

US EPA ARCHIVE DOCUMENT



ECOLOGICAL RESEARCH PROGRAM

In cooperation with Regions 5, 7 and 8

US EPA ARCHIVE DOCUMENT

FUTURE MIDWESTERN LANDSCAPES STUDY FOCUSES ON ECOSYSTEM SERVICES

Issue:

EPA's Ecological Research Program (ERP) in the Office of Research and Development (ORD) is focused on the study of ecosystem services, or the benefits to human well-being provided by ecological systems. The ERP is initiating studies of ecosystem services in a number of specific places in the United States to better understand these services, and to develop analytical tools that enable decision-makers to take these benefits into account.

One study will be conducted in the Midwest. The Midwest region is critically important in supplying national and global demand for food, fiber, and fuel. Midwestern landscapes also play essential roles in the supply of water to homes and farms, recreation, flood control, and a host of other benefits essential to the quality of life.

The rapid growth of the biofuels industry, which uses crops and other biomass to make liquid fuel, is causing changes in agricultural practices and land uses across the U.S., and most strikingly in the Midwest. EPA's

Regional offices are interested in the long-term environmental implications of these changes. Therefore one component of the ERP, the **Future Midwestern Landscapes (FML) Study**, will examine projected changes in landscapes and ecosystem services in the Midwest. Given its immediate influence, biofuel production will be studied as a primary driver of landscape change.

Scientific Objectives:

The study goals are to:

- Understand how current and projected land uses affect the ecosystem services provided by Midwestern landscapes.
- Provide spatially explicit information that will enable EPA Regions and Programs to articulate sustainable approaches to environmental management.
- Develop web-based tools depicting alternative futures so users can evaluate trade-offs affecting ecosystem services.

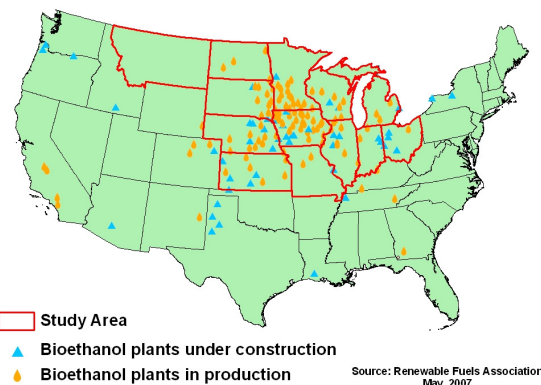


Figure 1. Bioethanol plants in the U.S. as of May, 2007 and proposed ecosystem services study area

Application and Impact:

For a large area of the Midwest, researchers will work with decision makers and use economic and spatial modeling tools to construct alternative landscapes that reflect different assumptions about biofuels policy, technology, and landscape management over the next 10 – 20 years. Some of these will be at the scale of the entire study region, others at subregional or watershed scales. Two distinct types of future scenarios will be created, differing in how landscape change is approached:

Policy-driven scenarios will use forecasting tools to project the landscapes that would be expected to

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result from current or potential energy and agricultural policies. These landscapes will be analyzed to evaluate the regional-scale impacts on ecosystem services as well as implications to national-scale issues such as chemical runoff into the Mississippi River and Lake Erie and loss of critical migratory bird habitat.

Landscape design-driven scenarios

will entail a suite of landscapes that seek to maximize all ecosystem services by placing crops according to soil erodability and productivity, opportunities to provide wildlife habitat, protection of drinking water, etc. These scenarios will help users to explore what is possible and to identify goals at the local or regional level.

The ecosystem services associated with each alternative landscape will be described and compared. A base year of 2005 also will be analyzed to capture a realistic, yet recent “pre-biofuels” landscape as a baseline; earlier years also may be examined to identify crop rotations in use. For some ecosystem services, descriptions are expected to be highly quantitative and include estimates of monetary value; for others only rough approximations will be possible. Many ecosystem services will require that we draw upon the expertise of other federal agencies.

Ecosystem services we will seek to assess include:

- Carbon balance (affects climate)

- Soil productivity (affects food and energy security)
- Hydrology and water quality (affect water supply, flooding, downstream aquatic ecosystems, recreation)
- Wildlife habitat and other natural areas (affect biodiversity and recreation)
- Air quality (affects health)

The landscape analysis methods developed for the FML Study will be implemented as a web-based environmental decision toolkit (EDT), similar to other toolkits previously created under EPA’s Regional Vulnerability Assessment Program (ReVA). We anticipate that the future FML-EDT will allow users to compare alternative Midwestern futures by examining trade-offs – that is, changes in the provision of a wide variety of ecosystem services – at both local and regional scales.

For local-scale decision-makers, we will also investigate the feasibility of incorporating ecosystem services into two existing software applications. The first is I-FARM, a popular, online integrated crop and livestock production and biomass planning tool that is operated by the Leopold Center for Sustainable Agriculture at Iowa State University, and provides a profitability analysis of different crops. The second is Purdue University's Long-Term Hydrologic Impact Assessment / Environmental Quality

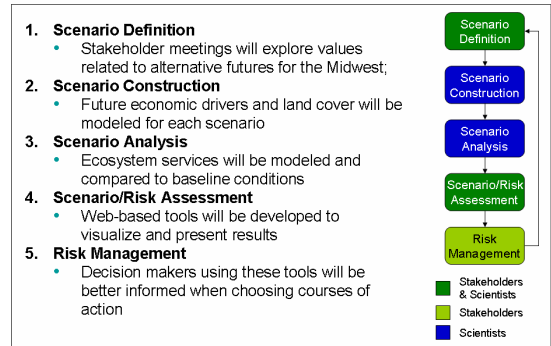


Figure 2. Overview of Research Approach (Liu et al. 2007)

Incentives Program (L-THIA/EQIP), which offers decision-support on best management practices to protect water quality.

General References:

Liu, Y., M. Mahmoud, H. Hartmann, et al., 2007. Formal scenario development for environmental impact assessment studies, in Jakeman, A., A. Voinov, A. E. Rizzoli, and S. Chen (eds), *State of the Art and Futures in Environmental Modeling and Software*. Elsevier (accepted).

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Westcott, P.C., 2007. Ethanol Expansion in the United States: How Will the Agricultural Sector Adjust? USDA FDS-07D-01. 20pp.

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