Salt River/Mark Twain Reservoir, Missouri

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

Characteristics

The Salt River Basin in northeastern Missouri is the source of water to the Mark Twain Lake, an 18,600-acre Army Corp of Engineers reservoir that is the major public water supplier in the region. The Salt River system, as depicted in Figure B3 encompasses an area of 2,518 mi^2 within portions of 12 northeastern Missouri counties. Sub-watershed areas monitored will range from 28 mi^2 to 460 mi^2. Soils within the basin were formed in Wisconsin and Illinoian loess overlying pre-Illinoian glacial till. Illuviation of the high clay content loess resulted in the formation of argillic horizons containing 40-60% smectitic clays. Topography within the watershed is flat to gently rolling, with most areas having 0-3% slopes. The Adco-Putnam-Mexico soil association predominates in the flatter upland areas, and these soils tend to be less eroded and have greater depths to the claypan than the terrace areas. The Mexico-Leonard soil associations occur in more sloping terrace and alluvial areas where the depth to claypan is often <15 cm on side slopes because of erosion. The claypan is not present within alluvial areas immediately adjacent to streams. The naturally formed claypan represents the key hydrologic feature of the basin, and it is the direct cause of the high runoff potential of these soils. Most soils within the basin are classified as Hydrologic Group C or D by NRCS. Land use is predominately agricultural within the basin. The primary row-crops are soybeans, corn, and sorghum. Forage production is mainly tall fescue. Livestock production is mainly beef cattle, but swine operations are increasing, particularly in the Middle and Elk Fork watersheds. Average annual precipitation is about 1000 mm per year, and stream flow (based on Goodwater Creek data) accounts for about 30% of precipitation. Runoff accounts for about 85% of total stream flow. Despite high runoff potential and poorly drained soils, sub-surface drainage is not employed because of the difficulties of installation in or below the claypan.

Environmental Impacts

Water Quality Runoff contaminated with sediments, nutrients (P, NO_3^-, NH_4^+), pesticides, and water-borne pathogens.

The basin has a known and well-documented history of herbicide and sediment contamination problems. The naturally formed claypan soils that predominate within the basin create a barrier to percolation and promote surface runoff. This results in a high degree of vulnerability to surface transport of sediment, herbicides, and nutrients. Mark Twain Lake serves a public drinking water supply for approximately 42,000 people, and consistently high spring and summer time atrazine levels have been an on-going concern. More recently, late summer algal blooms have created the need for more extensive water treatment to reduce odor and taste problems in drinking water, and may be a reflection of increased nutrient transport within the basin. Water-borne pathogen contamination of the major sub-watersheds of the Salt River basin has not been extensively studied to date. It is anticipated that this may be a problem in those subwatersheds with significant animal feed operations.

Management Practices

Studies are currently underway at field and plot scales to study the water quality impact of several different conservation practices. These studies include implementation of a precision agricultural system on an 88-acre field (590, 329A), plot-scale studies of the effectiveness of grass filters and grass hedges on contaminant mitigation from edge-of-field runoff and parallel tile outlet discharge (393), alternative weed management systems focused on reducing herbicide inputs (595), measuring soil quality under different cropping systems, and the potential for enhanced herbicide degradation in contour grass buffer strips (332). In addition, hydrologic simulation models will be used to predict water quality at multiple scales, determine contaminant source areas within watersheds, and serve as decision support aids for BMP implementation.

Research Objectives

Prevailing and traditional agronomic practices for row crop production have degraded soil and water resources in the Midwestern claypan soils region. Soil and water quality are inextricably connected, and surface runoff is the key hydrologic process that physically links them. Individual research projects are integrated by the development, implementation, and assessment of Best Management Practices (BMPs) to improve soil and water quality. An additional level of impact stems from the development of watershed models as tools for BMP assessment and watershed planning.
Specific objectives are to: 1) assess soil biological activities for describing soil quality under different agricultural practices; 2) develop criteria, evaluate performance, and determine economic impacts for implementation of alternative BMPs associated with herbicide, nutrient, and sediment contamination; 3) validate and improve watershed models to better assess the impact of field- watershed-scale management practices on surface water quality.

Approaches

The implementation of Best Management Practices (BMPs) to improve soil and water quality must be balanced with the need for socially acceptable practices that sustain profitable crop production. Our vision to meet this challenge entails an array of conservation, agronomic, and soil management practices. The proposed research encompasses three main approaches: (1) studies addressing the parameters and practices that control soil and water quality; (2) studies designed to test the effectiveness and economic impact of various BMPs and alternative weed management strategies; and (3) application of computer models to simulate the impact of BMPs on surface water quality at field and watershed scales. These broad objectives are divided into nine individual projects tied together by a common goal: the effective implementation of BMPs to improve and sustain soil and water resources. Projects include studies ranging from assessment of soil and water quality to application of genetic-based techniques for detection of water-borne pathogens to development and testing of new agronomic and conservation management practices. Expected results include improved indexing of soil quality parameters, new and profitable BMPs for field crop production that protect or improve soil and water quality, and a validated model for improved surface water quality assessment and planning.

Measurements In Place and Planned   Water quality monitoring at Goodwater Creek and at an 88-acre farm field within Goodwater Creek watershed will continue during CEAP. The field and watershed monitoring stations are equipped with v-notch weirs and automatic samplers. The automatic samplers are equipped with pressure transducers to measure the height of the water column for computing stream discharge. At the field scale, samples are collected for all runoff events. Shallow groundwater is also collected at two locations within the field twice each year and analyzed for dissolved nitrate levels. At the watershed scale, grab samples are collected weekly, and all runoff events are sampled by the automatic sampler. In addition, the USGS has an extensive network of hydrologic monitoring stations at nearly all major watersheds that discharge into Mark Twain Reservoir, as well as a monitoring station at the reservoir outlet (Fig. B3). Thus, stream discharge into and out of the reservoir is well characterized. In order to have a complete water quality monitoring network for computing the mass balance of contaminants into and out of the reservoir, additional monitoring stations will need to be established at Black Creek and Otter Creek (Fig. B3). In addition, two new monitoring sites will be established within the Long Branch Creek watershed to provide a multi-scale assessment of water quality. At all surface monitoring sites, contaminant monitoring will include commonly used corn and soybean herbicides, dissolved and total N and P, and sediment. Newly established sites will have rating curves developed to compute discharge. Enumeration of fecal coliforms and detection of pathogenic bacteria will be conducted periodically to assess the extent of pathogen contamination in the major sub-watersheds of the Salt River.

Selected references

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Collaborators and Cooperating agencies and groups

There are numerous agencies and groups currently involved in some type of CEAP-related activities within the Mark Twain/Salt River Basin as a whole. The following list indicates potential partners; *indicates confirmed project collaborators.
Federal partners: NRCS*, USGS, EPA, and possibly COE.
State partners: MO Departments of Natural Resources, Conservation, and Agriculture; University of Missouri Water Quality Extension (including the MO Watershed Information Network); Food & Agricultural Policy Research Institute (FAPRI)*.
Local/regional partners: CCWWC, Soil and Water Conservation Districts, Mark Twain Water Quality Initiative.
Non-profit advocacy partners: MO Corn Growers Association*, Environmental Resources Coalition*, MO Cattleman’s Association.

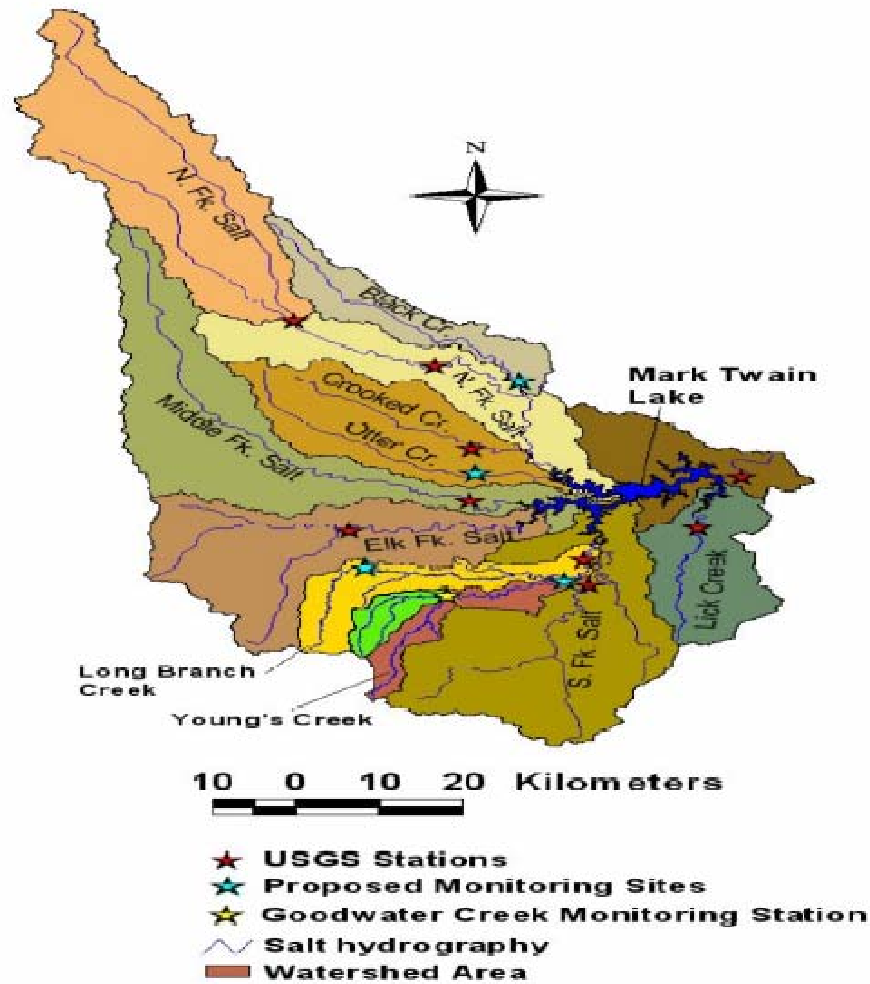

Figure B3. Salt River basin and major watersheds to Mark Twain Lake.