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AE501

Cattle Fencing BMP Can Reduce Phosphorus Loads from Florida Ranches[1]

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Introduction

During the past several decades, the water quality of Lake Okeechobee (LO) and downstream water bodies have degraded because of high phosphorus (P) inputs. The excess P that has reached LO has likely been the result of hydrologic changes and shifts in land-use that have occurred in the drainage area of the lake. In an effort to protect the lake and to ensure it provides potable water, irrigation water, flood control, fishing, boating, wildlife habitat, etc., the Florida Department of Environmental Protection (FDEP) developed a Total Maximum Daily Load (TMDL) to comply with the Clean Water Act (CWA). TMDL is the maximum amount of a pollutant that a water body can receive, while still meeting water quality standards. It is a numeric nutrient limit set to restore the water quality to its designated water use. (For more information, visit http://edis.ifas.ufl.edu/ss528.)

Even before the TMDL was established, the LO region stakeholders began efforts to reduce the amount of P reaching the lake. A common approach to address agricultural nutrient runoff is through the development of Best Management Practices (BMPs). The Florida Watershed Restoration Act (FWRA), which passed in 1999, formally established using BMPs to help meet the TMDLs established by the state. Before passage of the FWRA, the Florida Cattleman's Association had already initiated the process to develop BMPs for cow/calf operations in the state of Florida in 1997.

Pasture and rangeland occupy more than 11 million acres throughout the state, including approximately 5 million acres that can be considered improved pasture. An improved pasture is a pasture that is sown with a mixture of introduced grasses (e.g., Bahiagrass) and/or legumes and is fertilized on a regular basis (Blount, 2013; Department of the Environment and Heritage, 2001). In the Lake Okeechobee basin, cow/calf operations are the single largest land-use. Taking this into account, it is clear that reducing pollutant loadings from pasture lands is necessary to assist in meeting statewide load reductions.

BMPs are an important part of reducing non-point source pollution in agricultural settings. They are developed and implemented with the goal of enhancing and protecting the state's water resources without impacting the economic viability of agricultural operations. BMPs should be both science-based and implementable by the land owner or manager. Since they should be based on science, it is often necessary to verify their effectiveness. In fact, the FWRA requires that the FDEP verify that BMPs do actually reduce nutrient loadings to the state's waters.

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First published in 1999, the Water Quality Best Management Practices for Cow/Calf Operations in Florida (now titled Water Quality Best Management Practices for Florida Cow/Calf Operations; available at http://freshfromflorida.s3.amazonaws.com/Bmp_FloridaCowCalf2008.pdf) outlines the different BMPs that ranchers can use to help reduce pollutant loadings to downstream water bodies. It also outlines the requirements and procedures that ranchers must follow in order to be in compliance with the BMP program.

Fencing BMP

In 2004, a project was initiated to verify the effectiveness of the stream fencing BMP. According to the 2008 edition of the cow/calf BMP manual, the benefits of stream crossing fencing include (1) reduced occurrence of animals standing in water; (2) reduced stream bank erosion; and (3) reduced water quality degradation. The project focused on the last benefit—how does the BMP affect the water quality of discharge leaving the ranch?

The project consisted of pre- and post-BMP periods. The pre-BMP period (June 2005–October 2005) was before the BMP was implemented (i.e., before the stream fencing was installed). The cattle were allowed to freely enter and leave the stream. In June 2006, the BMP was implemented. The study considered data from three post-BMP wet seasons (June–October) from 2006–2008. The BMP consisted of fencing surrounding the stream and the installation of a crossover culvert and associated fencing that required the cattle to cross the stream without entering it. Additional water sources were also installed as part of the BMP to provide access to drinking water since access to the stream was no longer available. (For further details, see Shukla, et al., 2011.)

Water quantity and quality were monitored at three locations—two were upstream of the cattle exclusion area and one was downstream (Figure 1). Concentration data was collected using automated water samplers on a flow-weighted basis. Flow data was collected using trapezoidal flumes with stage measurement devices.

Nutrient loadings were calculated at the three measurement points by multiplying the nutrient concentration with the flow. To evaluate the BMP, the difference between outflow loadings (at Flume Site 3 in Figure 1) and inflow loadings (Flume Site 1 + Flume Site 2 in Figure 1) was calculated. While a positive value would indicate a net addition of nutrients from cattle activity, a negative or negligible value would indicate no addition due to the cattle.

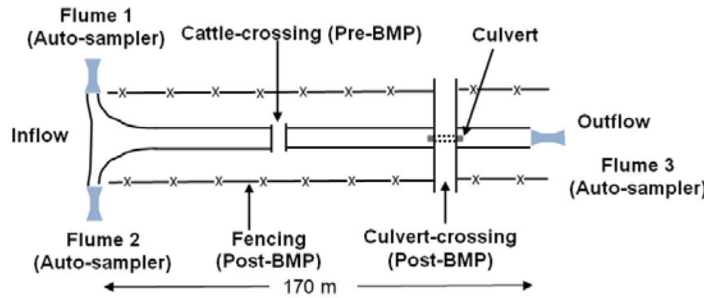

Figure 1. Diagram of stream-crossing fencing BMP with locations of water quality and quantity monitoring sites.
Credits: Shukla, et al., 2011

Results

During the pre-BMP period (June–October of 2005), there was a net addition of phosphorus between the inflow (upstream of fenced area) and outflow (downstream of fenced area) sites, indicating that cattle activity in the stream was causing the outflow loads to be higher than the inflow loads. This is indicated in a 22% increase in downstream total P (TP) concentration (Table 1). During the post-BMP periods of 2006 and 2007, the TP concentrations were relatively higher because of drought conditions. Although there was a positive addition of P during the post-BMP2 period, this is likely due to the release of P from aquatic vegetation that died and dried up because of the drought conditions. The post-BMP3 period confirms what is suggested by the first post-BMP periods—the fencing does reduce the P inputs from the cattle activity in the stream. During the pre-BMP period, downstream (Site 1, after fenced area) TP load was 20% higher than the upstream (before fenced area), indicating cattle crossing to be a source of P. Downstream loads of TP in 2006 and 2008 (post-BMP periods) became 26% and 11% lower than the upstream loads, respectively, indicating that the fencing and cattle crossing installed at the ranch reduced the P loads. Over the three-year post-BMP period, TP loads were reduced by 10% (64 lb./year), which can be attributed to the fencing and cattle crossing BMP.

Table 1. Total P inflow and outflow concentration for stream crossing fencing BMP.

	Pre-BMP (2005)	Post-BMP1 (2006)	Post-BMP2 (2007)	Post-BMP3 (2008)	Post-BMP Average
Inflow Concentration (mg/L)	0.54	2.28	1.51	1.69	1.83
Outflow Concentration (mg/L)	0.66	1.77	1.86	1.56	1.73
% Change	22.2	−22.4	23.2	−7.7	−5.3

Economic Analysis

An economic analysis was also conducted as part of the study. Capital costs of implementing the ditch fencing and alternative livestock water supply totaled $20,245, which when amortized over 20 years at 5% interest, results in an annual cost of $1,625. When calculated per head of cattle, it resulted in an annual cost of $10.20 or 3.9% of the feed and forage costs. Due to the relatively low cost of this BMP, it is unlikely that this would be a financial burden to a ranch owner. Additionally, the ranch owner involved in this study noted that the implementation of this BMP did not affect his ranch management activities, did not increase his overhead expenses, and did not adversely affect the health of his cattle. Although it was not assessed in this study, ranch owners believed that the alternative water supply would likely improve herd health.

Cost per pound of P treated was also calculated to determine how this BMP compares with other water-quality treatment alternatives. Based on the costs above and the amount of P removed due to the BMP, the cost per pound of P removed was $5.17. This is significantly less than the cost estimates by an UF/IFAS study for P removal ($200–$500/lb. P) achieved by the storm water treatment areas that treat water before it is discharged to the Florida Everglades (Sano, Hodges, & Degner, 2005).

Conclusion

BMPs are an important tool in helping the state and individual landowners protect and enhance state's waters. Given the water quality issues facing Lake Okeechobee and other sensitive water bodies, the importance of BMP implementation has increased since their official establishment as part of the FWRA. In order to ensure that BMPs are reducing nutrient loadings, on-farm research is needed to verify BMP effectiveness. A four-year study was conducted to evaluate the effectiveness of the cow/calf stream fencing BMP. The study concluded that the BMP did reduce the amount of P being discharged from the ranch. This BMP should continue to be included in the cow/calf BMP manual, and, hopefully, its widespread implementation will help the state in meeting its TMDLs.

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