The Economic Importance of Maintaining Flexible Grazing Strategies for Drought Management

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ABSTRACT

A linear programming model was developed to explore profit maximizing strategies when annual forage production varies. The land resources, production practices, and observed variability in weather and forage production on the New Mexico State University Corona Ranch in central New Mexico were used to define the multi-period (40 year) model. A Monte Carlo analysis was performed using 4,000 different beef price and production scenarios where both prices and available forage varied annually. Possible adjustments to variability in prices and forage levels included leasing outside forage, reducing herd size, and maintaining a core cow herd that is set below what would be detrimental to the range during drought years. The economic analysis clearly demonstrates the importance of maintaining stocking rate flexibility by including a flexible enterprise like purchased stocker animals in addition to the traditional cow/calf enterprise. Only one-third of available forage would optimally be harvested by a cow herd maintained on the ranch across multiple years. The remaining forage would be harvested by yearlings that could be purchased or not purchased depending on forage conditions. Further, the size of the cow herd would gradually decrease over the planning horizon. Average annual net returns would increase 119% by including flexible enterprises as compared to having only a cow/calf enterprise. Forage shortfalls would be expected 21% of the time given the distribution of annual forage production on the Corona Ranch. Optimal adjustments to drought periods included leasing relatively expensive outside forage when beef prices were favorable and reducing cow numbers, especially when multiple years of drought occurred. This research supports the conclusions of the Texas Agricultural Extension Service that breeding herds should constitute no more than 50% to 70% of total grazing capacity.

Typical recommendations for managing weather and forage production variability.

Successful rangeland managers in Australia have coped with climate variability by pursuing a mix of two extreme approaches.

1.Conservative Stocking - Practice conservative stocking so destocking is rarely necessary
- Forage reserves are maintained between years
- Tradeoff – relative low economic returns during non-drought periods

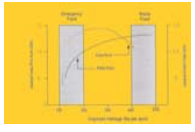
2.Flexible Stocking - Anticipate and follow fluctuating forage production levels (opportunistic or flexible stocking)

(Mark Stafford Smith 1992)

Stocking rate recommendations for shortgrass rangelands

Holechek, Pieper, and Herbel (2004) – range text book
Hart and Carpenter (2005) – Texas Agricultural Extension Service

1. Maintain herbaceous use rates < 35%
2. Set base stocking rates 10% below average
3. Breeding herds should constitute no more than 50% to 70% of total capacity
4. Leave ungrazed forage
   - Recommendation based on animal performance
   - Resilience of blue-grama grasslands
   - Proper Grazing
     - ✓ Leave 300 lb/acre (normal year)
     - ✓ Leave 200 lb/acre (dry year)
   - Bement (1969) stocking guide



Study Area

- Corona Range and Livestock Research Center in central New Mexico
  - ✓44 section (28,100 acre) NMSU research ranch
  - ✓Annual average rainfall
    - o14 inches (330 mm)
  - ✓Major forage species - Blue grama (*Bouteloua gracilis*)
  - ✓Average rangeland carrying capacity on blue grama areas
    - o 15 AUY/section (660 AUY total)

Methods and Procedures

- Long-term rainfall data (1914-2006) and data from long-term broom snakeweed study plots were used to estimate the forage production probability distribution for the Corona Ranch
- Developed a Multi-period Linear programming model to evaluate profit-maximizing grazing strategies
  - ✓Model Objective: Maximize the Net Present Value (NPV) of net returns over a 40-year planning horizon
    - oHerd structure and production rates typical New Mexico ranches
      - o Calf crop 86%
      - o Steer sale weights - 520 lb
      - o Heifer sale weights – 480 lb
    - oForage limitations and resources of the Corona Ranch
- Imposed "proper grazing" – The "Bement Stocking Guide Rule"
  - ✓Must leave 300 lb/ac (favorable year)
  - ✓Must leave 200 lb/ac (dry year)
- Adjustments allowed
  - ✓Reduce herd size
  - ✓Flexible yearling enterprise
  - ✓Lease forage to others
  - ✓Lease forage from others
    - ✓$50/AUM ($120/ton) – high cost alternative

Results

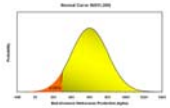
- End-of-season standing crop during the year (Y_t) was found to relate to key rainfall variables and amount of broom snakeweed by the equation:

(1) $Y_t = 129.88 + 1.75\ WINTER_t + 0.86\ Q2_t + 2.22\ Q3_t - 33.96\ LNGUSA_t$
(37.18) (0.21) (0.33) (0.17) (5.73)*

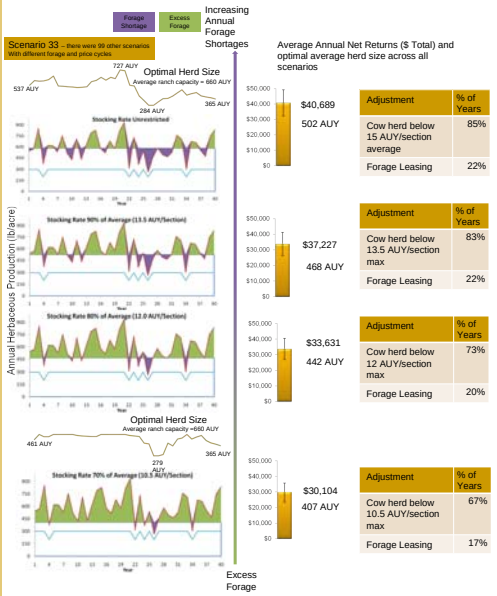
$R^2 = 0.31$, RMSE = 295.

* Standard error, all parameters were statistically significant at the 0.01 level or higher.
  - ✓WINTER = quarter 4 rainfall (mm) during the previous year plus quarter 1 rainfall of the current year,
  - ✓Q_{2t} = quarter 2 rainfall (mm),
  - ✓Q_{3t} = quarter 3 rainfall (mm),
  - ✓$LNGUSA_t$ = natural log of broom snakeweed (kg/ha) present on the area.

- Forage production on the Corona Ranch was found to be normally distributed with a mean of 651 kg/ha (581 lb/acre) and a standard deviation of 200 kg/ha (178 lb/acre).
  - To leave 336 kg/ha (300 lb/acre) as residual ungrazed forage means the Corona Ranch can expect to have no grazing capacity about 6% of the time. Annual herbaceous production would be less than 300 lb/acre with this frequency.



Economics of Conservative Stocking Strategies (Cow/calf only)



Adjustment	% of Years
Cow herd below 15 AUY/section average	85%
Forage Leasing	22%

Adjustment	% of Years
Cow herd below 13.5 AUY/section max	83%
Forage Leasing	22%

Adjustment	% of Years
Cow herd below 12 AUY/section max	73%
Forage Leasing	20%

Adjustment	% of Years
Cow herd below 10.5 AUY/section max	67%
Forage Leasing	17%

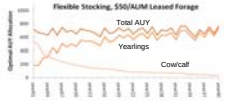
Analysis assumptions:
- Compared alternative maximum stocking rates with management as a cow/calf enterprise
- Bement Rule enforced
  - Leave 300 lb/acre (normal year)
  - Leave 200 lb/acre (dry year)
    - 11% sale weight reduction
    - 5% calf crop reduction
- Overgrazing not allowed
  - Reduce herd size or
  - Lease expensive ($50/AUM) forage
- Inter-year dependence of herd size considered

Results:
- Maintaining herd size at maximum levels was not profit maximizing (optimal herd size was reduced during dry years)
  - As others have also shown (Riechers, Conner, and Heitschmidt, 1989; Campbell et al. 2000), average net annual returns increase at least up to the average carrying capacity for the area, but with more income variability
- Feed thru short droughts and reduce herd size with multi-year droughts

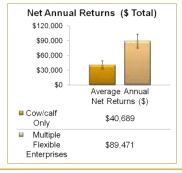
Texas Agricultural Extension Service
Hart and Carpenter (2005)
"..breeding herds should constitute no more than 50% to 70% of total capacity".

Economics of Flexible Grazing Strategies (Cow/calf and yearlings)

Adjust stocking rates every year to match forage conditions. When conditions are favorable lease forage to others or buy yearlings in addition to the base cow herd.



Averaged over all price scenarios, the Corona Ranch would gradually move to a yearling operation
- Stock at 15.7 AUY/section (688 AUY) on average
- Switch to a yearling ranch as forage shortfalls force cow herd reductions
  - ✓ Purchase variable numbers of yearlings
- Across all years, 64% of grazing capacity would be allocated to yearlings, but yearling numbers increase over time
- Within 10 years the average size of the cow herd would be reduced to < 200 AUY.
- Once cows are sold they are not repurchased except in the early years
- **Multiple enterprises can more than double average net annual returns relative to cow/calf only**
  - ✓ **If one could just anticipate the weather!**



Can Flexible grazing be implemented? (The dilemma)

- Yearlings need to be purchased in April-May
- Warm season grasses don't grow much until June-July

The Economic Value of an Accurate Weather (Forage) Forecast

- Flexible grazing has the potential to more than double annual net returns if one could anticipate forage conditions
  - Maintain just the cow herd during average or below average years
  - Buy yearlings or lease forage during favorable years

Corona Ranch average net returns from livestock

Cow/Calf Only $40,000/year → Cow/calf Purchased yearlings Leased forage $90,000/year

Perfect forage forecast

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