USE OF MARGINAL LAND AND WATER FOR SUSTAINABLE BIOFUEL PRODUCTION

Gayathri Gopalakrishnan, M. Cristina Negri, May Wu, Michael Wang, and Seth Synder
Energy Systems Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL 60439

INTRODUCTION

The development of sustainable, renewable energy sources has become an issue of increasing importance due to both the recent increase in gasoline prices in the United States and the international scientific consensus to reduce greenhouse gas emissions to mitigate climate change. Advanced biofuels are a primary component of the emerging energy portfolio. To strengthen the nation's energy security, mitigate greenhouse gas emission, and revitalize rural economy, the Energy Independence Security Act of 2007 mandated the production of 36 billion gallons of biofuels by 2022, of which 21 billion gallons must be advanced biofuels. This would result in an increase in biomass production by approximately 7 times the current amount – from 190 million dry tons to 1.36 billion dry tons of biomass (DOE-USDA 2005 joint study). Biomass is a land-based renewable resource and such a significant increase is likely to result in large-scale conversion of land from current uses to energy feedstock generation; potentially causing increases in the prices of food, land and agricultural commodities as well as disruption of ecosystems (UN report, 2007). Further, while a majority of current bioenergy crops are not irrigated, their yield is usually dependent on water availability. This study evaluates sustainable production of bioenergy crops through the use of marginal land and impaired water and discusses the potential for growing cellulosic biofuel crops such as poplar and switchgrass in optimized systems such that (1) marginal land is brought into productive use; (2) impaired water is used to boost yields (3); clean freshwater is left for other uses that require higher water quality; and (4) feedstock diversification is achieved that helps ecological sustainability, biodiversity, and economic opportunities for farmers.

EXPERIMENTAL

A spatial analysis using the Geographic Information System (GIS) software ArcGIS v 9.2 was conducted for the states of Nebraska and Illinois to estimate the spatial distribution and availability of marginal land and water sources. The two states were selected to evaluate production strategies under conditions of water scarcity (Nebraska) and water abundance (Illinois). Land use data was obtained from the National Resource Conservation Service (NRCS), Nebraska Farm Service Agency and Illinois Farm Service Agency. Marginal land resources for both states were identified as CRP land, riparian buffer strips and roadway and rail buffer strips. Degraded water sources were identified as groundwater contaminated with nitrate and wastewater from confined animal feedlot operations (swine, cattle and poultry farms). Groundwater quality data was obtained from the United States Geological Survey (USGS), Nebraska Environmental Protection Agency (NEPA) and the Illionis State Water Survey (ISWS). Feedlot data was obtained from the last available USDA Agricultural Census data (2002 data). Land use and groundwater quality data used was for the largest available database of sampled data for a single year (2005 data).

RESULTS

The spatial analysis for Nebraska did not find significant overlap between CRP land and degraded water resources; however, riparian and road buffer strips could potentially contribute significantly to increased biofuel production in areas where degraded water resources were available. The spatial overlap between CRP land and degraded water resources was more evident for Illinois; buffer strips might also contribute to increased biofuel production. Approximately the same area as available CRP land (~1 million acres) was identified in both Nebraska and Illinois for a strategy using buffer strips.

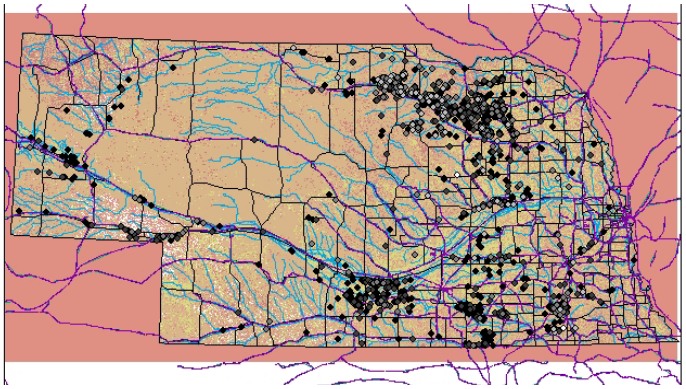

Figure 1: Spatial distribution of marginal land and impaired water for Nebraska

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