Pasture Economics: Managing for pasture and animal production while mitigating risk

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Introduction

Pasture economics is a challenging measurement because of a variety of stochastic variables, such as temperature and precipitation, that play a vital role in production, as well as plant heterogeneity complicating our evaluation of growth rates. Spatially, there are also vast differences in pasture types and quality – ranging from irrigated pasture with heavy legume components to native rangelands. The economic potential of pasture comes largely from its ability to create forage for livestock – and proper management is essential to keep this forage resource viable over time without the need for costly inputs.

To understand the basics of pasture economics I will first overview the forage production functions and show how pasture regrowth contributes to economic success. The importance of stocking rates and measuring pasture yield will follow, along with a how grazing systems can help to optimize resource use. Finally, I will discuss livestock sale considerations and the various insurance products that are available to help livestock producers mitigate their risk.

Pasture Management and Livestock Economics

The growth of most living things follows a sigmoid-shaped growth curve – growth is rapid when we are young and slows substantially at some point, which we refer to as maturity (Voisin, 1959). Humans, cattle, and plants all follow the same patterns, albeit on different timelines. In economics we think “on the margin” – is next unit of output less than, equal to, or greater than the previous unit. In pastures, unless irrigated, the inputs are largely stochastic, such as temperature and precipitation. However, early in the growth cycle, there is substantially more output for each unit of input and, unlike in animal agriculture, taking advantage of the rapid growth rate is more valuable than waiting for a final mature product.

Grazing forage during the growing season gives the added benefit of regrowth. As long as enough biomass is left over to allow for adequate photosynthetic activity, a grazed plant will continue to grow given the proper inputs (water and light). This is where stocking rate becomes very important. Stocking rate is the number of animal units in a given area for a specific length of time. The rule of thumb for calculating the proper stocking rate is “take half, leave half”; the “take half” refers to the forage biomass that the livestock eat and trample/defecate on not exceeding 50% of total available forage biomass. The amount eaten versus destroyed depends on grazing efficiency, which is typically a function of time spent in a pasture or paddock.

Increasing grazing efficiency and maximizing regrowth potential will result in more pounds of livestock gain coming off a pasture. Accurately estimating the amount of forage available in the

pasture can be done in several ways; the most accurate would be the clip-and-weigh sampling method (Ogle and Brazee, 2009) however this method is time consuming and removes forage from the pasture, so the clipping information collected can be calibrated to a grazing stick (Bauman, 2021) for easier future measurements. Once proper stocking rate is calculated, grazing efficiency and maximizing regrowth potential can both be improved by subdividing a pasture with electric fencing and moving animals through sub-pastures in an organized rotation. This first increases grazing efficiency by giving the livestock less forage selection, so they have less ability to roam the pasture for their preferred plants; animals are incentivized to eat what is available to fill their rumens when they otherwise may have passed over. The shortened time component also contributes to decreases in wasted forage; it is more likely that when the animal urinates or defecates, the ground on which it lands has already been grazed, thus not wasting potential forage. Grazing efficiency is positively correlated with stocking density, or the number of animal units within an area of land at a single moment in time, therefore the smaller the pastures and quicker the rotation, the higher the efficiency, but also, the higher the infrastructure and labor input costs. Producers should determine what kind of rotation works best for their operation.

In irrigated pasture systems, rotational grazing often leads to adequate forage regrowth to allow a second grazing within each pasture. In rangeland systems it still increases the grazing efficiency, but returning to already grazed pastures is not typically advised; instead the rotation has the potential to contribute to future rangeland health and increased productivity by allowing a longer rest period. It is important to note that overgrazing leads to decreased pasture productivity for multiple years, especially in low input systems like rangelands where irrigation, seeding, and fertilization are inefficient.

There are several ways in which stocking rate can be used to calculate the value of production for a pasture. Pasture can be leased using a fixed rate per animal (Equation 1), pasture value can be calculated by weighing animals before turning them into a pasture and again when removed and the market value of that gain can be calculated as the value (Equation 2), or the value can be determined by the sale value of calves plus the avoided cost of feeding the dam hay or in a drylot setting (Equation 3) (Neibergs and Westerhold, 2024).

$$Pasture\ revenue = Stocking\ rate * pasture\ rent \frac{\$}{AUM} * \#\ of\ months \quad \text{Eq. 1}$$

$$Pasture\ revenue = Stocking\ rate * lbs\ of\ gain\ on\ pasture * Market \frac{\$}{lb} \quad \text{Eq. 2}$$

$$Pasture\ revenue = Stocking\ rate\ of\ dams * \left(calf\ weights * Market \frac{\$}{lb}\right) + avoided\ dam\ feed\ costs \quad \text{Eq. 3}$$

Pasture rental rates (in Eq. 1) can be charged a variety of ways, with price per animal unit month (AUM) or animal unit day (AUD) being the most common; other ways include price per acre or price per animal. Pasture rent also varies by land type and services offered. Irrigated pasture

where the landlord maintains fencing and water infrastructure would be leased for a premium, while native rangeland with no services offered would be priced at a basic rate (Rimbey *et al.*, 2014).

Pasture is typically thought of as a feed resource only during its active growing season, however, stockpiling forage for winter grazing reduces the amount of feed that needs to be purchased or set aside for winter months. Winter feeding of livestock is the single largest expense for livestock producers. Stockpiling lower quality feed in the pasture can reduce total feed costs while also increasing the value obtained from pasture.

When pasture value is determined by weights and market value of livestock (as in Eqs. 2 and 3) there is large variation in both intra- and inter-year values. Intra-year valuation differences result from seasonal changes in demand. Demand is typically highest in the early summer, however in much of the country feeder cattle are sold in October – after the growing season ends. At this time, due to typical supply and demand economics, the price for feeder cattle is at its seasonal lowest. There are potential benefits to selling cattle earlier than the typical October date to take advantage of higher prices, while also 'banking' the forage that would have been grazed for winter use, thus saving on winter feed costs (Baldwin *et al.*, 2022) Inter-year cattle prices fluctuate substantially, with historic price highs seen in 2014-15 and currently in 2023-24. Immediately after the 2014-15 highs, came very low prices in 2016; when pasture value is determined by the sale prices of livestock it devalues the pasture, but in terms of leases it can help mitigate some of the downside risk.

Concerns may arise about the economic losses associated with selling cattle at an earlier date due to the lower weights going to market. Though there would be some profit loss, it would be partially alleviated by the existence of the price slide. The price slide is a phenomenon where lower weight cattle sell for a slightly higher price than their heavier counterparts. This 'slide' is steeper and likely to reward sellers of lower weight cattle when corn prices are low. Similarly, the slide is less steep when corn prices are higher and the cost of putting weight on a steer in the feedlot is higher. Further analysis should be done to determine when selling early and grass banking are most economical, but low corn prices and high hay prices could both be potential indicators.

Insurance and Risk Mitigation Tools

Proper pasture management helps mitigate production risk, however there are still some risks that cannot be perfectly managed for. Drought and livestock market declines are two such risks. Luckily for producers, there are insurance programs aimed at alleviating the consequences of these problems. Two insurance programs offered by the USDA Risk Management Agency (RMA) are Pasture, Range, and Forage (PRF) and Livestock Risk Protection (LRP). PRF was introduced as a pilot program in 2007 to insure pasture or hay ground losses due to below-average precipitation. LRP was established in 2003, however recent changes to the program have increased its popularity. LRP was created to insure producers against declines in market prices. Insurance programs are designed such that producers pay a premium to receive a specified level

of coverage; if losses meet or exceed that level, the producer receives an indemnity payment to compensate for the losses. Disaster relief is not an insurance program, but it is another way producers can receive compensation for losses. One specific program for pasture is the Livestock Forage Program (LFP) which provides assistance payments in the event of severe drought or wildfire on grazing lands.

The PRF insurance program is a subsidized insurance based on a rainfall index; each rainfall index covers a 17 x 17-mile grid, which is equivalent to a 0.25-degree change in longitude and latitude. Coverage levels range in 5% increments from 70% to 90% of normal historical precipitation, measured by NOAA since 1948. 70 and 75% coverage are subsidized at 59% of the premium, 80 and 85% at 55% of the premium, and 90% at 51% of the premium. Finally, there are 11 2-month intervals, of which a producer must choose at least two non-overlapping intervals. The intervals are January-February, February-March, March-April, April-May, May-June, June-July, July-August, August-September, September-October, October-November, and November-December.

If a producer leases or owns pasture within one of the 17 x 17-mile grids, they may insure that pasture as either pasture or hay ground, not both. If they insure their acreage for two interval periods at an 85% coverage level, they would need to purchase that coverage by December 1 of the previous year, but they would not need to pay their 45% share of the subsidized premium until September 1 of the following year, after their covered period. If rainfall within either or both of the covered periods was less than 85% of the historical average, then the premium would come out of the indemnity payment paid to the producer.

The LRP insurance program is also subsidized and protects producers from declines in livestock market prices; this program is available for beef and dairy cattle and swine. Coverage can be purchased for 70 to 100% of the expected price at the end of the coverage period, based on futures market pricing. There is not upside risk to this program, if cattle sell for a higher price than a producer insures for, they only have to pay their premium. The length of coverage options ranges from 13 to 52 weeks, in 4- to 5-week gaps and there a two insured weight ranges, 100-599 lbs and 600-1,000 lbs. Coverage can be purchased for cattle ranging from unborn calves to fed cattle, and the same cattle can be covered up to three times in their lives, as long as ownership is retained. Similar to PRF, premium payments are due one month after the end of the insured period.

Finally, the LFP disaster relief program was created to compensate wildfire- or drought-related pasture losses up to 60% of the monthly feed costs incurred due to the disaster. The program is administered through local Farm Service Agency (FSA) offices and relief is tiered by drought intensity. If a county is in a D2 intensity drought for at least 8 weeks, assistance is equal to a one month of payment, a D3 intensity drought for 4 weeks equals 4 monthly payments, and a D4 intensity drought is automatically eligible for 4 monthly payments. If D4 intensity drought persists for over 4 weeks, 5 monthly payments of assistance are paid. If drought forced the sale of livestock in two years prior to the current production year, that producer may still receive

80% of eligible payments. To receive benefits from this program, enrollment within 30 days of qualifying drought conditions at a local FSA office is required.

Conclusion

Proper pasture management is the first step to improving or maintaining the economic value of pasture. Implementing a grazing rotation can yield higher forage returns or provide an alternative to purchased winter feed. Keeping the forage resource healthy over the long term can result in more consistent livestock gains and delayed response to drought conditions. If drought conditions do arise, insurance and disaster relief are options to mitigate losses, and if pasture value is tied to the sale of livestock, there are insurance options to mitigate those losses as well.

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