

Tradeoffs for Environmental Sustainability: Water Yield and Poplar Yield when Deploying Biomass Production in the Northern Great Lakes Region

*Robert E. Froese, Michigan Technological University¹
Scott C. Hillard, Michigan Technological University²

The establishment of tree plantations on former agriculture land has potentially significant impacts on water resources. Yet plantation biomass can be an excellent feedstock for bioenergy, offsetting fossil carbon emissions. There is a tradeoff, therefore, in ecosystem services and dimensions of environmental sustainability when trees are farmed for energy or biofuel feedstock. We investigated the potential to deploy hybrid poplar production systems on retired farmland in the northern Great Lakes Region, and the consequential impacts on water yield from a variety of deployment scenarios involving area and rate of conversion. We first developed a site suitability framework using geospatial models of poplar productivity. Then, we calibrated the Soil and Water Assessment Tool (SWAT), a landscape-scale model for simulating basin-wide hydrologic processes and outputs. We applied the model to three disparate watersheds each currently comprised of mixed forest/agriculture cover, and compared five conversion scenarios each over a 20-year period. Our results showed the net effect on river discharge (into the Great Lakes) from each watershed was negligible, at less than 0.35% in each case, and was generally insensitive to deployment scenario. The lack of a significant adverse result reflects several factors, including modelling assumptions but also the fraction of land that is suitable for deployment, which in our study watersheds rarely exceeded 13% by area. Estimated poplar yields were comparable to similar modelling studies and empirical results in local plantation trials. These results suggest little adverse effect on water yield might be expected from poplar production in similar geographic regions.

Keywords: Hybrid poplar, watershed scale, production system, deployment, hydrology, water impact, ecosystem services, yield.

¹Michigan Technological University, 1400 Townsend Drive, Houghton MI 49931
froese@mtu.edu; 906-487-2723

²Michigan Technological University, 1400 Townsend Drive, Houghton MI 49931
schillar@mtu.edu; 810-620-0547

Biography for Robert E. Froese

Robert Froese is Associate Professor of Forest Biometrics and Management at Michigan Technological University. His diverse research program spans forest biomass and carbon resource analysis, inventory, spatial and simulation modelling, productivity in managed forests and growth/yield and GHG fluxes under intensive plantation forestry. Since 2008 he has coordinated a hybrid poplar research plantation network in Michigan, funded by the Wolverine Power, the US Forest Service, and the US Department of Energy. His lab maintains the Michigan Forest Biomass Information System, a web-based geospatial tool designed to make forest inventory data accessible to non-technical users. Robert obtained his PhD in Forestry from the University in Idaho, and prior to his academic career was a natural resource analyst in the private sector in British Columbia, Canada. He is an SAF Certified Forester, a Registered Professional Forester in the Province of British Columbia, and a Registered Forester in the State of Michigan.