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Evaluating potential land use constraints on food and bioenergy production: Are low carbon sustainable biofuels possible?

Ethan B. Davis, Pennsylvania State University, State College PA, USA.

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Increasing population and consumption patterns are driving higher demand for food and energy, placing additional pressures on already stressed agricultural and natural resources. This is especially true in Latin American and African countries which tend to have high population growth rates and relatively low per capita energy consumption. Moreover, with today's globalized economy, changes due to E.U. or U.S. biofuel or agricultural policies could trigger development patterns in Latin America or elsewhere that arises in response to changes in international food or bioenergy markets. This leads to questions regarding the sufficiency of existing cropland to feed and fuel the world without clearing forests or converting grasslands to agricultural uses. The food vs. energy dilemma is ultimately determined at the nexus of land productivity and land scarcity. This research examines how consumption and production of food for a growing population can result in strikingly different agricultural land use patterns. Outcomes from previous researchers suggest that a scarcity of agricultural land could constrain biofuels, or just the opposite, and find there is an abundant supply of land for both food and bioenergy. Using geographically distributed models, we examine how ecological intensification on grazing land could potentially spare land which could be kept in food production, used for biofuels, or become grassland or forest. Growing degree days, average precipitation, precipitation variability, future climates, soil fertility, and soil erosion are all potentially limiting factors. A precipitation index was developed to determine how variability could impact forage yields and subsequently ungulate production. The role of future climates on intensification is estimated using output from Global Climate Models (GCMs) for various IPCC emission scenarios. The Food and Agricultural Organization Harmonized World Soils Database was used to develop proxies for soil fertility and inputs for the RUSLE soil erosion model. We will evaluate two different techniques for estimating intensification—a climate binning approach and a statistical approach (random forest). Outcomes will further our understanding of the degree to which biofuels and food may or may not be constrained by land availability—especially in Latin American and African countries.

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