Drainage Ditch Management to Mitigate Nutrient Losses from Agroecosystems

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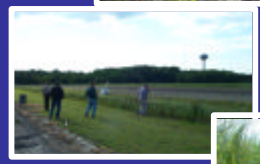
Project Description

In ditch-drained regions, efforts to address agricultural losses of nutrients have focused primarily on field management and have not accounted for the modifying effect of ditches on water quality. Improved ditch management could be an effective component of improved regional nutrient management planning and policy. Experiments are being conducted at the University of Maryland Eastern Shore Research Farm, in four on-farm trials, and in the Manokin Branch watershed. Field scale processes of nutrient transport and the effects of ditch management practices will be modeled and interpreted at a watershed scale using an intensive field survey and simulation modeling. We will assess the benefits of two ditch management practices – water-control structures and ditch clean-outs. Twelve high school scholars will participate in a summer internship program in 2005 and 2006. Extension materials will be developed and offered to Certified Nutrient Management Consultants, Certified Crop Advisors (CCA), land managers, Extension Educators, and third-party Technical Service.

This project is a collaboration between The University of Maryland College Park (UMCP), the University of Maryland Eastern Shore (UMES), the Maryland Department of Natural Resources, the USDA-ARS Pasture Systems and Watershed Management Research Unit, and the Somerset County Soil Conservation District.

Drainage Ditches

Drainage is necessary for agriculture to exist in most of the Lower Eastern Shore of Maryland. Drainage ditches are widespread in the United States either for direct land drainage or for tile drain effluent. Ditches function in some respects like streams and in some respects like wetlands. They short circuit overland flow and shallow subsurface flow pathways, linking field edges with local streams and rivers. During high flow, ditches carry eroded sediments and associated nutrients from agricultural fields to downstream water bodies. They also buffer the impact of field management on downstream water quality through sedimentation, sorption (adsorption and precipitation), denitrification, and biological uptake (microbial immobilization and plant uptake). During periods of low-flow and high temperature, biological uptake and oxidation/reduction cycles affect the nutrient transport characteristics of ditches.



Site Description

The UMES Research Farm

The UMES Research Farm is located on the UMES campus in Princess Anne, MD. At this site we are conducting a variety of intensive experiments and watershed monitoring.

The Manokin Branch watershed

Our watershed scale research is being conducting in the The Manokin Branch watershed. We are collecting water quality data at three locations and will be surveying and characterizing ditches throughout the watershed. After a three-year calibration period, ditch management practices will be installed on one of the forks of the Manokin Branch in a attempt to achieve watershed-wide nutrient export reductions.

On-farm trial

We are working with four cooperators in Somerset County. At each site, we are monitoring agronomic variables and three ditches for water quality parameters. After a one-year calibration period, water-control structures will be installed and clean-outs will be performed to assess the effects of these mar n-farm setting.

Data

We are collecting an extensive data set at these sites including:

Water: Total N, total P, nitrate-N, dissolved reactive P, TSS, dissolved organic C and N.

Drainage ditch soils: Total N, total P, inorganic-N, water-extractable P, Mehlich-3 P, pH, particle-size, organic C, P sorption isotherms, heavy metals, oxalate P, Fe, and Al.

Field soils: Mehlich-3 P, organic C, total N, total P, pH

Field runoff: Total P, dissolved reactive P, TSS, nitrate-N, total N, pH

Wells and lysimeters: Dissolved reactive P, nitrate-N, pH

Fundamental processes of nutrient transport

Drainage sitch soil morphological properties: Implications for nutrient transport

Robert Vaughan (UMCP), Brian Needelman (UMCP), Peter Kleinman (USDA-ARS), Arthur Allen (UMES), John McCoy (MDDNR), Frank Coale (UMCP), Martin Rabenhorst (UMCP)

Organic matter studies in drainage ditch soils

David Ruppert (UMCP), Brian Needelman (UMCP) , Peter Kleinman (USD

Using fertilizer trials to assess the fate of N in a Coastal plain landscape

John Schmidt (USDA-ARS), Peter Vadas (USDA-ARS), M.S. Srinivasan (USDA-ARS), Arthur Allen (UMES)

Assessment of Nitrous oxide emissions from ditch-drained agricultural fields in the coastal plain

Curtis Dell (USDA-ARS)

Effect of Phosphorus and Nitrogen – Based manure management on soil and runoff phosphorus

Andrew Sharpley (USDA-ARS), Arthur Allen (UMES), Peter Kleinman (USDA-ARS), Lou Saporito (USDA-ARS) and William Stout

Managements

1. Water Control Structures:

Low-cost P-sorbing materials will be placed inside permeable bags and placed within water-control structures at ditch outlets to promote sediment deposition and dissolved P adsorption from ditch effluent. These P-sorbing "pillows," have shown promise in controlling sediment and dissolved nutrient losses in overland flow from agricultural lands (Stout, unpublished data). A preliminary experiment will be conducted to determine the most efficient P-sorbing material for use in this study. Three P-sorbing materials will be evaluated: water treatment residual containing residual alum ($Al_2(SO_4)_3$); anthracite refuse ash containing amorphous Fe ($Fe(OH)_2$); and by-product gypsum ($CaSO_4$).

2. Clean outs:

Acknowledgement

http://www.sawgal.umd.edu/DrainageDitches/

Modeling

Processes affecting phosphorus transport in subsurface flow pathways

Peter Vadas (USDA-ARS), M.S.Srinivasan (USDA-ARS), Peter Kleinman (USDA-ARS), Andrew Sharpley (USDA-ARS), Arthur Allen (UMES), Brian Needelman (UMCP)

Modeling the soil and aqueous Organic Carbon in Agriculture Drainage Ditches

Sumathi Iyappan (UMCP), Brian Needelman (UMCP)

Extraction of Drainage ditch features from LIDAR-derived Digital Elevation Models

Michael I. Rubinstein (UMCP) and Brian Needelman (UMCP)

Education outreach

High School

Twelve high school scholars will be screened, and invited to participate in internships with the strategic outcome of providing them hands-on, interactive, and team dynamics activities designed to create an awareness of problems in our environment. Specific emphasis will be placed on the deleterious effects of nutrient loading, and other land use patterns and practices on water resources in the Delmarva region. These students will intern each summer for the last two years of the project. Students will be trained to perform analysis for pH, nitrate-N, dissolved oxygen, salinity, ammonia, water extractable phosphorus, etcetera. A journal will be kept by each student who will use his/her data to plot graphical illustrations. Students will then be taught how to make intelligent scientific deductions from such data. Teams of three will be required to present their data in PowerPoint or other presentation software or in poster presentation format to an audience comprised of faculty, students, and project investigators at a culminating event each Summer

On-farm

Data from this study and general information concerning the effects of ditch management on off-farm nutrient transport will be integrated into several Cooperative Extension curricula including the Maryland Certified Nutrient Management Consultant certification and continuing education programs, Certified Crop Advisor (CCA) training, and the annual Mid-Atlantic Crop Management School. Annual field days will be held at the UMES Research Farm. Web-based fact sheets will be developed on nutrient transport through drainage ditches, water-control structures, and the effects of ditch clean-outs on ditch function and nutrient transport which will be directed to farmers, land managers, Extension Educators, Certified Nutrient Management Consultants, and third-party Technical Service Providers involved in conservation planning and program implementation.