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Research Paper

How do sociocultural factors shape rural landowner responses to the prospect of perennial bioenergy crops?

Weston M. Eaton[a,*], Morey Burnham[b], C. Clare Hinrichs[a], Theresa Selfa[c], Sheng Yang[d]

[a] Pennsylvania State University, Department of Agricultural Economics, Sociology, and Education, Armsby Building, University Park, PA 16802, USA
[b] Idaho State University, Sociology, Social Work, and Criminology, 921 S. 8th Avenue, Stop 8114, Pocatello, ID 83209, United States
[c] State University of New York College of Environmental Science and Forestry, Department of Environmental Studies, 106 Marshall Hall, 1 Forestry Drive, Syracuse, NY 13210, USA
[d] State University of New York College of Environmental Science and Forestry, Department of Environmental Resources Engineering, 402 Baker Lab, 1 Forestry Drive, Syracuse, NY 13210-2787, United States

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ABSTRACT

Renewable energy transitions in the U.S. have included growing interest in promoting perennial bioenergy crop production within different rural landscapes. However, landowners' receptivity to such land use and development in mixed-use landscapes is not well understood. Previous research has shown that economic motivations and market factors contribute to farmer decision-making about growing energy crops in working landscapes, while research on public responses to renewable energy technologies has found that sense of place and symbolic meanings regarding land, nature, and technologies are influential. The goal of this study is to integrate these strands of research to examine the influence of sociocultural factors on both landowners' general support for local bioenergy crop production and their willingness to participate directly by growing dedicated energy crops in mixed-use landscapes. The study draws on a survey completed by 908 landowners and farmers in rural New York, Pennsylvania, and Ohio. Seeing bioenergy as a broadly progressive technology significantly increased the likelihood of support for local bioenergy crop production, as did having a college degree and larger landholdings, while sense of place factors were not significant. Seeing bioenergy as a progressive technology also significantly increased the likelihood of being willing to grow bioenergy crops on one's own land, as did having a college degree, knowledge about switchgrass, having idle land, as well as concerns about bioenergy markets. This study demonstrates that in addition to other variables, sociocultural factors influence both support for local bioenergy crop production and landowner willingness to grow bioenergy crops on their own land.

1. Introduction

Many technical and scientific experts have turned to perennial bioenergy crops, such as warm-season grasses and short rotation woody plants, as an answer to some of the environmental and food security problems associated with the widespread production of maize and other first generation bioenergy crops (Pimentel et al., 2009; Searchinger et al., 2008; Borras Jr, McMichael, & Scoones, 2010; German et al. 2017). Perennial bioenergy crops have been shown to improve soil, water, and air quality (Dale, Lowrance, Mulholland, & Phillip Robertson, 2010; Dale, Efroymson, Kline, 2011; U.S. Department of Energy, 2016), as well as potentially address food security problems associated with growing energy crops on productive agricultural land because perennial bioenergy crops can be grown on marginal or abandoned cropland (Baxter & Calvert, 2017; Milbrandt, Heimiller, Perry, & Field, 2014; Shortall, 2013; Stoof et al., 2015). Many bioenergy advocates further envision perennial bioenergy crop production as providing economic development opportunities in flagging rural communities (Burnham, Eaton, Selfa, Hinrichs, & Feldpausch-Parker, 2017).

In the United States, where bioenergy currently provides nearly half of all renewable energy produced (EIA, 2018) analysts report perennial bioenergy crop production could provide up to 61 percent of the nation's biomass by 2030 and replace as much as 30 percent of its petroleum feedstock (U.S. Department of Energy, 2016). Importantly, the abandoned and marginal lands targeted for perennial bioenergy crop production are privately owned and dispersed across working and mixed-use landscapes (Baxter & Calvert, 2017). The term "working landscapes" refers to lands where land managers strive to produce market goods (e.g., crop production) and non-market goods (e.g., environmental benefits) in a synergistic fashion (Plieninger, Ferranto,

* Corresponding author.
E-mail addresses: eatonwes@psu.edu (W.M. Eaton), burnmore@isu.edu (M. Burnham), chinrichs@psu.edu (C.C. Hinrichs), tselfa@esf.edu (T. Selfa), syang16@syr.edu (S. Yang).

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Huntsinger, Kelly, & Getz, 2012), while the term mixed-use landscapes refers to areas where non-commercial land use activities, such as recreation or other amenity-based land uses, are interspersed among commercial production farming activities. Thus, establishing widespread perennial bioenergy crop production across these diverse land use contexts will require engaging both farming and non-farming landowners, with a range of commercial and non-commercial interests, who reside in and manage mixed use landscapes (Eaton, Burnham, Hinrichs, & Selfa, 2017; Hipple & Duffy, 2002).

A growing body of social science literature has found that multiple economic, demographic, structural and social constraints, and non-commercial production objectives shape landowners' decision-making about growing bioenergy crops on their lands (Skevas, Swinton, & Hayden, 2014; Swinton, Tanner, Barham, Mooney, & Skevas, 2017; Dorning, Smith, Shoemaker, & Meentemeyer, 2015). While this research has provided key insights into farmers' willingness to plant bioenergy crops in the context of working landscapes with a uniform set of landowners (Cope, McLafferty, & Rhodes, 2011; Villamil, Alexander, Silvis, & Gray, 2012), only a few studies have investigated how landowners with varied land use goals and priorities have responded to the prospect of producing bioenergy crops in mixed-use landscapes (Skevas, Hayden, Swinton, & Lupi, 2016; Swinton et al., 2017). Further, while profit related factors, including willingness to pay measures, have helped to explain farmers' decision-making in working landscapes, how non-commercial, sociocultural factors shape both farming and non-farming landowners' willingness to grow perennial bioenergy crops on their land, and their support for local production in mixed-use landscapes remains under examined (Galik, 2015).

The primary objective of this article is to broaden the literature on rural responses to bioenergy crop production by jointly investigating attitudinal and behavioral responses of both farming and non-farming landowners to bioenergy crop production in mixed-use landscapes. Gaining this knowledge is important to temper policy assumptions about the availability of privately-owned rural lands for extensive establishment of second-generation biomass energy feedstock crops and to inform more responsive engagement strategies with landowners and other local stakeholders (Araújo, Mahajan, Kerr, & Da Silva, 2017; Eaton et al. 2017). To do this, we bring the literature on *farmer* responses to bioenergy crops, including their decision-making on bioenergy crop adoption, into conversation with a body of scholarship on *public* responses to and acceptance of local bioenergy development (Rossi & Hinrichs, 2011; Selfa, Kulcsár, Bain, Goe, & Middendorf, 2011; Upreti & van der Horst, 2004; Van der Horst & Evans, 2010; Selfa, Iaroi, & Burnham, 2015; Eaton, Gasteyer, & Busch, 2014) and related land use projects (Devine-Wright, 2011, 2012). This latter body of research on public acceptance has found that sociocultural factors, that is, the suite of factors not captured in a profit-based motivation framework, influence positions of support and opposition for local bioenergy and other renewable energy technology developments. As we detail below, sociocultural factors assessed in these studies include the symbolic meanings people attribute to their community, land and landscapes, and technology development projects (Jacquet & Stedman, 2013; Anderson, Ford, & Williams, 2017; Eaton, 2016; McLachlan, 2009), as well as dimensions of the sense of place conceptual framework (i.e., attachment, identity, dependence) (Devine-Wright, 2011, 2012; Stedman, 2003).

Studying landowner responses to perennial bioenergy crop production in mixed-use landscapes provides a unique opportunity to bridge these literatures because successful bioenergy development hinges both on local support for local bioenergy crop production, processing facilities, and other infrastructure required to support it, as well as on landowner willingness to grow bioenergy crops on their lands. This study offers an investigation into symbolic meanings, sense of place, and other sociocultural factors in mixed-use landscapes as drivers of willingness to grow and support for local bioenergy crop production across both farming and non-farming landowners.

2. Literature review

2.1. Landowner decision-making on bioenergy crops

While bioenergy crop models typically assume landowners are profit maximizers, research on landowner decision-making to plant bioenergy crops has shown that both economic and non-economic factors play roles in determining willingness to plant bioenergy crops (Galik, 2015). In a systematic review, Galik (2015) found that three groups of factors provide a "more comprehensive view" of willingness to adopt bioenergy crops than strict reliance on profit maximization. These include a) the non-production objectives of landowners (e.g. management preferences for wildlife habitat, recreation, hunting, conservation, and aesthetics) (e.g., Hipple & Duffy, 2002; Cope et al., 2011); b) structural, social, and demographic factors (e.g. age, farm size, existing cropping system, soil type, location, participation in other farm related programs, and time availability) (e.g., Jensen et al., 2007; Skevas et al., 2016); and c) the influence of market features (e.g., financial and policy risk and uncertainty, as well as perceptions of markets, contracting, and information) (e.g., Skevas et al., 2014).

Studies that investigate landowner willingness to plant bioenergy crops or supply biomass by incorporating these and other sociocultural considerations have indicated that, "[D]ecisions about land are based not only on economic imperatives but also pragmatic concerns related to farming practices, social relations such as tenancy, aesthetic judgments about landscape appearance, values about environmental stewardship, and attitudes toward nature, family, and community" (Cope et al., 2011, p. 854; see also Becker, Eryilmaz, Klapperich, & Kilgore, 2013; Joshi & Mehmood, 2011; Markowski-Lindsay et al., 2012; Rämö, Järvinen, Latvala, Toivonen, & Silvennoinen, 2009; White & Selfa, 2013). This research has also found landowner attitudes about the natural environment and technology development may shape willingness to adopt bioenergy crops (Cope et al., 2011; Skevas et al., 2014, 2016). To improve our understanding of these processes in the context of mixed-use landscapes, we test several of these established measures in our study, including the non-commercial production objectives of landowners and structural, social, and demographic factors, as well as include measures for the role of SOP and symbolic meanings, both discussed below.

2.2. Sense of place

Recent research on landowner behavior has investigated how landowner SOP is related to conservation decision-making (Cross, Keske, Lacy, Hoag, & Bastian, 2011; Mullendore, Ulrich-Schad, & Prokopy, 2015). First explored in amenity landscapes, SOP describes people's subjective experience of their lived socio-physical environment (Stedman, 2003). This broad concept has been shown to consist of three distinct dimensions (Jorgensen & Stedman, 2001). The first, place dependence, describes "a tangible reliance on an environment" (Mullendore et al., 2015, p. 68) or locality. This reliance can either be an economic dependence (Cross et al., 2011) or dependence as measured by how the physical characteristics of a place enable particular forms of activity, such as hiking or hunting. Second, place identity emphasizes a cognitive connection between individuals and an environmental setting. Third, place attachment describes an emotive connection between individuals and specific places (Jorgensen & Stedman, 2006).

Work on SOP by Stedman (2003); Jorgensen & Stedman, 2001) focused on amenity property landowners, and established SOP as a concept capable of predicting conservation behavior. Recent scholarship on SOP in working landscapes has found that the meanings landowners attribute to landscapes influence their land management behavior (Cross et al., 2011; Jorgensen & Stedman, 2006; Mullendore et al., 2015; but see Dorning et al., 2015 for a counter-example). In a survey of farmers in central Indiana, Mullendore et al. (2015) found

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