Managing Cow-Calf Operations in Subtropics: Implication to Nitrogen and Phosphorus Levels in Surface and Ground Water

Gilbert C. Sigua*, Chad C. Chase, and Kirstin D. Foulks

USDA-ARS, Subtropical Agricultural Research Station, Brooksville, FL USA 34601

*Gilbert Sigua Current Address: Coastal Plains Soil, Water, and Plant Research Center, USDA-ARS, Florence, SC 29501 *(gilbert.sigua@ars.usda.gov)*

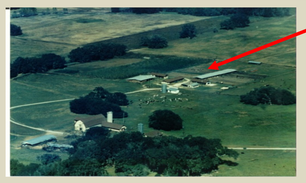
What Is This Research Project?

The long-term research goal of the Subtropical Agricultural Research Station located in Brooksville, FL, was to integrate the environment, plant, and animal genetic resources into a sustainable beef cattle agro-ecosystem for the subtropical United States. For the last eight years, this research project was focused on developing and evaluating environmentally sustainable forage and nutrient management systems that protect and enhance water and soil resources in forage-based beef cattle agro-ecosystems of the subtropics.

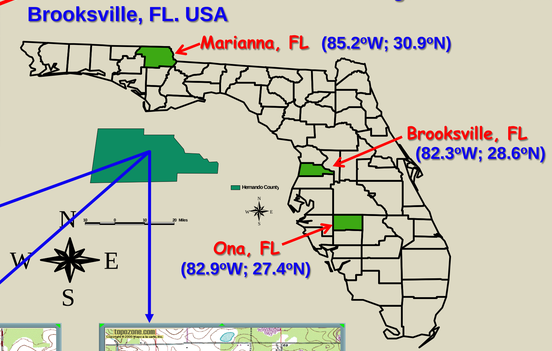
What Problem Does It Address?

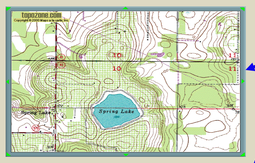
(1) Forage-based cow-calf operations have been suggested as one of the major non-point pollution sources, especially P contributing to the degradation of water quality in lakes, reservoirs, rivers, and groundwater aquifers in south Florida. Consequently, the interaction of pasture management and hydrology that may affect nutrient dynamics and water quality is an important issue to environmentalists, ranchers, and public officials. (2) Forage-beef cattle research programs must adopt an integrated approach that will lead to the development of appropriate sustainable pasture technologies that optimize beef cattle ranching profitability. (3) Another equally important issue concerns the balance of fertility management for forage-livestock agro-ecosystem that may result in increased nutrient use efficiency and, therefore, less likelihood of nutrient loss to the environment due to leaching and/or runoff.

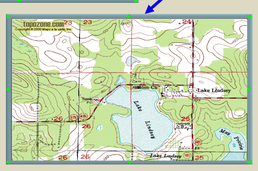
Research Location and Methodologies



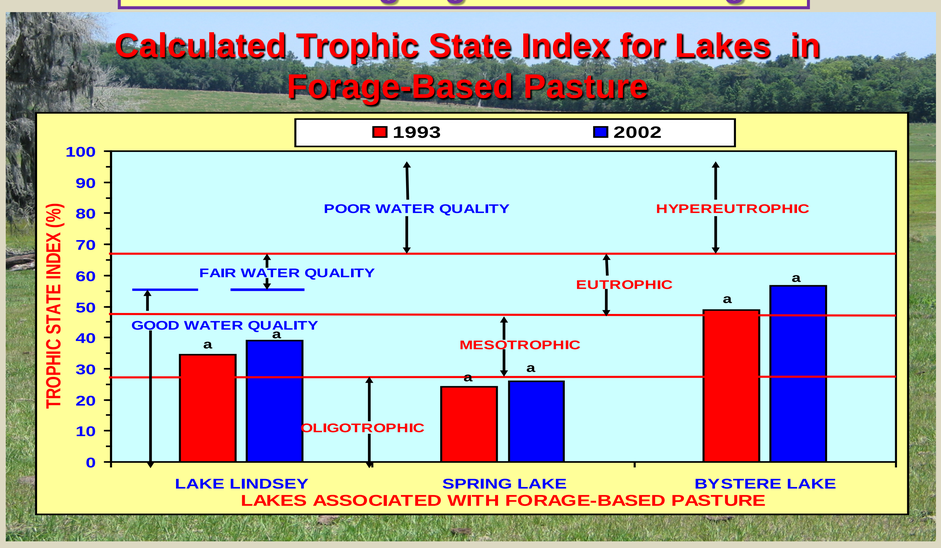
USDA-ARS STARS Main Station: Forage-Based Pasture, Brooksville, FL. USA







Research Highlights and Findings



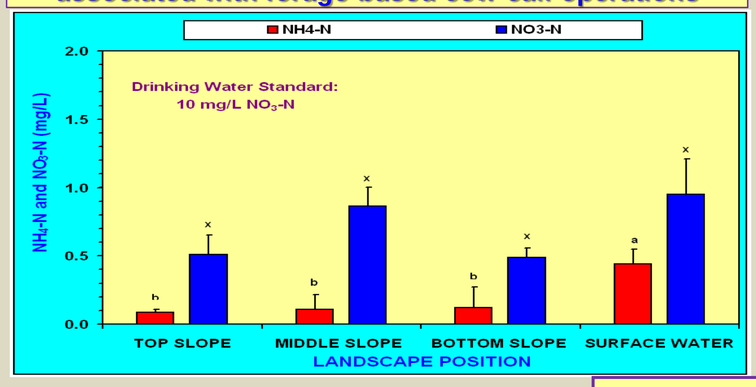
Surface Water Quality Assessment

The lakes that we studied were adjacent to or within about a 14-km radius from the USDA-ARS, Subtropical Agricultural Research Station (STARS), Brooksville, FL. These lakes were associated with forage-based beef cattle operations. The lakes were (1) Lake Lindsey; (2) Spring Lake; and (3) Bystre Lake.

TN and TP levels in lakes associated with forage-based cow-calf operations

	1993	2006
1. Bystere Lake		
TN	1.12	0.76
TP	0.08	0.34
2. Lake Lindsey		
TN	0.82	0.80
TP	0.02	0.02
3. Spring Lake		
TN	0.65	0.78
TP	0.19	0.01

Levels of Inorganic N in shallow groundwater (SGW) associated with forage-based cow-calf operations



Trophic State Index (TSI) Development

The Florida TSI was devised to integrate different but related measures of lake productivity or potential productivity into a single number that ranges from 0 to 100. The measures included in the calculation of TSI were water transparency (Secchi depth), chlorophyll *a* (measurement of algae content), TN, and TP. The Florida TSI for Lake Lindsey, Spring Lake, and Bystre Lake were 35, 30, and 46, respectively. Based on this, the TSI of these lakes can be classified as "good" according to Florida Water Quality Standard (TSI of 0-59 = "good"; TSI of 60 to 69 = "fair"; and TSI of 70 to 100 = "poor").

Maximum and minimum levels of inorganic nitrogen of shallow groundwater (2004-2006).

Parameters	NO_3-N	NH_4-N	TIN
(mg L^{-1})		2004	
Maximum	4.66	1.30	5.96
Minimum	0.18	0.03	0.21
		2005	
Maximum	4.13	2.79	6.92
Minimum	0.05	0.11	0.16
		2006	
Maximum	2.68	0.41	3.09
Minimum	0.08	0.12	0.20

Average concentrations of NO_3-N (0.4 to 0.9 mg L^{-1}) among the different sites were well below the maximum of 10 mg L^{-1}, set for drinking water. On the average, the concentrations of NO_3-N did not vary significantly due to landscape position (LP), and as with TIN, the levels were significantly lower than surface water from seepage area. The maximum NO_3-N concentrations in SGW were also below the drinking water standards for NO_3-N. Similar trends in LP were found for average concentrations of NH_4-N.Again, the concentrations of NH_4-N in SGW did not vary significantly among TS, MS, and BS wells. These levels of NH_4-N were significantly lower than that of the surface water.

Ground Water Quality Assessment

Two adjacent 8-ha pasture fields with cow-calf operation were instrumented with a pair of shallow wells placed at different landscape positions. The different landscape positions were top slope (TS; 10-20% slope, 2 ha; middle slope MS; 5-10% slope, 2 ha and bottom slope; BS; 0-5% slope,2 ha). The wells were constructed of 5-cm schedule 40 PVC pipe and had 15 cm of slotted well screening at the bottom. A centralized battery-operated peristaltic pump was used to collect water samples. Wells were completely evacuated during the sampling process to ensure that water for the next sampling would be fresh groundwater. Water samples were collected from the groundwater wells every two weeks.

Summary and Conclusion

Current pasture management including cattle rotation in terms of grazing days and current fertilizer (inorganic + manures + urine) application rates for bahiagrass pastures in subtropical regions of USA offer little potential for negatively impacting the environment. Properly managed livestock operations contribute negligible loads of total P and N to shallow groundwater and surface water. Overall, there was no buildup of soil total P and N in bahiagrass-based pastures. Contrary to early perception, forage-based animal production systems with grazing are not likely one of the major non-point P pollution sources contributing to the degradation of water.