GREEN MANURE PRODUCTION AS A VALUE-ADDED COMPONENT OF TREATMENT WETLANDS FOR LIVESTOCK WASTEWATER

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ABSTRACT Producing plant-based fertilizers – green manures – in treatment wetlands for livestock wastewater could provide economic benefits similar to land application of manures without the environmental hazard. Land application provides low-cost nutrients for agricultural production and is, for many high density animal agriculture operations, the only economical method of waste handling. However, direct land application can harm local ecosystems, public health, and long-term soil fertility. Treatment processes for liquid manure, including treatment wetlands, improve water quality but do not effectively utilize manure nutrients. Using small, fast-growing wetland plants like duckweed and the nitrogen-fixing fern Azolla for nutrient capture and green manure production in treatment wetlands allows the treatment system to provide the same benefits as land application – water reuse and agricultural fertilizer – at a higher quality for both. The current study explores optimization of water purification and green manure production in a wetland system treating liquid dairy manure, consisting of a duckweed growth pond (with multiple, wild-collected Lemnaceae species), a horizontal subsurface-flow wetland, and an Azolla growth pond (with A. caroliniana). Hydraulic retention time and plant harvest rate will be manipulated to determine conditions for maximum water purification (by reduction of COD, TP, TN, NO₃, and NH₃) and plant production. Data will be modeled using both dimensional analysis and a nutrient-based dynamic growth model. The best resulting model will be developed to suggest design criteria for treatment wetlands producing maximum yields of green manure while meeting site-specific water quality needs.

Keywords: Green Manure, Liquid Manure, Constructed Wetlands, Azolla, Duckweed, Fertilizer, Livestock Wastewater.