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Research article

Determinants of field edge habitat restoration on farms in California's Sacramento Valley

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ABSTRACT

Degradation and loss of biodiversity and ecosystem services pose major challenges in simplified agricultural landscapes. Consequently, best management practices to create or restore habitat areas on field edges and other marginal areas have received a great deal of recent attention and policy support. Despite this, remarkably little is known about how landholders (farmers and landowners) learn about field edge management practices and which factors facilitate, or hinder, adoption of field edge plantings. We surveyed 109 landholders in California's Sacramento Valley to determine drivers of adoption of field edge plantings. The results show the important influence of landholders' communication networks, which included two key roles: agencies that provide technical support and fellow landholders. The networks of landholders that adopted field edge plantings included both fellow landholders and agencies, whereas networks of non-adopters included either landholders or agencies. This pattern documents that social learning through peer-to-peer information exchange can serve as a complementary and reinforcing pathway with technical learning that is stimulated by traditional outreach and extension programs. Landholder experience with benefits and concerns associated with field edge plantings were also significant predictors of adoption. Our results suggest that technical learning, stimulated by outreach and extension, may provide critical and necessary support for broad-scale adoption of field-edge plantings, but that this alone may not be sufficient. Instead, outreach and extension efforts may need to be strategically expanded to incorporate peer-to-peer communication, which can provide critical information on benefits and concerns.

1. Introduction

Simplified agricultural landscapes maximize crop yields, but these large-scale monoculture cropping systems lead to a loss in habitat, biodiversity, and associated ecosystem services (MEA, 2005). As a result, there is wide spread concern that our farming systems have experienced a reduction or loss of critical ecosystem services and ability to sustain food production (Tilman, 1999; MEA, 2005; Foley et al., 2011; Rusch et al., 2016). Best management practices (BMPs) designed to voluntarily restore or conserve habitat on farms are emerging as a strategy to enhance biodiversity on farmlands, and have significant policy support both internationally (European Commission, 2016) and nationally through the United States Department of Agriculture (USDA), Agricultural Act of 2014, best known as the Farm Bill. The Farm Bill includes support for a number of BMPs through the Conservation Stewardship Program, State Acres for Wildlife, and the Environmental Quality Incentives Program (USDA, 2015). These programs aim to inform and engage private landholders (farmers and landowners) with technical and financial support, using an approach that bridges private interests of landholders and the public benefits of on-farm conservation practices.

Field edge habitat plantings have received a great deal of attention as a BMP that can enhance biodiversity and ecosystem services in simplified agricultural landscapes (NRCS, 2010; USDA, 2015). These strips of permanent vegetation are planted along field edges, farm borders, and marginal areas; thus, no cropland is taken out of production. Plants include native shrubs, wildflowers, and perennial bunch grasses that generally do not compete with adjacent crops for resources (Long and Anderson, 2010; Williams et al., 2015). Potential benefits of field edge habitat plantings include water quality protection, increased biodiversity, and habitat

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for native bees and natural enemies that enhance pollination and pest control in adjacent crops (Zhang et al., 2010; Fahrig et al., 2011; Kremen and Miles, 2012; Morandin et al., 2016).

Despite the potential benefits, there has been low adoption of BMPs, and field edge habitat plantings in particular (Brodt et al., 2009), suggesting constraints in the process (Burton et al., 2008; Griffiths et al., 2008; Carvalheiro et al., 2011; Mckenzie et al., 2013). Decision-making studies emphasize the importance of farmers' environmental knowledge and attitudes on influencing behavior (Brodt et al., 2009; Farmer et al., 2011). While these characteristics are hypothesized to have a positive relationship on BMP adoption, a recent review found mixed signals for each category (Prokopy et al., 2008). There is considerable debate surrounding which factors can best be used to describe and predict adoption of on-farm conservation practices, hampering efforts to strategically increase their use (Griffiths et al., 2008; Brodt et al., 2009).

Investigating how landholders learn about management practices and use the pathways that support decision-making—including social, experiential, and technical learning—is critical to understanding patterns of adoption of new practices (Lubell et al., 2014). Social learning refers to peer-to-peer interactions whereby landholders (farmers and landowners) learn directly from each other as well as knowledgeable people in the farming community. Technical learning refers to obtaining information through traditional extension programs and their support resources, including websites, books, and online resources. Experiential learning is the process of learning through “hands-on” experience and trial and error. These pathways can inform management decision-making (Lubell et al., 2014) by providing information on the benefits and concerns associated with innovative practices, and shaping patterns of adoption of these innovations (Rogers, 2003). Landholders often use multiple learning pathways, which can be complementary and mutually reinforcing (Lubell et al., 2014), as landholders draw on their own personal experience and beliefs on management practices.

The goal of this study was to investigate drivers of adoption of field edge habitat plantings in California's Sacramento Valley. The region ranks among the nation's top leading producers of almonds, walnuts, and tomatoes (NASS, 2016) and exemplifies primary challenges of conserving ecosystem services in working farmlands: the opportunity costs of encroaching on cultivated areas in high-value, large-acreage specialty crops may affect field edge management decisions, regardless of farm demographics.

To understand patterns of adoption of field edge habitat plantings, we conducted a survey of landholders in California's Sacramento Valley in 2013. Our investigation included landholders' information sharing along two learning pathways: technical learning (e.g., extension and outreach agencies) and social learning (e.g., landholder-to-landholder). It also evaluated the influence of landholder experience with potential benefits and concerns associated with the plantings, and engagement with agencies that provide technical support and cost-share funding. This study provides an approach to bridge a critical knowledge and action gap by documenting potential barriers and facilitators to the adoption of field edge habitat plantings, a BMP that aims to enhance ecosystem services in simplified agricultural landscapes.

2. Methods

We surveyed landholders in California's Sacramento Valley in 2013. The study area comprised Yolo, Solano, Sacramento, Colusa, Sutter, Yuba, and Glenn Counties. This area was chosen to cover the diversity of farming practices and crop types including field, row, and orchard crops, organic and conventional production, and large and small scale cropping systems. The study area reflects the range of farm sizes and grower demographics, including age, income, and gender diversity that occur in the Sacramento Valley (Table 1).

Our survey investigated field edge management practices based on the following themes: farm demographics, including acreage, conventional versus organic farming; information sources accessed by landholders; personal contacts with whom they exchanged information; experience with and perceptions of benefits and concerns; and agencies and partner organizations with whom landholders work. Taken together, these variables provided an overview of potential drivers of adoption of field edge habitat plantings. We focused on landholders to ensure we reached those who make management decisions on the farm. Landholders is a common term used in previous research (Cocklin et al., 2007) as both farmers and landowners play a significant role in crop production (Nickerson et al., 2012). Our survey included 29 questions with most of the responses a yes/no or on 4-point Likert scales, including an option for “Don't Know.” Landholders that had field edge plantings received several additional questions about these plantings. The survey can be found online at: http://ceyolo.ucanr.edu/Custom_Program/Hedgerows/. Prior to distribution, we tested the survey with a small group of growers to help assure relevance and clarity of survey questions.

To reach the agricultural community, we used mailing lists provided by local Resource Conservation Districts (RCDs), University of California Cooperative Extension (UCCE), and Audubon California. We used a modification of Dillman's tailored design method (Dillman et al., 2014), following the introduction letter and initial mailing with two follow-up reminders. Our survey questionnaire was mailed to 300 landholders with self-addressed stamped return envelopes. We distributed the same survey electronically to 2840 landholders by emailing them an electronic link to the survey hosted on the website listed above. While we recognized that the landholder sample was not truly random, we expected that coverage was increased and non-response errors were reduced through the multi-modal nature of the survey and the contacts reached through stakeholder organizations and the extensive outreach of UCCE (Roberts, 2007). Returned surveys were coded into an electronic database and quantitative data were analyzed using R statistical software version 3.0.2 (R Core Development Team, 2013).

First we divided respondents into two groups, those who adopted and currently use field edge plantings and those who did not, hereafter referred to as adopters and non-adopters. We summarized responses, using Welch's t -test to evaluate differences in responses between the two groups. We used logistic regression to evaluate adoption and use of field edge plantings, including hedgerows of native shrubs, trees and strips of native wildflower and/or native grass plantings, in practices currently used by adopters. Our model included fixed effects for grower experience, social learning, technical learning, as well as farm capital characteristics and production practices. We also included a random effect for county. Grower experience with, and perception of, field edge plantings were indicated by two variables, the percent of potential benefits (of 14 total) that landholders ranked as high benefits and the percent of potential concerns (of 11 total) ranked as high concern (range = 0–1).

We investigated social learning in two ways. To understand the composition of contacts within information sharing networks—-which describe who interacts with whom (Wasserman and Faust 1994)—we asked landholders to name five contacts with whom they exchange information about field edge management. Since we were particularly interested in social information sharing between landholders, we also considered the rating of “personal communication with other landholders” as an information source