Using the Past to Create a Sustainable Future for Agriculture: The Impact of Federal Farm Policy on Environmental and Social Landscape Change in Iowa

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ABSTRACT

There is growing recognition that intensive row crop agriculture's predominantly uniform landscape lacks both environmental resilience and socioeconomic sustainability. As global agriculture charts a new course in a new century, policy initiatives must consider historical outcomes of previous policies, current socioeconomic and environmental issues, and a future vision related to agricultural and rural sustainability. Our interdisciplinary research project examines concomitant changes in rural Iowa landscapes and U.S. federal farm policies between 1933 and 2002. U.S. federal farm policy initiatives have generally attempted to ameliorate the impact of chronic overproduction caused by revolutionary technological change, influence the economic and social well-being of rural society, and protect the natural environment. Initial results show that cropping systems and land use decisions have been affected during federal farm policy eras. The changes we document coincide with historic national and international events over the past 70 years. Knowledge gained through this research will assist policy makers in formulating sound decisions regarding sustainable agriculture practices and systems, exploring policy proposals and alternatives, and identifying potential barriers to more sustainable policies.

Keywords: Landscape ecology; Resilience; Social-ecological systems; U.S. Corn Belt

INTRODUCTION

North American row crop agriculture has evolved into one of the greatest success stories in human history (Bruckner et al. 2005). Fueled by successive mechanical, petro-chemical, bio-genetic, and managerial revolutions during the final 75 years of the 20th century, agriculture has been swept along by a whirlwind of breathtaking change (Lasley 2005). After centuries of subsistence living and the perennial concern about the adequacy of the food supply, agriculture in the United States has become highly industrialized, providing the country's citizens with inexpensive food despite ongoing concerns regarding overproduction and farm income stability until the recent emergence of the bioeconomy (Bruckner et al. 2005). Some would say the consequences associated with this change have left the rural landscape and society in a state that is something less than it was at the dawn of the previous century (Jackson and Jackson 2002).

The State of Iowa is a specific example where agriculture is highly developed and functions in a highly modified landscape both in terms of vegetation (less than 2% of the native vegetation remaining) and hydrology (Iowa 2000). Beginning with Euro-American settlement in the 1830's through the early part of the twentieth century, yeoman farming dominated, communities were established, and the landscape was transformed (Iowa 2000). The state's productive soils, temperate climate, and hard-working immigrants quickly propelled agriculture from subsistence farming to a vibrant economic enterprise (Iowa 2000). There is growing recognition, however, that intensive row crop agriculture's predominantly uniform landscape lacks both environmental resilience and socioeconomic sustainability (Beeman and Pritchard 2001). For

example, poor water quality in the region has been recognized as a national priority for over a decade (USOTA 1995). Row crop agriculture has further been implicated as the primary cause of the hypoxic dead zone in the Gulf of Mexico (Rabalais et al. 2002). Iowa is also losing the once numerous, mid-sized, owner-operated farms; farming is increasingly dominated by large, corporate farms (Keeney and Kemp 2002, Duffy 2006).

U.S. federal farm policy initiatives have generally attempted to ameliorate the impact of chronic overproduction caused by revolutionary technological change, influence the economic and social well-being of rural society, and protect the natural environment (Lipton and Pollack 1996). Despite the investment of vast resources in federal farm programs (Morehart 2003), rural populations, land ownership patterns, and environmental quality have continued to change in ways that are often contrary to policy objectives (Duffy 2005; Keeney and Kemp 2004; Klopatek et al. 1979; USGS 1999, 2006). Because the number of farms continues to decline, soil-depleting annual crops are produced on the majority of the cropland, environmental degradation is attributed to agricultural practices, and natural ecosystems continue to deteriorate, the American taxpayer is beginning to seriously question their return on investment (Duffy 2005). The present movement to a bioeconomy provides an opportunity to redirect federal farm policy to achieve objectives that benefit the environment and society at local, national, and global scales. But as global agriculture charts a new course in a new century, policy initiatives must consider historical outcomes of previous policies, current socioeconomic and environmental issues, and a future vision related to agricultural and rural sustainability (Beeman and Pritchard 2001; Jackson and Jackson 2002).

In an effort to inform these future policies, we use a combination of ecological and social techniques to examine the question: *what linkages exist between environmental and social landscape change in rural Iowa?* We explore and describe these linkages through two research objectives:

1. Understand the linkages between environmental and social landscape change in Iowa from 1930 to 2002.
2. Understand the role of federal farm policy as a key driver of environmental and social landscape change in Iowa over the study period.

Because federal farm policies have been implemented in response to increases in productivity from technical and economic developments making it increasingly profitable to substitute capital inputs for labor (Heady et al. 1965), we expect them to have an influence on cropping systems and land use decisions and to leave a visual imprint on the landscape over time. To analyze policy change over time, we divided the study period into five federal farm policy eras between 1930 and 2002, which coincide with historic national and international events over the past 70 years (Edelman 1989; Lipton and Pollack 1996; U.S. Senate 1998). These are:

- The Great Depression & the New Deal: 1930 -1940,
- War, Peace, & Plenty: 1941-1955,
- Soil Bank & Food Security: 1956-1970,
- Plant Fencerow to Fencerow: 1971-1985, and
- Budget Concerns & New Approaches: 1986-2002.

METHODOLOGY

Study area

We selected three Iowa small towns and townships for study using purposive sampling. Each of these townships falls within a different section-level ecoregion (Cleland et al. 2007), as we expect that different farming systems have evolved within the ecoregions over the course of the study period. Ecoregions selected are the North Central Glaciated Plains (hereafter, Glaciated Plains), North Central Driftless and Escarpment (hereafter, Driftless Area), and the Central Dissected Till Plains (hereafter, Dissected Plains). The Glaciated Plains area is a nearly level to gently rolling till plain. The Driftless Area consists of hilly uplands dissected by both large and small tributaries of the Mississippi River. Bottom land along all streams is narrow. The Dissected Plains is rolling to hilly, but some of the broad uplands far from the large streams are level to undulating. The smaller streams have narrow valley floors, but the large streams have broad flood plains.

Townships selected for study (1) contained a small town with a 1930 U.S. Census population of between 300 and 499 that was (2) located relatively closely to the township center, (3) had a high school education program in 1930, (4) had at least one through highway in 1930, and (5) were located at least 10 miles from a major population center in 1930. Three town-township combinations met all selection criteria: Orient-Orient in Adair County, Delmar-Bloomfield in Clinton County, and Ringsted-Denmark in Emmet County (Figure 1).

Data collection and analysis

Data for quantifying landscape change were derived from historic aerial images. Images were obtained from the University of Iowa Map Collection, the U.S. National Archives and Records Administration, and the USDA Farm Service Agency Aerial Photo Field Office. The starting point for each township is the year aerial images were first taken. Purposive sampling was utilized to select subsequent aerial image dates that coincide with federal farm policy eras (Table 1). Standard GIS protocol was used to georectify and capture landscape elements from the aerial images. Each set of images is unique because they were taken at different points during the growing season. In response, the lead researcher created a guide to capture landscape elements from each series of images. Student coders were trained to use the guide to enhance their visual understanding of the landscape, to delineate ecosystem boundaries, and to classify land cover types. Overall, landscape elements were classified into one of the 13 following land cover types: row crop, hay, small grains, grass, timber pasture, forest, wetland, drainage way, grass waterway, farm pond, home site, road, and railroad. All landscape elements captured were error checked by the lead researcher to insure accuracy.

Data for quantifying social change were derived from U.S. Census statistics, Iowa Department of Education archival records, USDA archival records, and Census of Agriculture statistics. Written community histories (i.e., Delmar Centennial 1871-1971; A Collection of Recollections, Orient, Iowa 1882-1982; and Ringsted's First Hundred Years 1899-1999) were also used as secondary data sources. Secondary data analysis was used to analyze these data. Because of the historical nature of the required data,

the sources identified were selected as the best and most consistent repositories of this information.

RESULTS AND DISCUSSION

On the Glaciated Plains, grain production has been an important agricultural enterprise where row crops and small grains dominated initially. An almost complete shift to row crops (corn and soybeans) occurred from the mid part of the 20th century to present, as represented by Denmark Township (Figure 3a and 3b). The uniform landscape provides scale efficiencies that have pushed field size up to a much greater extent here, compared to other regions (Figure 2b). Although field size was similar across all three townships in the 1930s, increasing row crop area (Figure 2a) was linked to increasing field size (Figure 2b) and loss of small grain (Figure 2c) in Demark Township. As farms in this region became less diverse and more specialized, the number of home sites (mostly, farmsteads) also declined (Figure 2d), especially during the Plant Fencerow-to-Fencerow Era forward. Although these changes have been incremental over time, the end result has been an extreme level of landscape simplification. While in 1938, farms in this area were similar to the typical Iowa farm in terms of diverse crop and livestock enterprises, overtime the township was transformed into a relatively homogeneous landscape consisting of primarily row crops (Figure 3).

Cropping systems have been more diverse in the Dissected Plain and Driftless Area physiographic regions. In contrast to Denmark Township, row crop area actually declined from 1938 to 1953 in Bloomfield and Orient Townships (Figure 2a), concomitant with slight increases in the area in small grains (Figure 2c). Row crop area

increased state-wide during the farm depression years following World War I (Schwieder 1993). Economic hardship forced many owner-operators and tenants to over extend the row crop capabilities of farms in the Dissected Plain and Driftless Area physiographic regions (Iowa 1935). These erosion prone areas were the first beneficiaries of federal soil conservation programs thereby decreasing area in row crops and increasing the area in small grains. These trends reversed thereafter, and declines in the area of small grains on the landscape were sharp (Figure 2a, c). Row crop area in Bloomfield actually declined during the final time step through enrollment in the Conservation Reserve Program and a major highway constructed through the township. The physical environment, in the form of rolling topography, constrains field size to a much greater extent in Bloomfield and Orient Townships compared to the Glaciated Plain; however, field size increased steadily from 1953 through 1984 in both townships and then reached a plateau or declined slightly (Figure 2b). In terms of social changes, as with Denmark Township, the number of home sites declined in Orient Township. This decline was steady in the case of Orient, however, rather than tied to the Plant Fencerow to Fencerow Era, as in the Glaciated Plain. Because of its location in a more populous region of the state, Bloomfield Township experienced growth in home sites until 1984 and then decline thereafter.

CONCLUSION

Transitioning to a new agricultural era is something that Iowa and its citizens have experienced numerous times since the settlement period. Since the 1930's, tremendous increases in productivity have occurred from technical and economic

developments making it increasingly profitable to substitute capital inputs for labor (Heady et al. 1965). Changes in farm productivity, labor efficiency, rural life, and environmental impacts are well documented (Heady et al. 1965; Schulte et al. 2006; Schwieder 1993; Tweeten 1970). Future work associated with this study will examine the social and environmental impacts of probable further simplification and intensification of annual cropping systems to inform future federal farm policy directions.

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TABLES AND FIGURES

Table 1. Dates of aerial images captured for landscape change analysis.

	Aerial Image Dates				
Town-Township	Policy Era I: 1930-1940	Policy Era II: 1941-1955	Policy Era III: 1956-1970	Policy Era IV: 1971-1985	Policy Era V: 1986-2002
Orient-Orient	1938	1954	1970	1983	2002
Delmar-Bloomfield	1937	1951	1969	1984	2002
Ringsted-Denmark	1939	1953	1972	1985	2002

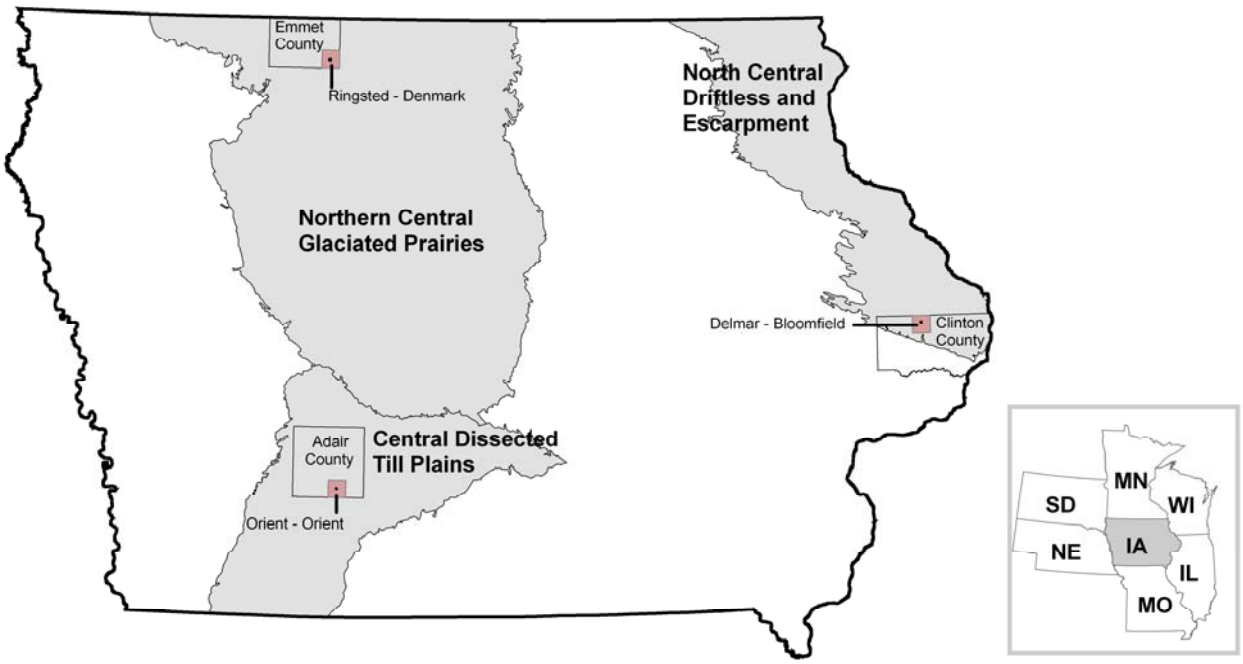

Figure 1. Location of study townships within Iowa counties and ecoregions; small town falling within township also shown. Inset: Location of Iowa within the Midwestern U.S.

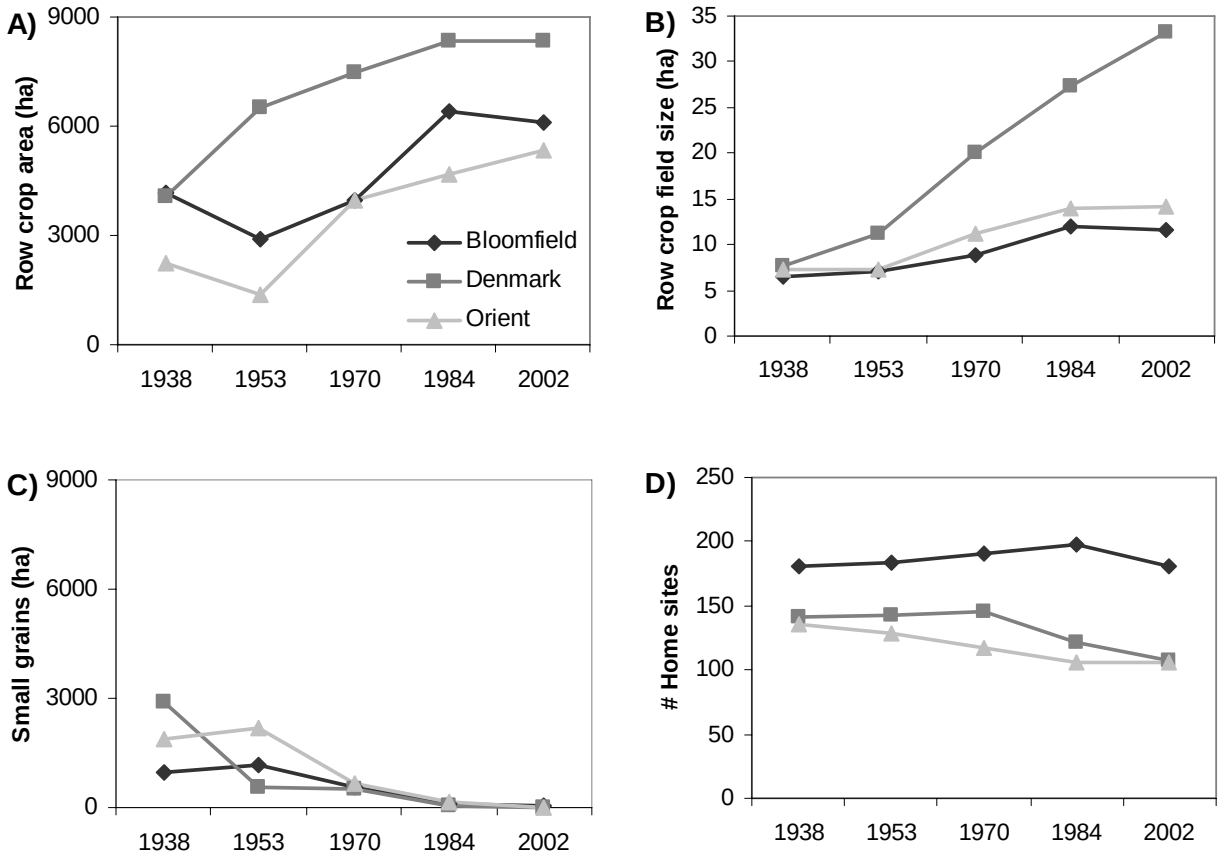

Figure 2. Change in A) the area in row crops, B) average row crop field size, C) the area in small grains, and D) number of home sites in three Iowa townships over time.

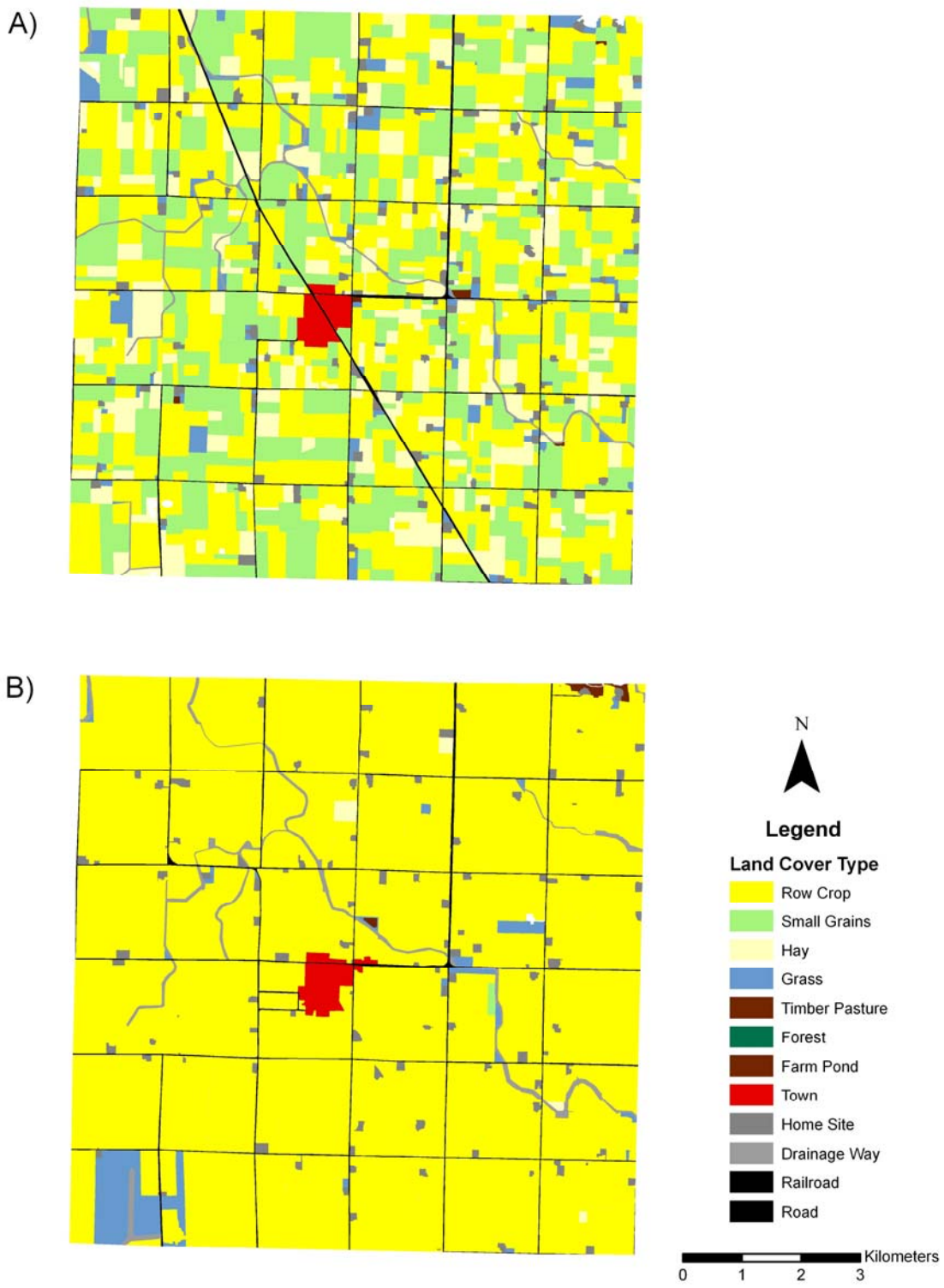

Figure 3. Land cover of Denmark Township, Emmet County, Iowa: A) 1939 and B) 2002.