Biomass Feedstock Sustainability

A Systems Approach to the Food, Energy, and Water Nexus

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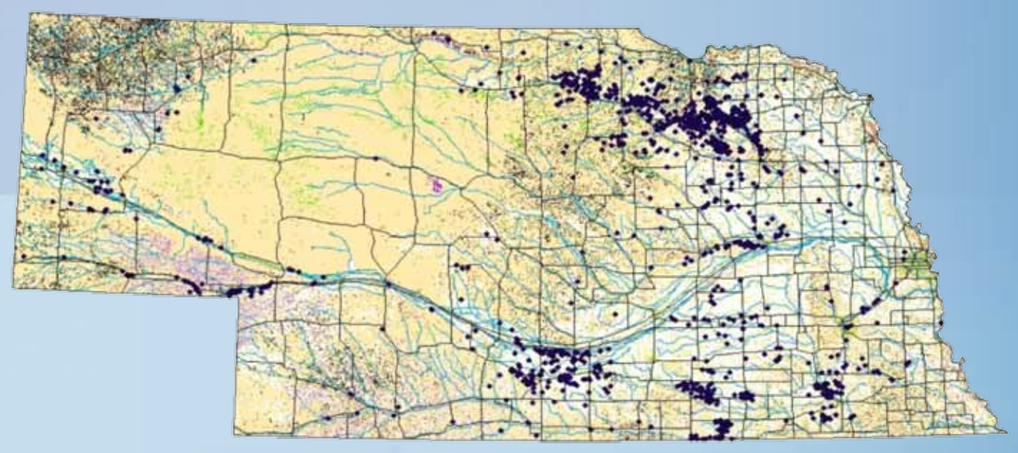
Opportunity

The 2007 Energy Independence Security Act mandated a seven-fold increase in the production of bioenergy, a land-based renewable resource. This mandate is expected to result in a significant amount of land being repurposed from current uses to energy feedstock generation potentially causing increases in the prices of food, land, and agricultural commodities as well as the disruption of ecosystems. Such a large-scale conversion of land has led to much debate in the scientific community concerning the impact on greenhouse gas emissions, water quality and quantity, and biodiversity.



Land use and contaminated groundwater for the state of Nebraska using computer software ArcGIS (■ = fallow and idle cropland including CRP, □ = cropland, ■ = grass and pasture land, ■ = herbaceous wetlands, ◆ = contaminated groundwater).

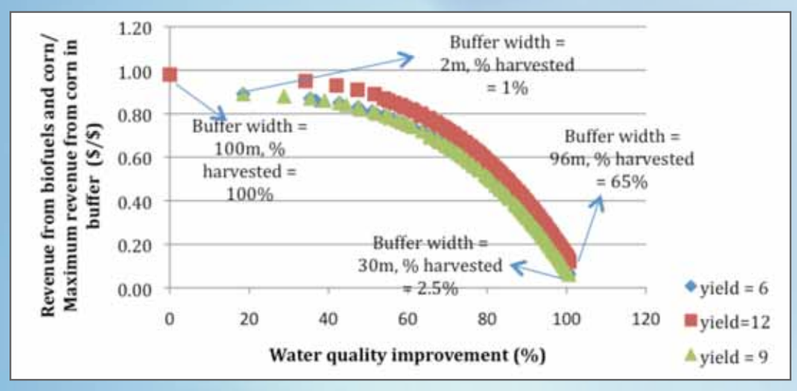
Solution

Argonne researchers are evaluating the sustainable production of bioenergy crops on marginal land (riparian and roadway buffer strips, Conservation Reserve Program [CRP] land) using degraded water resources (nitrate-contaminated groundwater and wastewater). The research is also looking at the potential for growing cellulosic bioenergy crops, such as poplar trees and switchgrass, in optimized systems such that environmental problems become resources for bioenergy feedstock production.

What We've Achieved

An initial analytical assessment at the state and regional scales to estimate availability of marginal land and degraded water resources was completed using GIS technology and available databases from the USDA, USGS, EPA, etc. Our results show there is sufficient marginal land at the regional level to support the production of a large amount of biomass without converting valuable cropland. Further, if degraded water resources are incorporated, these benefits would be significantly greater.

Argonne researchers are developing the framework for a multi-objective optimization tool that allows stakeholders such as farmers, policy makers, and environmental groups to visualize the tradeoffs between different land management strategies based on the preferred objective. This project will incorporate field-scale research in collaboration with Argonne's Environmental Sciences Division and integrates with the systems analysis of EESA. The effort supports DOE's mission of sustainable energy production.



Benefits

Argonne's research is helping enable the sustainable and responsible production of bioenergy, which has the potential to:

- Strengthen the nation's energy security
- Mitigate greenhouse gas emissions
- Revitalize rural economies

Future Work

- Quantify ecosystem services and greenhouse gas emissions at new field sites using this biomass feedstock production strategy
- Collaborate with the USDA to explore social and economic acceptability at the farm scale

Funding for this work is provided by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, Biomass Program.

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