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Biofuels and Land-Use Change: Estimation Challenges

Biofuels have been promoted as a low-carbon alternative to petroleum with a range of other possible benefits, including the potential to support the farm sector and revitalize rural communities. In recent years, however, concerns have been raised about the magnitude of land-use change that could be generated as production of biofuel feedstocks like corn, soybeans, and switchgrass increases. A review of research suggests that projected land-use changes as biofuel production expands could potentially generate greenhouse gas emissions and other environmental problems.

Increased demand for land to produce biofuel feedstocks is reflected in the conversion of land directly into feedstock production (direct land-use change) as well as into nonfeedstock crops whose production patterns shift as agricultural commodity prices change (indirect land-use change). If feedstock production in the United States displaces soybean production, which results in the conversion of grasslands or forests for soybean production elsewhere, such conversions are indirect land-use impacts. Indirect land-use change in response to domestic biofuel production can occur anywhere on the globe.

The science of modeling land-use change has evolved rapidly as assumptions about variables such as future crop yields and the productivity of land not yet in production have been challenged and refined. Initial estimates of land-use change assumed that an acre of U.S. land converted to feedstock production would result in an acre of indirect land-use change somewhere. ERS researchers reviewed increasingly sophisticated estimation efforts, which rely on complex analyses of demand responses, historical land-use-change patterns by region, and projected yield and productivity estimates for both domestic and international crops and cropland to answer a series of interrelated questions:

- How much feedstock will be required to meet projected biofuel demand?

- How much land will be required to produce that much feedstock?
- Where will land for feedstock production come from?
- How will domestic and international commodity prices change as land devoted to feedstock production increases?
- How will global agricultural production and trade patterns adjust to these and subsequent price changes?
- What types of land will be affected?

Uncertainty is an unavoidable aspect of policy impact modeling. Representations of this highly complex and uncertain system continue to improve, however, as researchers identify and debate key assumptions, appropriate system boundaries, and methods of accommodating and illustrating system uncertainty. While variability remains, most studies estimate significant increases in land-use requirements for agricultural production resulting from scaled-up biofuel production. Additional research on variables such as projected crop yields and the potential productivity of new lands converted to agriculture, which have been identified as critical drivers in determining the land-use impacts of biofuels policy, will be instrumental in narrowing the bands of uncertainty associated with such projections. W

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This finding is drawn from...

Measuring the Indirect Land-Use Change Associated With Increased Biofuel Feedstock Production: A Review of Modeling Efforts, by Elizabeth Marshall, Margriet Caswell, Scott Malcolm, Mesbah Motamed, Jim Hrubovcak, Carol Jones, and Cynthia Nickerson, AP-054, USDA, Economic Research Service, February 2011, available at: www.ers.usda.gov/publications/ap/ap054/