

Impacts of Land-use Changes on Biofuels

ORNL History of Exploring Changes in Land Use in the United States

For over thirty years ecologist, social scientists and geographers across the Laboratory have documented and explored the processes responsible for land-use change and the implications of those changes. Building from their work on environmental costs and benefits associated with biofuel production, ORNL is now exploring a way to design landscapes that optimize ecosystem health and productivity which should positively impact the sustainability of the biofuels industry.

Building understanding of land-use change from work round the world

ORNL has decades of field expertise investigating the complex forces driving land-use change around the globe (especially Asia, Africa and Latin America) and associated sustainability issues. Understanding how to allocate land-use change impacts due to biofuels production is important to determine eligibility under the Energy Independence and Security Act. This empirical information is essential for modeling baseline land-use change processes as reference points for the analysis of biofuel alternatives. Research suggests that current models also need improvement to reflect other key factors influencing emission calculations, such as fires and soil carbon sequestration.

Modeling land-use change over time and space

- Land-use modeling for US croplands is done using the POLYSYS (Policy Analysis System) agricultural economics model and drawing on ORNL and University of Tennessee (UT) data sets on land management, agricultural inputs, and remote sensing products. The model estimates changes in agricultural land-use as a result of external incentives (for bioenergy crops, carbon sequestration, conservation practices, etc.) and energy and CO₂ emissions associated with all inputs to production, allowing full carbon accounting. On-going work addresses updating cost functions for agricultural and forestry residues and incorporating INL/ORNL design report data.
- ORNL has pioneered the spatial and spectral algorithm and protocol development for remote sensing based land use change detection models for the nation under the Coastal Change Analysis Program (CCAP) and extending this capability at global scale for population distribution modeling.
- ORNL has modeled and identified regions in the US where land-use conversion for bioenergy feedstock production can occur. The modeling predicts potential supply of energy crops across a state and uses this information with current land-cover maps and road networks to spatially distribute potential energy crops and calculate transportation costs.
- Because bioenergy infrastructure is bound to biophysical conditions that vary over space, we are using geospatial competencies to better model implications of land-use change decisions and thus to optimize environmental and socio-economic sustainability of biomass production.
- ORNL's Dynamic Ecological Land Tenure Analysis (DELTA) model developed for an Amazon River Basin study is now being used to provide understanding of how sustainable farming practices can affect carbon emissions and land tenure.

Testing understanding of key forces and Implications via field studies

The State of Tennessee Biofuels Initiative cellulosic ethanol facility in East Tennessee will be provided with switchgrass via a three year contract on former pastures and land used for corn & soybean rotations. UT and ORNL scientists are collecting baseline soil samples on up to 8000 acres to determine total soil carbon, soil structure and soil components, and anticipate determining soil changes over time on these fields which will be used for soil carbon and watershed model verification, pending funding support.

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