Energy Economics 55 (2016) 292–302

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneeco

Farmers' willingness to contract switchgrass as a cellulosic bioenergy crop in Kansas

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ARTICLE INFO

Article history:
Received 16 September 2014
Received in revised form 4 August 2015
Accepted 29 January 2016
Available online 26 February 2016

JEL classification:
Q1
Q2
Q4

Keywords:
Switchgrass
Cellulosic biofuel
Stated choice survey
Farmer adoption
Latent class

ABSTRACT

Farmers' adoption of cellulosic biofuel feedstock enterprises plays an important role in the future of agriculture and the renewable fuels \industry. However, no set markets currently exist for bioenergy feedstocks outside of very localized geographic locations and farmers may be reluctant to produce the feedstocks without contracts that help mitigate uncertainty and risk. This study examines farmers' willingness to grow switchgrass under contract using a stated choice approach. Data were collected using an enumerated survey of Kansas farmers and analyzed using latent class logistic regression models. Farmers whose primary enterprise is livestock are less inclined to grow switchgrass. Shorter contracts, greater harvest flexibility, crop insurance, and cost-share assistance increase the likelihood that farmers will grow switchgrass for bioenergy production.

1. Introduction

Much research has assessed the technical feasibility of producing biofuels from lignocellulosic materials on agricultural land in North America (De la Torre Ugarta et al., 2007; Graham, 1994; Graham et al., 2007; Heid, 1984; Gallagher et al., 2003; Perlack et al., 2005; Walsh et al., 2003; Nelson et al., 2010). However, technical feasibility studies do not assess "necessary economic and institutional conditions" required by a cellulosic biofuel industry (Rajagopal et al., 2007). While farmers' ability to produce adequate quantities of biomass for bioenergy throughout the Great Plains has been determined economically feasible, their willingness to do so under different contractual, pricing, and harvesting conditions is relatively unknown, especially with respect to perennial biomass crops such as switchgrass and miscanthus. Large-scale commercial production of these biomass sources is not yet viable economically, and a great deal of uncertainty exists about biomass production, storage, and transportation (Qualls et al., 2012; Alexander et al., 2012).

The lack of an established market adds a great deal of uncertainty for farmers during development of this nascent industry. Farmers' willingness to adopt new technologies or practices often depends on their knowledge of the technology or practice and their skills at operating or implementing the practice (Pannell et al., 2006). However, farmers' willingness to grow new crops likely depends not only on knowledge and skill, but also on land tenure, demographic, and social characteristics. Some research has attempted to determine how these factors affect farmers' adoption characteristics with respect to biofuel crops (Bransby, 1998; Hipple and Duffy, 2002; Jensen et al., 2007; Kelsey and Franke, 2009; Paulrud and Laitila, 2010; Qualls et al., 2012). Farmers will grow bioenergy crops if the returns to the crop outweigh production costs, including opportunity costs (Rajagopal et al., 2007). However, the production of dedicated energy crops combined with decreases in traditional crop, forage, and livestock production will cause prices for these displaced commodities to increase in the long term, increasing competition for dedicated energy crops (Dicks et al., 2009; Walsh et al., 2003).

Because biomass markets are not yet established, it is likely that farmers will grow bioenergy crops only under contractual relationships that establish pricing, timeframe, harvest parameters, storage requirements, acreage requirements, quality levels, and other arrangements between farmers and biorefineries (Altman et al., 2007; Epplin et al., 2007; Glassner et al., 1998; Larson et al., 2007; Stricker et al., 2000; Wilhelm et al., 2004). Disparities between biorefineries and farmers'

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http://dx.doi.org/10.1016/j.eneco.2016.01.015
0140-9883/

views about the value of the biomass necessitate careful contract design so all parties are satisfied.

A potential bioenergy crop in the Great Plains is switchgrass. Switchgrass planting decreases soil erosion over cultivation, uses less nitrogen fertilizer than corn, requires lower herbicide applications except in the establishment year, and is both more drought and flood tolerant than traditional crops (McLaughlin and Walsh, 1998). However, switchgrass production is less likely to occur on highly productive land and may be more suitable for marginal land or land already enrolled in conservation programs, such as CRP, to increase revenue (Paine et al., 1996). Paine et al. (1996) recommended growing switchgrass and other perennial energy crops on marginal lands, such as highly erodible land (HEL), poorly drained soils or areas used for wastewater reclamation, which would avoid competition with food crops and increase the amount of arable land. HEL land is generally unsuitable for residue removal, but potentially viable for perennial energy crop production. USDA (2006) states that switchgrass requires few field passes and little soil disturbance resulting in low soil erosion rates.

The purpose of this study is to determine farmers' willingness to grow switchgrass as a bioenergy crop while helping facilitate contract design and biomass price establishment. With farm profitability expected to decline in 2015 from record highs during the period 2011 to 2013, it is even more important to assess whether farmers are willing to enter into bioenergy crop enterprises or continue with their established practices. A stated choice survey was developed to elicit Kansas farmers' willingness to grow switchgrass as a bioenergy crop under alternative contractual, pricing, and harvesting arrangements. The stated choice format allows farmers to choose among alternatives following Hensher et al. (2005) and survey results are analyzed using a latent class conditional logistic regression model (Greene and Hensher, 2003).

The next section discusses growing switchgrass as a bioenergy crop, followed by a description of the survey and data. The conceptual model and econometric analysis follow the survey discussion. Finally, the results and conclusions finish the paper.

2. Switchgrass as a bioenergy crop

The viability of producing switchgrass as a bioenergy feedstock in the Great Plains has been the topic of much research (Perlack et al., 2005; Mapemba and Epplin, 2004; Epplin et al., 2007; Bangsund et al., 2008; Perrin et al., 2008). The switchgrass is a perennial grass, native to much of the Great Plains, and has been identified as a significant potential bioenergy crop based on research conducted across 31 locations over several years in the late 1980s and early 1990s. It requires low maintenance after its establishment phase, is noninvasive, and is suited to many soil types in different parts of the country, including marginal lands not as productive for high-value crops such as corn or soybeans (Wright, 2007). Harvesting, transporting, and storing switchgrass are similar to well-established hay production practices (Wright, 2007), although long-term biomass storage may reduce ethanol yields (Rigdon et al., 2011).

Production costs for switchgrass in the initial establishment phase vary depending on the amount of field preparation needed, fertilizer needs, and seeding rate. Establishment costs can range from about $150 to $200 per acre while yield during the first 2 years of production are reduced until the crop becomes fully established (Griffith et al., 2010). Annualized costs of establishing switchgrass are between $20 and $30 per acre over 10 years. Annual production costs can range from $175 to $285 per acre, depending on biomass yields (2 to 6 tons per acre), transportation costs, and capital costs (Griffith et al., 2010). Switchgrass is planted in the spring and weeds are controlled via spraying, mowing, or grazing (Ohlenbusch, 1997). After the crop is well established, 90 to 120 lb of nitrogen fertilizer can be applied to increase production, followed by phosphorus and potassium if soil testing warrants it (Ohlenbusch, 1997; Teel et al., 2003). Fertilizer rates and costs will vary depending on soil requirements and location.

McLaughlin et al. (2002) determined that there is potential to produce switchgrass in the United States east of the Rocky Mountains on 16.9 million acres at a price of $39.92 per short ton at the farm gate. This price may entice farmers to plant switchgrass rather than traditional crops if yields are high. However, record-high commodity prices in recent years may preclude farmers' planting of switchgrass in favor of traditional cash crops.

3. Materials and methods

A stated choice survey was administered from November 2010 to February 2011 in three areas of Kansas by Kansas State University and the USDA, National Agricultural Statistics Service (NASS). The survey assessed farmers' willingness to produce three different types of

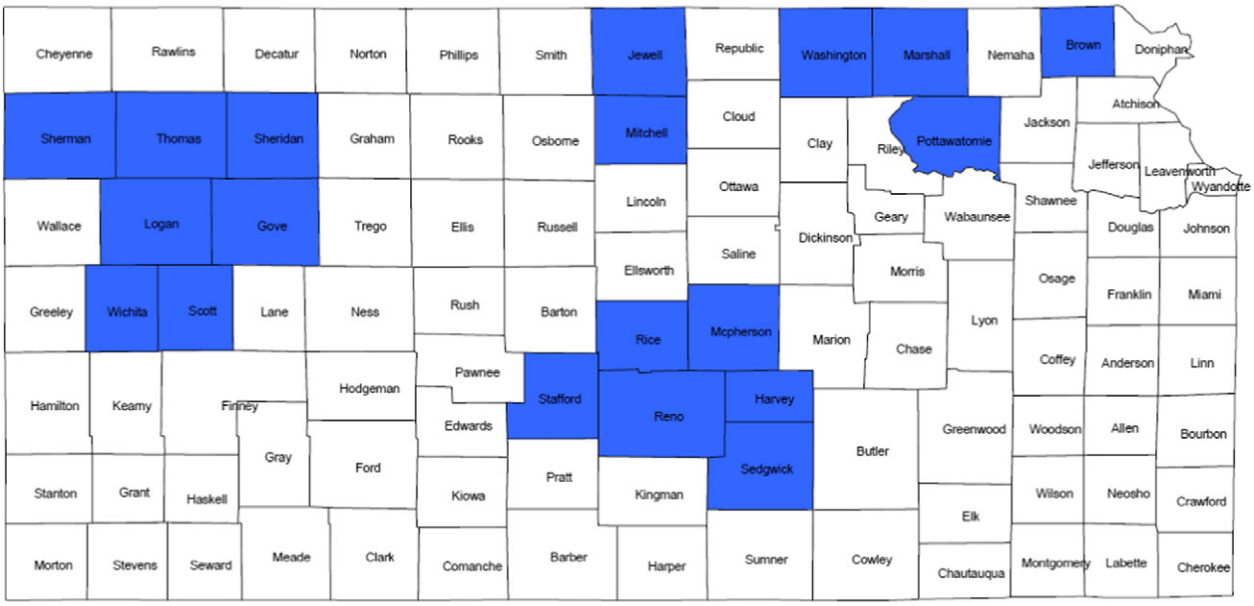

Fig. 1. Map of state of Kansas with survey areas highlighted.