



Determinants of Motives for Land Use Decisions at the Margins of the Corn Belt



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ABSTRACT

The extent of United States Great Plains grass agriculture has ebbed and flowed over decades in response to market incentives, government policies, technological innovations and weather patterns. Our thesis is that the land most responsive to these drivers is at the economic margin between grass-based production and cropping. Much of the eastern Dakotas is such an area, primarily under crop-based agriculture although grass remains an important land use. We surveyed land operators in the area on their views about motivators for land use choices. Their views are largely consistent with the economic margin viewpoint. The importance of crop output prices, crop input prices, innovations in cropping equipment and weather patterns on land use decisions grow as one moves north toward the economic margin. Land in more highly sloped areas is more sensitive to crop prices and crop insurance policies. Consistent with human capital theory, older operators are generally less responsive to factors that affect land use. Those renting more land, being more exposed to market forces, are more responsive. As farm size increases, respondents declared higher land use sensitivity to policy issues and technological innovations, suggesting that scale effects render land units more sensitive to land use change drivers.

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1. Introduction

An increase in grassland to cropland conversion in the United States has occurred in recent years. According to Claassen et al. (2011a), much of this conversion has taken place in the Northern Plains. This region, which includes Kansas, Nebraska and the Dakotas, encompasses 18% of the U.S. rangeland but accounted for 57% of U.S. rangeland to cropland conversion during 1997 to 2007. Similar findings were reached by Faber et al. (2012), who estimated that between 2008 and 2011, 23.7 million acres of grassland, shrub land and wetlands were converted to cropland across the U.S., with more than 3.2 million acres of habitat removed in the Dakotas alone. Focusing on land cover data from the Western Corn Belt between 2006 and 2011, Wright and Wimberly (2013) concluded that grassland conversion was mostly concentrated in the Dakotas, east of the Missouri River. Lark et al. (2015) imputed that net conversion

to cropland during the 2008–2012 interval was 0.21 million acres in North Dakota and 0.53 million acres in South Dakota.

Grassland conversion is associated with many undesirable consequences. Firstly, the resulting loss of habitat has negative consequences for many grassland-dependent species, including North American duck, Sprague's Pipit and the Dakota Skipper butterfly (Swengel and Swengel, 2015; Lipsey et al., 2015). In addition, grassland is associated with less soil erosion potential than cropland (Pimentel et al., 1995). Conversion to cropland also causes secondary effects such as downstream water pollution, due to increased agricultural use as well as the elimination of buffers that filter farm runoff (Faber et al., 2012). In addition substantial amounts of stored carbon provided by well-managed grassland will be lost upon conversion to cropland (Eve et al., 2002; Gascoigne et al., 2011) and recovery may take decades once the losses occur (Gelfand et al., 2011). Furthermore, soil microorganisms, which are important to the quality of grassland habitat, cannot be readily restored (Johnson, 2000).

Efforts to protect ecosystem services have been diverse. Some have addressed revenue claims that property rights support, rather than the property rights themselves. Commencing with the 1985 Farm Bill, growers found to have drained wetlands are deemed ineligible for

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certain government farm payments. In that bill highly erodible land was also made ineligible for certain government payments related to crop production unless an environmentally sound land management plan was agreed between operator and the government. However the advent of conservation tillage in conjunction with glyphosate tolerant crop seed has weakened this indirect constraint on cropping (Perry et al., 2016). The 2014 Farm Bill constrained the availability of subsidized crop insurance for those who convert native grassland to cropping. Other interventions have addressed property rights directly, for example a 2015 Environmental Protection Agency ruling that sought to bring many comparatively isolated wetlands under the Clean Water Act jurisdiction.

Perhaps the most targeted and extensive interventions have been grassland and wetland easements, which use 'Duck Stamp' hunting fees to buy conservation easements from willing landowners. The Northern Great Plains are predominately privately owned (Hardy Vincent et al., 2014). As a result, land use management decisions, which directly impact the function of land and ecosystem services, are largely made by individual landowners (MEA, 2005). These easements are a market-based instrument that separates the right to engage in certain land uses from other property rights (Cooke and Moon, 2015). The U.S. Fish and Wildlife Service administers these easements and has worked with private partners to protect over 340,000 ha in the area since 1998 (Walker et al., 2013).

Economic returns from different land use options directly affect land use decisions (Rashford et al., 2010; Miao et al., 2014), implying that factors that increase cropland profitability prompt farmers to convert to cropland. Candidate factors include rising crop prices, subsidized crop insurance, and improved corn/soybean cultivars. In Minnesota and the Dakotas, for example, high crop prices and rising crop insurance subsidies have been suggested as the main economic factors that contributed to increased conversion rates (Wright and Wimberly, 2013). Motamed et al. (2016) inferred that the advent of ethanol plants expanded corn acreage at the expense of other crops and non-cultivated land use across the greater Corn Belt during 2006–2010 but Arora et al. (2016a) found less convincing evidence around specific plants in North and South Dakota. Claassen et al. (2011b) estimated that crop insurance, disaster assistance, and marketing loans contributed to a 2.9% increase in cropland acreage between 1998 and 2007 while Miao et al. (2016) arrived at a similar impact. Miao et al. (2014) point out that crop insurance reduced the effective cost of land conversion by stabilizing crop revenues.

Other factors believed to have contributed to land use change include change of ownership structure, technology improvements, the impact of labor requirements, and weather/climate (Reitsma et al., 2015). Land ownership structure in the U.S. is gradually evolving, with 40% of farm land currently under lease (Nickerson et al., 2012; Janssen et al., 2015). Many land units are rented on a short-term basis, which might encourage short-term profits at the expense of long-run sustainability, see Lichtenberg (2007) or Jacoby and Mansuri (2008) for detailed developments on the argument. Technological innovations, such as genetic improvement and improved no-till planters, have also helped to drive the Corn Belt's westward expansion (Clay et al., 2014; Lee et al., 2014). Labor requirements may also prompt land use change as many farmers and ranchers move toward retirement and the land under grazing may be converted for cropping to relieve the workload associated with animal production (Reitsma et al., 2015).

Growing degree days have increased in the area (Travers et al., 2015), allowing for longer season crop varieties but precipitation trends are much less clear (National Climate Assessment, 2014). Wetlands in the area are typically ephemeral or impermanent and the region passes through wet and dry intervals of several years. Wetlands complement grasslands in determining ecosystem productivity because many species, and also therefore their predators, depend on wetlands for food and grasslands for protection. Changing climate will affect ecosystem productivity directly (Withey and van Kooten, 2011) and also through

impacts on land use, where research on how climate will affect land use has been very limited.

Despite the growth in research on land use determinants in the area, there are many gaps in the literature. No work that we are aware of has sought to compare the relative importance of these driving forces from the private land owner's perspective. By contrast with the western United States as a whole, in the eastern Dakotas land ownership is predominantly in private ownership and private land owners typically makes the land use decisions. Moreover, no study has investigated whether farms and farm operators of certain characteristics may view those driving forces differently. Our goal is to better understand motivations for land use choices. In particular we posit and test the claim that the land whose use is most sensitive, as assessed by the owners themselves, to changing market prices, government policies, technical innovation and other factors will be at the edge of the crop-growing region. Based on the analysis of a large survey conducted during Spring 2015, we find that land owner responses largely agree with this marginal view of land use decisions.

In the manuscript's main text we first use standard production theory to provide a conceptual model of how external shocks should affect land use and when responses are likely to be sensitive. We infer that land will be most sensitive to shocks in locations where grass uses and crop uses are comparably rewarding. Based on the model we view land owner declarations on the relative importance of land use drivers to be the objects of interest. If these self-declared land use motivations vary in a manner that is consistent with land use decisions as predicted by our model then we have evidence in favor of the margin-is-most-competitive thesis. Furthermore, we would not need to infer motivation for land use change through correlating variation in land use actions with variation in potentially causal variables. This is because consciously-given direct evidence has been provided by the decision-maker. Our conceptual model is followed by descriptions of survey design and administration, and of the data collected. The econometric tools used are then explained, followed by a presentation and discussion of results. A discussion section concludes.

2. Conceptual Model

Claassen et al. (2011b) have proposed a model in which profitability under cropping less than under grass agriculture is an increasing function of land quality. The crops and grass profit curves in Fig. 1 reproduce the essence of their Figure 9. A representative farmer's land quality density function is also provided. The margin is where the profit curves intersect. If only profitability considerations matter then the area under the density curve but left of the land quality level at which the curves intersect will be under grass. When the mass density of land in the neighborhood of this cut-off point is large then the land use choice will be sensitive to factors that affect grass and crop profitability.

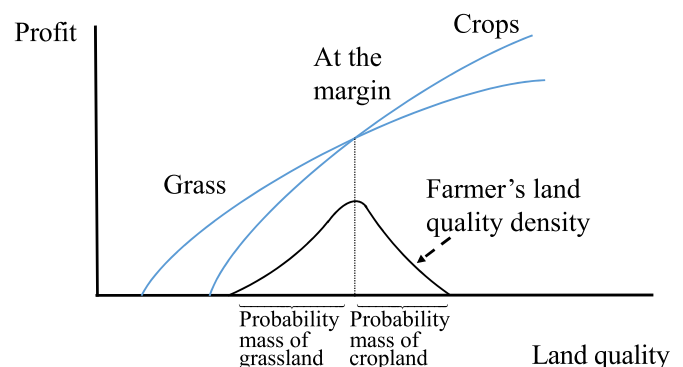


Fig. 1. Land switching between grass and cropping uses.

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