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BIOECONOMIC ANALYSIS OF NUTRIENT REDUCTION STRATEGIES IN THE LOWER MISSISSIPPI RIVER BASIN TO ADDRESS HYPOXIA IN THE NORTHERN GULF OF MEXICO

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Hypoxia in the Northern Gulf of Mexico results in large part from agricultural nutrients in the Mississippi River Basin (MBR) leaving the landscape and entering this riverine system. Producers in the MRB attempt to reduce nutrient loss by field-based practices (nutrient and tillage management) and structural practices (agricultural drainage management). In lower portions of the MRB, drainage management is confined to inundating farmland for rice production or for draining water from fields during the growing season. With slight modification, these systems could lessen nutrient outflow during the off-season with negligible cost to producers. Given the potential environmental benefits from such systems, we evaluated the cost-effectiveness of drainage management to that of other BMPs in the Cabin-Teele Subwatershed of the lower MRB at achieving a specified nutrient reduction. Additionally, we compared current or baseline conditions with an intensification of corn (ethanol) scenario.

Production and farm income (returns to management and land) data for field-based practices and construction and maintenance cost estimates for drainage management structures were gathered for the study area. Crop acreage and management information were gathered into a geographic information system (GIS) and these data were used in the AnnAGNPS model, developed to analyze drainage hydrology and agrochemical transport, to simulate in-field BMPs and drainage management structures in the watershed. Outputs from the biophysical modeling were used as technical coefficients in the integrated bioeconomic model. This mathematical model maximized net farm income in the watershed subject to baseline land uses, soil types, and nutrient and tillage management.

Modeling results indicated the effectiveness of drainage management at removing nutrients varied by location in the watershed, though nitrate-nitrogen removal was negligible in all locations. Structures located closest to the mainstem were most effective at reducing phosphorus and sediment. However, our results indicated that controlled drainage was not cost-effective at reducing nutrient losses relative to other BMPs available to producers. In the corn-ethanol scenario, nutrient losses and farm income increased with expanded corn production. Field-based BMPs were more cost-effective than drainage management at reducing nutrient losses from the study watershed.

Our research provides policymakers and producers with needed information on the effectiveness and cost-effectiveness of potential practices for addressing the negative environmental impacts from production agriculture (hypoxia). Results from our analysis indicate that in the lower MRB certain field-based practices allow producers to mitigate their environmental impact in our coastal communities yet continue providing benefits to society (farm commodities and some ecosystem services) in an economically feasible manner.

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