USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Title:Effectiveness of a constructed buffer strip in capturing nitrogen in the Midwestern agricultural landscape

Duration: Two Years

Year 1 Year 2 Total

Federal Funds Requested: $20,0OO $20,000 $40,000

Non-Federal Matching Funds: $53,376 $54,623 $107,999

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Congressional District: Third

Statement of Critical Regional or State Water Problems

The Midwestern USA is one of the most agriculturally productive regions where intense production has been possible because of the quality and availability of the natural resources and suitable topography (Burkhart et al. 1994.) Modification of the local and regional hydrology has been an essential part of this conversion. Creation of extensive networks of subsurface tile drains, excavation of surface drainage ditches, and channelization of many perennial streams has facilitated the conversion of nearly all of the land to agricultural uses and has provided direct conduits for nonpoint source

pollutants to surface waters. The resulting impact on the quality of surface and groundwater of the region has been profound.

A challenge for resource managers in such landscapes is the development and implementation of restoration-based management approaches that build upon traditional pollution control efforts. One promising approach to increase the effectiveness of efforts to protect soil and water quality while also enhancing the physical, chemical, and biological integrity of the terrestrial and aquatic systems is the creation or restoration of landscape buffer zones (National Research Council 1993). Few models exist, however, for landscape restoration within intensively modified agricultural ecosystems.

A riparian management system model for reestablishing health)' riparian systems is being developed for Midwestern region. The model is unique in that it provides three subsystems to treat the three major sources of nonpoint source pollutants. The three systems include a multi-species riparian buffer strip, bioengineering techniques to stabilize streambanks and constructed wetlands to intercept and process tile water before it enters the stream. The model is flexible in design depending on landowner objectives, cost-share opportunities, and hydrologic linkages in the landscape. Present application of this system is envisioned in the headwaters reaches of most agricultural streams. However, major questions exist about the total length and width of the buffer strips that would be need to achieve target reductions in nonpoint source pollution 1oadings within a given landscape and watershed.

To this end, the National Research Council has called for accelerated research "to develop design and management standards" for landscape buffer systems. While the mitigating influence of naturally vegetated riparian buffer strips in reducing the delivery of nonpoint source pollutants from agricultural land to stream channels has been identified as an important element in overall agroecosystem management, the actual mechanisms of pollutant removal are not well understood and there is a general lack of regional information on the effectiveness of reestablished buffers. The proposed research would demonstrate the effectiveness of an established multi-species riparian buffer strip in retaining and/or transforming nitrogen contained in water moving from crop fields through the buffer strip. The results would be used to calibrate the Riparian Ecosystem Management Model (REMM) being developed by the USDA-ARS Southeast Watershed Research Laboratory for Midwestern landscapes. This model could then provide a decision making tool for resource professionals when designing watershed and field level buffer systems.

Statement of Results and Benefits

An explicit goal of this work is to refine the riparian management system design developed by researchers at Iowa State University to provide broad scale applicability to watersheds in the Midwestern agroecosystem. To accomplish this, we need to identify the pathway and process variables involved in nitrogen movement through the buffer zones. By constructing a detailed water budget to accurately model water fluxes and by monitoring the flow of nitrogen within groundwater and vadose zone water moving

through the buffer strip a clearer picture of the fate of the most prevalent chemical nonpoint source pollutant will be developed. Integrating these results using the Riparian Ecosystem Management Model (REMM) will provide researchers, planners, and field professionals a tool for making credible recommendations regarding buffer strip widths, compositions of plant species, etc. to accommodate site-specific conditions. At present most of these recommendations are based on intuitive and subjective estimates based on limited field demonstration sites. County, state, and national governmental and non-governmental organizations are requesting better tools for making riparian best management practices recommendations. The proposed work will help provide such tools. It directly addresses the research priority areas of watershed processes and management, nonpoint source pollution reduction, and groundwater and surface water quality of this request for proposals.