Land Use Policy 45 (2015) 76–85

Contents lists available at ScienceDirect

Land Use Policy

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

Associating conservation/production patterns in US farm policy with agricultural land-use in three Iowa, USA townships, 1933–2002

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ARTICLE INFO

Article history:
Received 31 October 2013
Received in revised form
21 December 2014
Accepted 3 January 2015

Keywords:
Agricultural policy
Conservation programs
Historical land-use change
US farm bill

ABSTRACT

Agricultural policy objectives in developed nations include counteracting overproduction, increasing economic and social well-being, and environmental protection. Such policies, however, often work at cross-purposes. While vast financial resources have been invested in farm programs, little research connects historic trends in agricultural policy with land-use patterns in agricultural landscapes. We connect the legislative history of US farm bills with land-use decisions as observed on the historical agricultural landscape in three townships in Iowa, USA, 1933–2002. With a high proportion of agricultural land, increasing biofuels development, and high participation in federal conservation programs, Iowa presents an ideal case study to explore the relationship between policy and historical land use. Using data from the US Census of Agriculture and historical aerial photography, we conduct our analysis within a framework that identifies alternating eras of US farm policy in terms of legislative focus on conservation vs. production. We describe the impact of US farm policy on the following indicators: maize and soybean area, production, and productivity; hectares in idled land, pasture, and hay ground; and adoption of soil conservation practices. Patterns of agricultural and conservation land use support the idea of alternating conservation–production eras of US farm policy. Three important patterns emerge: (1) despite reductions in maize hectares that correspond with conservation-oriented policy eras, supply management policies have failed to control maize production due to increased productivity; (2) as pasture and hay hectares decline, government set-aside programs are increasingly important for perennial vegetation within agricultural landscapes; and (3) although soil conservation practices have generally increased as agricultural land use has intensified, persistent links between poor environmental quality and farm programs suggest that implementation alone will not achieve environmental quality goals. Environmental improvement likely requires a shift from policies focused on the quantity of commodities produced to policies focused on pattern and process of production in multifunctional agricultural landscapes, and we discuss how policies that promote extensification abroad might inform domestic agricultural policy reform.

Introduction

Governments intervene in agricultural policy to increase social welfare, restructure income distribution, and control trade (De Gorter and Swinnen, 2002). For example, many developed countries seek to protect farmers from price declines caused by overproduction and increase the economic and social well-being of rural society (Cochrane, 1985; Hurt, 2002; Winders, 2009) using policy tools that range from price supports and public commodity storage to land retirement (Rausser, 1992; Claassen et al., 2008). Specific policy implementations, however, depend on political economic priorities, which are becoming increasingly global in scope. In the 19th century, European policymakers began promoting free trade over the protection of domestic interests, a scenario classically illustrated by England's repeal of the protectionist Corn Laws but also played out across Europe (Kindleberger, 1975; Swinnen, 2009). And although European policymakers reverted to protectionist interventions over the course of the 20th century, Australia

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http://dx.doi.org/10.1016/j.landusepol.2015.01.002
0264-8377/

and New Zealand largely abandoned government intervention in agriculture as part of broad economic deregulation (Edwards, 1980, 2003; Johnson et al., 1989).

Many governmental interventions in agricultural policy also seek environmental outcomes such as natural resource protection and ecosystem service provision (Cain and Lovejoy, 2004; Claassen et al., 2008). But integrating environmental protection into complex political objectives and economic contexts creates a broad—and often conflated—range of policy tools and justifications for government intervention. For example, in the United States (US), legislation aimed at increasing farm income during the Great Depression was only determined legal once policy objectives explicitly included the public interest in improving and protecting soil quality (Winders, 2009). Likewise, policymakers in the European Union (EU) highlight the important contributions agriculture can make toward the conservation of biodiversity in multifunctional landscapes to justify farmer payment programs that might violate free trade agreements under the World Trade Organization (Potter and Tilzey, 2007; Dibden and Cocklin, 2009).

US environmental–agricultural policy has focused on reducing negative externalities, often by incentivizing specific practices or removing environmentally-sensitive land from production (Baylis et al., 2005, 2008). But economic and environmental outcomes sought by US agricultural policy are not always mutually realized. Firstly, farmer participation in voluntary conservation programs can vary with policy and market conditions (Stuart and Gillon, 2013). Secondly, the primary intent of US farm policy has been to stabilize commodity prices and improve farm incomes, with environmental goals largely secondary (Ribaudo et al., 2001; Claassen et al., 2008). As such, vast financial resources have been invested in the US Corn Belt through farm programs but the landscape has changed in ways that are often contrary to environmental objectives (Mattison and Norris, 2005; Broussard et al., 2012). For example, programs intended to mitigate poor market conditions or natural disasters could potentially encourage intensification or cultivation of biophysically-vulnerable land (Glauber, 2004), and indeed, evidence suggests that US farm programs lead to environmental degradation despite conservation-oriented farm programs and legislation aimed at decreasing environmental impact (Tegtmeier and Duffy, 2004; Hatfield et al., 2009; Broussard and Turner, 2009; Heathcote et al., 2013).

In recent years, increasing commodity prices have driven the expansion of intensive agriculture in the US and transformed agricultural land use (Secchi et al., 2011; Wright and Wimberly, 2013; Johnston, 2014), but the pattern in which a few, input-intensive annual crops supplants crop diversity and integrated animal agriculture is not new. Indeed, technological progress has transformed agriculture and its associated rural economies and communities across North America throughout the 20th century (Hurt, 2002; Irwin et al., 2010).

Here we use land-use and crop production data to quantitatively examine how historical changes in agricultural land use in three rural Iowa, US, townships are connected to broad trends in the legislative history of US farm bills between 1933 and 2002. We focus on Iowa because the state has both a high proportion of agricultural land use and high participation in federal farm programs (Secchi et al., 2011), and thus presents an important case study for the relationship between agricultural policy and land use in the US.

We apply a statistical analytical framework to document changes in the production of specific crops (maize and soybeans), land use (pasture, hay ground, and idle land area), and in-field conservation practices attendant with patterns of agricultural policy emphasis on conservation vs. production. For each township, we use historical US Census of Agriculture data divided into five policy eras (Table 1) to test the following predictions: (1) Cropped area of maize and soybeans were greater during production-oriented policy eras than conservation-oriented policy eras; (2) overall production of maize and soybeans increased regardless of policy era; and (3) participation in conservation programs was greater in conservation-oriented policy eras than production-oriented policy eras. Following our analysis of these historical data, we discuss other economic and policy influences on land-use and compare US conservation and production policies to those of EU and non-EU countries. In particular, we differentiate between intensive vs. extensive policy emphasis and how each might relate to domestic agricultural policy reform.

Methods

We use land-use and crop production data to test patterns in land use with respect to the historical farm bill framework developed by McGranahan et al. (2013), which describes five eras of US farm policy and characterizes each as being either production-oriented or conservation-oriented (Table 1). With crop history and land cover data compiled in a geographic information system (GIS), we used a historical comparative approach (Medley et al., 1995; Heasley, 2003) to document landscape changes in agricultural production and conservation efforts in three Iowa townships between 1933 and 2002. In terms of commodity crops, traditional farm bill programs in Iowa have focused on maize (*Zea mays*), although our analysis also occurs over the period in which soybeans (*Glycine max*) became a widely planted annual crop. In terms of supply management and conservation, farm bill programs relevant to the study area throughout the study period have consisted of (1) "set-aside" programs, in which farmland is idled for a growing season or more; (2) shifting production from "soil-depleting uses" to "soil-conserving uses" (e.g., from annual row crops such as maize to vegetation planted specifically to protect or enhance soil quality such as perennial plants and non-grain legumes), as described by the foundational legislation, the 1936 Soil Conservation and Domestic Allotment Act, and (3) encouraging farmers and landowners to apply specific soil conservation practices. We used the following metrics to describe the impact of farm bill programs on land-use change at the township scale: (1) hectares of maize and soybeans planted, as well as the total amount of each row crop produced and the average productivity (per-hectare yield) for each; (2) the area of cropland idled for soil conservation purposes and the area of pasture and hay ground; and (3) the frequency of in-field and edge-of-field soil and water conservation practices relative to crop hectares.

Study area

We selected three Iowa townships located within three physiographic regions for study using purposive sampling, a form of nonrandom sampling whereby especially informative cases are selected for their suitability to a specific research question (Neuman, 2005). We identified three major land resource areas (MLRAs) (USDA, 2006) as our physiographic regions because we expected them to represent extensive but different biophysical settings and different farming systems in Iowa. These physiographic regions include the Illinois and Iowa Deep Loess and Drift (MLRA #108D, hereafter, Dissected Plain), Northern Mississippi Valley Loess Hills (MLRA #105, hereafter, Driftless Area), and Central Iowa and Minnesota Till Prairies (MLRA #103, hereafter, Glaciated Plain) (Fig. 1). In general, the Dissected Plain is rolling to hilly, with level to undulating uplands away from large streams; the Driftless Area has hilly uplands dissected by tributaries of the Mississippi River and narrow bottomlands along streams; and the