



2009 CSREES National Water Conference; St. Louis, MO

Evaluation of multi-stage lagoon and wetland systems for southern dairies

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Abstract:

Lake Pontchartrain is an estuarine ecosystem located on the Gulf coast. Land use ranges from heavy urban/suburban to sparse agriculture and forestry. Over the past several decades Lake Basin water quality has decreased because of numerous insults, including dairy wastes. A single-stage lagoon system with periodic pump-out and land application is currently recommended for local dairies. A sequential wastewater treatment system (anaerobic lagoons - ANL, aerobic lagoons - AEL, constructed wetlands - WLD) showed potential for improving effluent quality at the Southeast Research Station. A concerning aspect of the new system is that adequately sized aerobic lagoons require large potentially productive land area which may limit technology adoption by local small producers.

The objective was to evaluate pollutant abatement effectiveness of replacing second stage aerobic lagoon with smaller constructed wetlands.

The Dairy Wastewater Treatment Evaluation System is a three-stage system composed of ANL, AEL, and three WLDs, replicated. The system was used to simultaneously compare and quantify treatment effectiveness of a control, three-stage system (ANL, AEL, WLDs) with a two-stage treatment (ANL, WLDs). Wastewater COD, solids, nutrients (TKN, TP), and coliforms were monitored at all stages in the system for 6 months. Treatment was applied 3 months to each replicate while the counterpart was maintained as control in a cross-over design. Statistical comparison was made among WLD effluents in different systems.

Small difference in pollutant abatement between idle AELs and AELs continually receiving ANL effluent is attributed to the effectiveness of AELs in the complete system. Most treatment efficacies were significantly reduced when AELs were bypassed. The two stage system (ANL-WLD) performed at 65% of the control system (ANL-AEL-WLD). Constructed wetlands combined surface area represented 41% of the AELs. ANL-fed WLDs resulted in approximately 40% of the treatment efficacies of AEL, ranging from 1% for TKN to 49% for COD. Nitrogen removal was limited by decay of organic matter accumulated in WLDs receiving ANL effluent.

Impact Statement:

Recycling of manure nutrients is an essential factor in well designed nutrient management plans. Increasing herd size and greater proximity to human dwellings require improved waste management. However, under certain conditions it is uneconomical to spread manure onto land because of high operation costs, absence of custom operators, or land shortage. Livestock operations can use sequential treatments to remove nutrients. LSU AgCenter partnered with the Lake Pontchartrain Foundation with financial support from USDA and NOAA to develop wastewater treatment systems that minimize nutrient and pathogen losses from small dairy operations in southeast Louisiana. Sequential anaerobic-aerobic lagoons followed by constructed wetlands intensified nutrient and pathogen removal in this project. The study carried out in 2006-2007 evaluated the potential for constructed wetland to substitute for aerobic lagoons, following anaerobic lagoons in sequential systems. Replacing aerobic lagoons with wetlands could potentially reduce costs to dairymen, but the study showed that land requirement for wetlands to maintain comparable removal efficacies of nitrogen fractions would be large in two-stage treatment systems set as anaerobic lagoons followed by constructed wetlands. For situations in which nitrogen removal is required, we recommend two-stage sequential treatments as anaerobic lagoon-aerobic lagoon or three-stage sequential treatments as anaerobic lagoon-aerobic lagoon-constructed wetland.

Category: Agricultural BMPs

Type of Presentation: Poster Presentation