# Economic Analysis of High Fertilizer Input, Over-seeded Clover and Native Pasture Production Systems in the Texas Coastal Bend

**Authors**
**Dr. Lawrence L. Falconer**
**Professor and Extension Economist-Management**
**Texas AgriLife Extension Service**
**10345 State Hwy 44**
**Corpus Christi, TX 78406**

**Dr. Gerald W. Evers**
**Regents Fellow and Professor - Pasture Management**
**Texas AgriLife Research**
**P. O. Box 200**
**Overton, Texas 75684**
**Phone 903-834-6191**
**Fax 903-834-7140**
**g-evers@tamu.edu**

**Dr. Luis A. Ribera**
**Assistant Professor and Extension Economist**
**Texas AgriLife Extension Service**
**2401 East Highway 83, Weslaco, TX 78596**
**Phone: (956) 968-5581**
**Fax: (956) 969-5639**

# Economic Analysis of High Fertilizer Input, Over-seeded Clover and Native Pasture Production Systems in the Texas Coastal Bend

## Lawrence L. Falconer, Gerald W. Evers and Luis A. Ribera

## Introduction

The objective of this paper is to examine the relative cost and production efficiency of a system based on high fertilizer inputs, a system that utilizes overseeded-clover that provides fixed nitrogen and a minimal-input native grazing system to provide information on what might be the most economically sustainable system for cattle producers in the Texas Coastal Bend.

## Background

Introduced warm-season perennial grasses form the basis of pasture systems in the southeastern US because they are well adapted to the high temperatures, have good drought tolerance, and tolerate close continuous grazing. However they require N fertilizer and have lower nutritive value than cool-season grasses and legumes (Ellis and Lippke, 1972). The sharp increase in fertilizer prices over the past five years has put pressure on grazing systems based on high fertilizer inputs to remain economically sustainable.

## Data and Methods

The grazing study was conducted in southeast Texas on Lake Charles clay. Grazing treatments were a high input 6 acre pasture, a medium input 6 acre pasture, and a no input 8.7 acre pasture. The high input pasture system was planted to common dallisgrass at 6 lb pure live seed/acre on a prepared seedbed. Annual management practices were 50 lb N and 60 lb P/acre in April with an additional 50 lb N/acre about June 1 and August 1. Grazon P+D and 0.5 lb a.i./acre 2,4-D was applied in April for broadleaf weed control. Stocking rate was 1 cow-calf pair/acre.

The medium input pasture system was planted to common dallisgrass in the same manner and time as the high input pasture. 'Louisiana S-1' white clover was broadcast at 4 lb/acre on the undisturbed dallisgrass sod in October. Annual management practices were 60 lb P/acre in the autumn and mowing one time in summer for weed control. Stocking rate was 1 cow-calf pair/1.5 acres. Poloxalene-molasses blocks were available to the cattle to prevent bloat for 6 weeks in spring when white clover represented more than 75% of the available forage.

The no input pasture system was undisturbed grassland typical of the Gulf Coast Prairie consisting of native and naturalized species. Dominant grasses were common dallisgrass, common bermudagrass, and smutgrass. No fertilizer or weed control practices were used on the no-input pasture system. Stocking rate was 1 cow-calf pair/2.9 acres.

Hereford-Brahman crossbred cows with Santa Gertrudis sired calves were used to evaluate the three pasture systems. Cows and calves were fasted overnight (no water or feed) and weighed in the morning when placed on, or removed from, the pastures to determine animal weight gain. A 12% calcium-12% phosphorus mineral and salt were available during the grazing season and winter feedingperiod on all pastures.

The length of the winter feeding period was calculated by subtracting the 4-year grazing season average from 365 days. Winter feed cost was based on 30 lb of hay per head per day and 2 pounds of 20% protein supplement per head per day.

A stochastic simulation of each system was used to empirically estimate the unit cost of production distributions for the alternative grazing systems to test for economic sustainability of the alternative grazing systems. Multivariate empirical (MVE) distributions of input prices, gazing days and gains estimated are used in the simulation. A MVE distribution has been shown

to appropriately correlate random variables based on their historical correlation (Richardson et al., 2000). Additionally, the MVE distribution is a closed form distribution, which eliminates the possibility of values exceeding reasonable values observed in history (i.e. negative prices).

The stochastic simulation model that was used to empirically estimate the unit cost of production distributions for the alternative grazing systems is represented by:

$$CG_i = (PE_i + WF_i)/G_i$$

where

$CG_i$ is the stochastic cost per pound of calf gain for pasture system i

$PE_i$ is the stochastic pasture expense for pasture system i

$WF_i$ is the stochastic winter feeding cost for pasture system i

$G_i$ is the stochastic calf gain for pasture system i.

and

$$PE_i = QN_i * PN_i + QP_i * PP_i + HMRC_i$$

where

$QN_i$ is the pounds of nitrogen applied annually for pasture system i

$PN_i$ is the stochastic price of nitrogen

$QP_i$ is the pounds of phosphorus applied annually for pasture system i

$PP_i$ is the stochastic price of phosphorus

$HMRC_i$ is the annual cost of herbicide, mowing and rent for pasture system i

and

$$WF_i = FP_i * (CSM_i + PHAY_i) + S + M + V$$

Where

$FP_i$ is the stochastic winter feeding period in days for pasture system i

$CSM_i$ is the stochastic cost of cotton seed meal fed for pasture system i

$PHAY_i$ is the stochastic cost of hay fed for pasture system i

S is the annual cost of salt fed

M is the annual cost of mineral fed

V is the annual cost of vaccines

Prices for fertilizer and feed items, length of feeding period and gains are the stochastic variables in the model. A multivariate empirical (MVE) distribution of prices, feeding period and gains was estimated and used to simulate these variables. The historical price series were tested using linear regression to account for the effects of trend. Residuals from trend were used to estimate the parameters of the MVE price distributions (Ribera, et al). The mean values over the three-year experiment were used as the average feeding period and gains for the MVE distributions.

### Results and Discussion

Historical price data was gathered on PN, PP, CSM and PHAY prices for the ten-year period 2000-2009. The price series for fertilizer inputs were found to contain trends, for nitrogen ($P>0.001$) and phosphate ($P>0.03$). The nitrogen and phosphate prices were also found to be significantly correlated, with a calculated t-value of 4.58 compared to a critical value of 2.31. Based on these results, the prices were de-trended using linear regression, and deviations from trend and correlation between the prices for nitrogen and phosphate were used to simulate the risk about the projected mean for those input prices.

The price series for feed inputs were also found to contain trends, for cotton seed meal ($P>0.0001$) and hay ($P>0.007$). The cotton seed meal and hay prices series were also found to be

significantly correlated with each other, with a calculated t-value of 2.50 compared to a critical

value of 2.31. Based on these results, the prices were de-trended using linear regression, and

deviations from trend and correlation between the prices for cotton seed meal and hay were used

to simulate the risk about the projected mean for those input prices.

Grazing performance results indicated that the medium input or overseeded clover grazing

system reduced the average annual feeding period by 35 days compared to both the high input

and no input grazing systems (Table 1).

Table 1.  Length of grazing season of three pasture systems over four years

| Year | High input N + grass | Medium input clover + grass | No input |
|---|---|---|---|
| | Grazing season (days) | | |
| 1986 | 210 | 244 | 210 |
| 1987 | 227 | 268 | 227 |
| 1988 | 234 | 266 | 234 |
| 1989 | 226 | 258 | 226 |
| Average | 224 b† | 259 a | 224 b |

†Values in a row followed by the same letter are significantly different at the 0.05 level, Fisher's
Protected LSD.

Animal performance for both cows and calves on a per head basis was greatly enhanced by the

use of the medium input grazing system. As shown below in Table 2, all the performance

measures for the cows were significantly different for the medium input system relative to the

two alternative grazing systems. The calf gain per head was significantly greater for the medium

input system, with an expected improvement of 130 pounds per head over the high input system

and 101 pounds per head over the no input system. However, the calf gain per acre was not

significantly different from the high input system.

Table 2.  Animal performance on three pasture systems average over four years.

| | High input<br>N + grass | Medium input<br>clover + grass | No input |
|---|---|---|---|
| | ------------------------------------lbs-------------------------------------- | | |
| Cow | | | |
| Gain/cow | 100 b† | 255 a | 117 b |
| Gain/acre | 100 b | 168 a | 48 c |
| Avg. daily gain | 0.45 b | 0.98 a | 0.52 b |
| Calf | | | |
| Gain/calf | 340 b | 470 a | 369 b |
| Gain/acre | 340 a | 307 a | 143 b |
| Avg. daily gain | 1.57 b | 1.82 a | 1.66 ab |

†Values in a row followed by the same letter are significantly different at the 0.05 level, Fisher's
Protected LSD.

Table 3.  Simulation results for cost of pound of calf gain by grazing system.

| | High input<br><br>N + grass | Medium input<br><br>clover + grass | No input |
|---|---|---|---|
| Mean | $1.48 | $0.85 | $1.14 |
| StDev | 0.231941 | 0.101975 | 0.181205 |
| CV | 15.68714 | 11.9957 | 15.89046 |
| Min | $1.01 | $0.64 | $0.88 |
| Max | $2.15 | $1.15 | $1.64 |

As shown in Table 3, the expected value for the calf cost of gain of the medium input system is substantially lower than the competing systems, primarily due to the longer grazing season associated with that system. The simulation results also indicate that the range of results associated with medium input pasture is significantly lower ($.51) compared to ($.76) for the no input system and ($1.14) for the high input grazing system. These results indicate that the medium input grazing system is also less risky than the two competing systems. This result along with the higher expected value would lead to the conclusion that the medium input system would stochastically dominate the competing systems, as illustrated below in Figure 1.  In addition, since the cumulative distribution functions shown in Figure 1. do not cross, the medium input system has first degree stochastic dominance meaning that all decision makers would prefer the medium input system over the other two systems.
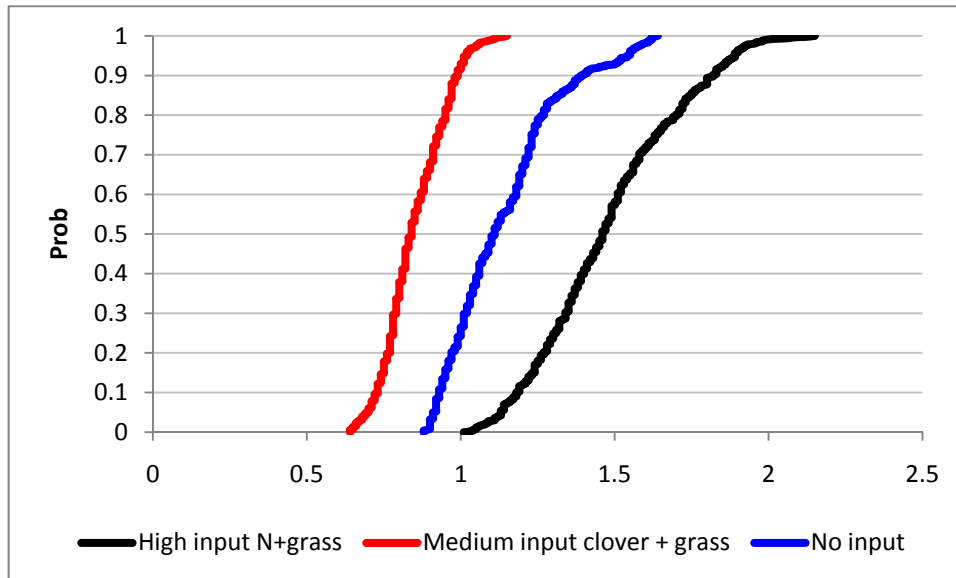
Figure 1. Cumulative distribution functions for calf cost of gain by system.

**Conclusions and Need for Further Research**

This study indicates that medium input (overseeded clover) grazing system will dominate both the high input and no input grazing systems with respect to unit cost of production of calves. This study also indicates that the medium input grazing system has less cost of production risk than the high input and no input grazing systems. The level of dominance is important due to the fact that some establishment cost will be required to convert to the overseeded clover grazing systems, which is crucial information for producers to have when making that decision. This study estimates that based on average calf gain per acre, the annual advantage to the medium input grazing system relative to the high input system would be $243 and $97 relative to the no input system, which would easily cover establishment cost of the overseeded clover. Future research is planned to develop stochastic production elasticity estimates for cost of gain and fertilizer and feed inputs.

# References

Ellis, W. C., and H. Lippke. 1972. Nutritive value of forages. Pp. 26-66. In Grasses and legumes in Texas – Development, production, and utilization. Research monograph 6C, Texas Agric. Exp. Sta., College Station, Texas.

Ribera, L.A., F.M. Hons and J.W. Richardson. An Economic Comparison between Conventional and No Tillage Farming Systems and Burleson County, Texas. Agronomy Journal. 96:415-424.

Richardson, J.W., S.L. Klose, and A.W. Gray. 2000. An Applied Procedure for Estimating and Simulating Multivariate Empirical (MVE) Probability Distributions in Farm Level Risk Assessment and Policy Analysis. J. Agric. Applied Econ. 32(2): 299-315.