EPA/600/F-20/444

www.epa.gov/research

science in ACTION

INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE

EVALUATION OF ECOSYSTEM SERVICES IN SUBSURFACE-DRAINED AGRICULTURAL CATCHMENTS THAT INCLUDE WATER QUALITY WETLANDS IN THE UPPER MIDWEST, USA

Background

The state of Iowa has set a goal to reduce nitrogen and phosphorus loading to surface waters by 45% through a variety of in-field, edge-of-field, and catchment-scale practices. Water quality wetlands are of particular interest because they can intercept and decrease nitrogen loads from tile-drained agricultural systems to downstream waters including streams, rivers, and the Gulf of Mexico. This conservation strategy has the potential to enhance a suite of additional ecosystem services, including greenhouse gas regulation (CO_2, CH_4, N_2O), waterfowl and amphibian habitat and associated recreational opportunities, and floodwater storage.

At the same time Iowa is addressing nutrient runoff concerns, agricultural drainage improvements are needed to increase crop yields, replace failing systems, and improve resilience to changing weather and climate patterns. Understanding the relationships between tile-drainage, crop yields, nutrient reduction by wetlands and overall ecosystem service performance will better inform local and regional management decisions. For example, improving tile-drainage may increase crop yields, but it is unclear how this would affect the export of nitrate to downstream ecosystems. Installing a water quality wetland may mitigate the potential increase in nitrate export as well as reduce the system-wide export of N_2O, a potent greenhouse gas.

These system-wide dynamics, in addition to the ecological benefits gained from improvements in habitat resulting from wetland installation, are rarely accounted for in the decision-making process. Applying a broader systems approach to evaluating relevant management scenarios will provide new and more precise information about the complex relationships between crop yields, water quality, greenhouse gas regulation, and other ecosystem benefits. The approach will support future management decisions and provide valuable insight about the effects of changing tile drainage and installing water quality wetlands in Iowa.

Figure 1. Water quality wetland in Iowa constructed to intercept and treat agricultural subsurface drainage.

U.S. Environmental Protection Agency
Office of Research and Development

The EPA's Office of Research and Development, EPA's Office of Water, and Region 7 are working on this effort with collaborators in Iowa including the Iowa Department of Agriculture, Iowa Farm Bureau, the Agribusiness Association of Iowa, Iowa State University, Iowa Department of Agriculture and Land Stewardship, and the Iowa Department of Natural Resources. This collaborative group has identified several land use scenarios and ecosystem services of interest for landowners and managers in the region that will be studied using a systems approach.

Figure 2. Collaborators tour water quality wetland.

Next Steps

ORD, Region 7, and our collaborators plan to model four different land management scenarios (see Box 1) at the catchment scale to assess the resulting changes in crop (corn/soy) yields and ecosystem services across the agricultural field-wetland system (Figure 3).

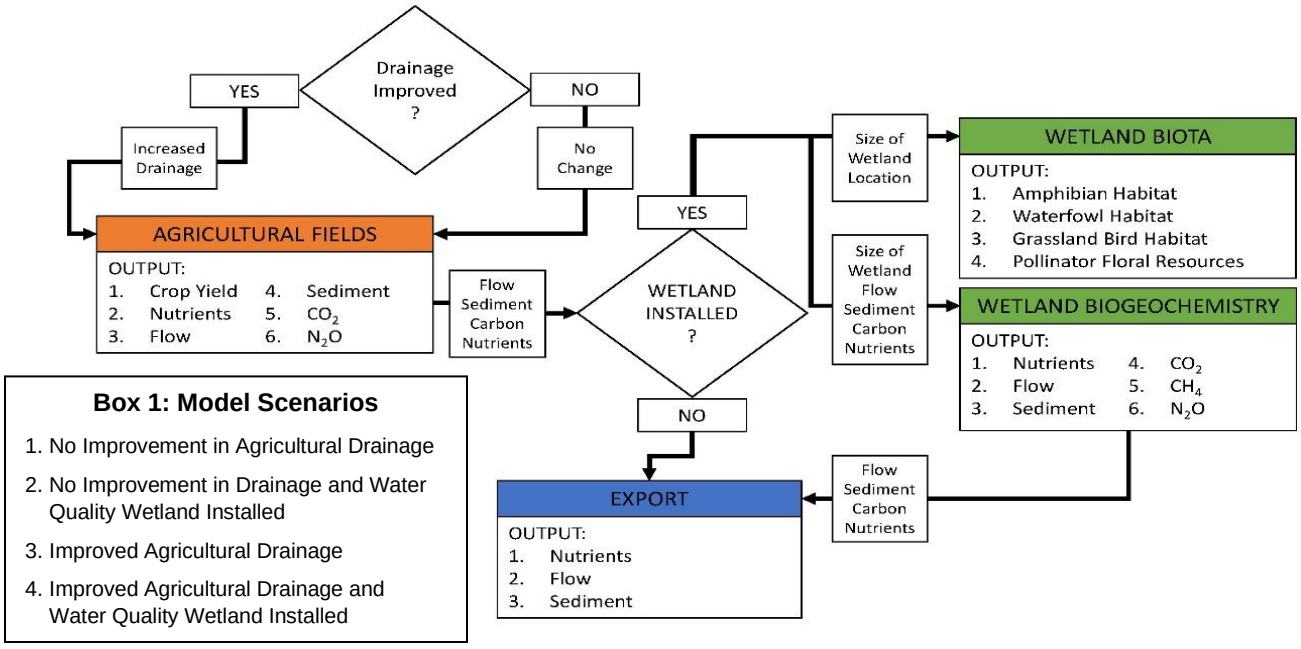

Figure 3. Model diagram showing the modeled scenarios and outputs from the agricultural fields, wetland biota, and wetland biogeochemistry modules and the resulting export from the catchment.

Evaluating both the changes and resulting tradeoffs in ecosystem services across field drainage and water quality installation scenarios will enhance our understanding of the cumulative impacts that multiple land use changes may have on system-wide ecosystem services. This work will provide important information that will describe the broad ecosystem service effects of water quality wetlands and support decision making based on the best available science.

CONTACT:

Ken Forshay, Research Ecologist, 580-436-8912, Forshay.Ken@epa.gov

Tammy Newcomer-Johnson, Research Ecologist, 513-569-7150, Newcomer-Johnson.Tammy@epa.gov

Mark Mitchell, ORISE Postdoctoral Fellow, 513-569-7221, Mitchell.Mark.E@epa.gov

Chris Taylor, Region 7 Science Liaison, 913-551-7736, Taylor.Christopher@epa.gov