



Scaling up to address new challenges to conservation on US farmland

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ABSTRACT

Land used for agricultural production comprises a significant portion of the United States (US) land area and is increasingly the focus of conservation efforts. These efforts include programs to protect and improve the quality of water, soil, and wildlife habitat. Government conservation efforts in the US focus on voluntary conservation programs. As the success of these programs depends on the participation of agricultural producers, much research has examined factors influencing producer decision-making. This research has provided important insights regarding micro and meso-scale factors influencing participation, but has tended to overlook macro-scale political and economic factors that increasingly shape production decisions. We argue that researchers examining producer decision making need to scale up their analysis to include macro-scale factors, which pose increasing challenges to conservation efforts. We use two case studies, in California and Iowa, to illustrate scenarios where policy and market changes have led to a significant loss of participation in conservation efforts. Quantitative and qualitative methods were used in each case to examine how new political and economic conditions influence producer decision-making regarding conservation. In both cases new policies conflict with federal conservation initiatives, creating situations where producers feel they must abandon conservation practices. The emergence of these macro-scale challenges highlights the vulnerability of current voluntary approaches and indicates that alternative policy tools need to be explored. This discussion deserves immediate attention, given current proposals to cut funding for US conservation programs. New policy combinations should be explored that can effectively sustain producer participation in conservation efforts despite changes in policy and market conditions.

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Introduction

Close to half of the land area in the United States (US) is used for agricultural production (USDA Economic Research Service, 2012). Most of this land is privately owned and operated, including 99% of cropland and 61% of rangeland (Lubowski et al., 2006). Agricultural producers depend on this land for their livelihoods, but also make decisions that impact a large portion of the nation's natural resources. The collective decisions of individual landowners impact society's broader efforts to maintain soil, water, and habitat quality. While the US has a long history of excluding agriculture from environmental regulation (Browne, 1988; Browne et al., 1992), government agencies at multiple levels, as well as non-governmental organizations (NGOs), have developed a variety of voluntary environmental stewardship programs to educate private land managers and to provide support for conservation. As these efforts continue and evolve, it is critical to identify opportunities for supporting

these initiatives as well as how changing social, political, and economic contexts may impact participation.

This paper explores how current approaches to improve soil, water, and habitat quality on agricultural lands in the US can suffer major setbacks due to changes in agricultural policies, standards, and market conditions. While significant strides have been made in an attempt to increase the ecological benefits provided by agricultural landscapes, some of these gains may be short-lived. We focus on how macro-scale factors, including government policies and corporate production standards, shape producers' abilities and willingness to participate in voluntary stewardship efforts. Although much attention has been given to micro and meso-scale factors shaping producers' decisions to participate in conservation efforts (e.g., Napier et al., 1986, 1988; Morris et al., 2000; Rogers, 2003; Lubell and Fulton, 2008), this paper illustrates that in certain cases macro-scale influences can outweigh other factors and therefore should not be ignored. We use two case studies to demonstrate how current approaches to enhance conservation can suffer significant setbacks when confronted with powerful political and economic forces from within the agricultural sector. We explore current trends in California and Iowa and identify sources of conservation program vulnerability. While these cases are markedly

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different, they reveal similar patterns and outcomes and suggest that additional policy approaches are necessary to sustain long-term commitments to conservation on US agricultural lands. This paper empirically supports the argument that macro-scale factors, including policy and market conditions, have an increasingly important role in shaping producer decision-making regarding environmental stewardship (Atwell et al., 2009, 2010).

Agriculture and the environment

Intensive agricultural production contributes to significant environmental degradation in the US. According to the US Environmental Protection Agency (EPA), agriculture represents the largest source of non-point source water pollution, accounting for more than 45% of impaired lakes and 18% of impaired estuaries (Ribaud and Johansson, 2007). Agriculture remains the major source of nutrient deposition in the nation, contributing to the degradation of 60% of US coastal rivers and bays (Howarth et al., 2002). The largest-scale example of these ecological impacts remains the formation of a “dead zone” in the Gulf of Mexico: a consequence of nutrient pollution moving from Midwestern farms into the Mississippi River (Rabalais et al., 2002).

Intensive agricultural production also contributes to biodiversity loss (Mattison and Norris, 2005). Agriculture is cited as one of the primary causes of species endangerment in the Americas (Kerr and Deguise, 2004) and is responsible for the majority of species listed as federally threatened or endangered in the US (Cox, 2007 as cited in Batie, 2009). Intensive agricultural production in the US often relies on planting large fields with a single crop variety, reducing landscape diversity and habitat availability. Indiana, Illinois, and Iowa produce large quantities of commodity crops and also rank last among US states in terms of natural vegetation remaining (Klopatek et al., 1979 as cited in Santelmann et al., 2004). Wildlife species are also indirectly affected by increased chemical use, impaired water quality, and dramatic alterations in nutrient cycles (Pimentel et al., 1992; Vitousek et al., 1997). Aquatic organisms, even those located far from agricultural production, are negatively impacted due to soil erosion and chemical run-off (Richter et al., 1997).

Although intensive agriculture has contributed to significant environmental degradation, there is a growing movement to redefine relationships between agriculture and conservation (Banks, 2004). Agricultural landscapes can provide important ecological benefits or “ecosystem services,” such as maintaining watershed functions, regulating water flow, protecting against floods, providing wildlife habitat, maintaining clean water supplies, and supporting aquatic ecosystems (Robertson and Swinton, 2005; Swinton et al., 2007; Scherr and McNeely, 2008). With increasing land conversion and development, conservation organizations are now turning towards agricultural landscapes to provide important wildlife habitat and connective landscapes for migration. A growing number of individuals, scientists, and organizations assert that in addition to providing food, agricultural producers have an important role as conservationists (Badgley, 2003). In this view, productive agricultural landscapes are “multifunctional,” providing economic, ecological, and social benefits (Boody et al., 2005; Jordan and Warner, 2010).

Despite growing movements to combine agricultural and environmental goals, weak environmental regulation of agriculture continues. The US has largely excluded agriculture from environmental regulation, regardless of obvious environmental damage associated with intensive production (Browne, 1988; Browne et al., 1992). For example, non-point source pollution from agriculture was almost entirely left out of the Clean Water Act. The EPA does regulate the largest confined livestock operations; however, many livestock producers required to have discharge permits have

failed to comply (Montpetit, 2002). Some states have taken certain actions to address non-point source pollution, using federal funding granted through an amendment to the Clean Water Act (Section 319). Overall, environmental regulation for agriculture remains very weak and difficult to implement and enforce in the US.

Voluntary approaches to conservation

Voluntary programs remain the preferred approach to enhancing conservation and environmental stewardship on US agricultural lands. The US Department of Agriculture's (USDA) Natural Resource Conservation Service (NRCS) administers many of these programs. The NRCS was founded in 1933 in response to depressed agricultural economies and widespread soil erosion. It was then known as the Soil Erosion Service, and later the Soil Conservation Service. Today, NRCS programs continue to focus on soil erosion, as well as enhancing habitat and reducing nutrient and chemical pollution. Many NGOs also support conservation on agricultural lands, working closely with producers and government agencies to encourage environmental stewardship.

Voluntary approaches to conservation on agricultural lands primarily focus on taking eligible land out of production or reducing the impacts of land in production. Government agencies and NGOs encourage producers to “set aside” agricultural land from production activities to reduce erosion and provide wildlife habitat. Conservation programs also focus on improving ecological outcomes on “working lands” producing agricultural products. Working lands conservation practices include cover cropping, hedgerows, grassed waterways, filter strips, contour buffer strips, tailwater recovery systems, constructed wetlands, riparian zone restoration, and reducing chemical inputs (NRCS, 2011). Hedgerows and buffer strips, for example, provide habitat and filter nutrients out of agricultural run-off. Grassed waterways perform similar functions and slow runoff and reduce erosion. This practice-based approach allows flexibility for producers to adopt site appropriate practices that are most affordable for their situation (Gerowitt et al., 2003).

Since 1985, conservation programs through the NRCS have been growing in number and gaining support with increasing (but currently threatened) federal funding. In the Farm Security and Rural Investment Act of 2002 and the Food, Conservation, and Energy Act of 2008 (US farm bills), Congress significantly increased funding available for conservation titles and stewardship on working lands. Programs funded include the Environmental Quality Incentive Program, the Conservation Reserve Program, the Grassland Reserve Program, the Wetlands Reserve Program, the Wildlife Habitat Incentive Program, and the Conservation Stewardship Program (formerly the Conservation Security Program). NRCS employees, working out of offices in most US counties, are available to advise producers on program options and technical aspects of program participation and practice implementation. Other organizations, such as county Soil and Water Conservation Districts, Resource Conservation Districts, regional NGOs, and state-level agencies, work closely with producers to define conservation goals, encourage participation in programs, and share information about conservation practices.

We focus on two federal programs: the Conservation Reserve Program (CRP) and the Environmental Quality Incentive Program (EQIP). The CRP was established in 1985 to set aside sensitive lands from production through 10–15 year contracts. It provides acreage-based rental payments and cost-share assistance for producers to retire cropland and plant and maintain approved conservation ground cover (e.g., grasses and trees). EQIP was created in 1996 and offers financial incentives, including cost-sharing of up to 75%. While the majority of EQIP funds go to livestock operations, these

funds also support the installation of vegetative practices (such as grassed waterways and hedgerows) in crop production systems.

Conservation practices can significantly reduce the intensity and extent of environmental degradation associated with agriculture. For example, the CRP has significantly reduced soil erosion and surface water pollution (Frisvold, 2004) and provides important wildlife habitat (Johnson and Schwartz, 1993; Best et al., 1997; Coppedge et al., 2001). Many of EQIP's conservation practices regulate pest pressure, improve nutrient recycling and water quality, reduce soil erosion, and increase pollination services (Altieri, 1991; Osborne and Kovacic, 1993; Briggs et al., 1999; Fiener and Auerswald, 2003; Dabney et al., 2006). While conservation practices and programs have been shown to be effective at reducing environmental impacts and enhancing ecological benefits, their overall effectiveness depends on sustained voluntary participation. However, individual decisions to participate may be significantly influenced by larger scale changes within the social, political, and economic context of agriculture.

Understanding producer decision-making

Because the environmental impacts of agriculture emerge from the cumulative actions of individual producers, many researchers have explored the range of factors influencing producer decision-making regarding conservation practices. The majority of the adoption literature has focused on micro (individual producer or farm) or meso-scale (community level) factors. This work has examined the importance of demographic, farm structure, and socio-economic variables (Napier et al., 1988). Researchers have also looked at the role of personal values and beliefs, access to information, risk perceptions, and other individual characteristics (Napier et al., 1986, 1988; Napier and Camboni, 1988; Morris et al., 2000). Others have scaled up their analysis beyond individual producers to explore the spread of information and the importance of social networks and social capital (Rogers, 2003; Lubell and Fulton, 2007; Lubell and Fulton, 2008). However, many of these studies overlook the role of larger scale factors.

Macro-scale factors, including policy and market conditions, have an increasingly important role in shaping producer decision-making regarding conservation (Atwell et al., 2009, 2010). To fully understand producer decision-making, it is necessary to scale up analyses to examine the broader political and economic context in which producers remain embedded (Buttel and Newby, 1980; Blaikie and Brookfield, 1987). Even when ideas about environmental stewardship may resonate with a producer, management decisions may be constrained by external factors (Foster and Magdoff, 2000; Lawrence et al., 2004; Hendrickson and James, 2005). Moving away from the time when individual farmers made decisions largely on their own, now many decisions in industrialized agriculture are constrained by commitments and/or contracts with both upstream suppliers of agricultural inputs and downstream retail and wholesale buyers (Hendrickson and James, 2005). In addition, producers who have participated in conservation efforts in the past may abandon such endeavors based on changing market conditions (Roberts and Bucholz, 2006; Lubowski et al., 2008).

The goal of this paper is to empirically demonstrate how current approaches to conservation on US farmland are vulnerable to macro-scale factors and to identify sources of vulnerability. While many studies have explored specific deficiencies in conservation programs (e.g., Giannakas and Kaplan, 2005; Teels et al., 2006; Smith et al., 2011; Wardrop et al., 2011; Winsten et al., 2011), we focus on overall program vulnerability. We draw from two case studies, in distinctive settings, where participation in conservation programs has recently declined. Each study explores the extent of decline and the influence of different macro-scale factors. First, we

examine recent trends in the California produce sector and the role of new industry food safety standards. This serves as an excellent example of macro-scale market and policy configurations that originate from the private sector via standards, which are increasingly common tools in agricultural and food governance (see Higgens et al., 2008). In this case, we show how private standards can redefine appropriate practices, even when new standards are in direct conflict with federal regulatory objectives. We then explore changes in Iowa, where federal biofuel mandates have influenced commodity crop markets and altered agricultural and conservation practices. The Iowa case study explores how biofuel initiatives contribute to changes in both conservation program participation and uncompensated conservation practices, such as crop rotations and diversified farming systems, which have received less attention than program participation. This analysis demonstrates the importance of recognizing linkages and trade-offs between biofuel and conservation policies. Examining two cases together provides an opportunity to draw broader conclusions regarding emerging challenges that may result in substantial setbacks for conservation efforts. These trends suggest the need for a reassessment of current approaches to protect and enhance environmental quality on US farmland.

Methods

This paper draws from two distinct case studies. While these studies were conducted separately, they provide a unique opportunity to compare factors influencing participation in US conservation programs. When presented as an integrated analysis, the nature of macro-scale influences on conservation practices becomes more apparent. Each methodological approach was intended to explore a different set of political and economic influences and their effects on voluntary conservation practices. Methods in each case consisted of extensive interviews and document analysis. Below are the detailed methods used in each study.

California case study

The California case study examined tensions between conservation efforts and new food safety standards using qualitative and quantitative research methods. Newspaper articles, magazine articles, and government reports were the primary focus of archival research aimed to understand the context of agricultural changes in California. Interviews with crop producers were conducted in Monterey County, a significant vegetable producing region. The Monterey County Agricultural Commissioners Office provided a list of producers, from which 43 vegetable producers were randomly selected for interviews. Interviews with crop producers were semi-structured and focused on the implementation of new food safety standards and changes in farm management, including the use of conservation practices and participation in conservation programs. In addition, semi-structured interviews were conducted with 68 key informants to explore different perspectives regarding food safety and conservation efforts. These included NRCS staff and representatives from conservation organizations, agricultural organizations, environmental agencies, food processing companies, food retail companies, and food safety auditing and consulting firms. Interviews were recorded, transcribed, and coded to identify key themes in responses (Miles and Huberman, 1994).

In addition, a mail survey was developed in partnership with and funded by the Resource Conservation District of Monterey County. In the spring of 2007, the survey was mailed to 600 row-crop producers in Monterey, San Benito, Santa Barbara, Santa Clara, Santa Cruz, and San Luis Obispo Counties. The five-page survey contained 39 questions including multiple choice, yes/no, and

open-ended questions. The survey asked participants for details about farm operations, participation in conservation programs, adoption of conservation practices, specifics about food safety requirements, and information on how respondents may be changing their conservation practices. Five point likert-scale questions explored producers' opinions and values regarding environmental stewardship. The last page of the survey asked for personal comments. Data analysis involved generating descriptive statistics for groups of respondents and comparing them using Pearson's Chi Square statistic to test for differences. Analysis focused on changes in management practices that might result in negative environmental impacts and which types of farmers were changing their practices in these ways. Selected findings from this survey are presented here to illustrate trends in management changes. For full survey results, see [Beretti and Stuart \(2008\)](#).

Iowa case study

The second case study focuses on tensions between conservation efforts and biofuel initiatives in Iowa. Both qualitative and quantitative research methods were used to examine changes in conservation practices. Quantitative analysis draws on existing USDA census and survey data. This analysis focused on the state of Iowa and the Northeastern region of Iowa in particular. Qualitative methods include extensive interviews, participant observation, and policy and document analysis conducted to situate producer practices in the broader political and economic context.

Interviews took place in Northeastern Iowa. This region was chosen as a study area based on the following characteristics: (1) high farm type diversity allowing for analysis of agricultural change across production strategies; (2) a topographically varied landscape making conservation practices especially important; and (3) the presence of biofuel refineries and relationships with the biofuel industry. Over 75 semi-structured interviews were conducted in this region between 2007 and 2009. Interviews were completed with county conservation technicians, other NRCS staff, Soil and Water Conservation District (SWCD) board members and employees, over 40 corn producers, and regional residents. Interviews focused on understanding changes in agricultural and conservation practices under new biofuel policies. Conservationists were identified in Northeastern Iowa county offices and through monthly public SWCD meetings. Respondents for producer and rural resident interviews were identified using snowball sampling methodology to reveal networks among producers, conservationists, and residents ([Bernard, 2006](#)). Research also included participant observation of conservation practice planning and implementation in Northeastern Iowa. Field notes and transcribed interviews were coded and analyzed using a grounded theory approach ([Bernard, 2006](#)).

New challenges to conservation on US farmland

New challenges to conservation in California

California remains a leader in agricultural production. Although the state encompasses less than 5% of the total land in the US, it ranks first in the production of 48 crops and produces the majority of many fruits and vegetables nationally. However, the intensive and industrial nature of agriculture has contributed to close to 700 impaired watersheds ([EPA, 2012](#)) and close to 300 federally listed endangered and threatened species. With a growing population and a thriving agricultural market, there have been increasing efforts in California to improve and protect environmental quality in agricultural watersheds. These efforts have been largely voluntary and lead by government agencies and NGOs. While

cooperation with producers has grown dramatically in the past few decades, new food standards created by the produce industry have undermined this progress. To examine this trend, we focus on an exceptionally productive agricultural region of California: the Central Coast.

The Central Coast region of California is well known for vegetable and fruit production. The region encompasses seven counties: Monterey, San Benito, Santa Cruz, Santa Barbara, Santa Clara, San Mateo, and San Luis Obispo counties. It also contains the Salinas Valley, known as the "Salad Bowl of America," exporting 570 million pounds of produce annually ([Salinas Valley Chamber of Commerce, 2012](#)). In addition to lettuce, many other leafy green vegetables are grown including: spinach, chard, and kale. Much of the produce grown in the region is sold through contracts to large-scale buyers, such as Dole and Fresh Express who together control over 70% of the leafy greens market. Due to the intensive nature of Central Coast agriculture, the region faces significant environmental degradation that threatens its coastal waterways, wetlands, and biodiversity. The watersheds of the region drain into the Monterey Bay National Marine Sanctuary, the largest marine protected area in the US. The waterways emptying into the sanctuary contain high levels of fertilizers, pesticides, and sediment ([Hunt et al., 1999](#); [Caffrey, 2001](#)). This pollution impacts aquatic wildlife in the region, including endangered fish species and red-legged frogs.

Innovative environmental protection strategies from government agencies and NGOs have attempted to address environmental problems associated with agriculture in the Central Coast. Those interviewed at regional NRCS offices explained how they work closely with producers to share information about conservation programs and provide technical assistance for installing conservation practices. EQIP is the primary program used in the region and conservation practices promoted include grassed waterways, filter strips, and buffer strips. All of these practices rely on non-crop vegetation to filter and absorb organic matter, metals, pesticides, nutrients, fertilizers, and animal wastes from agricultural run-off. Although the effectiveness of conservation practices remains site and design specific, they are considered by the NRCS as the most effective way to reduce the environmental impacts of agriculture. NRCS staff in the Central Coast region described how they have worked closely with producers for years, establishing the trust needed for ongoing working relationships.

In addition to the NRCS, other organizations work extensively with producers to promote conservation practices. These organizations include: county Resource Conservation Districts (RCDs), county Farm Bureaus, and over a half dozen other farm, water, and/or wildlife focused NGOs. These organizations are often able to offer additional financial support for installing conservation practices through grants and special programs. In contrast to other regions in California, organizations in the Central Coast are extremely cooperative and coordinated. Primarily due to threats to the marine sanctuary, the Agriculture Water Quality Alliance formed to encourage farm stewardship. The organization is a partnership between the marine sanctuary, six county Farm Bureaus, the NRCS, six RCDs, and the University of California Cooperative Extension. In addition, the "Agricultural Waiver Program" through the Central Coast Regional Water Quality Control Board mandates water quality education, the creation of a farm management plan, and water quality monitoring ([Dowd et al., 2008](#)). The program also promotes the use of the same conservation practices supported by the NRCS. This program represents the strongest effort to address non-point source pollution from agriculture in the state. According to interview respondents, coordinated conservation efforts in the Central Coast remain unsurpassed statewide.

Despite increasing participation from producers in conservation efforts, key informant respondents all agreed that food safety concerns have recently emerged as a strong disincentive to adopting

Table 1

Interview responses from California producers regarding changing management practices due to food safety concerns.

- “For food safety they want clean farms, they want you to clear out all brush in riparian zones, and they want a sterile environment.. some of our [river] banks where we used to leave vegetation—because it’s good for erosion and it’s good animal habitat—we’ve sprayed those and we leave them bare now.”
- “Unfortunately we’re not allowed to have little rabbit tracks or animal tracks in our fields anymore. We’re living in a world of fear right now.”
- “We used to have grassed waterways and ditch plantings. We worked with the RCD on those, but had to take them out soon after the *E. coli* outbreak because our buyers said it harbored rodents.”
- “The buyers won’t allow us to put in grassed waterways anymore, so we don’t.”
- “We have to go with our buyer’s standards. It is not negotiable. It is frustrating because we don’t agree with them. They are not based on science.”

conservation practices in the Central Coast. Food safety became a critical issue for regional agriculture in September of 2006, when an outbreak of *E. coli* O157:H7 associated with processed bagged spinach affected consumers in 26 states (CDC, 2006). Despite an official investigation, the US Food and Drug Administration (FDA) and the California Department of Health Services (CDHS) have not conclusively determined the causes of the spinach outbreak (CDHS/FDA, 2007). Much attention in their final report was given to cattle, which were found to carry the same strain of *E. coli* O157:H7 as found on the contaminated spinach. According to interview respondents, the 2006 spinach outbreak resulted in dramatic changes in the fresh produce industry.

Because no government mandated food safety standards for fresh produce existed, the produce industry responded to the spinach outbreak by creating their own food safety standards. These include commodity guidelines (Gorny et al., 2006), a new marketing agreement with mandatory standards for signatories (LGMA, 2010), food safety standards used by third party food safety certifiers (Primus Labs, 2008), and new production standards for individual processing, retail, and restaurant firms. Producers and key informants reported that standards used by private companies are more rigorous, often calling for controversial food safety measures. If producers do not meet food safety standards, their crops can be rejected resulting in significant financial losses. Facing pressure from their buyers (shipping, processing, and retail firms), most producers interviewed expressed that they feel they must follow these standards or face losing their production contracts.

Vegetable producers interviewed shared that due to food safety concerns, they are encouraged by their buyers to reduce the presence of wildlife and any habitat that might harbor wildlife, including vegetated conservation practices (Table 1). Wildlife (including deer, birds, rodents, amphibians, and reptiles) are viewed as possible vectors of disease and are to be kept away from fields. Any signs of wildlife can result in deductions on audits and/or crop rejection. Producers shared that measures used to reduce the presence of wildlife include traps, poisoned bait, and fences, as well as removing vegetation. In addition, standards specifically call for the creation of bare ground buffers around fields, where vegetation and trees are cleared. These standards, which emphasize maintaining a “clean” field, are in direct opposition to efforts to protect and enhance water quality and wildlife in the Central Coast. Only weeks after the spinach outbreak, NRCS staff reported seeing producers spraying herbicides to kill grasses planted using EQIP funds. Conservation organizations responded by conducting a literature review, revealing that less than 1% of wildlife associated with natural environments are known to carry *E. coli* O157:H7 (Stuart et al., 2006). Despite these findings, food safety standards that discourage wildlife and vegetation remain in effect. Key informants suggested

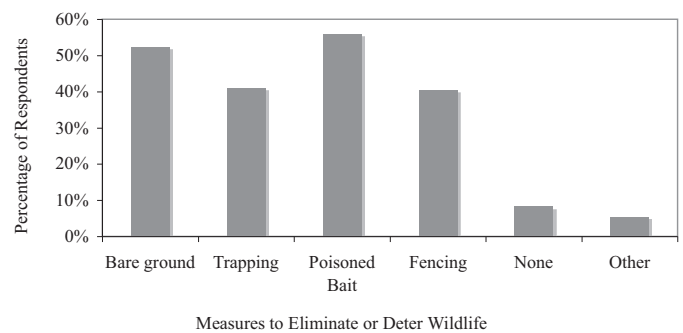


Fig. 1. Percent of mail survey respondents in the Central Coast Region of California adopting measures to deter or eliminate wildlife.

that competition between firms and fear of litigation and/or a tarnished brand name may be driving these measures.

Survey results indicate that new food safety measures are having a significant impact on farm management in the Central Coast. In the spring of 2007, a mail survey was sent to all row-crop producers in the Central Coast region and 30% of 600 producers responded. Over 91% of respondents had at one point adopted at least one conservation practice, as defined by the NRCS (although not all used EQIP funds). However, results illustrate that most producers of leafy green vegetables are facing pressure from their buyers to eliminate wildlife and any vegetation that could serve as wildlife habitat (Beretti and Stuart, 2008). Nearly 89% of respondents had adopted at least one measure to eliminate or deter wildlife. Over 50% of respondents admitted using poisoned bait stations and over 40% claimed to be using other wildlife traps. In addition over 50% had created bare ground buffers around fields and over 30% had removed non-crop vegetation (Fig. 1). Lastly, over 20% of leafy greens producers had removed or discontinued the use of conservation practices. Interviews indicate that this percentage has most certainly increased since the time of the survey. Written comments on surveys indicate that these actions are responses to pressure from buyers and that in many cases producers regret what they feel forced to do:

“Food safety auditors have been very strict about any vegetation that might provide habitat. We are very concerned about upsetting the natural balance, but we have to comply with our shipper’s requests.”

According to key informants, these changes in management practices are having serious impacts on wildlife and water quality. Direct impacts include the elimination of wildlife: traps or poisoned bait stations can be seen every 50 feet along most vegetable fields, representatives from California Fish and Game report increased requests for deer depredation permits, and producers admit to toxic dumping in ponds to eliminate frogs. In addition, non-target wildlife species can be victims: California Fish and Game reported finding over 60 Canada Geese killed by rodenticide poisoning in the summer of 2008. Indirect impacts to wildlife include the removal of habitat and secondary poisoning of predator species that consume poisoned prey. Impacts to water quality include the deposition of poisons into waterways and increased deposition of agricultural pollutants and sediment from the removal of non-crop vegetation and conservation practices. This also impacts aquatic ecosystems and wildlife. The National Marine Fisheries Service is very concerned about sedimentation affecting endangered anadromous fish species in the Salinas River.

NRCS staff and other key informants agreed that conservation programs and other environmental initiatives are facing significant setbacks. While efforts have focused on promoting wildlife and non-crop vegetation, current pressure from the produce industry have pushed producers in the opposite direction. Producers

interviewed also described taking out vegetation and ending participation in programs (Table 1). In 2004, EQIP had 83 participants in the region. This number dropped to 42 in 2007, the year following the spinach outbreak. While NRCS staff admitted that other factors such as the state of the economy and agricultural markets can influence participation, they also reported that food safety was the primary reason producers provided for not participating or withdrawing from programs. After spending years building relationships with producers, staff at the regional NRCS office described having a difficult time finding producers to enroll in programs and were therefore unable to use all of their funds for EQIP. Some staff viewed the situation as a temporary stall in their efforts, yet others acknowledged that it is a detrimental setback that could impact participation for years to come. Widespread removal of vegetation and conservation practices is likely to have significant negative impacts on water quality in California (Beretti and Stuart, 2008).

Despite its regulatory approach, key informants agreed that the Central Coast Regional Water Quality Control Board could do very little through the Agricultural Waiver Program. Their program focuses on mandatory producer education, farm management planning, and monitoring. However, at the time of the outbreak, monitoring was in its early stages and the board had few resources for enforcement. Most enforcement measures to date have focused on producers who have failed to enroll in the program. Fines applied are also relatively insignificant. While the non-point source programs in California may be evolving, they are constrained by limited and ephemeral funding. Limited monitoring and lack of enforcement greatly reduces the program's ability to keep producers using pollution reducing conservation practices. When food safety standards were imposed, the water board did not have enough influence to prevent producers from removing conservation practices. Similar to voluntary programs through the USDA, conservation efforts through this weak regulatory approach have faced significant setbacks. Water board staff shared that their program has been significantly jeopardized by new food safety standards, as producers have decided to remove or not to install conservation practices that use vegetation. They now focus more attention on other conservation practices that can be used to reduce non-point source pollution.

This case study illustrates how quickly conservation gains can be reversed and programs can be stymied under current voluntary approaches. Because current approaches are based on education and incentives, they have not been able to withstand new industry mandates that threaten producers' livelihoods. Individual firms have significant influence over farm management decisions. Despite decades of building relationships with producers, current approaches to conservation are vulnerable to changes within the agricultural industry. We now explore similar trends in Iowa.

New challenges to conservation in Iowa

Agriculture is Iowa's primary land use, with over 90% of the state's 36 million acres in farmland. Approximately 26.8 million of these 32.9 million agricultural acres (81%) are devoted to crop production and only California and Texas top Iowa in agricultural sales (USDA, 2010). Iowa also produces more corn and ethanol than any other state, approximately 20% and one third of US totals, respectively (USDA, 2011; Renewable Fuels Association, 2011; Fig. 2). Due to intensive cultivation, Iowa suffers from highly polluted ground and surface water and heavy soil erosion. In 2008, nearly half of Iowa's 1108 water bodies were considered impaired by the EPA, representing a 56% increase from the 279 water bodies listed as impaired in 2006 (IDNR, 2010). Surface waters with high levels of nutrients flow through Iowa and contribute to hypoxic conditions in the Gulf of Mexico (Rabalais et al., 2002). Since Iowa prairie was intensively plowed in the mid 1800s, over half of

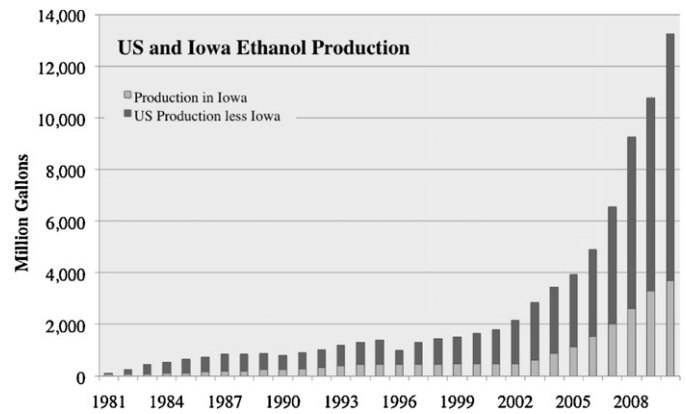


Fig. 2. US and Iowa ethanol production, 1981–2008.

Source: Renewable Fuels Association (2011) and EIA Annual Energy Review (2010), Table 10.3. Available at: <http://www.eia.doe.gov/emeu/aer/renew.html>. Last accessed 27 March 2010.

the state's 14–16 inches of topsoil have eroded. Iowa also ranks last in the US for native habitat availability, with 0.01% of native prairie remaining (Santelmann et al., 2004). The extent of ecological impacts from agriculture in Iowa makes conservation practices particularly important.

Iowa farmers and conservationists interviewed reported that conservation efforts in Iowa have been historically significant, receiving widespread support. Despite generally declining environmental quality, conservation programs and practices have improved soil, water, and habitat quality in numerous watersheds. The NRCS administers conservation programs to the state's landowners, in partnership with the Iowa Department of Agriculture and Land Stewardship and Soil and Water Conservation Districts (SWCD). These agencies typically share one county office and work closely to improve local conservation practice adoption, funding opportunities, and outreach efforts. In general, the NRCS communicates federal conservation program goals and allocates funding to county offices, as mandated by the Farm Bill and other legislation. The SWCD's elected board members, in consultation with the NRCS, allocate conservation funding at the county level according to what residents believe to be the region's most pressing stewardship concerns. Consequently, conservation priorities vary from county to county depending on farm types, topography, program availability, and conservation practitioner preference. Similar arrangements exist in many other states, although the institutional arrangements differ, particularly with respect to conservation districts. Those interviewed claimed that this partnership model effectively allows for farmer participation in conservation planning, tailoring available resources to the needs of particular places. One farmer stated: "it's local people who are given the task of making sure that number one, the projects are worth it, and number two, that they get put on the ground and done right." Atwell et al. (2010) also identify the longstanding partnerships between federal agencies, local conservationists, and SWCD boards as ideal networks for building conservation capacity in Iowa.

Iowa's most popular conservation programs include the CRP, EQIP, and the Conservation Stewardship Program (CSP). More farmers in Iowa have conservation contracts through the CRP than any other state. Over the last decade or more, conservation programs have been highly successful, overall, even if funding appropriation levels have remained low. A recent USDA assessment of conservation practices in the Upper Mississippi River Basin found that on average, cropland conservation practices reduce sediment loss from fields by 69%, total nitrogen loss by 18%, and pesticide and phosphorus loss by 51 and 49%, respectively (USDA, 2010). For lands in long-term cover, such as those enrolled in the CRP, soil

erosion and sediment losses have been reduced to almost zero, while phosphorus and nitrogen pollution have decreased by 97 and 81%, respectively. Soil organic carbon has increased by over 400 pounds per acre on these lands (USDA, 2010).

Lands in conservation programs also provide important wildlife habitat: it is estimated that if all 3 million CRP acres in the Prairie Pothole region of the Great Plains were put into production, “over 25 million ducks would be lost from the fall migratory flight” (Dale et al., 2010, 7). In addition to federal programs, NGO efforts in state conservation have also become more significant. Pheasants Forever, for example, is surveying all agricultural landowners in Iowa to learn about conservation practices and preferences. Other hunting and wildlife-focused groups have also been major sources of support for state conservation legislation and the Nature Conservancy has recently increased its involvement with the state’s NRCS office.

Despite ongoing conservation efforts, recent US biofuel policies create substantial barriers to conservation program participation. Renewable Fuels Standards passed in 2005 and 2007 mandate increased biofuel production from 1.7 to 36 billion gallons per year (BGY) between 2001 and 2022. Corn processed into ethanol accounts for over 90% of domestic biofuel production, which is currently at approximately 13.5 BGY (Renewable Fuels Association, 2011). Iowa produces approximately 28% of this total (Fig. 2). In the future, corn ethanol is set to contribute 15 BGY or 40% of the national mandate. In 2011, the production of 13.9 billion gallons of corn ethanol accounted for 40% of US corn use, requiring 5.05 of the 12.36 billion bushels of corn produced in the US (USDA, 2012a). Although the specific contribution of corn ethanol production to increased food prices remains contentious (see Meyers and Meyer, 2008; Mitchell, 2008; Westoff, 2010), there is little doubt that using nearly half of US corn for ethanol production represents a significant change that affects crop prices and planting decisions (see Babcock and Fabiosa, 2011: 9). As biofuel production intensifies, new ethanol refineries contribute to increasing corn demand and draw on the surrounding landscape. In Iowa, corn acreage increased from approximately 11.7 to 14.1 million acres between 2001 and 2011 and the 2012 US corn planting (95.9 million acres) was the largest since 1937 (USDA, 2012b).

Corn cultivation, in particular, exacerbates many of agriculture’s persistent negative environmental impacts. In many cases, corn production is more erosive and nutrient polluting than the production of other row crops (Pimentel et al., 1995). Nitrogen often represents a limiting factor in corn production, which encourages higher fertilizer application rates. Unfortunately, corn’s low nitrogen use efficiency means that a substantial portion of nitrogen fertilizer applied to fields is not absorbed and could escape as nutrient pollution (Doberman and Cassman, 2002). This excess nitrogen fertilizer can also convert into nitrous oxide gas, making corn production a significant source of greenhouse gas emissions (Meyer-Aurich et al., 2006). These problems are exacerbated when corn is planted continuously, instead of in a rotation with nitrogen-fixing soy, alfalfa, oats, hay or other cover and animal fodder crops.

Increased corn demand, communicated to producers via rising, but volatile, commodity prices makes achieving conservation goals more difficult. Voluntary conservation initiatives, like the CRP, that depend on current conservation payments being competitive with agricultural markets are particularly vulnerable. The CRP began in the midst of a US farm crisis in 1985 as a way to improve environmental quality and control grain supplies in the context of falling commodities prices. While the program has been highly successful in improving soil, water, and habitat quality, program participation is impacted by fluctuations in commodities markets, which may quickly value an acre of corn at a much higher price compared to an acre of implemented conservation practice. Under these circumstances, enrolled landowners can choose to not re-enroll

Table 2

Interview responses from Iowa producers regarding changes in conservation practices in the context of increased corn production for ethanol.

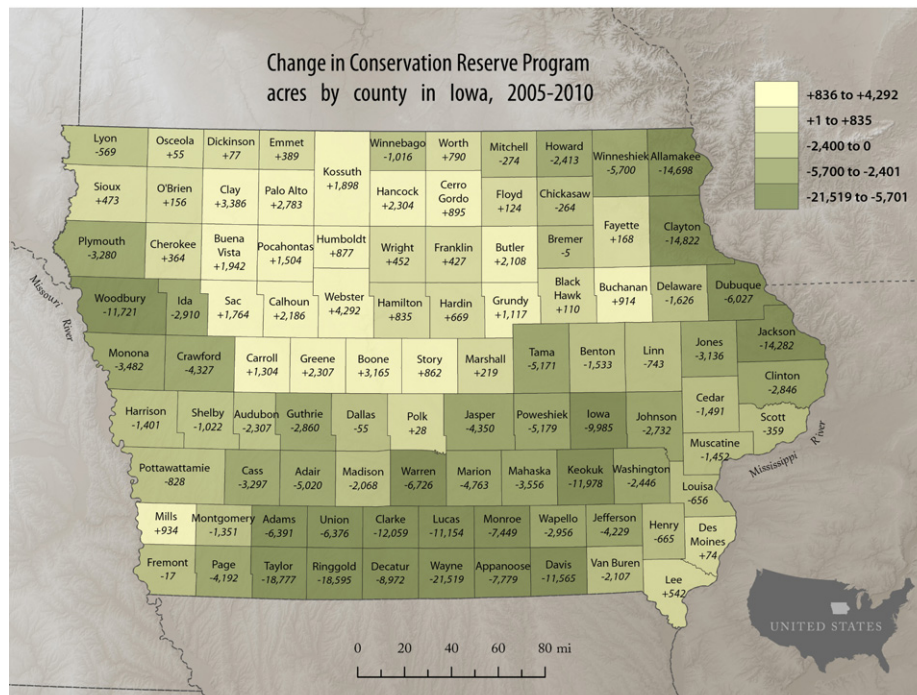
-
- “You know, losing conservation land is probably one of the worst parts about this whole ethanol thing.”
- “The big boys [large-scale producers] have their eyes on my land now—they’ll give me two times as much [as the government programs will]. How can I resist that?”
- “We’re tearing the soils up so fast, in such a short time, to gain so little.”
- “... and there is a guy and he’s a big farmer in Jones County. I mean he farms thousands and thousand of acres. But he just won’t leave a waterway. He’s afraid he’ll get less corn... but he never gets any corn off it anyway because it erodes...”
- “This is... our problem. It’s the market [putting pressure on conservation practices] and we need to do what we can to work together.”
-

when contracts expire or to terminate contracts early and repay all contract income, plus interest. Nationwide, between 2006 and the spring of 2012, CRP-enrolled acres declined from over 36.7 to 29.6 million acres. In Iowa, over the same period, CRP acreage dropped from over 1.96 to 1.64 million acres (Fig. 3). If corn prices continue to receive a boost from ethanol, CRP acres are likely to continue to decline and soil, nitrogen, and phosphorus losses from Iowa agricultural lands could significantly increase (Secchi et al., 2009).

The remainder of this case study focuses on changes in Northeastern Iowa. Northeastern Iowa was selected as a region for in-depth analysis due to its unique topographical and agricultural characteristics, which make changes in conservation practices more important and evident. This region is hillier than most of Iowa, as much of the land was not glaciated. Cultivation on steeply sloped land can exacerbate soil erosion and nutrient pollution. Therefore, the topographic variation in the region makes conservation practices, as well as practices that integrate less erosive and nutrient polluting non-row crop agriculture, essential for preventing widespread erosion and nutrient pollution.

With less ground suitable for row crop production than the rest of the state, “set-aside” conservation programs like the CRP are popular in Northeastern Iowa. Nonetheless, CRP participation has declined. Corn producers interviewed in Northeastern Iowa cited multiple reasons for withdrawing from or choosing not to enroll in CRP contracts. The most common and straightforward explanation given by producers was that corn prices made government conservation contracts uncompetitive (Table 2). Interviews indicated that both producers and absentee landowners have terminated conservation contracts early. Many also cited rising Iowa land values and rental rates as contributing factors. Between 2007 and 2008, Iowa land values increased an average of 19% and they have continued to increase (USDA, 2008). Land that would have been too marginal to profitably cultivate became more valuable as cropland and commodity prices rose. For example, one retiring farmer was considering re-enrolling in a CRP contract, but ultimately decided to rent the land for corn production because the income would be almost twice as much.

In addition to ending CRP participation, producers are making other management changes that will likely impair environmental quality. Soybean production throughout the region has declined as corn production increased over the last several years (Fig. 4). In Iowa, soybean acreage was reduced from over 11 million acres to 8.6 million acres between 2001 and 2007. Some farmers who typically rotated corn and soybeans, and perhaps a third crop, shifted to continuous corn production. Soybeans, as a legume, fix nitrogen from the atmosphere and allow for reduced nitrogen fertilizer application both pre- and post-harvest. The lower fertilizer requirements of soy help to mitigate the more intensive fertilization associated with corn production. Decreased soybean production, especially when replaced by corn, results in increased nitrogen



Source: USDA Farm Service Agency (2011)

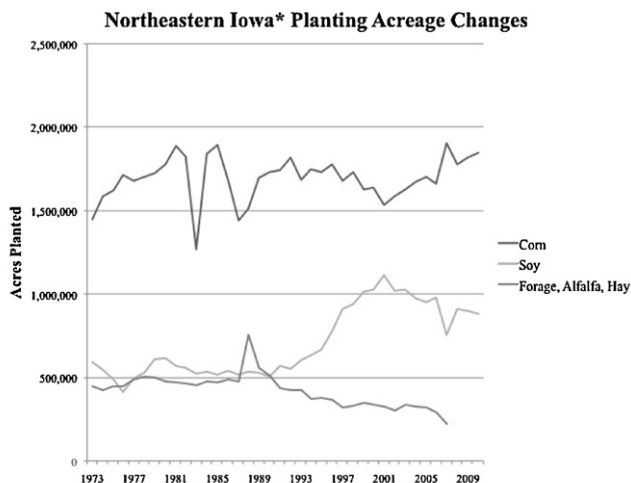
Fig. 3. Change in Conservation Reserve Program Acres by County in Iowa, 2005–2010.

fertilizer application. Donner and Kucharik (2008) analyzed potential changes in Mississippi River Basin nutrient loading and found that nitrogen pollution flowing into the Gulf of Mexico would likely increase between 10% and 34% due to increased corn production for ethanol. Although soybean acreage is beginning to rebound, this trend highlights the need to recognize connections between policies stimulating crop production and the unintended consequences associated with changing land use regimes.

Recent changes in agricultural policies and market conditions have also affected integrated crop–livestock farms in Northeastern Iowa, production systems that have historically been a common

feature of the region. Integrated farming can reduce the need for synthetic fertilizers when animal manure is used in their place. However, rising grain prices have spurred producers to convert pasture for livestock into cropland. Without a cropping history, pasture acreage is not eligible for CRP enrollment making cultivation the only option for increasing income from the land. Between 1997 and 2007, Iowa pasture acreage fell from over 2 million to approximately 830,000 acres and farms with pastures declined from approximately 30,000 to 13,500 (USDA, 2011). EQIP provides financial assistance for planting pasture. However, funding is insufficient for maintaining regional integrated livestock production especially in the face of livestock industry consolidation, making grazing financially impractical compared to confined feeding (Heffernan, 2000; Welsh et al., 2003). EQIP projects to plant pasture are funded at a lower level than nutrient management practices for Confined Animal Feeding Operations. Other research in Iowa also reveals current conservation programs' limitations in supporting more sustainable rotational grazing systems (Atwell et al., 2010).

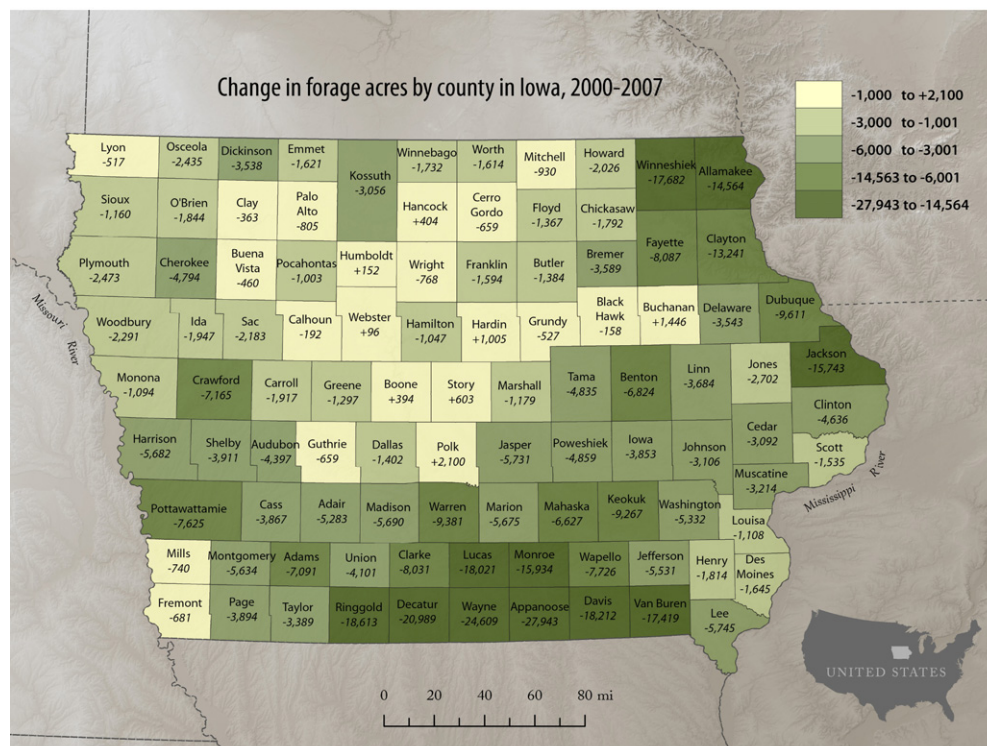
As corn prices rise and as the livestock industry becomes increasingly competitive, many producers in Iowa are persuaded to reduce forage crop cultivation and increase corn production, with potentially serious ecological consequences. Producers integrating livestock into farming operations often cultivate other forage crops, such as hay and alfalfa, which provide environmental benefits. These crops are commonly grown on marginal land or in strips alternating with corn or soybeans. Rows of hay are commonly planted to break up row-crop cultivation on steeply sloped land and reduce erosion. While forage crops may be grown and sold for a profit, they earn producers less money than corn. In addition, hay and alfalfa are not designated as commodity crops, which makes the land they are grown on ineligible for conservation program enrollment and compensation. Thus, corn or soy can be profitable alternatives to hay when enrolling potentially marginal land into conservation contracts is not an option. Forage, hay, and alfalfa acreage in Northeastern Iowa declined between 2000 and 2009 as corn acreage rose (Figs. 4 and 5). It is difficult to determine



Source: USDA (2011)

*Northeastern Iowa is an agricultural district including Black Hawk, Bremer, Buchanan, Chickasaw, Clayton, Delaware, Dubuque, Fayette, Howard, and Winnebago counties. Data from topographically and agriculturally similar Jones and Jackson counties are also included.

Fig. 4. Northeastern Iowa corn, forage, alfalfa, hay and soy plantings, 1973–2010.



Source: USDA (2011)

Fig. 5. Change in Forage Acres by County in Iowa, 2000–2007.

specifically which lands were removed from forage production, but a reduction in forage acreage likely means a reduction in “working lands” conservation practices and associated ecological benefits.

Modeling potential future change, Secchi et al. (2009) find that if corn prices remain high, Iowa will continue to lose conservation land, and the soil and water quality benefits it provides. These trends will also affect wildlife and greenhouse gas emissions. In an analysis of the Great Plains' Prairie Pothole Region, Brooke et al. (2009) describe dramatic negative effects that CRP land loss will have on wildlife. Because the conversion of fallow land or native habitat releases carbon, others question the ability of biofuel production to reduce greenhouse gas emissions when planted on land brought under cultivation for this purpose (e.g., Piñeiro et al., 2009; Fargione et al., 2008). Gelfand et al. (2011) found that, depending on specific management practices, it would take corn ethanol production between 29 and 123 years to make up for the carbon emitted from the conversion of 22-year-old CRP land into crop production. The EPA (2011) also calls attention to the ecological consequences of increased biofuel production in their recent draft report, *Biofuels and the Environment: First Triennial Report to Congress*. The EPA highlights the role of corn ethanol production in increasing soil erosion, nutrient pollution, and conservation acreage conversion and suggests that supporting existing conservation programs is critical to mitigate these impacts.

This case study illustrates how new macro-scale changes can create significant challenges to maintaining participation in conservation efforts. The combination of increased corn demand under biofuel mandates, rising and volatile commodity prices, and declining integrated livestock producer viability have created a situation where conservation payments are much less competitive and uncompensated working-lands conservation practices are more difficult to maintain. Producers interviewed expressed their desire to maintain conservation practices, but also stated that conservation was difficult, due to strong incentives to increase crop production.

Addressing new challenges to conservation

In both California and Iowa, new scenarios highlight the vulnerability of current voluntary approaches to conservation on US farmland. These case studies depict a loss of participation in federal conservation programs and the abandonment of conservation practices. While the agricultural, political, and economic context in each case significantly differs, we find a similar pattern of policy and market changes greatly influencing producer decision-making regarding conservation. It is likely that similar trends can be identified in other regions. While micro and meso-scale factors do influence producer decision-making, these cases illustrate situations where macro-scale political and economic factors have trumped other factors. In this section, we discuss why voluntary conservation programs through the USDA remain vulnerable to macro-scale changes. We specifically illustrate how this vulnerability is linked to the emergence of conflicting policies and economic drivers, creating scenarios where producers feel they must abandon participation in conservation efforts. We also discuss how current approaches will become even more vulnerable given decreasing budget allocations for conservation initiatives. To address this vulnerability we suggest that additional policy tools are needed to encourage producers to maintain participation in conservation efforts during times of policy and market changes.

Conflicting policies and economic drivers of change

In each case study, loss of participation in conservation efforts can be linked to the emergence of new policies that reshaped the context in which producers make decisions. In California, new food safety standards created by the produce industry called for measures to deter or eliminate wildlife and to remove wildlife habitat around farmland. Because non-crop vegetation is required for many of the conservation practices funded through EQIP, these practices were abandoned by a significant number of crop

producers and EQIP participation declined. Producers were put in a difficult position with conflicting messages from conservation and environmental agencies on the one hand and companies whom they sell their produce to on the other. Most producers would not risk losing their growing contracts and chose to adhere to new food safety rules.

Food safety standards in California were not created in cooperation or consultation with the NRCS, EPA, or the Water Resources Control Board. After the standards were created, these agencies wrote letters to persuade industry leaders to reconsider their rules given that a scientific literature review showed that less than 1% of wildlife carry pathogens causing foodborne illness (Stuart et al., 2006). Despite these findings, food safety standards continue to have producers remove vegetation and deter and eliminate wildlife. In contrast, a coordinated approach may have been successful in finding a balance between the goals of food safety and conservation. Conservation organizations are still working with produce companies and industry groups to find middle ground, as this seems like the only way they will gain back producer enrollment in EQIP and revive efforts to protect the Monterey Bay National Marine Sanctuary.

Even if industry group standards are modified, individual companies maintain food safety standards imposed on producers through production contracts. Contract farming has grown in the US, representing 12% of production value in 1969 and 37% of production value in 2007 (Hoppe and Banker, 2010). In the Central Coast, contract farming is common and vegetable production contracts entail following new food safety standards. As found by FitzSimmons (1986), contracts in specialty crop production in the Salinas Valley favor actors in the supply chain with economic power. Because producers rely on large companies to buy their produce, they must follow the terms of their contracts. Despite the growing popularity of private standards in agriculture (Higgins et al., 2008), they should be carefully evaluated regarding social and ecological impacts (Konefal et al., 2005). Addressing conservation program vulnerability in the Central Coast may require a rebalancing of power that may involve new food safety regulation, more stringent environmental regulation, or producer organizations renegotiating contract conventions.

In Iowa, new federal energy policies encouraging ethanol production have increased agricultural commodity prices and the number of acres planted in corn. Conservation initiatives in Iowa are highly susceptible to changes in commodity markets. Biofuel mandates have a significant and negative impact on ongoing USDA conservation efforts, as well as on uncompensated working-lands conservation practices. This case study illustrates a failure to recognize or address the linkages between these two policy goals and a failure to coordinate policy approaches. Despite years of federal funding to support conservation programs and their known success, emerging goals to reduce greenhouse gas emissions through biofuel production are beginning to override these programs and longstanding resource stewardship priorities. To address this problem, conservation impacts and agro-ecological analysis could be incorporated in the regulatory scientific analyses of biofuel policy, which currently focuses on carbon and energy fluxes alone. As the EPA (2011) suggests in a draft report, improved analysis of the broader environmental effects of biofuels, better policy coordination, and support for existing federal conservation programs may help to reduce the potential for conflicts in the future.

Addressing US commodity subsidy programs in future farm and food policies is also relevant to improving conservation outcomes. The majority of crops grown in Iowa are commodity crops eligible for subsidies, including direct payments based on acres planted. Coupled with downward pressure on commodity prices, these payments give producers incentives to maximize acreage and realize economies of scale after investing in farm machinery

and other fixed costs. Federal commodity crop subsidies also make expanding agricultural production onto marginal land attractive (Lubowski et al., 2008). Although this land may be less productive and have disproportionately negative environmental effects when cultivated, direct payments and crop insurance may keep production on marginal cropland profitable. Ultimately, these policies remain in conflict with ongoing funding through USDA conservation programs that encourage the adoption of less intensive practices.

There have been repeated attempts to end, reduce, or revise federal commodity subsidies in the US Congress. The Obama administration, for example, unsuccessfully proposed to limit direct payments to those farms with annual gross receipts of less than \$500,000. More recently, proposals have focused on reforming direct payments into some form of a crop insurance program, although this approach may still incentivize production on lower quality, more highly erodible land. Other possible approaches include linking insurance eligibility to conservation compliance in the absence of direct payments or redirecting direct payments toward targeted watershed projects, similar to those in the Conservation Stewardship Program. Reducing direct payments would remove an incentive for overproduction and may not drastically affect a producer's income. Often, landowners capture the value of a renting farmer's subsidy by increasing the rent to include the subsidy payment. If land values and rents respond to reflect policy changes, the net loss to producers might be evenly distributed and relatively small.

Overall, for conservation programs to remain effective, federal conservation funding should be supported alongside other policy initiatives, including crop subsidies, biofuel mandates, and food safety standards. This remains especially important given the close link between voluntary conservation programs and the changing circumstances of agricultural markets. While policies that support food safety, renewable fuel, and farm income may all be important to society, conflicts between initiatives need to be addressed to protect producers from having to choose one social goal over another.

Limited and threatened funding

The case studies presented in this paper illustrate that the incentives provided through USDA conservation programs are often not substantial enough to encourage and sustain participation. When policy and/or market conditions change, monetary incentives through conservation programs can quickly become less attractive or irrelevant to producers. In regions such as California, where land and specialty crops are extremely valuable, higher incentives may be needed to entice and sustain producer participation in conservation programs. In Iowa, energy policies and corn prices changed abruptly making CRP payments suddenly much less attractive to corn producers. Federal conservation funding should receive support alongside other policy initiatives, like biofuel mandates, given how conservation programs are closely linked to agricultural markets. In many cases, conservation payments need to be increased or be more closely tied to land and crop values to discourage producers from abandoning programs when conditions change. However, increased federal support for conservation programs has become politically infeasible given recently proposed budgets.

Despite increased funding from previous farm bills, US conservation programs now face considerable funding cuts. The federal government cut funding for conservation programs by \$500 million in 2011. The 2012 agricultural appropriations bill called for over \$925 million in cuts to conservation programs, cutting EQIP by \$350 million (about 20% of total EQIP funding). Significant cuts to operational budgets have decreased the level of

technical assistance and support available through NRCS offices. President Obama has called for \$32 billion in cuts to farm programs over the next 10 years. The President's proposed budget for the 2012 Farm Bill calls for over \$595 million in cuts to conservation programs including EQIP, which would lose an additional \$347 million. Lawmakers are reducing funding available for conservation programs, while maintaining support for expensive biofuel production incentives and other policies that continue to threaten conservation goals. Diminishing funding for conservation programs into the foreseeable future extinguishes any possibility for increasing the effectiveness of current voluntary approaches and suggests that other policy tools need to be explored.

Adding a bigger "Push" to the "Pull"

Voluntary approaches have remained the most popular way to addressing environmental problems associated with agriculture. Voluntary measures are well liked by producers because they grant freedom as to how to tackle environmental problems and involve little to no regulatory oversight. Voluntary programs are also well liked by regulators because they require fewer resources compared to other approaches (Dowd et al., 2008). However, when the benefits to society do not align with the benefits to the individual land manager, either a very strong incentive or regulation enforcement is needed to ensure that benefits to society are protected. It remains unrealistic to believe that small incentives will be adequate to sustain cooperation in reaching conservation goals (Cary and Roberts, 2011). Current voluntary approaches in the US provide relatively small incentives, remain vulnerable to political and economic changes, and face significant budget cuts. Therefore, additional policy tools are necessary to effectively sustain conservation efforts on agricultural lands.

To address environmental issues on US farmland, a combination of policy tools is more likely to be effective than any single tool alone (Segerson and Walker, 2002; Gunningham, 2007; Dowd et al., 2008). Gunningham (2007) discusses the importance of "push-pull" combinations, using both the carrot and the stick. Current voluntary approaches encourage producers to participate in conservation (the "pull"); however in most cases, there is very little "push." Stronger mandatory approaches may need to be added to the current mix. Gunningham (2007) argues that it is important to maintain the appropriate order of introduced policy changes. First, perverse incentives need to be removed. Next, measures should be introduced that do not seem overly coercive, like voluntary programs. Then, when necessary, mandatory measures should be added. Regarding the first step, efforts to address perverse incentives such as commodity subsidies, food safety rules, and bioenergy policies continue to face strong opposition. Conservation programs represent the most widespread voluntary approach but remain vulnerable due to the persistence of perverse incentives, their inability to respond to political and market changes, and significant funding limitations. Given the vulnerability of current voluntary programs, new mandatory approaches need to be explored.

A variety of mandatory approaches could be used to address environmental issues on US farmland. Segerson and Walker (2002) and Dowd et al. (2008) each provide an extensive review of policy options to address non-point source pollution associated with agriculture. Mandatory approaches include: direct regulation, taxes and fees, and marketable permits. Currently, most regulatory policies for agricultural pollution in the US remain weak. For example, the Central Coast Regional Water Quality Control Board's mandatory program requires producer education, farm management plans, and monitoring. The board also has limited resources for enforcement, and fines for non-compliance remain small. Some states have implemented taxes on fertilizer and pesticide sales, but these extra costs remain relatively low and are

unlikely to have a large impact on application. For example, in 1987 Iowa producers consented to a nitrogen fertilizer tax to reduce pollution and fund the Leopold Center for Sustainable Agriculture; however, this tax has not been significant enough to substantially reduce application rates. Marketable permit systems represent another option, but have not been widely applied in agricultural settings (Segerson and Walker, 2002).

Substantial taxes and fees may serve as an effective "push" to support conservation on US farmland. They may also allow for greater flexibility to adjust to changing economic conditions and may be more cost-effective than other approaches (Gunningham, 2007; Cary and Roberts, 2011). Increasing the cost of inputs such as fertilizer or fuel through a tax, or eliminating subsidies and tariff protections that distort the real costs of these inputs, may be an option worth pursuing. However, any price increase for fertilizer would need to be substantial in order to have an impact on application rates (Segerson and Walker, 2002). Increased input costs create a situation where producers have every incentive to be efficient and will experiment with new technologies and crop varieties (Hamblin, 2009). In Australia and New Zealand, where the prices producers pay more accurately represent the real cost of inputs, producers apply less than half of the quantity of fertilizers and agricultural chemicals per land area compared to producers in the Midwest (Price, 2006 as cited in Hamblin, 2009). Other fees or charges could also be applied to discourage certain behavior. For example, a significant fee could be used to deter producers from putting set-aside land back into production or from taking out conservation practices. Proposals to apply new taxes and fees would likely face considerable opposition from producers, agri-business, and agri-business supporters. While currently these options may not be politically feasible, evidence continues to support the need for additional policy tools.

Conclusion

Private farmland constitutes a large percentage of the US land base and therefore remains an important focus for efforts to enhance and maintain the environmental quality and ecological integrity of US landscapes. Environmental outcomes continue to depend on the cumulative decisions of individual land managers. Therefore, much research has explored producer decision-making about conservation and environmental stewardship. Most of this work has focused on micro (individual producer or farm) and meso-scale (community) factors, overlooking macro-scale influences. This micro and meso-scale work includes analyses of farm and producer characteristics (e.g., Buttel and Newby, 1980; Napier et al., 1988) and social capital (e.g., Lubell and Fulton, 2008). While these factors remain important, more attention needs to be directed towards macro-scale factors that have emerged as increasingly influential in shaping production trends.

Some research has indicated the importance of macro-scale factors when exploring producer decision-making. Lubell and Fulton (2007) and Lubell and Fulton (2008) stress the importance of social capital in their work, but also illustrate how external policy decisions can impact local networks and impair social capital. Wejnert (2002) suggests that larger scale political factors can deter or postpone the adoption of conservation practices. Atwell et al. (2010) go further to indicate the need for those working on conservation efforts at the regional level to scale up their work to address macro-scale drivers of change. In this paper, we illustrate that macro-level factors not only influence producer decision-making, but that they can outweigh other factors. As agriculture becomes increasingly industrialized and globalized, macro-scale forces will have greater influence on land management. For example, future World Trade Organization negotiations and other international agreements may

shape national agricultural policies and markets in new ways. Future research on producer decision-making should focus more on macro-scale factors or at least include these factors in a multi-scale analysis. Research focusing on multi-scale factors can include qualitative interviews, as described in this paper, but could also entail the inclusion of multi-scale variables in models that quantitatively explore factors influencing producer decision-making. Investigations of how macro-scale changes in agriculture influence producers' decision-making processes over time would also improve our understanding of the relative effects of macro-scale variables. For example, longer-term studies might demonstrate the changing influence of macro-level variables on model parameters that measure producer decision-making.

In order to address environmental degradation associated with agriculture, attention must shift from the decisions of individual producers to the decisions of governing bodies and industries that increasingly influence land use. Based on our case studies, we agree with Atwell et al. (2010) that conservation efforts remain dependent on attention to economic and political dynamics at regional, national, and international scales. In California, contracts between producers and private companies constrain participation in conservation efforts and threaten achieving state and federal water quality goals. In Iowa, participation in conservation programs remains vulnerable to market volatility, increases in commodity prices, and policy efforts to increase biofuel production. In each case, the success of voluntary conservation approaches remains linked to macro-scale policies and markets that influence stewardship decisions. This paper illustrates the vulnerability of voluntary approaches to conservation and how macro-scale changes have resulted in considerable setbacks. Given this vulnerability and decreasing funding to support voluntary approaches, new policies should be explored to better protect and enhance environmental quality on US farmland.

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