Assessing Water Quality of Wetland Reserve Easements in the Mississippi Alluvial Valley

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Wetland systems receive nutrient inputs from atmospheric, terrestrial, and aquatic sources, transforming them through various biogeochemical processes that enhance downstream water quality and ecosystem productivity. However, extensive agricultural conversion in the Mississippi Alluvial Valley has exacerbated wetland loss, diminishing an important function of net nutrient sinks amid bottomland hardwood forests. The Agricultural Conservation Easement Program-Wetland Reserve Easement program, administered by the United States Department of Agriculture-Natural Resources Conservation Service, aims to mitigate wetland losses and degradation and restore wetland function on private lands. A core objective of the Wetland Reserve Easement program is to improve water quality through restored hydrology and vegetation, thereby enhancing processes of nutrient retention and removal. To assess restoration success, we examined seasonal water quality patterns from 37 sites (5 cropland fields, 5 historic wetlands, and 27 Wetland Reserve Easements) quarterly from June 2023 to May 2024 in Mississippi and Louisiana. Water quality conditions in Wetland Reserve Easement sites differed ($p < 0.05$) from both cropland and reference sites. Across multiple parameters, restored sites maintained water quality values intermediate between cropland and reference conditions. Water temperature was a consistent driver of water quality across all modeled parameters. Nutrient concentrations were significantly elevated in cropland fields, particularly during summer and autumn, while reference wetlands consistently maintained the lowest levels across all seasons. Total nitrogen and dissolved reactive phosphorus were 40–50% and 30–75% lower, respectively in Wetland Reserve Easement sites across seasons compared to cropland sites. Total organic carbon was lower in cropland sites compared to Wetland Reserve Easements ($p < 0.05$), and total suspended solids were more variable in Wetland Reserve Easements, with values between cropland and reference conditions. Alkalinity was also of intermediate level in restored sites and declined across all site types in winter and spring. Specific conductance and total dissolved solids decreased significantly in cooler seasons, but there was no effect among site types. Our findings suggest that water quality of Wetland Reserve Easement sites is enhanced from cropland sites, reflecting transitional ecological conditions and seasonal patterns, and partial functional recovery following restoration