1st International Symposium on
Energy Challenges & Mechanics

8-10 July 2014
Aberdeen, Scotland, UK

Integration of agricultural and energy system models for biofuel assessment

Amani Elobeid[1], Simla Tokgoz[2*], Rebecca Dodder[3], Tim Johnson[4], Ozge Kaplan[3], Lyubov Kurkalova[5], Silvia Secchi[6]

[1]*Center for Agricultural and Rural Development, Iowa State University, Ames, Iowa, USA*
[2]*International Food Policy Research Institute, Washington D.C., USA*
[3]*National Risk Management Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Research Triangle Park, NC, USA*
[4]*Nicholas School of the Environment, Duke University, Durham, NC, USA*
[5]*Department of Economics and Department of Energy and Environmental Systems and Department of Energy and Environmental Systems, North Carolina A&T State University, Greensboro, NC, USA*
[6]*Department of Agribusiness Economics, Southern Illinois University, Carbondale, IL, USA*

Accepted for publication on 9th May 2014

The use and production of biofuels in the U.S. transportation sector has expanded, accelerated by subsidies, rising gasoline prices, special provisions for flex-fuel vehicles, and 2007 Renewable Fuel Standard. In the past, energy prices influenced agriculture by affecting the costs of producing and transporting agricultural commodities. Now, energy prices directly influence the demand for crops used in biofuels. In the other direction, increased biofuel production impacts transportation fuel prices. Such linkages will be maintained, if not strengthened, in the future since biofuel production is expected to continue to rely on land-based feedstocks since cellulosic biofuel production will utilize agricultural residues or dedicated energy crops. To sum up, agricultural production is now being driven by energy market dynamics, while energy production for transportation purposes is becoming dependent on weather, climate change, and global demand for food and feed. While there is recognition of the need to examine the impacts of biofuel policies on agricultural markets and on energy systems, these are often done in isolation of one another. However, effective policymaking necessitates an integrated agricultural-energy market framework for analysis, since we need to understand the full ramifications of our policy design. Since both current and future biofuel feedstocks are land-based, it is important to assess the effects of these changes on agricultural land use and the environment. This paper presents a modeling framework to capture the dynamics of these 'new' linkages between agriculture, energy and the environment. The framework incorporates agricultural and energy market interactions at the macro-level, and the assessment of production practices and environmental impacts at the micro-level. The integrated modeling framework presented here links two well-established models: the CARD U.S. agricultural markets model and the MARKAL energy systems model. The integrated modeling of agricultural and energy markets will be useful in analyzing a range of scenarios regarding the role of biomass feedstocks from the agricultural sector in an expanding market for biomass-based fuels and energy. Moreover, by linking the macro-level analysis to the micro-scale (field-level) analysis, we can represent shifts in farming practices, average productivity, and costs of production, as well as the environmental consequences of farmers' decisions.

Keywords: Biofuels, agricultural markets, energy systems, environment;