South Fork of the Iowa River, Iowa

(An ARS Benchmark Research Watershed, one of 24 CEAP watershed projects.)

Characteristics

The watershed of interest is the South Fork of the Iowa River (Hardin and Hamilton Counties, Iowa). The total drainage area of this watershed is approximately 78,000 ha, and the watershed area to be evaluated is about 76,250 ha. Major sub-basins or Tipton Creek (19,850 ha), Beaver Creek (18,200 ha), and the upper South Fork (25,600 ha) are instrumented with separate gaging stations. Instrumentation of two small drainage districts (500 – 2500 ha) in Tipton Creek is planned for 2005.

The Clarion-Nicollet-Webster soil association (Typic Hapludolls – Aquic Hapludolls –Typic Haplaquolls) dominates the landscape, with Harps soils (Typic Calciaquolls) occupying glacial potholes with the Webster soil. The landscape is composed of glacial till deposited 10-15,000 years ago. The terrain is poorly dissected and internally drained "prairie potholes" are common in the upper parts of the watershed. The low relief creates poor drainage conditions, and hydric soils occupy 54% of the watershed area. A major lateral moraine of the Des Moines Lobe crosses the upper part of the watershed. Subsurface tile drains and ditches were installed beginning more than 100 years ago. The artificial drainage accelerates transport of several dissolved contaminants. Normal annual precipitation is 750 mm with 60% falling during May through August in relatively short, but intense events. Annual baseflow constitutes 60% of the total stream discharge. Much of the remaining runoff is derived from subsurface drain inlets. About 85% of the watershed is under corn and soybean rotation, and about 6% in grass (CRP) and pasture. Most of the remainder is roadways and developed land cover, only about 1% is forest or wetland. There are about 100 confined swine-feeding operations, most of which are located in Tipton Creek and the upper South Fork.

Environmental Impacts

1. Water Quality: Nitrate loads from subsurface drainage systems, phosphorus, and sediment in runoff, and pathogens in streamflow are major water quality concerns.
2. Soil Quality: Trends in carbon sequestration as practices are implemented, and buildup of phosphorus in soils receiving frequent manure applications.

Management Practices

1. Conservation tillage (329A and 329B)
2. Riparian Buffers (391)
3. Nutrient management (590)
4. Waste utilization (633)
5. Constructed wetlands (656)
6. Grass waterway (412)
7. Subsurface Drainage (606)

Research Objectives

General: Evaluate watershed and river basin responses to conservation practices including those supported by USDA conservation programs.

Specific:

1. Evaluate loads of sediment, nitrate, phosphorus, and E. *coli* from the South Fork watershed and the capacity of the above conservation practices to reduce those loads.
2. Identify locations where conservation practices should be most effective in meeting water quality goals.
3. Assess the impact of current tillage and cropping practices on soil quality using the NRCS Soil Conditioning Index (SCI) and the Soil Management Assessment Framework (SMAF) being developed by the ARS and NRCS Soil Quality Institute.

Approaches

The capacity of in-field and edge-of-field conservation practices to achieve water quality goals will be evaluated in large watersheds. Landscape assessment will use terrain-modeling techniques, applied to widely available data on topography, soils, and climate to conceptualize areas where conservation practices will be most effective. A comprehensive evaluation of the distribution of existing conservation practices in the watershed will be undertaken, with assistance from NRCS.

Synoptic sampling and long-term monitoring will be used to determine nutrient, sediment, and pathogen loads in streams draining watersheds at nested scales, and assess retentions and losses associated with conservation practices. The distribution of practices and sensitive areas within the watershed and its sub-basins will guide the final experimental design. Increased funding for new conservation practices (e.g., EQIP), if available, along with collaboration with the Southfork Alliance will help encourage implementation of new conservation practices. Paired watershed comparisons and/or water quality trends will be evaluated to determine the impact of new practices that producers volunteer to implement. Results will also be used to parameterize models (EPIC, SWAT) that predict the effects of management systems on watershed processes and water quality.

Soil quality assessments will be made using existing data, and employing two different approaches. First, recognizing that soil organic matter is a primary indicator of soil quality and an important factor in carbon sequestration and global change, the NRCS Soil Conditioning Index (SCI) will be used to assess the consequences of the tillage and cropping systems being used within the watershed. The SCI will provide estimates on whether the applied conservation practices are maintaining or increasing soil organic matter. The predictions will be verified with the available data being collected by either the farmercooperators (i.e. through their soil test records) or other researchers contributing to the overall CEAP database. A more comprehensive assessment of soil quality will be made using the Soil Management Assessment Framework (SMAF) that is currently being developed by the ARS and the NRCS Soil Quality Institute. SMAF is designed to evaluate the dynamic impact of soil management practices on soil function and consists of three steps: indicator selection, indicator interpretation, and integration into an index. Designed as a framework, SMAF allows researchers to continually update and refine the interpretations for many soils, climates, and land use practices. Therefore, in addition to providing soil quality assessments for CEAP, the project will provide data for further improvements of the SMAF. This will occur by applying decision rules based on management goals and other site-specific factors in the selection step for each watershed. The interpretation step will provide site-specific indicator scores. Individually and collectively (through the index), the indicator scores will be correlated to critical endpoints including crop yield, water quality (i.e. nitrate, phosphorus, and sediment loads), and air quality indicators.

Selected references

Tomer, M.D., and D.E. James. 2004. Do soil surveys and terrain analyses identify similar priority sites for conservation? Soil Sci. Soc. Am. J. 68:1905-1915.

Tomer, M.D., D.E. James, and T.M. Isenhart. 2003. Optimizing the placement of riparian practices in a watershed using terrain analysis. J. Soil & Water Conserv. 58(4):198-206.

Collaborators and Cooperating Agencies and Groups

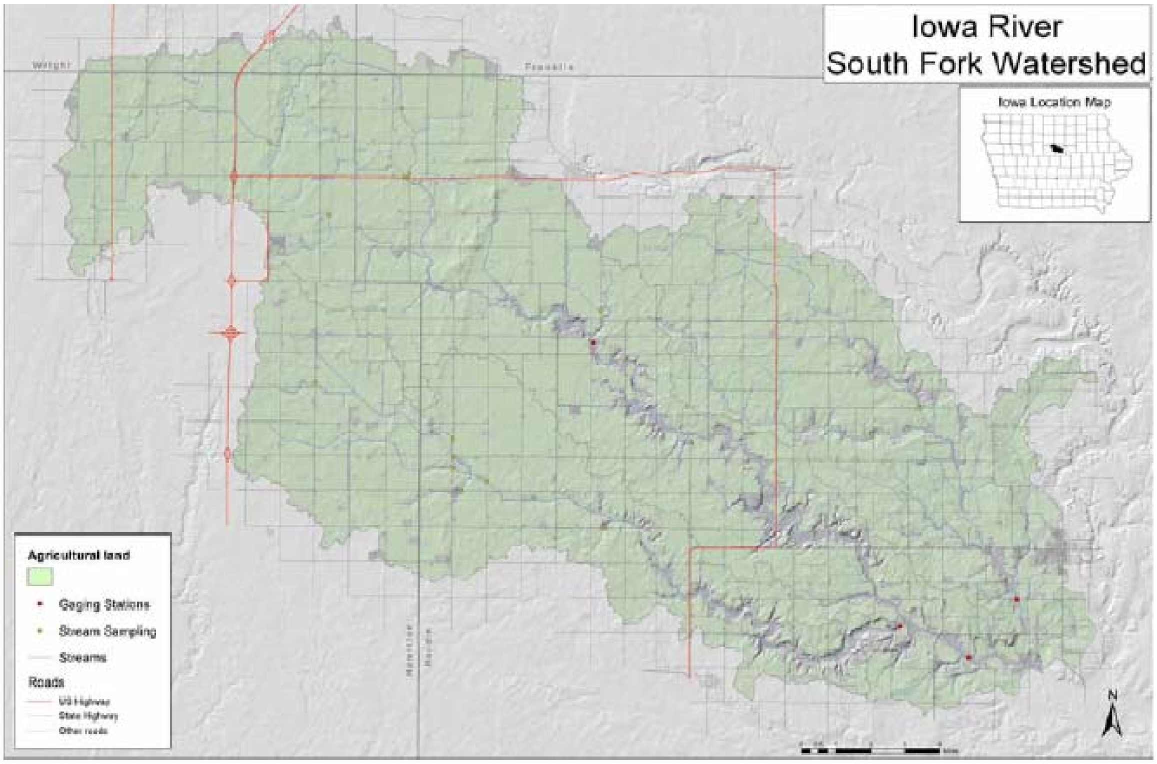
Southfork Watershed Alliance, a local organization, is working to encourage implementation of conservation practices that can protect and improve water quality.

NRCS has identified the physiographic region as the focus of their CREP program in Iowa and is using methods developed by NSTL to locate appropriate sites for wetland restoration.

USGS maintains continuous discharge stations at two sites where the NAWQA program found nitrate concentrations to be among the highest observed in the US. Measurements of pharmaceuticals have been a subject of recent research.

USEPA has expressed interest in coordinating ORD research with that of ARS to answer questions related to Clean Water Act program administered by Region VII.

NRCS Soil Quality Institute (Dr. Susan Andrews) will work with the SMAF, contributing refinements in and developing new scoring curves for critical indicators within the various watersheds.


Iowa River
South Fork Watershed
Iowa Location Map
Wright
Franklin
Agricultural land
Gaging Stations
Stream Sampling
Streams
Roads
US Highway
State Highway
Other roads
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