

## Economic Analysis of Management Options Following a Range Fire in Elko County, Nevada

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### Introduction

Ranchers throughout the West who lease federal rangeland for part or all of their grazing land are dependent upon the US Forest Service (USFS) and US Bureau of Land Management (USBLM) to determine the number of animal unit months (AUMs) they can run each year. The number of AUMs permitted on federal rangeland is determined by USFS and USBLM based on range conditions and other factors such as fire and wildlife presence. In Nevada where a number of large range fires have occurred, ranchers have experienced grazing re-entry delays ranging from one to five years.

The uncertainty of how long rangeland must be idled after a range fire has forced ranchers to consider alternative range management options. The most frequently discussed management options include:

- reduce the herd size,
- lease more rangeland and maintain herd size,
- buy alfalfa hay and maintain herd size,
- plant alfalfa hay and maintain herd size, and
- retire.

Certainly the length of the delayed re-entry after a fire affects the ranchers' decision. A short delay may lead ranchers to purchasing alfalfa hay and redoubling their efforts to grow meadow hay. Longer delays caused by range fires which cover most of the federal grazing land could encourage ranchers to invest in their own alfalfa production (if water is available) or even reduce herd size or retire.

The objective of this paper is to analyze the economics of alternative range management options for ranchers in Nevada following a range fire.

Elko County, Nevada was selected for the analysis because the region has suffered several large range fires over the past ten years. A panel of ranchers representative of full-time, moderate to large cow/calf operations in the region was interviewed to obtain specific information for the analysis. The panel has been interviewed semi-annually for the past ten years by the Texas A&M Agricultural and Food Policy Center to obtain the production data and costs for a representative ranch in Northeast Nevada. The representative ranch has been used for numerous policy analyses, e.g., Richardson, et. al (2013). The methodology for the analysis involves simulating the representative ranch for alternative range management options using

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the Farm Level Income and Policy Simulation (FLIPSIM) model developed by Richardson and Nixon (1986).

### **Range Management Options**

Interviews with ranchers in Elko County, Nevada on the subject of range/herd management after a range fire indicated that the least preferred option ranchers would consider was reducing herd size. The reasons for not reducing the herd size revolved largely around the issue of restocking the herd when re-entry was permitted. Due to the extensive size of the pastures, limited number of water holes, and seasonal movement of herds, the ranchers have found it best to maintain a closed herd. They raise replacement heifers, buy bulls, and only cull cows due to age and sickness. Purchasing replacements from other areas has not been successful in the past and the ranchers did not consider it as a viable option. The ranch panel indicated that their experience with purchasing replacements were shared by ranchers across Nevada and most likely shared by the majority of ranchers in the West.

Leasing additional grazing land is an option but one which is not feasible as rangeland in Elko County is fully occupied and the same is true for most of the rangeland in the Western states. Additionally, leasing rangeland incurs added costs of transportation, management, and loss in performance from grazing rangeland unfamiliar for the cattle.

The ranch panel indicated that planting alfalfa would be the only option short of retiring if the delayed entry was expected to last more than a year. Meadow hay presently grown on the ranch currently covers their needs when there is no fire but would not be sufficient when fire delayed re-entry. The ranch panel indicated that Elko County has adequate ground water for irrigating alfalfa, if the representative ranch used a pivot irrigation system.

### **Representative Ranch**

The representative ranch in Elko County, Nevada has 650 mother cows, 100 replacement heifers, and 38 bulls. The ranch raises its replacement heifers, has a 96 percent calf crop on bred cattle, and culls 10 percent of the cows each year. The ranch has 1,300 acres of meadow hay which has an average yield of 1.75 tons per acre. The owned pastureland is 8,725 acres and the ranch leases 5,450 AUMs of grazing; 4,500 AUMs leased from the government and 1,000 AUMs leased from private landowners. Costs of production for the ranch are provided by the panel and are summarized as: \$226 of variable costs per cow and \$364 of fixed costs per cow per year.

The representative ranch is simulated for a ten year planning horizon assuming initial long-term debt is one percent and intermediate term debt is five percent. Debt to purchase an irrigation pivot and additional haying equipment is financed for five years and the debt is added to the ranchers initial assumed intermediate term debt.

### **Scenarios Analyzed**

The number of years after a fire a rancher must wait to re-enter is dependent on how extensive the fire was and regrowth of the grass. Because the number of years to re-enter the rangeland is an exogenous variable, a number of scenarios are analyzed. Another exogenous variable is the percent of the USBLM land that is closed out due to fire. The following scenarios were simulated to accommodate the range of possible re-entry conditions.

- Base scenario has no fire on federal land.
- 25 percent of federal land is damaged by fire and re-entry is delayed for 1, 2, 3, 4, or 5 years.

- 50 percent of federal land is damaged by fire and re-entry is delayed 1, 2, 3, 4, or 5 years.
- 75 percent of federal land is damaged by fire and re-entry is delayed 1, 2, 3, 4, or 5 years.
- 100 percent of federal land is damaged by fire and re-entry is delayed 1, 2, 3, 4, or 5 years.

The ranch panel indicated that purchasing one or two 120-acre pivots for alfalfa should be considered given the uncertainty of the re-entry period. So for each of the scenarios indicated above, the representative ranch was analyzed assuming:

- Buy alfalfa hay to supplement meadow hay produced on the ranch.
- Install one 120-acre pivot to grow alfalfa hay.
- Install two 120-acre pivots to grow alfalfa hay.

### **Economic Model**

FLIPSIM is a firm level simulation model that simulates the annual production, marketing, financial, tax, and cash flow for a ranch (or farm) over a 10 year planning horizon. The model simulates annual beef production using empirical distributions for calving rates and weaning weights provided by the ranch panel. Annual cattle and hay prices for the representative ranch are simulated by localizing stochastic cattle prices developed by the Food and Agricultural Policy Research Institute (FAPRI) in their August 2013 Baseline.

The number of federal AUMs available to the ranch has ranged from 1,723 to 6,200 with an average of 4,500 over the past ten years in the absence of delayed re-entry due to fire. To incorporate the risk for federal AUMs an empirical probability distribution for AUMs was added to FLIPSIM. Data to fit the distribution was provided by the representative ranch panel. The representative ranch panel also provided 10 years of meadow hay yields. Meadow hay is used to supplement the random loss of federal AUMs and to provide supplemental feed. FLIPSIM simulates annual meadow hay and alfalfa hay yields using a multivariate empirical distribution fitted to ten years of actual yields for ranches in Elko County, Nevada.<sup>2</sup> Alfalfa hay is purchased in the model if the meadow hay plus alfalfa hay production is less than the feed required by the herd.

The base costs of production provided by the ranch panel were inflated over the planning horizon using annual inflation rates in the August 2013 FAPRI Baseline. Interest rates for the analysis are the annual FAPRI Baseline interest rates plus a basis adjustment for the local market. Similar adjustments were made to adjust FAPRI's stochastic annual national cattle and hay prices to the Nevada market assuming the average basis for the past three years remains constant in the future.

The FLIPSIM model simulated the ranch for ten years and repeated the planning horizon for 500 iterations. Each iteration used a different draw of stochastic prices, yields, and AUMs. The key output variable reported for this paper is the average annual net cash farm income (NCFI). The NCFI equals total receipts minus total cash production expenses. Cash outlays not included in NCFI are: family living withdrawals, federal income taxes, social security and Medicare contributions, and principal payments.

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<sup>2</sup> The multivariate empirical distribution simulation methodology is described by Richardson, Klose, and Gray (2000).

## Results

The average annual NCFI and standard deviation of NCFI for the base scenario without delayed re-entry due to a fire are \$67,450 and \$35,530, respectively (Table 1). In Table 1 two variations of the base scenario are presented; adding one 120-acre pivot of alfalfa and adding two 120-acre alfalfa pivots, both without AUM reduction due to fire. Adding one pivot of alfalfa increases average annual NCFI 47 percent to \$99,330 and reduces relative risk more than 50 percent<sup>3</sup>. Adding one pivot of alfalfa produces sufficient forage to cover supplemental feed requirements caused by AUM risk and meadow hay yield risk 90 percent of the time. However, adding two pivots of alfalfa increases NCFI by only 11 percent as the added debt servicing requirements for the second pivot and larger haying equipment does not pay for itself in the base case. The results indicate that even in the absence of a fire the ranch would be financially better off by adding one 120-acre pivot for alfalfa, if adequate water is available.

The results for the 60 scenarios assuming different combinations of fire coverage (25, 50, 75, and 100 percent) on the public land and number of years with no grazing (1, 2, 3, 4, or 5) are summarized in Table 2. Not adding a 120-acre pivot for alfalfa and depending only on buying alfalfa hay is the worst option. If the years of no federal grazing is only one and the fire is only on 25 percent of the federal rangeland the ranch's NCFI is reduced 11 percent from the base.

**Table 1. Average Annual Net Cash Farm Income for a Representative Nevada Ranch, Assuming No Fire and Alternative Hay Production Scenarios.**

(\$1,000s)	
<b>Buy Alfalfa Hay</b>	
<b>NCFI</b>	67.45
<b>Std Dev</b>	35.53
<b>1 Pivot</b>	
<b>NCFI</b>	99.33
<b>Std Dev</b>	24.24
<b>2 Pivots</b>	
<b>NCFI</b>	75.31
<b>Std Dev</b>	23.52

But if the fire prevents grazing for five years on 50 percent of the federal land, average annual NCFI falls from \$67,450 to -\$29,630 (Tables 1 and 2). The results for the buy alfalfa hay scenario indicate that the more extensive the fire and the longer the period of no grazing on federal lands, the lower the average annual NCFI. These results indicate that if a ranch is forced to buy alfalfa hay for an extended number of years, it may be better off financially to reduce the herd and/or retire.

Installing one 120-acre pivot of alfalfa greatly improves the ranch's NCFI relative to the buy alfalfa option (Table 2). The 50 percent fire damage and five year no grazing of federal lands has a projected average annual NCFI of \$47,560, but this value is much greater than its buy alfalfa hay counterpart of (-\$29,630). The addition of one 120-acre alfalfa field yields a higher average annual NCFI than buying alfalfa hay across all combinations of fire damage and years of no grazing. Additionally the relative risk on NCFI is reduced by growing alfalfa.

<sup>3</sup> Relative risk is another term for coefficient of variation which is calculated as the ratio of the standard deviation and the mean expressed as a percentage.

**Table 2. Average Annual Net Cash Farm Income for a Representative Nevada Ranch, Assuming Alternative Years of Reduced Grazing on Federal Land Due to Fire.**

	Years with No Grazing on Federal Land				
	1 Year	2 Year	3 Year	4 Year	5 Year
	(\$1,000s)	(\$1,000s)	(\$1,000s)	(\$1,000s)	(\$1,000s)
<b>25% of Federal Land Closed Due to Fire</b>					
<b>Buy Alfalfa Hay</b>					
NCFI	60.08	52.82	45.80	38.92	32.07
Std Dev	35.63	35.63	35.68	35.72	35.70
<b>1 Pivot</b>					
NCFI	<b>98.39</b>	<b>97.34</b>	<b>96.14</b>	<b>94.69</b>	<b>92.65</b>
Std Dev	25.03	26.06	27.14	28.51	29.69
<b>2 Pivots</b>					
NCFI	75.26	75.18	75.03	74.85	74.42
Std Dev	23.62	23.74	23.94	24.14	24.35
<b>50% of Federal Land Closed Due to Fire</b>					
<b>Buy Alfalfa Hay</b>					
NCFI	47.04	27.07	7.80	(10.87)	(29.63)
Std Dev	34.61	33.10	31.69	30.60	29.44
<b>1 Pivot</b>					
NCFI	<b>94.64</b>	<b>84.33</b>	<b>71.49</b>	58.86	47.56
Std Dev	26.59	28.82	29.55	29.97	30.43
<b>2 Pivots</b>					
NCFI	74.69	73.23	71.35	<b>69.39</b>	<b>66.32</b>
Std Dev	23.81	23.87	23.82	24.02	24.88
<b>75% of Federal Land Closed Due to Fire</b>					
<b>Buy Alfalfa Hay</b>					
NCFI	34.53	2.50	(28.85)	(59.65)	(90.68)
Std Dev	34.32	32.00	29.78	27.95	26.03
<b>1 Pivot</b>					
NCFI	<b>85.44</b>	60.09	35.27	11.17	(13.21)
Std Dev	27.05	26.26	25.52	25.00	24.60
<b>2 Pivots</b>					
NCFI	73.35	<b>68.19</b>	<b>54.48</b>	<b>38.76</b>	<b>23.29</b>
Std Dev	23.90	24.48	25.03	25.16	24.74
<b>100% of Federal Land Closed Due to Fire</b>					
<b>Buy Alfalfa Hay</b>					
NCFI	21.11	(24.00)	(68.07)	(111.29)	(154.70)
Std Dev	34.51	32.01	29.60	27.67	25.87
<b>1 Pivot</b>					
NCFI	<b>72.62</b>	34.81	(2.75)	(40.56)	(79.63)
Std Dev	26.46	25.00	24.02	23.35	22.63
<b>2 Pivots</b>					
NCFI	71.03	<b>42.79</b>	<b>13.34</b>	<b>(16.27)</b>	<b>(45.52)</b>
Std Dev	24.11	22.84	21.43	20.94	19.53

\*Bold values indicate the maximum NCFI for each rangeland damage assumption.

As the extent of the fire damage and the number of years with no federal grazing increase, the benefit of having two 120-acre pivots with alfalfa increases (Table 2). For half of the scenarios, average annual NCFI is greater for the two-pivot option than the one pivot option.

For example, a five-year close out due to a 75 percent fire damage has a -\$13,210 NCFI with one pivot and a \$23,290 NCFI with two pivots.

## **Summary**

Rangeland fires in the West are a significant problem for the economic viability of ranches due to the slow recovery of grasses and browse and the extensive nature of fires that burn thousands of acres. The land managers of USFS and USBLM restrict grazing on federal lands until the range has recovered from fire damage. Ranchers who depend on federal land grazing for part or all of their pasture are limited in their management options when fires prevent their use of federal land. Reducing the herd is often the least preferred option, which leaves buying, raising alfalfa hay, or retiring as their remaining options.

The purpose of this study was to analyze the economic consequences of buying or raising alfalfa hay on a representative ranch in Northeast Nevada if the ranch was faced with one to five years of no grazing on federal rangeland. An economic model of a representative ranch with 650 mother cows in Elko County, Nevada was used to analyze alternative scenarios for buying vs. raising alfalfa hay assuming four different fire damage scenarios and five different number of years without federal grazing.

The results showed that the ranch should invest in one 120-acre pivot of alfalfa as insurance against normal AUM risk and meadow hay yield risk. Doing so would increase average annual NCFI from \$67,450 to \$99,330 (Table 1) and reduce the relative risk on NCFI by 50 percent.

In the event of a range fire that affects 25 or 50 percent of the federal AUMs, the ranch would see a much higher average NCFI if it had one pivot of alfalfa rather than buying alfalfa hay; regardless of the number of years without federal grazing. However, as the extent of the fire damage increases to 75 or 100 percent the ranch would need two 120-acre pivots of alfalfa in an effort to maintain NCFI if the number of years of no federal land grazing exceeds one year.

The results of the analysis indicate that if ranchers in Elko County, Nevada have adequate ground water they should invest in one 120-acre pivot to raise alfalfa hay. The investment would increase NCFI over buying alfalfa hay even when there is no loss in federal AUMs due to range fire. If there is a range fire which damages up to 50 percent of the federal AUMs that delay grazing for 1, 2, or 3 years the ranch is better off financially with one pivot rather than two. But if a range fire damages more than 50 percent of the federal rangeland and the delay in grazing is longer than one year the ranch should invest in a second 120-acre pivot of alfalfa. From a risk management angle the results suggest buying one pivot for alfalfa immediately and buying a second pivot if fire prevents grazing more than 50 percent of the federal land for more than one year. If grazing is delayed more than three years, negative average NCFI will likely occur even with 240 acres of alfalfa so herd reductions must be considered.

Other factors that must be considered if the re-entry period exceeds three years are: ground water availability for multiple alfalfa pivots, impacts of increased herd pressure on feeding areas and private rangeland, and labor availability for raising, harvesting and feeding the increased hay production for 240 acres of alfalfa. These areas are open for future research for range management in regions affected by wild fires.

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