Upper Washita River, Oklahoma

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

Characteristics

The Upper Washita River Hydrologic Unit in southwest Oklahoma drains an area of 8260 km^2 (827,000 ha). The Washita River is a tributary to the Red River, flowing into Lake Texoma, the largest reservoir in Oklahoma. Monitoring and assessment for CEAP will focus on two subwatersheds, (approximately 11-digit HUC size), the Little Washita River and Fort Cobb Lake watersheds. The region is sparsely populated with predominantly agricultural land use, consisting of mixed cropland and grazing land. Localized areas of irrigated cropland exist in association with water supply from reservoirs or groundwater. The region is underlain primarily by Permian sandstone, siltstone, and claystone. Both watersheds receive about 76 cm of precipitation annually, with most of the precipitation occurring during the spring and fall months.

The Fort Cobb Lake - Lake Creek subwatershed (78,800 ha) has mixed agricultural land use, including rangeland/pasture (41%), dryland crops (41%), irrigated crops (10%), forests (6%), and water (2%). Irrigation in the Fort Cobb Lake watershed is by center pivot systems on sandy soils, supplied by groundwater. Cattle grazing, predominantly stocker cattle, utilize the range and pasture lands. Confined swine operations are located in the upper portions of the watershed. The reservoir provides public water supply, fishing, boating, and wildlife habitat. Over 80% of the soils in the watershed are fine sandy loams, with the remaining 17% having loamy and silt loam textures.
The 61,000 ha Little Washita River Experimental Watershed (LWREW) is also a mixed land use watershed with pastures and grasslands (60 %), cropland (20 %), and miscellaneous land-use (20 %). There are 45 USDA-funded flood control structures within the Little Washita River subwatershed. There are 64 defined soil series in the LWREW, with fine sand, loamy fine sand, fine sandy loam, loam and silty loams being the predominant textures of the soil surface. In general, soils with moderate infiltration rates cover approximately 70% of the watershed.

Environmental Impacts

1. Sedimentation and nutrient (phosphorous and nitrogen) loading.
2. Channel instability in some of the tributaries.
3. Impaired water bodies for municipal water supply, recreation, and fish and wildlife.
4. Degradation of wildlife habitat.

Management Practices

1. Pasture and hay planting (512)
2. Grassed waterway (412)
3. Fencing (382)
4. Use exclusion (472)
5. Grade stabilization structure (410)
6. Critical area planting (342)

Research Objectives

General: The overall goal is to develop better understanding of the integrated effects of land use, land management (including conservation practices) and climate variations on

hydrologic processes at watershed to regional scales. The Southern Great Plains is subject to recurring climate extremes, particularly drought, which slows economic growth mainly due to limited and unreliable water supplies. Because agriculture dominates land use, conservation and other agricultural management practices have a large impact on water resources.

Specific:

1. Quantify hydrologic processes that affect regional surface water supplies as a basis for development of strategies and methodologies to better meet the water quantity and quality needs of downstream users.
2. Determine infiltration, ground water recharge and return flows to ascertain impacts on ground water supplies And surface/groundwater interactions.
3. Integrate remote sensing estimates of surface soil water content with other spatial data sets to monitor and predict root zone soil water content and availability at regional scales to improve watershed and regional water balance calculations.

Approaches

World-class instrumented watershed facilities, state-of-the-art simulation models, field studies, and remotely sensed data are utilized in this project to address the three interrelated objectives noted above. Hydrologic data collected between 1961-1985 from various sub-basins within the Upper Washita Watershed are available for model calibration. Weir sites from prior studies still exist and could be re-instrumented, if needed and pending land owner approval. Substantial monitoring of climate and streamflow is supported by ARS, the Oklahoma Mesonet, and USGS in the LWREW and Fort Cobb watershed. Extensive monitoring was conducted from 2000 to 2002 by USGS in the Fort Cobb watershed. Beginning in 2005, a bi-weekly cycle of stream water quality measurement will be initiated by ARS, including: pH, dissolved oxygen, conductivity, salinity, total dissolved solids, temperature, turbidity, oxygen reduction potential, nitrate concentration, ammonia concentration, suspended sediment, and phosphorus.

The Great Plains RC&D will work collaboratively with ARS to contact farmers to obtain conservation and production management information relevant to the assessments. The Oklahoma Conservation Commission will conduct a habitat assessment of selected stream segments.

The suite of EPIC/APEX/SWAT models will be used in scaling analyses to determine linkages of conservation practices, soil properties, edge-of-field responses, and watershed scale responses. The SWAT and SWAT/MOD models will be used for assessing the impacts of conservation practices on surface and groundwater, respectively, at the watershed scale. CONCEPTS will be used to assess the role of stream bank stability and channel processes within the watershed. Land use, soil, remotely sensed estimates of surface soil water content, and other spatial data sets will be utilized to produce regional estimates of soil water content in the root zone. Impacts of conservation practices on soil physical, biological, and chemical properties will be evaluated collaboratively with the National Soil Erosion Laboratory. Geohydrologic data will include groundwater data sets from historic ARS wells, USGS groundwater wells from surrounding areas, and historical and current stream gages. The historical database contains data for 34 drill holes, for which 21 were used to monitor ground water levels within the LWREW. The other 13 drill holes were used for stratigraphic control. In addition, historical databases from hundreds of monitoring wells from other

experimental watersheds in this region, and in similar geologic terrain, are also available. Areas within the LWREW and Ft. Cobb watersheds that have little stratigraphic control will be drilled, cored, and some will be completed as groundwater monitoring wells to provide insight in regions where information is scarce.

Selected References

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2/7/05 CEAP Project Plan
132
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Collaborators and Cooperating Agencies and Groups

USDA-ARS National Soil Erosion Laboratory, Natural Resources Conservation Service, United States Geological Survey, Environmental Protection Agency, Oklahoma Climatological Survey, University of Oklahoma, Oklahoma State University, Oklahoma Conservation Commission, Great Plains RC&D, Local Landowners