Assessment of Marginal Lands for Bioenergy Crop Production in the Continental U.S.

Sarah Acquah[1*](sa31@illinois.edu), Chongya Jiang[1], Kaiyu Guan[1], and **Madhu Khanna[1]**

[1]University of Illinois at Urbana-Champaign, Urbana, IL.

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Project Goals: This project seeks to: (A) assess the availability of low-quality land that is currently not under active and continuous crop cover or continuously under grass cover in the Continental United States; and (B) determine the supply of biomass from energy crops (Miscanthus and Switchgrass) and crop residues (corn stover and wheat straw) at various biomass prices considering the availability of different land types and the yields of energy crops on these land types.

The Renewable Fuel Standard (RFS), established in 2007 by the Energy Independence and Security Act (EISA), sought to increase biofuel production through conventional and advanced biofuels based on the type of feedstocks. While the mandate for 15 billion gallons of corn ethanol has been met, a minimum level of 16 billion gallons of advanced biofuels from cellulosic biomass is yet to be established. To achieve the cellulosic target, emphasis is placed on cellulosic feedstock production from perennial energy crops such as miscanthus and switchgrass. Both are particularly attractive because of their high yields per unit land, low input requirement, and the ability to grow on low-quality lands that are not productive for row crop agriculture. A major concern with large-scale biofuel production is the competition it poses for land under food/feed production versus fuel, its implications for food/feed prices, and indirect land use change that can offset some of the greenhouse gas benefits of biofuels.

Several studies have proposed that idle, degraded, and abandoned lands could be used to produce perennial energy crops that would avoid competition with food production, since the yields of these crops are less susceptible to soil quality than those of annual row crops (Tilman et al., 2006; Campbell et al., 2008; Fargione et al., 2008; Christopher et al., 2007; Cai et al, 2010; Nijsen et al., 2011; Clifton-Brown et al., 2011). These studies have attempted to measure land availability using different data sources and different definitions of available land categories. Yet, the non-consensus characterization of land availability has led to results that are not only difficult to compare, but also provide only a partial assessment of land available for bioenergy crop production. For example, Campbell et al. (2008) estimate the amount of abandoned land, Cai et al. (2010) estimate marginal agricultural land, while Nijsen et al. (2011) estimate the amount of degraded land available for biomass production. Campbell et al. (2008) defined abandoned land as land no longer in crop or pasture due to the relocation of agriculture and due to degradation from intensive use. Cai et al. (2010) consider several possible definitions of marginal land based on its biophysical productivity and do not consider whether that land is

currently under crop production or idle. Nijsen et al. (2011) define degraded land based on expert consultation with some soil scientists and qualitative soil characteristics that indicate the reduced suitability of that land for crop production, and Gelfand et al. (2013) examine the availability of marginal lands, based on soil quality and slope. In addition, prior assessment of land availability for biofuels based on a biophysical definition of marginal land disregards the fact that land use is determined by economic factors, such as crop prices, which vary over time and can affect the extent to which even low-quality land might be used for conventional crop production.

We propose a novel approach for assessing the amount of marginal land in the rainfed region of the U.S. Marginal land is defined as land that was classified as cropland at a point in the past but has been classified as a non-cropland cover type for at least two consecutive years. Potential marginal lands are identified by removing permanent croplands, permanent natural vegetation, permanent non-vegetated areas, and low-productive soils. This is implemented through a comprehensive spatiotemporal analysis using the 10 years 30-m resolution satellite data and soil survey data across the continental U.S.

The results are expected to show the amount of marginal land available in rainfed U.S. that is economically and biophysically suitable for energy crop production. The analysis will also indicate the spatial distribution and productivity of marginal land. This research is based on a dynamic view of marginal land as reflected in the variations in land use (and not just biophysical attributes) and its availability for producing bioenergy crops which varies with economic drivers. The prevailing impression implicit in most analyses to date is that land availability is fixed and static. Our approach incorporates economic determinants of land availability and will provide a realistic view of the production capacity on low-quality land. The results will stimulate discussion on the potential for using marginal land for bioenergy crops and the extent to which these crops can avoid competition for land with food crop production.

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