



## **Ranch economic aspects of Lesser Prairie Chicken habitat conservation efforts in central USA rangelands**

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### **Abstract**

The lesser prairie chicken has been listed as a threatened and endangered species by the U.S. Fish and Wildlife Service in distinct population segments. Approximately 95% of the species' habitat is in private land ownership. Conservation efforts focus on these lands, with funding potentially supplied through the Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP). Under EQIP, practice payments are made to landowners to implement planned conservation practices. This project estimates the economic impact of implementing lesser prairie chicken conservation practices on small and large representative ranches in 4 Major Land Resource Areas (MLRA).

Economic models were developed in the General Algebraic Modelling System (GAMS) as recursive linear programs and run for 20 years. Random precipitation patterns and cattle price sets were used. Baseline models were first developed to balance forage with the average herd size. Models evaluated practices on all or half the rangeland area, with the ranch paying 100, 25, or 0% of the conservation cost and then compared to baseline models. The baseline models were based on a small and a large representative ranch for each MLRA with no conservation practices or payments. Results show that restoring lesser prairie chicken habitat on private rangeland may or may not be profitable, depending on ranch size, area treated, forage response, cattle prices, and how much of the conservation practice cost is paid by the rancher.

For all analysis scenarios and cattle prices, small and large ranches have higher household income (HI) when they pay 0% of the cost, regardless of treatment area. Small and large ranches show a decrease in HI when the ranch pays 25% of the conservation cost. These results may not be applicable to every ranch, so an individual ranch analysis should be conducted before participation in LPC conservation. Ranchers should also determine if profit, household income, or some combination is most important. The basic framework used in this study can guide individual ranch analysis.

### **Introduction**

The US Fish and Wildlife Service has listed two Distinct Population Segments (DPS) of Lesser Prairie Chickens (LPC) under the Endangered Species Act. The Northern DPS is identified as threatened status and the Southern DPS is designated for endangered status. Elmore et al. (n.d.) noted that the current threats

to the LPC include, but are not limited to, tree invasion and planting, long-term fire suppression, and improper cattle grazing management. Cattle grazing can reduce the height and density of grasses and allow for shrubs to become too dense (Van Pelt et al. 2013).

Approximately 95% of the land area of the species is in private land ownership. Conservation is thus focused on these lands with funding potentially supplied through Natural Resources Conservation Service (NRCS) conservation programs, most notably through the Environmental Quality Incentives Program (EQIP). Under EQIP, practice payments are made to landowners to implement planned conservation practices. The NRCS, through the Working Lands for Wildlife program, has taken the lead in encouraging private landowners to implement LPC conservation practices since 2010 with the Lesser Prairie Chicken Initiative (NRCS 2023a). Voluntary participation in the Working Lands for Wildlife can have significant long-term benefits to the landowner through protections for incidental take under the Endangered Species Act (NRCS 2023b).

Removing trees is a primary goal to improving habitat for LPC. Using prescribed fire is often described as the most efficient method, but it is not always an acceptable practice. In cases where it is not desired, using herbicides followed by skeleton removal mechanically is the option. Alternatively, prescribed grazing can be used to create habitat heterogeneity if properly applied.

This project seeks to understand the economic impact on small and large ranches in four Major Land Resource Areas (MLRA) covering most of the LPC habitat. As shown in Figure 1, we are focused on the southern portions of MLRAs 72 and 73 in Kansas, the northern portion MLRA 77D in New Mexico, and the eastern portion of MLRA 77E in Texas.

## **Methods**

LPC conservation practices are derived from the Van Pelt et al. (2013) publication by the Western Association of Fish and Wildlife Agencies. LPC habitat occurs in the southern Great Plains, with a dry temperate climate that has a mean annual temperatures ranging from 45°F to 79°F. The annual precipitation in this area ranges from 10 to 30 inches.. Potential lesser prairie-chicken habitat was reduced by 56% from a potential of 43,258 km<sup>2</sup> to the current 18,908 km<sup>2</sup> in ~115 years (Portillo-Quintero et al. 2022). The MLRAs that were chosen correlate with the four vegetation types defined by Van Pelt et al. (2013) and each has different representative ranches and sizes and different practices that would be most likely. Ranch models were developed for each MLRA based on a small and large size. A baseline model used a representative ranch with no LPC conservation practices.

Counties in each MLRA were selected based on the algorithm used in Maczko et al. (2022). A rangeland county is defined as having more than 25% rangeland vegetation and fewer than 200 people per square mile. Only counties with more than 50% of their land area within an MLRA were included. The 2017 Census of Agriculture (NASS 2019) beef cattle and operation numbers were used to estimate a small and large size operation. Each counties numbers were weighted by the percentage of rangeland vegetation for a weighted average. Small ranches were considered to have 50-199 beef cows and large had greater than 200 beef cows.

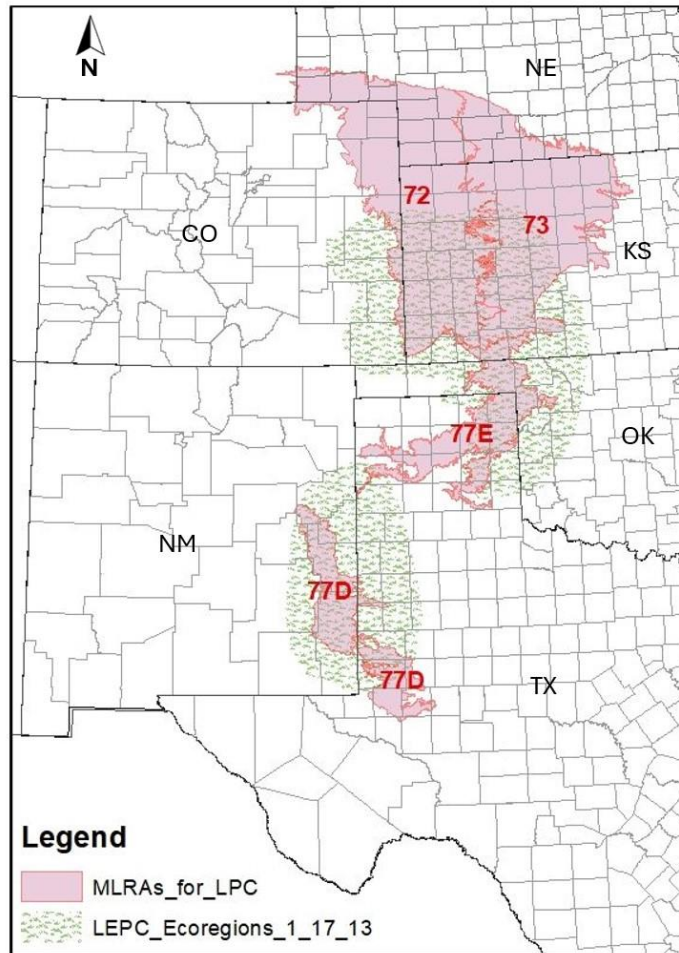


Fig 1a. Major Land Resource Areas 72, 73, 77D and 77E with Lesser Prairie Chicken habitat.

Fig 1b. Historic Lesser Prairie Chicken range (blue) and current habitat (green). Map by BirdLife International.

Ranch models for each MLRA are based on representative enterprise budgets published for each region. MLRA 72 and 73 were based on Dhuyvetter et al. (2014). MLRA 77D was based on NMSU (2019a, 2019b). MLRA 77E was based on Amosson (2017). Values were indexed to 2019 using index values from NASS following the procedure by Rimbey and Torell (2011). These enterprise budgets fed into the ranch models described below. The ranch models seek to maximize the present value of net ranch income as shown in Equation 1.

$$I = \sum_{t=1}^{20} \frac{[(L_t P_{lt} + H_t P_{ht} - [FC]_t - [AC]_t - [LC]_t - [LPC]_t)]}{(1+r)^t} \quad [1]$$

Where I = Net Ranch Income

L<sub>t</sub> = Livestock sales in year t

Plt = Price of livestock in year t

Ht = Hay sales in year t

Ph = Price of hay

FCt = Forage cost in year t

ACt = Animal cost in year t

LCt = Loan cost in year t

LPCt = Lesser prairie chicken conservation cost in year t

r = Discount rate

The model is solved subject to a variety of constraints with the most important being to balance the forage sources with the herd size in each season of the year.

$$\sum_{s=1}^n [(LC)_{s,n} (AU)_{c,s,n}] = \sum_{s=1}^n [(NR)_{st} (PPT)_{t+} (RES)_{st+} (FEED)_{st}] \quad [2]$$

Where: LCs = Livestock class numbers in each season

AUc = Animal unit equivalents for livestock class

Sn = Season

NRst = Native rangeland production in season s and year t

PPTt = Precipitation index in year t

RESst = Crop residue production in season s and year t

FEEDst = Hay fed in season s and year t

What we feel is more important to a ranch family is Net Household Income (Equation 3) which is defined as,

$$HI = L_t P_{lt} + H_t P_{ht} - [FC]_t - [AC]_t - [LC]_t - [LPC]_t + O - FAM - [FIX]_t \quad [3]$$

Where O = Off Ranch Income

FAM = Family living expenses

FIXt = Fixed costs in year t

Off ranch income is set at the level defined by ERS (2022; 2023a; 2023b) and ERS NASS (2022).

## **Results by MLRA**

### ***MLRA 72***

When all rangeland areas are treated on both large and small ranches, net ranch income (NRI) and household income (HI) only increase when NRCS pays for 100% of conservation practices regardless of cattle prices. In all other cases, the ranch would see declines. In the case of treating half the rangeland area, large ranches would see increases in NRI and HI when the ranch pays 25 or 0% of the conservation practices. Small ranches would see increases when they pay 0% of the conservation practices, except for a slight increase in HI at high prices. Brood cow numbers increase the most at low cattle prices and decline at higher prices.

### ***MLRA 73***

When all rangeland areas are treated, large ranches generally gain both NRI and HI when the ranch pays 25 or 0% of the conservation practice costs, except for NRI at low cattle prices. Small ranches generally see a decline in NRI and an increase in HI when they pay 25 or 0% of the conservation practices. When treating half of the rangeland area, large and small ranches have the same responses, but at higher amounts. Brood cow numbers increase the most at low cattle prices and decline at higher prices.

### ***MLRA 77D***

When all rangeland areas are treated, large ranches show increases in NRI and HI when the ranch pays 25 or 0% of the conservation practices. Small ranches also show an increase in NRI at high prices and HI at medium and high prices when they pay 100% of the conservation costs. Brood cow numbers increase the most at low cattle prices and decline at higher prices.

### ***MLRA 77E***

When all rangeland areas are treated, large ranches show increases in NRI and HI when the ranch pays 100, 25, or 0% of the conservation practices. Small ranches also show an increase in NRI and HI except when they pay 100% of the conservation cost at low cattle prices. When half of the rangeland area is treated, large ranches show a decrease in NRI and HI when they pay 100% of the conservation practice costs. Small ranches show an increase in NRI and HI at all levels of them paying the conservation practice costs. Brood cow numbers increase about the same number regardless of cattle prices.]

## **Discussion**

We examined the economic impacts of lesser prairie chicken habitat improvement on small and large ranches in four Major Land Resource Areas using NRCS conservation practice scenarios. All of the scenarios show that with some level of financial assistance ranchers can implement LPC conservation practices without experiencing lasting negative impacts to their ranch or personal household incomes. However, without assistance, it is unreasonable to expect ranchers to implement conservation at the personal cost it would require. Based on the scenarios of removing trees from half or all the rangelands and implementing prescribed grazing with reduced utilization, results show varying responses across ranch sizes and MLRAs.

## **Conclusions and Implications**

Consideration of the economic impacts of implementing conservation and management practices to LPC habitat on ranches in the 4 MLRAs addressed by this research shows that both removal of trees and grazing heterogeneously are key techniques to use (Van Pelt et al. 2013). Trees can be removed using herbicides followed by mechanical removal of the skeletons, chaining, or prescribed burning. In all cases, follow up treatment is necessary to remove trees missed in the initial treatment and to prevent reestablishment. Grazing at a light utilization rate can be used to create heterogeneous habitat that the LPC prefer at different life stages.

Specifically, our research focused on elucidation of economic impacts associated with implementing these practices on small and large ranches, using NRCS conservation scenarios. Modelling shows that restoring lesser prairie chicken habitat on private ranches may or may not be profitable for the rancher or the ranch household, depending on the size of the ranch, how much area needs to be treated, the forage response to removing trees, cattle prices, and how much of the conservation practices need to be paid by the rancher.

It is important to note that we considered representative ranches in each MLRA based on enterprise budgets for each state, rather than individual ranches in a given region. Because individual ranches vary greatly, results may not be directly applicable to every ranch. It is important for private lands and public lands ranchers to conduct an individual ranch analysis before participating in LPC conservation if profit or household income is important for the operator. The basic framework used in this study can guide such individual analyses.

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