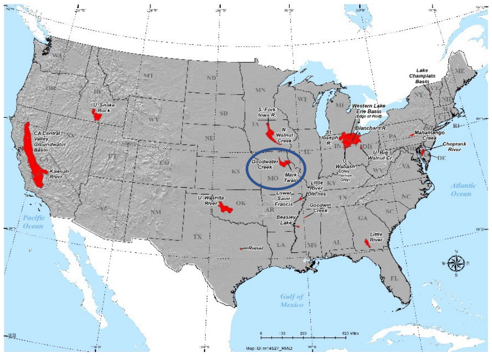
Mark Twain/Salt River and Goodwater Creek Watersheds

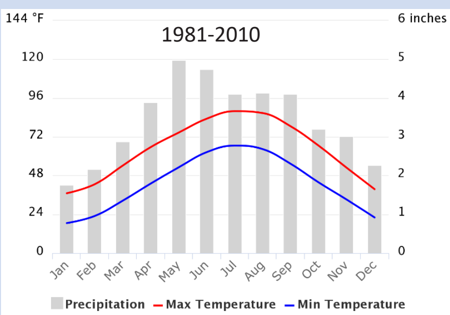
A Conservation Effects Assessment Project (CEAP) Watershed Assessment Study: A collaboration between the Agricultural Research Service and the Natural Resources Conservation Service



Location

The slightly under 2,300-mi^2 Salt River Basin is the drainage area for Mark Twain Lake, in Missouri. The lake was built for flood control and drinking water supply. Goodwater Creek is a headwater stream.

Temperature and Precipitation



Major land uses

Cropland: Corn, Soybean, Sorghum, Wheat.

Grassland: Pasture and Hay.

Woodland

Data collection

As early as 1971, stream gauges measure discharge every 5 to 15 minutes. Automated samplers collect water samples during storm events with additional samples collected every one or two weeks. Since 1991, monitoring equipment measure discharge and collect water samples from plots and fields. Measurements of sediment, nitrogen, phosphorus, and herbicides concentrations in these samples assess water quality. Rain gauges since 1971 and a meteorological station since 1993 measure precipitation, temperature, relative humidity, and solar radiation.

Concerns

Most soils in the Salt River Basin and in Goodwater Creek Watershed have a restrictive layer (the claypan). This layer reduces percolation and the storage of soil water. Reduced percolation causes excessive soil moisture in the spring and increases the peak flow of area streams.

High levels of soil moisture result in increased water erosion of soil, increased sediment transported to surface water, excessive agricultural nutrients and pesticides transported to surface water, organic matter depletion, and poor soil health. Increased peak flows in streams cause higher rates of stream bank erosion.

The thin top soil also affects grain production. Excessively wet fields can delay planting, and in the worst case, make it impossible, because equipment cannot enter the fields. During dry and hot summer periods, there is a potential for insufficient soil moisture for plant growth.

Excess nutrients and pesticides in the water entering Mark Twain Lake have increased treatment costs for the water supply facility. Excess nutrients leaving the lake contribute to Gulf hypoxia.

Main conservation practices used

A number of conservation practices are regularly used in the watershed. Several have been assessed and developed during the studies. These practices include no-till; winter and summer cover crops; timing of nitrogen, phosphorus, and pesticides applications; nitrogen injection into soils as opposed to broadcast surface application; strategic conservation tillage to incorporate pesticides (rotary harrow); vegetated upland buffers; and targeting practices to the most vulnerable land.

Other practices used in the watershed include terraces, grassed waterways, riparian buffers, streambank protection, and conservation tillage.

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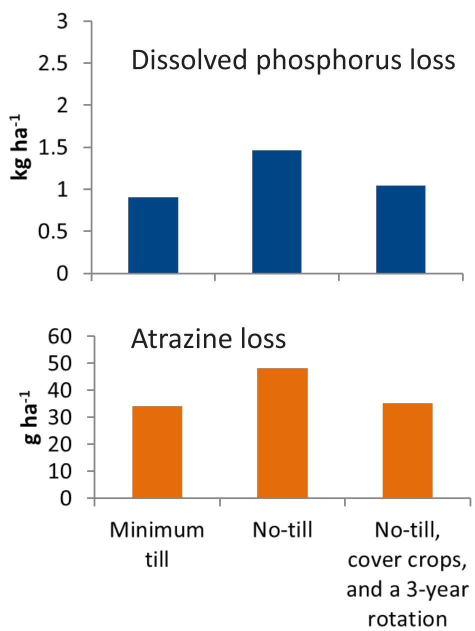
Outcomes/Findings

Plot and field scale

- No-till does not reduce runoff volume and doubles or triples atrazine and dissolved phosphorus losses on claypan soils.
- Light tillage with a rotary harrow incorporated herbicides without destroying residue cover. This reduced edge-of-field atrazine losses from fallow plots by 50% compared to losses from no-till plots.
- Vegetated buffers reduced sediment losses by 65% and herbicides by 20-30% by trapping sediment, increasing infiltration, increasing adsorption, and enhancing degradation.
- A precision agriculture system (PAS, no-till, cover crops, cropping systems defined by zones, and precision applied inputs) reduced soil loss by 85%, and surface runoff nitrogen loss by 40%.
- Although no-till alone, on claypan soils, increased herbicide and dissolved P losses, PAS mitigated these negative effects (see graph at right), and maintained crop yields compared to a minimum-till system.
- No-till with cover crops and a 3-year rotation increased soil organic carbon in the topsoil by 32% relative to no-till alone. No-till alone increased soil organic carbon in the topsoil by 22% relative to mulch till.
- In annual cropping systems, reducing soil disturbance, using longer rotations, and incorporating cover crops improves soil function and soil health scores.
- Overall, perennial systems improve soil function and soil health scores over annual cropping systems.

Clockwise from left: Measuring flow at Young's Creek, plot monitoring infrastructure in the winter, Mark Olson takes a water quality sample in Goodwater Creek.



Watershed scale

- Stream bank degradation produces 65-85% of the stream sediment in streams of Mark Twain Lake watershed.
- Effective sediment, herbicide, and nutrient stream load reduction requires targeting of practice implementation.
- The Soil Vulnerability Index identifies the vulnerability to losses of sediment, nutrients, and pesticides as a function of slope and select soil properties. For mild slopes (<2%), accounting for the depth to the claypan may improve the usefulness of the index.

Collaborators and Stakeholders

National Corn Growers Association · USGS science for a changing world · Soil Health Institute · FFAR · The Nature Conservancy · Soil Health Partnership · MU

More Information

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