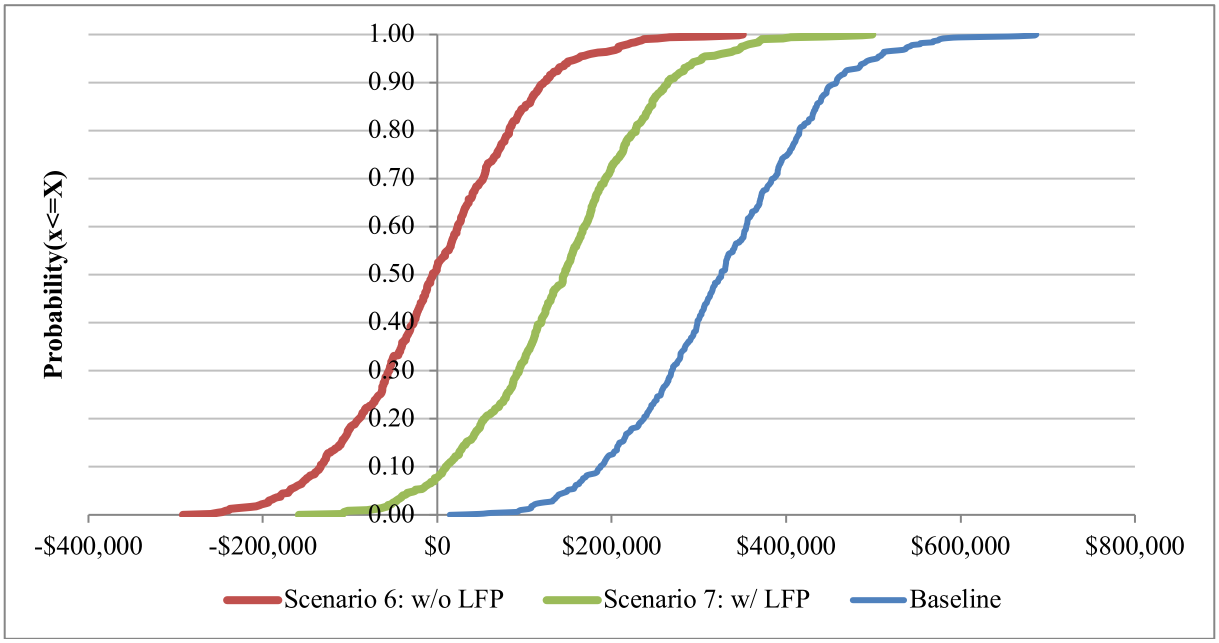

Figure 4.17 Scenarios 6 and 7 Net Present Value CDF

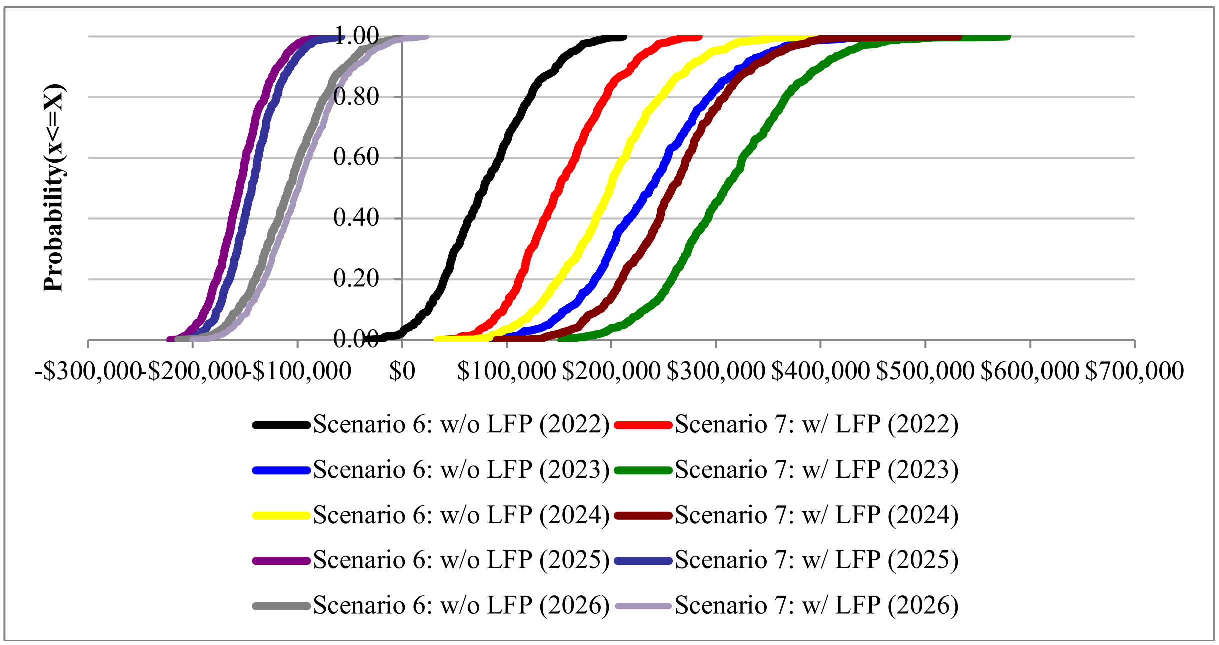

Figure 4.18 Scenarios 6 and 7 Net Cash Farm Income CDF

Ending cash (Figure 4.19) presents an interesting case. Even though LFP payments are decreased in 2025 and 2026 due to the ranch no longer being in drought, the cash inflows from previous LFP payments, in addition to mitigated livestock receipts in drought years, increase the probability of ending cash being positive in those years. In 2025, since payments are being received for cattle culled 1 and 2 years prior, the probability of ending cash being positive in scenario 7 is 98%. Payments are only received for cattle culled 2 years prior in 2026, and the probability of the ranch's ending cash being positive in scenario 7 is 40%. Without LFP payments, the likelihood of ending cash being positive in 2025 and 2026 is only 40% and 2%, respectively.

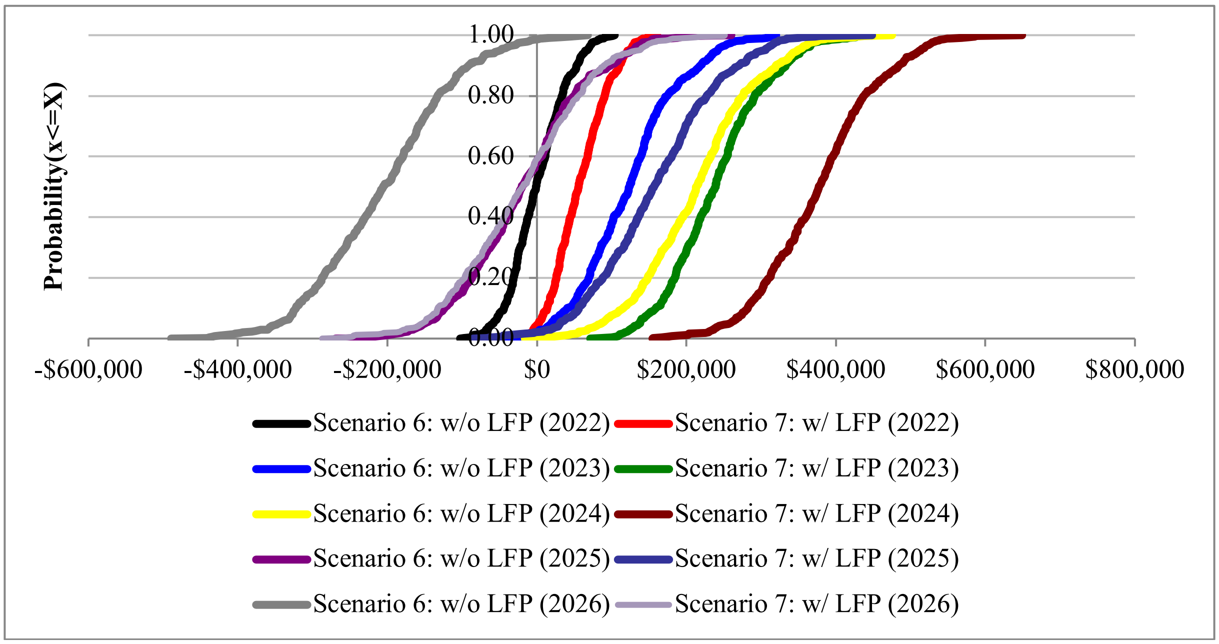

Figure 4.19 Scenarios 6 and 7 Ending Cash CDF

Scenarios 8 & 9 – Relocating in Response to a Three-Year Drought

In scenarios 8 and 9, cattle are relocated to an area outside of the drought. As with scenarios 4-7, the drought is assumed to continue for three years, and results are presented without and with LFP payments. Twenty-five percent of the herd is relocated each year in 2023 and 2024, and the same numbers are moved back each year after the drought ends. LFP payments were only received during drought years since no livestock were sold or otherwise disposed of due to drought. The USDA has stringent rules for LFP eligibility when cattle are being temporarily managed by someone else in an alternate location. This ranch was assumed to have met the necessary contracting requirements to maintain eligibility in scenario 9.

Figures 4.20 and 4.21 depict the expected NCFI and ending cash for scenarios 8 and 9. With the addition of hauling and management costs and no additional market receipts, projected NCFI falls significantly below the baseline without LFP payments in scenario 8. LFP payments in 2022 and 2023 improve the ranch's NCFI, but by 2024 when half of the herd is relocated and incurring management costs, NCFI with LFP payments falls below the baseline. In 2025 and 2026, when LFP payments aren't received, expected NCFI in scenario 9 tracks more closely to NCFI in scenario 8 (no LFP payments received). As the herd is returned to the original ranch, NCFI increases as management costs decrease.

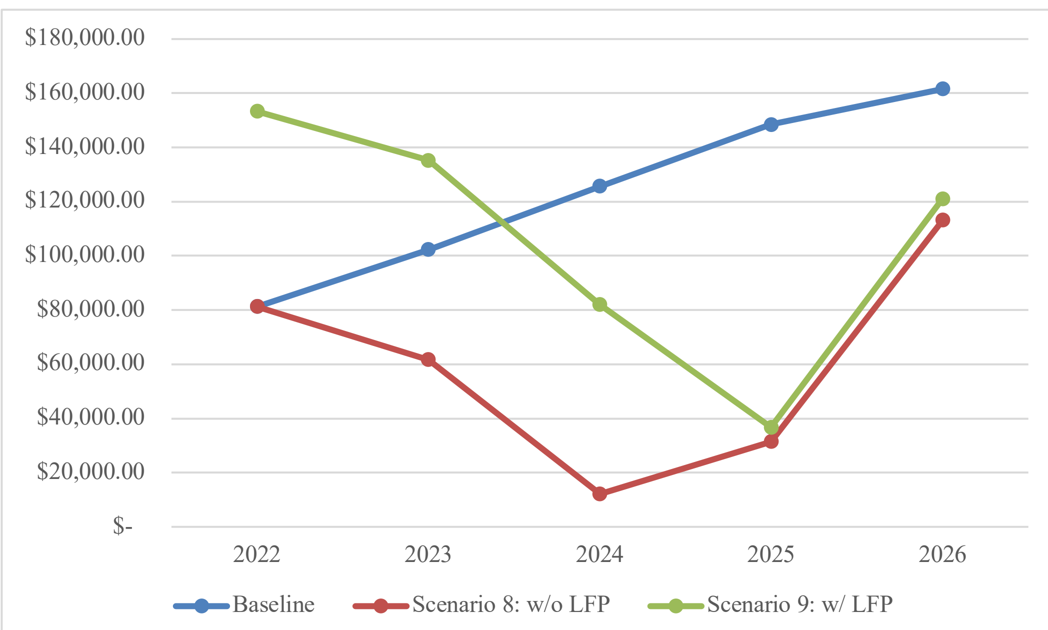

Figure 4.20 Projected Expected Net Cash Farm Income for Baseline and Scenarios 8 and 9

Expected ending cash (Figure 4.21) with LFP payments manages to stay above the baseline, falling below when LFP payments cut off due to no longer being in drought. Without

LFP payments, ending cash falls below $0 within the first year of drought and never recovers above $0.

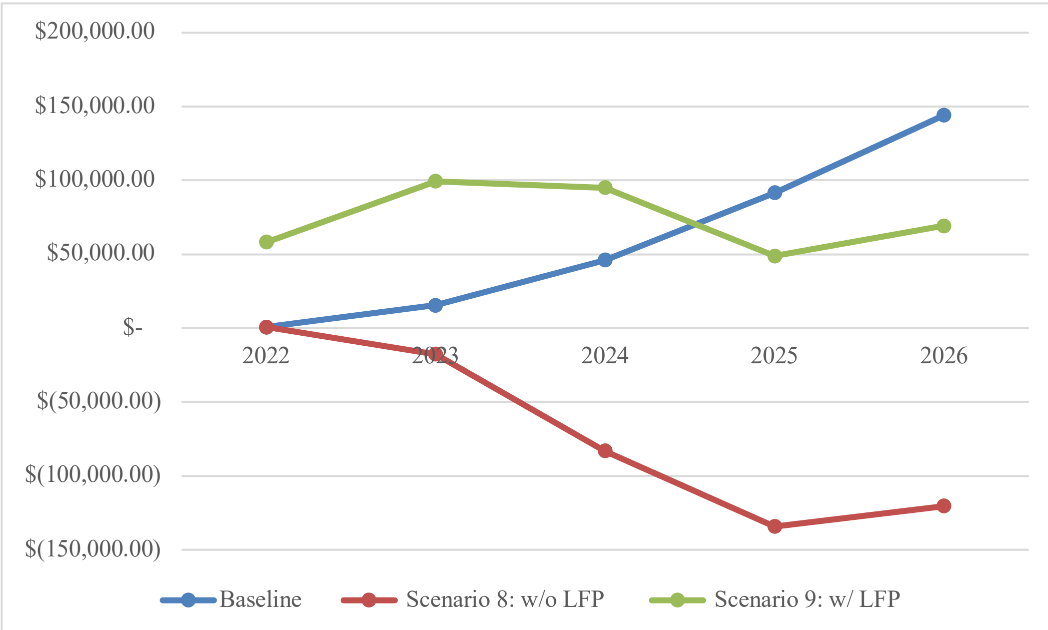

Figure 4.21 Projected Expected Ending Cash for Baseline and Scenarios 8 and 9

Figures 4.22, 4.23, and 4.24 depict the CDFs for NPV, NCFI, and ending cash, respectively, under scenarios 8 and 9. Without LFP payments, NPV stands a 16% chance of being negative. With LFP payments, the probability of NPV falling below $0 decreases to less than 1%. The NPV for both scenarios has a higher chance of being negative than the baseline scenario NPV, though with LFP payments factored in, the NPV is closer to baseline than without. NCFI has a significant chance of being positive, both with and without LFP payments. The highest probability of NCFI being negative is in 2024 without LFP payments at 40%. NCFI in 2025 for scenarios 8 and 9 have close to identical chances of being negative, around 25%, due to LFP payments not being received in that year in either scenario.

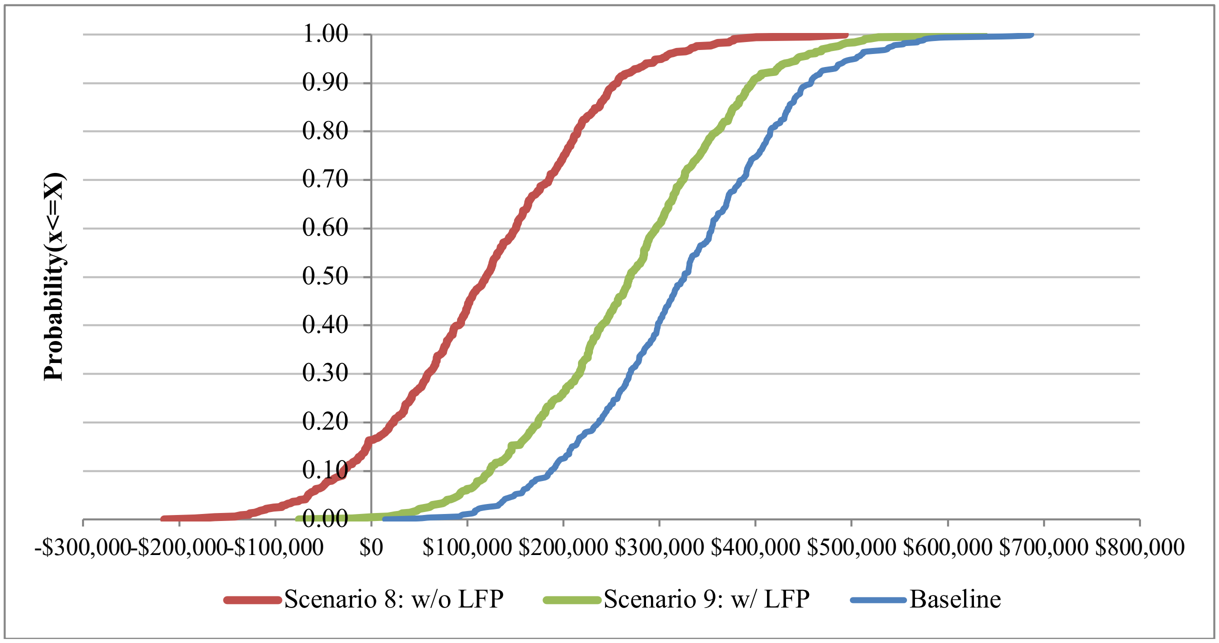

Figure 4.22 Scenarios 8 and 9 Net Present Value CDF

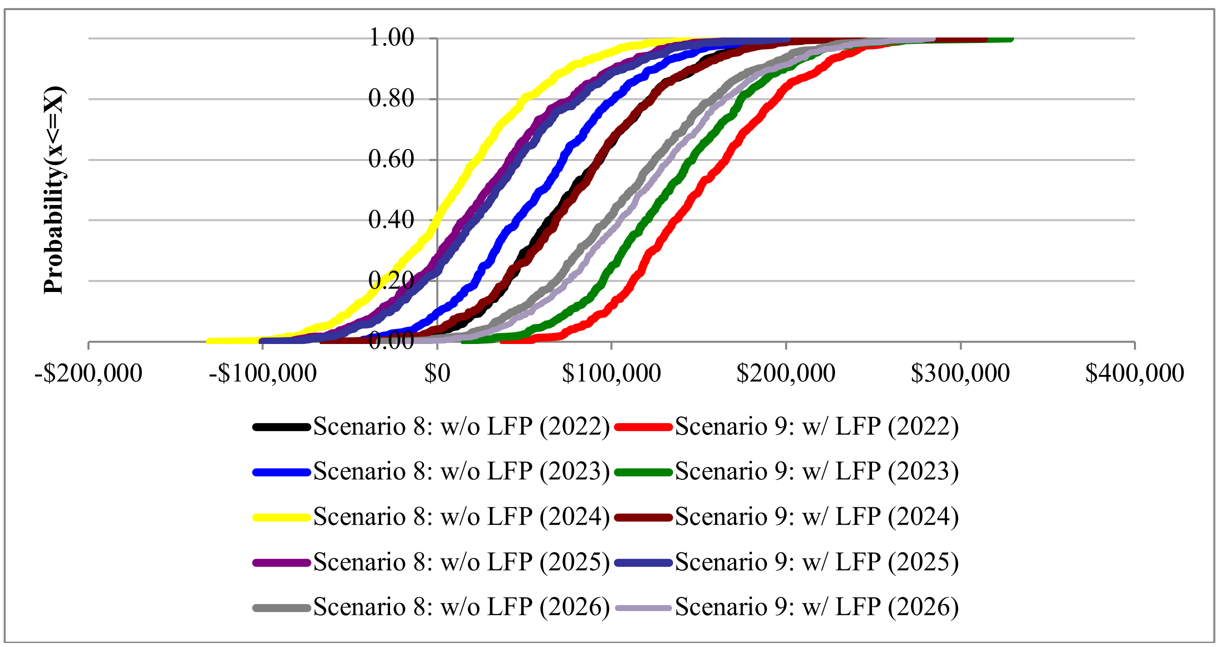

Figure 4.23 Scenarios 8 and 9 Net Cash Farm Income CDF

Ending cash (Figure 4.24) without LFP has a high chance of being negative in 2024, 2025, and 2026, with all years having an approximately 90% probability of being negative. Under scenario 9, 2026 ending cash is negative in 23% of the 500 iterations. After the drought ends, LFP payments are no longer incorporated in scenario 9, resulting in a higher probability that ending cash is negative since hauling and management expenses are still present. As time goes on, variability in ending cash increases as ending cash shortfalls compound.

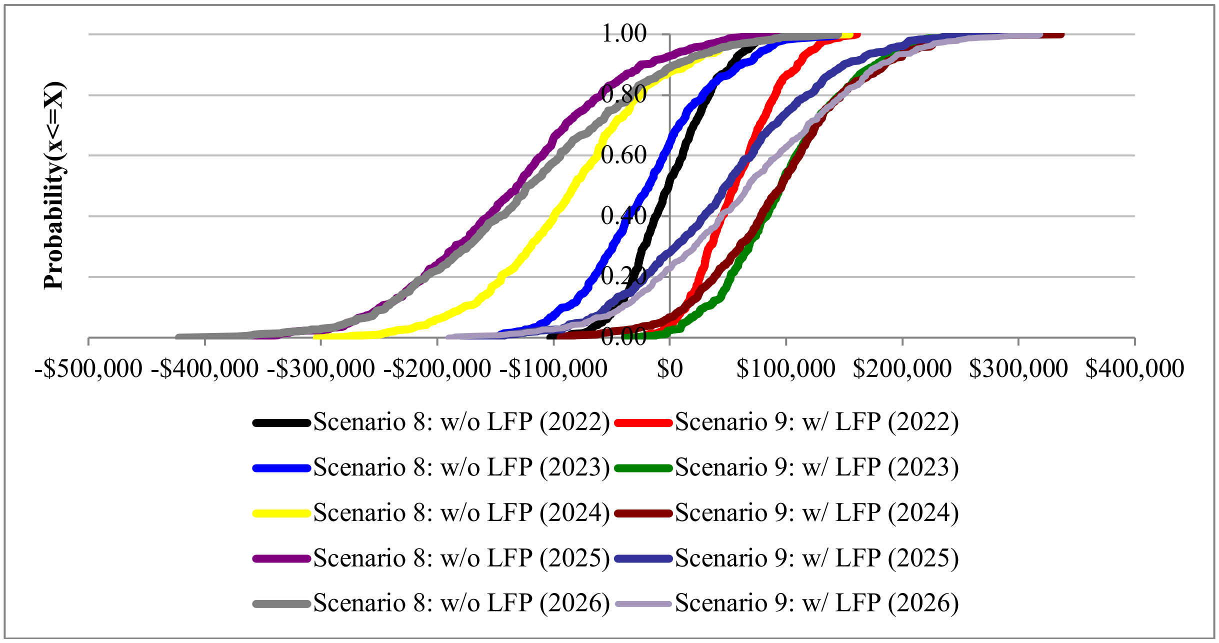

Figure 4.24 Scenarios 8 and 9 Ending Cash CDF

Management Response to a Three-Year Drought with LFP Payments

Out of the four management responses analyzed, three of them were in response to persistent drought (i.e. three-year drought). Figure 4.25 compares the NPV between all three scenarios (with LFP payments) and the baseline. Out of all three scenarios, relocation provides a consistently larger NPV for this ranch. Feeding through a three-year drought is least preferred, with a greater than 20% chance that NPV will be negative. When the management response is to cull, the likelihood of NPV being negative drops to 8%; by contrast, with relocation, NPV is negative only 0.2% of the time.

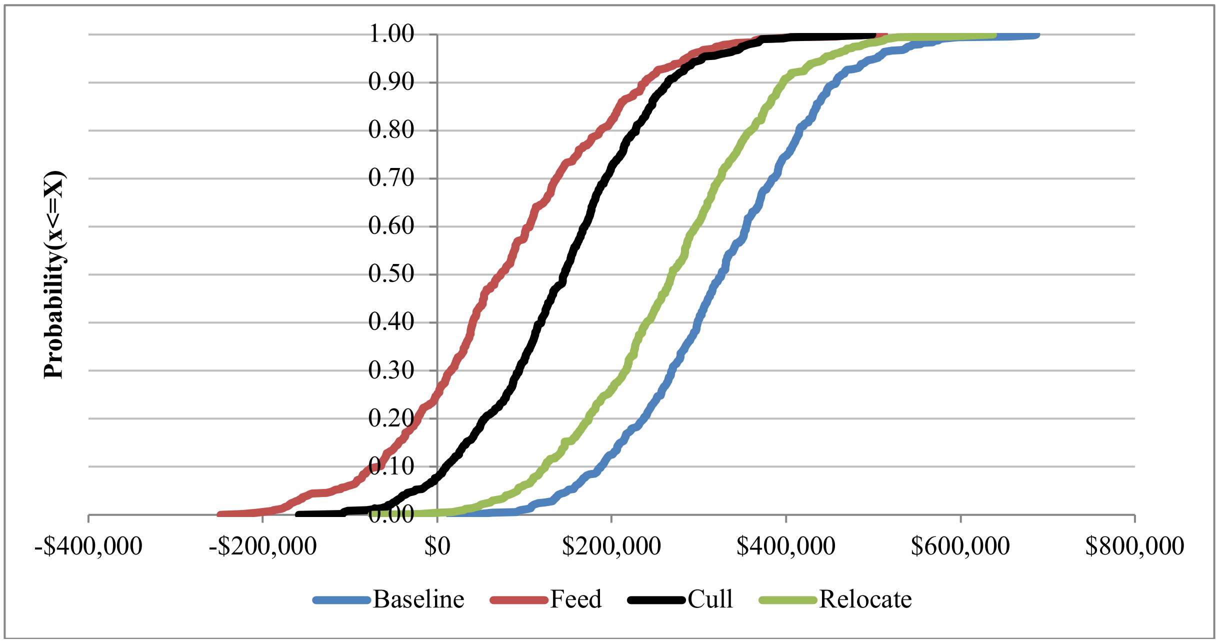

Figure 4.25 Three-Year Drought Management Scenarios with LFP Net Present Value CDF

Summary

The compensation received from LFP in the case of drought mitigates the additional costs incurred, but it does not make a producer whole. In the case of a one-year drought, LFP is fairly well calibrated. LFP payment rates are designed to cover 60% of feed costs, and that is largely what this research found in this scenario. In that case, the ranch was still on the hook for 40% of the additional costs incurred, which has a long-term impact on cash flow. However, as drought persists and alternative management strategies are utilized, LFP compensates for an even smaller share of the costs incurred due to drought. When facing a three-year drought, the preferred option for this ranch would be to relocate the herd outside of the drought area, though this is highly dependent on diesel prices, hauling rates, and management expenses.

CHAPTER V

CONCLUSIONS

Agriculture's dependency on uncontrollable factors has always made the industry a volatile one. Livestock production in particular is vulnerable to regional weather patterns and events, such as drought and wildfire, which can significantly affect a ranch's financial health. Producers not only suffer through the drought as it is happening, but they feel the effects years later as they rebuild their herd and cash reserves.

From 2011-2013, a majority of the country, including major livestock producing, states were in drought. The 2014 Farm Bill permanently funded the Livestock Forage Disaster Program (LFP), codifying payments to ranchers for grazing losses due to drought. The maximum payment thresholds were maintained at 5 months in the 2018 Farm Bill, with one monthly payment equivalent to 60% of calculated feed costs.

Objectives

The primary objective of this research was to analyze the extent to which the current LFP payment rates are calibrated to the actual costs of production that ranchers face during drought. A secondary objective was to evaluate the financial impact LFP has on a ranch under alternative drought management responses. Risk was incorporated into the model to determine the variability of outcomes, and to give a more robust analysis regarding comparisons of financial variables. Historical prices for feed and cattle were used to estimate distributions and determine stochastic variables. Using these stochastic prices, resulting net present value (NPV), net cash farm income (NCFI), and ending cash were simulated 500 times to generate a range of probable outcomes under baseline and alternative scenarios.

Results

The model developed from the King County representative ranch was used to evaluate four alternative management scenarios with and without LFP payments. Without LFP payments, the ranch faced enormous losses, regardless of drought management response. While LFP payments did improve this ranch's bottom line, they did not compensate for all additional costs incurred. The longer the drought persisted, the less helpful LFP payments were. When having to buy back cattle to rebuild the herd or maintaining the herd while giving additional feed due to prolonged drought, ending cash and expected NCFI suffered. While LFP payments provided significant financial support to the ranch as it was suffering from exceptional drought, they in no way made the ranch "whole".

In the case of a one-year drought, LFP is fairly well calibrated. LFP payment rates are designed to cover 60% of feed costs, and that is what was found in that scenario. However, the remaining additional costs had a long-term impact on cash flow. As drought persists and alternative management strategies are utilized, LFP compensates for an even smaller share of the costs incurred due to drought. If LFP is revisited in the next farm bill, policymakers may wish to consider increasing payment rates, particularly for longer droughts.

Future Research

This research evaluated LFP over the next five years – 2022-2026. Given rising input costs and current drought levels, this study undoubtedly could be updated to reflect these new realities. Additionally, this research assumed that maximum LFP payments were received when applicable. This model could be expanded to be responsive to differing levels of drought, ideally incorporating risk into a stochastic estimate of drought. Furthermore, local price responses for feedstuffs and replacement cattle in response to drought could be included to make the model more robust.

Only three management strategies were evaluated in this study: feeding, culling, and relocation. There are a number of other drought management responses that producers make, and this research can be built upon to be more comprehensive in that regard. For example, this ranch retains heifers to replace culled cows, and this strategy could be adjusted in future work. Future work on management strategies could also examine the sustainability of each approach and adjust incentives accordingly. Finally, future analysis could also examine combinations of drought management scenarios and evaluate additional farms in multiple locations to get a sense of the generalizability of the results.

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