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What type of landowner would supply marginal land for energy crops?

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ABSTRACT

Landowner perspectives can inform policy to encourage expansion of energy crop production onto non-crop, marginal land. This paper analyzes a survey of owners of non-crop marginal land in southern Michigan to classify landowners by their attitudes toward energy crop production. A factor analysis identifies common factors underlying their perceptions of bioenergy production, and those factors are used in a cluster analysis that classifies landowners into four types: disamenity-sensitive, profit-oriented, bioenergy supporters, and bioenergy skeptics. Multinomial logit regression using the identified landowner types elucidates how these types are grounded in landowners' perceptions of bioenergy production and their socioeconomic characteristics. Policy makers aiming to encourage bioenergy production should target the profit-oriented landowners and the bioenergy supporters as they are most open to energy crop production.

1. Introduction

Alternative energy development can play an important role in mitigating greenhouse gas emissions and reducing dependence on fossil fuel. Bioenergy is one promising form of renewable energy. It can be produced from a variety of energy crops, including row crops such as corn and wheat, perennial grasses, and woody crops. While bioenergy production from energy crops is a valuable initiative, there is widespread concern about the impacts of converting to bioenergy uses agricultural land that currently produces food. Converting cropland to bioenergy crops could increase greenhouse emissions [1], intensify the competition with food needs leading to decreased supply of food [2], and induce a stronger impact of fuel price on agricultural prices [3].

In order to mitigate the food system effects of bioenergy production on crop land, energy crops could be grown on marginal lands that have limited potential for food production. For instance, perennial grasses could be grown in marginal lands since they require less fertile soils [4]. Marginal land is typically defined by agronomists as land where productivity is reduced due to soil, climatic, or environmental restrictions (e.g., low soil fertility, high erodibility, steep slope, or poor drainage) [5,6]. On the other hand marginal land can be also defined in economic terms as land with a low potential for profit [7]. In this study we use the biophysical definition and define marginal land as land that does not contribute to food production and therefore its use for bioenergy crops is

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unlikely to affect food and feed supplies. For purposes of this study, there were two major advantages of using a biophysical definition of marginal land. First, such definitions are well suited to using remotely sensed geographic information systems databases to identify land parcels. Second, much of the academic debate has centered on the biophysical availability of marginal land for energy crop production [6] and the potential of bioenergy crops (especially bioenergy perennials) to provide environmental [8,9] and economic benefits to landowners [10].

The biophysical potential of marginal lands to give satisfactory biomass yields while mitigating greenhouse gas emissions is demonstrated by Gelfand et al. [6] in a study that examines productivity, greenhouse gas emissions and climate benefits of six biofuel-cropping systems in the midwestern United States over a 20-year period. The biophysical potential of marginal land to produce energy biomass is a necessary but not sufficient condition for a sustainable bioenergy industry. It is also essential that landowners be willing to make this land available for bioenergy crops.

Decisions to make marginal land available for bioenergy crops are influenced by a large number of factors, including agricultural policies, markets, social norms, cultural beliefs, and networks [11,12]. There is a growing literature on assessing how farmers' and landowners' attitudes and perceptions affect decisions to grow energy crops on cropland. Decisions to grow energy crops are affected by knowledge of production practices related to energy crops [13], information on their environmental implications, market structure [14], concerns on the economic viability of energy crops [15], land suitability issues, renting land based concerns, and market constraints [7,16]. Identifying traits of landowners willing to grow energy crops on their marginal land is crucial for assessing the potential of transforming marginal land to produce energy crops. Acosta et al. [17] used a cluster analysis and identified three types of stakeholders (i.e., idealist, ambivalent, realist) based on their perceptions on bioenergy and its effects on food security and economy in the Philippines.

The existing literature has mainly focused on farmers' willingness to grow energy crops on cropland. Little attention has been given to the traits that drive the willingness of owners of marginal land to make this land available for energy crops. This study aims to fill that gap by identifying the traits of owners of marginal land that influence their willingness to allow energy crops to be grown on their land. Hence, the goal of this study is to classify owners of marginal land based on their perceptions of bioenergy production and their willingness to make land available for bioenergy crops. By elucidating the characteristics of landowners who are willing to allow land to grow energy crops, the results of this analysis can help policy makers to design policies that encourage diffusion of bioenergy feedstock production.

The remainder of the article is structured as follows. Section 2 outlines the geographical context of the study, describes the data, and characterizes the empirical methods used to classify landowners according to their willingness to make land available for bioenergy crop production. In Section 3, results are analyzed, discussed and compared to results obtained from other studies. Finally, Section 4 presents conclusions, highlighting the opportunities for future work.

2. Data and methods

2.1. Data

The study makes use of a landowner survey carried out in the southern half of the Lower Peninsula of Michigan in 2012 [18]. The study focuses on landowners of non-crop marginal land. Since there existed no list of such owners, an area frame sample built from GIS databases of non-crop marginal lands was created. Area frame sampling is the process of selecting landowners whose ownership parcel intersects the area frame [19]. The Cropland Data Layer (CDL) [20] was used to create an area frame consisting of all current marginal lands in Michigan. Of the 53 land cover categories in this database, marginal land was defined as including: a) fallow cropland, b) shrubland, c) grassland, and d) pasture or hay. The study covers the southern half of the Lower Peninsula of Michigan (Michigan counties south of the county of Clare, around 43.9° latitude) where most of the state's agriculture is located. Twelve counties in this area were randomly selected from among the 57 non-metropolitan counties: Allegan, Barry, Branch, Ionia, Isabella, Lenawee, Livingston, Newaygo, Saginaw, Sanilac, Tuscola, and Van Buren. The sample in each of the selected counties included landowners with continuous parcels of non-crop marginal land greater than 4 ha. A random selection of these landowners took place and they were identified using county tax records. The sampling method resulted in a total of 1152 potential respondents.

The survey included questions on landowners' current land management and land uses, awareness of certain features of bioenergy crops, willingness to supply land for bioenergy crops, attitudes towards the environment and what concerns they might have with renting their land for bioenergy crops, and their general socioeconomic characteristics. Concerning land management and land uses, respondents were asked whether they currently rented any of their land, and whether they used it for any non-agricultural uses. The section on landowner willingness to supply land for bioenergy crops included binary choice questions on willingness to rent specific types of land (i.e., cropland, pasture, other land) for different bioenergy crops (i.e., corn[1], switchgrass, poplar, and prairie). Next, respondents were asked whether they strongly agreed or disagreed with 22 statements concerning attitudes towards the environment and concerns they might have with renting their land. The rating of each statement was based on a five-point Likert scale, including 'strongly disagree' (1), 'disagree' (2), 'neutral' (3), 'agree' (4), and 'strongly agree' (5). These statements were presented in three broad categories: willingness to rent land (e.g., renting rural land for different land uses such as growing crops or storing crop feedstock) (six statements), bioenergy and the environment (e.g., the

[1] Although corn yield on marginal land is reduced (Varvel et al.) [21], corn is included in the study as a potential bioenergy crop because corn is by far the most widely grown bioenergy crop in the United States.