OAK RIDGE NATIONAL LABORATORY FACT SHEET
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

A Field Experimental Study of Hydrology and Water Quality Impacts of Intensive Forestry for Bioenergy Feedstocks

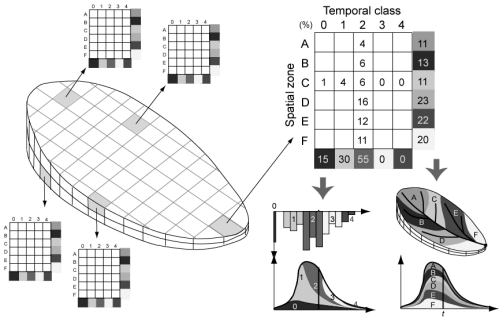
Need for Field Studies

The impacts on hydrology and water quality from growing cellulosic feedstock crops for bioenergy are largely unknown. In the Southeastern U.S., intensively managed forest plantations are projected to be a significant source of bioenergy. While empirical data exist on how traditional forestry and farming practices influence water quantity and quality, little work has been done to quantify how accelerated, early growth, high target yield forestry for cellulosic bioenergy might affect the magnitude and timing of water quantity, quality, and BMP design. In particular, impacts from mechanical site preparation, chemical weed control, and fertilizer application must be determined by controlled, watershed-scale field experiments that can inform predictive models.

The Approach

The study is being conducted at DOE's Savannah River Site (SRS) near Aiken, SC, by researchers from Oak Ridge National Laboratory, The University of Georgia, Oregon State University, and the U.S. Forest Service. Three small forested watersheds characteristic of a large and important timber growing region in the southeastern U.S. are instrumented to measure hydrologic properties and processes and to sample for water quality. One watershed serves as the reference and two watersheds are treatments consisting of short rotation pine. Pre-treatment data are collected from all watersheds prior to harvesting the existing forest, site preparation, planting and management of the bioenergy crops in treatment watersheds. Post-treatment data will be collected for at least 3 years following application of treatments to determine hydrologic and water quality impacts. Hydrologic measurements include precipitation, soil moisture and lateral subsurface flow, groundwater level, and stream flow. Hydrologic isotopic tracers (^{18}O and D/H) are measured to identify groundwater residence times along different flowpaths. Water quality measurements include nutrients (N and P) and dissolved organic carbon (DOC) in precipitation, lateral flow in soils, groundwater, and stream water, suspended sediments in stream water, and herbicides in lateral flow in soils, groundwater, and stream water. Isotopic tracers (^{15}N, ^{18}O) are measured to identify N sources in runoff (fertilizer vs. atmospheric deposition).

Application of Hydrologic Models



Assessment of water quantity and quality impacts from intensive forestry for biofuels requires predictive model development to allow extrapolation of field experimental results to other locations. We are using the Oregon State University Catchment Modeling Framework. This model uses a spatio-temporal accounting scheme to track pressure and particle transport through watersheds using flow path and residence time distributions within hillslope compartments related to topography, soil structure and hydraulic properties, and vegetation to predict stream discharge characteristics. After calibration and testing using data from the experiment at SRS, the model will be applied at other southeastern forest research sites with stream flow and water quality data. The approach will allow forest managers to anticipate significant water quality impacts and to deal with complex land use, watershed scaling, and mitigation strategies to improve BMPs for biofuels feedstock production.

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