Water quality impact assessment of large-scale bioenergy crop expansion

A. Pouyan Nejadhashemi[1, 2], Bradley Love[1], and Matthew Einheuser[1]

[1] *Michigan State University, Department of Biosystems and Agricultural Engineering, U.S.A.,*

[2] *Michigan State University, Department of Plant, Soil and Microbial Sciences, U.S.A., pouyan@msu.edu*

Production of biofuels can provide many benefits, including reduction of greenhouse gas emissions and decreased dependence on non-renewable energy sources. However, there are environmental challenges in transitioning to large-scale production of biomass for energy production. For biofuels to be a sustainable alternative to fossil fuels, their cultivation must avoid intensifying negative environmental impacts. Most significantly, expansion of cultivated land for renewable feedstock production requires increased fertilizer and pesticide application, which is detrimental to humans and aquatic ecosystem health. In order to evaluate the possible long-term water quality implications of bioenergy crop expansion, the Soil and Water Assessment Tool (SWAT) was used. Crop rotation and management data were collected for the main agricultural regions of Michigan, totaling over 53,000 square kilometers. Fifteen unique bioenergy crop rotations and four land use scenarios were integrated into the SWAT model. Bioenergy crops tested included both first and second generation crops. Land use scenarios were based on replacement of currently cultivated agricultural lands and expansion to marginal land with bioenergy crops. The results suggest that second-generation lignocellulosic bioenergy crops such as switchgrass are the most suitable for large-scale implementation, where traditional first-generation (canola, corn, and sorghum) row crops led to significant water quality degradation. In addition to nutrient impairment, increased canola, corn, and soybean cultivation leads to pesticide contamination that violates safe drinking water standards. Caution should be exercised in expansion of bioenergy crops on marginal lands for both first and second generation crops.