

Climate-Based Management Options for North Central Florida Beef Cattle Producers¹

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1.0 Introduction

Agriculture has been characterized as the most weather-dependent of all human activities (Oram 1989). Logically then, if climate were known ahead of time, decisions could be made that would reduce the negative impacts of expected bad climate or take advantage of expected good climate conditions. Recent advances in understanding global ocean and atmospheric processes have led to new capabilities for forecasting seasonal climate several months to a year in advance (Jones et al. 2000; OBrien et al. 1999). Most of these advances rely in some way on knowledge of the surface temperatures in the tropical Pacific Ocean and the El Niño-Southern Oscillation (ENSO) phenomenon.

ENSO refers to shifts in sea surface temperature (SST) in the eastern equatorial Pacific and related shifts in barometric pressure gradients and wind patterns in the tropical Pacific (the southern oscillation). ENSO activity is labeled either "El Niño," "Neutral," or "La Niña" phases, depending on specific SST anomalies. The impact of these phenomena affects interannual variability of climate

in many regions (Kiladis and Diaz, 1989; Ropelewski and Halpert, 1986, 1996).

Florida is a major producer of feeder calves. Approximately four million acres, or 12%, of Florida's land are used as pasture and rangeland (Florida Agricultural Facts Directory, 2000.) Together with woodland (20%) and cropland (35%), cattle production is a mainstay of the Floridian economy. Cattle products account for approximately 500 million dollars in annual sales (Mislevy and Quesenberry, 1999.) Returns on investment are typically low in this industry. Although economies of scale are important for profitability, there remain a large number of small (10-99 head) operations in north central Florida. This is often due to a lifestyle choice rather than a search for profitability.

The objective of this study was first to understand how ENSO seasonal change interacts with grass production and cow-calf production in north central Florida, and second, what management decisions ranchers could make to reduce risk and vulnerability, thus taking advantage of improved forecasts. For this study, 38 ranchers and 41 extension agents were interviewed.

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A longer-term objective of this type of study is to develop user-friendly decision support systems for the agricultural production clientele. This study is also available on the Southeast Climate Consortium's decision support system Web site at <www.AgClimate.org>.

Because much of the variability in production and profits in livestock production are associated with climate, we hypothesized that ranchers could reduce their risks and increase profits by using currently available methods for forecasting climate to adjust various decisions.

1.1 Seasonal Climate Effects in Florida

In Florida, El Niño winter months tend to be cooler and have higher rainfall, while La Niña autumn to spring tend to be warmer and drier than normal, with the strongest effect in the winter. Increased autumn and winter rainfall is associated with reduced solar radiation in El Niño years. Production and economic impact of ENSO on Florida field and vegetable crops is well documented. Previous studies have demonstrated that a substantial portion of the interannual variability for yields of maize (Handler 1990) and several winter vegetables, especially tomatoes (Messina 2001), in Florida is associated with ENSO-related seasonal variability. To date, however, relatively little attention has been paid to ENSO effects on livestock production.

Specifically, there is an excess of over 30% of the normal seasonal total precipitation across much of the state during an El Niño winter. During La Niña years, the opposite effect occurs. Deficits of 10% to 30% can last from fall through winter and spring. Monthly deviation from normal due to ENSO phase conditions exceeds 30% in all of Florida's climate divisions, and 50% in the southern peninsula. Departures from normal daily maximum or minimum temperatures associated with El Niño or La Niña are significant in Florida, especially during winter months. Florida can see average temperatures 2 to 3°F below normal during El Niño years. Temperatures 2 to 4°F above normal in winter are likely in La Niña years. La Niña's effect on temperature is more pronounced in north Florida.

Martsof (2001) identified hard freezes through the last century, and found that most occurred during Neutral ENSO phases. In December to April (winter and spring months), average daily maximum temperatures are higher than normal in La Niña years, and lower than normal in El Niño years through most of the state. La Niña effects on winter temperatures generally increase toward the north within the state. In south Florida, average daily minimum temperatures in the June to August (summer) tend to be lower than normal in La Niña years. Table 1 shows typical seasonal climate variability in the southeastern U.S.A.

2.0 Methodology Used in This Study

2.1 Linear Programming Model of Livestock Ranch

A nine-season (two years plus a third summer) dynamic linear program was developed for the conditions of north central Florida cattle ranch operations. A hypothetical 400-acre cow-calf production unit was simulated. The model included calves, stockers, heifers, and cows; pasture requirements, and connections with climate conditions. Coefficients from secondary data were improved by interacting with local ranchers in February 2002.

For summer months, bahiagrass was simulated, whereas a mixture of rye and ryegrass was simulated for winter pastures. Average pasture production for each ENSO phase and season were computed and used in decision models for studying options for adjusting management conditions on each phase. Average pasture production results were converted into livestock carrying capacities for each season (summer and winter) and each ENSO phase (El Niño, Neutral, La Niña). Animal unit and animal unit equivalents (Scarnecchia 1985) were used to relate the different classes of cattle to carrying capacity. Relating the ENSO phase to stocking rate was accomplished by using crop growth curves for bahiagrass in summer and a mix of rye-ryegrass in winter.

Beef Production in North Central Florida: Livestock Production System

Cow-calf production in Florida involves keeping breeding females and raising calves born to them each year. Calves are weaned at 6-8 months and often sold to a feeding operation in western states until slaughter. Calves can also be over-wintered and sold in the spring. Although the traditional system of buying weaned calves and bringing them up to slaughter weight with feed exists in Florida, by far the most prevalent beef cattle production system is the cow-calf operation.

2.1.1 Resources Required

Typically, each cow-calf pair is allotted some two acres of grazing land (stocking rate). Land is a major constraint on production and profits because stocking rate is a principal determinant of economic outcome, and the amount of land available is limited to the property, plus whatever amount can be leased profitably in a given season.

Running fences and checking cattle are typically the only constant labor a cow-calf operation needs. Winter-feeding and health treatments are occasional labor inputs. Although quality labor is often difficult to obtain at the right time, overall availability does not usually limit the cattle production system in Florida.

Facilities include start-up infrastructure (one-time expenses), such as pastures, fencing, corral, a squeeze chute, loading ramp, feed and mineral boxes and automatic water sources. Yearly costs include: fertilizer, depreciation for machinery, land use, supplemental feeds (including protein in the form of liquids or pellets, mineral blocks, hay or silage, molasses, and manufactured feeds), veterinary attention and medicine, insurance, taxes, maintenance and repair of buildings, interest on loans, and miscellaneous supplies and repairs.

2.1.2 Activities

Pasture Establishment and Upkeep

Bahiagrass (*Paspalum notatum*) is the most widely planted grass in Florida. It is well adapted, easy to establish, relatively productive, drought tolerant, and has the advantage of being planted by seed. The model used in this study assumes pastures are already planted. Winter annual grasses include ryegrass (*Lolium multiflorum*) and the small grains wheat, rye and oats. These are planted in the fall and can provide grazing in late winter and spring. They are either planted into a prepared seedbed or bahia sod, after it stops growing in late October. Grain rye is the most resistant to dry weather, while ryegrass takes excess water best, and oats probably make the best hay. Rye and ryegrass mixtures are very often used in north central Florida for longer winter grazing and adaptation to unpredictable weather. For this reason, the rye-ryegrass mix was included in the model as an option for winter.

Winter Supplementation

Feed (all forms combined) makes up the largest cost in cattle operations and has a great impact on both reproductive performance (i.e., calf crop, and weaning weight). The winter feeding period in Florida may be as long as 120 to 140 days, and may account for more of the actual feed costs than grazing for the remainder of the year (Stanley 1995).

In winter, the ranchers objective is to minimize feed costs while providing adequate nutrition. They must also decide whether to feed their stockers through the winter or sell them at weaning. The choice of feed and feeding system depends on local conditions. In general however, options are:

- Planting cool season grazing crops (ryegrass, wheat, oats, rye)
- Maintaining cattle on bahiagrass at a lower stocking rate in winter
- Preparing or buying hay during the previous summer
- Purchasing full feed concentrate. Good quality calves usually gain around 0.82 lbs. per day on these feeds.

Marketing

Market prices are often depressed by the large number of calves sold in late summer and early fall, and some cattlemen retain ownership of their calves with the objective of improving net sales income by added calf weight and by the probability of better prices by selling at times when fewer cattle are marketed. Substantial economical calf gain is needed to make retained ownership profitable (Peña, 2000; Braswell, 1992). While feeder calves are the most important output from cow-calf operations, sales of cull cows typically represent 15-20% of total revenues to a cow-calf producer (Spreen and Simpson, 1992.) Our model sells calves before or after winter. Prices can be altered according to changing circumstances.

3.0 Results

When crop production for the grasses is translated into carrying capacity, La Niña winters are significantly lower than Neutral, and Neutral than El Niño years. Then, from the standpoint of the ranch economy, the worst-case scenario is two consecutive La Niña events, and the best-case scenario is two consecutive El Niño events (Figure 1). Differences in carrying capacity affected by climate conditions can be observed in Table 2. Variations were generated from historical temperature data. (Available at: <<http://fawn.ifas.ufl.edu>>.)

3.1 ENSO Effects on Pasture Production

Bahiagrass can carry approximately 10% more cattle in either El Niño or La Niña years than it can in Neutral years (this is why ranchers ordinarily planning for Neutral summers is the worst-case scenario). On the other hand, the rye-ryegrass mix carries about the same number of head in a neutral year as in an El Niño year. By planning ahead according to an expected La Niña winter prediction, ranchers could buy hay in the summer, which ordinarily costs about half as much as what they would pay in winter.

In our model, the decision to graze a mixture of cool season grasses is greatly influenced by the choice of the ENSO phase for the winter period. When a La Niña is chosen, the model planted nearly 75% of the 400 acres in rye-ryegrass, whereas for El Niño a little less than 30% was planted. This result has important connotations for economic outcome because it shows how more stockers can be carried over the winter with good weight gains and receive higher prices when sold in spring. The great variability in herd size is accounted for mostly in the number of calves carried through winter and heifers during the summer in the different probabilistic scenarios

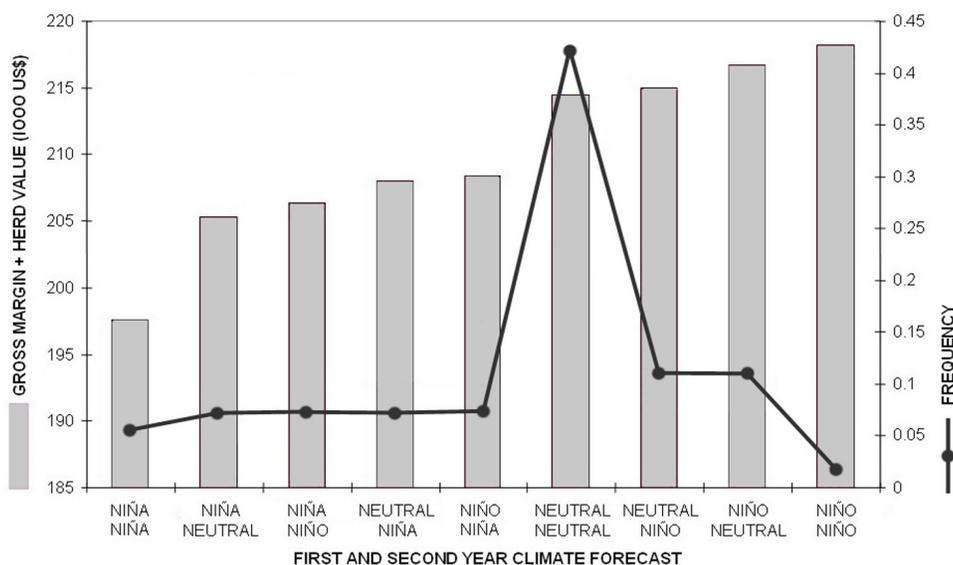


Figure 1. Two-year economic output values (Gross Margin + Herd Size) for nine scenarios tested and probability of occurrence (Frequency).

3.2 ENSO and Economic Output

We found that changes in economic output are mostly due to changes in the different categories of cattle carried over the winter in different ENSO phases. In La Niña situations, the model drastically reduces the number of calves it carries over the winter. It sells many calves before the winter at a lower price. In Neutral and El Niño years, the number of calves carried over is approximately the same; however, in El Niño years substantially more heifers are kept.

3.3 ENSO, Ryegrass Planting and Associated Probabilities

Ryegrass planting is a critical activity within the cow-calf operation because this is one of the best forage alternatives for the winter months. Therefore, ryegrass establishment and production are included in our model. For each ENSO phase, the model suggested different herd size and different area of ryegrass planted. With that initial information, the following possible situations could be tested from the point of view of profitability:

- Rancher follows recommendation
- Rancher does not follow the recommendation based on ENSO phase

If the rancher follows the recommendation and plants that amount of ryegrass, there are two possible situations:

- Ryegrass is established (correct climate prediction) or
- Ryegrass is not established (incorrect climate prediction).

When the rancher follows the recommendation and the prediction is correct, the incurred costs will be from planting on time, and there are no unexpected costs. When the rancher follows the recommendation and the ryegrass is not established because the prediction was not accurate, the rancher not only loses the money of planting the ryegrass, but also he or she needs to buy expensive hay in the winter to maintain the herd. In the case that the rancher does not follow the recommendations and does not plant any ryegrass,

meaning that he or she buys cheap hay in the summer (preparing for the winter), there are no unexpected costs.

Overall, end value is double or more when recommendations are followed and are correct versus the case where the rancher does not follow recommendations. The worst-case scenario is when the rancher follows recommendations and establishment fails due to incorrect climate predictions. These results represent a “perfect case” and do not take into account probabilities of occurrence or relative strength of a particular El Niño or La Niña event.

3.4 Tailoring Management to Climate Forecasts

Our results showed that several standard practices could be adjusted on beef cattle ranches in north central Florida in response to seasonal climate variability forecasts.

Among the simplest adaptations is carrying more cattle in El Niño years and fewer in La Niña years.

Another important decision that can be aided by knowing the upcoming climate for winter and spring is whether to plant winter annuals or not. Typically, El Niño years would be best for planting rye and ryegrass, whereas La Niña years would be more risky. Furthermore, in El Niño years, good response to fertilizer is expected from grass, unlike La Niña years in which fertilizer may be wasted. A downside to fertilizer application in El Niño years is that greater nitrogen leaching may occur.

Finally, in El Niño years, there would be little advantage in purchasing feed ahead of time, whereas in La Niña years, better economic output is obtained by buying feed well ahead of the winter/spring. These results are summarized in Table 3.

4. Conclusions and Recommendations

Our findings suggest that ENSO-based climate forecasts could improve beef cattle ranch decisions in north central Florida. Some practical options for tailoring management altering area of rye-ryegrass

planted, changing date of hay purchase and adjusting size of to be carried over the winter. Climate forecasts could also aid producers by allowing more stocking during good rainfall winters, accrued savings from buying hay in advance of a dry winter, and planting rye-ryegrass mixtures only in years when good production, and thus stocking possibilities, exist.

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Table 1. Typical seasonal climate variability in the southeastern U.S.

Phase	Region	Seasons			
		Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sep
El Niño	Peninsular Florida	Wet & cool	Very wet & cool	Slightly dry	Slightly dry to no impact
	Tri-State Region	Wet	Wet	Slightly wet	No impact
	Western Panhandle	No impact	Wet	Slightly dry	No impact
	Central and North Ala. & Ga.	No impact	No impact	No impact	Slightly dry
La Niña	Peninsular Florida	Dry & slightly warm	Very dry & warm	Slightly wet	Slightly cool
	Tri-State Region	Slightly dry	Dry	Dry	No impact
	Western Panhandle	Slightly dry	Dry	Dry	No impact
	Central and North Ala. & Ga.	Dry	Dry in the south, wet in NW Ala.	No impact	Wet in NW Ala.

Table 2. Bahiagrass and ryegrass responses to different ENSO phases.

Indexes	Bahiagrass (summer)	Rye (winter)
El Niño	1.050981	1.091682
Neutral	1	1
La Niña	1.042820	0.859967

Table 3. Management adjustment options based on seasonal climate variability.

Management	Adaptation to Seasonal Climate Variability	
	El Niño (cooler-wet fall/winter)	La Niña (hot-dry winter/spring)
Stocking Rate	Stock 7-10% more cattle	Stock 12-15% less cattle
Plant Winter Forage	Planting likely to succeed and produce forage	Less chance of establishment
Fertilizer Winter Forage	Good response likely from grass	Losses may be compounded
Buy Winter Feed	Little advantage to purchasing ahead of winter	Purchasing ahead of time is good strategy