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Factors influencing environmental stewardship in U.S. agriculture: Conservation program participants vs. non-participants

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ABSTRACT

United States Department of Agriculture (USDA) conservation policy has increasingly shifted from a traditional land-retirement focus to greater emphasis on producer adoption of working-land conservation practices. This research made use of USDA integrated field/farm surveys, the Conservation Effects Assessment Project (CEAP) and Agricultural Resources Management Survey (ARMS), to (1) enhance understanding of operator, field, farm, economic, and environmental characteristic differences between conservation program participants and non-participants across a farm typology, and (2) to enhance understanding of the relative importance of these factors on influencing farm stewardship intensity in corn and wheat production, i.e., how these factors influence differences in producer adoption of alternative levels of land and pest-management practices between conservation program participants and non-participants. The research used a cost-function acreage-based technology adoption model to examine farm stewardship differences. Results indicate that program non-participants invest more heavily in land conserving and pest-management practices than program participants. Relative prices, structural, and socio-environmental factors play significantly different roles across crops, and between conservation program participants and non-participants, in their influence on producer adoption decisions for land and pest-management intensity. The environmental effectiveness and cost efficiency of conservation programs will likely improve when their implementation more explicitly recognizes farm heterogeneity as well as differences in farmer motivations for stewardship investments. Recognizing these differences can help improve targeting of conservation incentive structures.

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Introduction

The U.S. Department of Agriculture (USDA) conservation programs have historically emphasized cropland retirement. Recent programs emphasize working-land conservation, specifically through the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP). Funding for working land conservation programs increased from $174 million in 2000 to roughly $2.4 billion in 2012 (Claassen, 2014). Working-land programs assist farmers with implementing and maintaining conserving land-management practices such as conservation tillage, crop rotations, cover crop management, enhanced nutrient management, precision agriculture, irrigation water management, pest management, and various conservation structural practices such as strip cropping, terraces, and stream-side herbaceous buffers (Lambert et al., 2007a,b; Schaible et al., 2009). Working-land conservation goals also benefit from USDA participation in Federal and State/local partnership agreements focusing on watershed-scale resource and environmental policy issues that go beyond the farm. Partnership agreements implement land, water, and habitat conservation activities on both working farmland and other lands that reduce salinity problems, improve water quality and supply, enhance fish and wildlife habitats, and promote environmental protection and compliance with Federal, State, and local regulations. With enactment of the Agricultural Act of 2014, the USDA now participates in watershed, State, and multi-State

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financial assistance-based conservation partnerships through the Regional Conservation Partnership Program (RCPP).[4]

Since 2004, the environmental effectiveness of USDA conservation programs has been evaluated by USDA's Natural Resource Conservation Service (NRCS) through its Conservation Effects Assessment Project (CEAP). USDA's vision for CEAP focuses on "*enhanced natural resources and healthier ecosystems through improved conservation effectiveness and better management of agricultural landscapes*" (USDA-NRCS, 2013a). The project's primary data source is a farmer survey of field-level conservation practices and program participation (for survey years 2003–2006), integrated with environmental data at National Resources Inventory (NRI) data points. We hypothesize many factors other than program incentives drive the environmental performance of U.S. agriculture. Good land stewardship and its environmental benefits often make good business sense even without program participation (Smith and Weinberg, 2004; Hopkins and Johansson, 2004; Robertson and Swinton, 2005; Bowman and Zilberman, 2013). In addition, for some producers non-financial concerns, such as moral and social values can be motivating factors encouraging the willingness to forgo some profits when adopting conservation practices (Chouinard et al., 2008; Mzoughi, 2011; Sheeder and Lynne, 2011).

In an effort to better understand farmer motivation related to conservation practice adoption, the USDA conducted a pilot national survey integration program during 2004 and 2005, the Conservation Effects Assessment Project – Agricultural Resources Management Survey (CEAP-ARMS). CEAP-ARMS integrated CEAP information [National Resource Inventory (NRI) data on field-level physical (environmental) characteristics and CEAP production practice and conservation program participation data] with USDA ARMS data on cost-of-production, operator, farm household, and farm economic/resource data (Lambert et al., 2007c). By linking these surveys, USDA intended to provide a clearer understanding of the differences between program participant and non-participant behavior to help it modify the design, implementation, and monitoring of conservation programs, as well as revise over time its environmental policy objectives — assumed to be inclusive of farm-related ecological services, such as improving air and water quality from changes in crop and farm resource management; reducing greenhouse gases (GHG) and enhancing carbon sequestration through the use of methane digesters, conservation tillage or no-till, and by converting cropland to grasslands and forests; preserving wetlands; and enhancing wildlife habitat (Ribaudo et al., 2008; Marshall and Weinberg, 2012; Horowitz and Gottlieb, 2010). In addition, USDA, in compliance with the Food, Conservation, and Energy Act of 2008 established the Office of Environmental Markets (OEM) designed to facilitate landowner participation in emerging markets for farm ecosystem services, with particular emphasis on measuring the environmental service benefits from conservation and land management activities.[5]

Using the 2004 and 2005 CEAP-ARMS data for wheat and corn production, we first compare operator, field, farm, economic, and environmental characteristics of conservation program participants with non-participants across a farm typology. Secondly, we use an econometric model to examine the relative importance economic, field/farm, resource, and environmental factors have on influencing farmland stewardship intensity by corn and wheat producers, i.e., how producer land and pest-management intensity differs between conservation program participants and non-participants, separately by crop. Based on CEAP-ARMS data, land-management practices include: (a) the use of crop rotations; (b) conservation tillage (no-till, strip-till, ridge till, or mulch till); (c) performing soil nutrient tests; (d) use of variable-rate technology (VRT) in fertilizer and/or seed application; (e) contour and/or strip cropping; and (f) use of GPS-based soils maps of field soil properties for improved crop production management. Pest-management practices includes: (a) scouting for pests; (b) keeping written/electronic records to track field pests over time; (c) comparing of pest scouting data to public threshold data; (d) using biological pesticides and growth regulators; (e) using rotated or tank-mixed pesticides to mitigate against pest resistance; (f) using field mapping to assist in pest management decisions; (g) use of diagnostic lab services for pest identification analysis; (h) use of crop seed varieties resistant to specific pests; (i) adjusting of crop planting/harvesting dates; (j) use of weather data for improved pest applications; (k) altering crop planting locations to avoid pest infestations; (l) use of water-management practices to help in pest management; and (m) use of alternative field cultural practices designed to reduce the spread of pests.

This paper extends use of an agricultural technology adoption framework from two perspectives: (1) it shifts the concept of production technology from the traditional practice-by-practice definition to a production systems (or stewardship intensity) perspective where alternative levels of stewardship intensity (a production technology system) involve producer use of multiple land and pest-management practices; and (2) it applies a cost-function acreage-based technology adoption model to evaluate producer adoption of alternative land and pest-management production systems. The econometric model is estimated using a Generalized Estimating Equations (GEE) procedure to accommodate for correlation across producer production system adoption decisions. As used here, farmland- and pest-management intensity for a crop field (i.e., the level of stewardship) is gauged by the crop acres managed under a set of conserving land- and pest-management practices applied in concert to the field.

The crop-specific models, each jointly estimated with four acreage-based technology adoption equations for program participants and non-participants, respectively, evaluate four production-system based practice decisions representing four land/pest-management production technology intensity classes, ranging (for both land and pest-management) from conventional production practices to the most-conserving practices. Alternative levels of stewardship associated with production technology intensity decisions were assumed to occur on wheat (2004) or corn (2005) fields consistent with the use of: (1) conventional land and pest-management practices; (2) conventional practices but with an emphasis on more-conserving land-management practices; (3) conventional practices but with an emphasis on more-conserving pest-management practices; or (4) more-conserving of both land and pest-management practices. Each model estimates land and pest-management intensity (in acres) across wheat or corn production as a function of normalized input costs (prices), the alternative types of land/pest-management choices available, the presence of field management structures (i.e., conserving irrigation systems and/or soil conservation structures), and covariates reflecting the influence of a variety of field, farm, and environmental characteristics on the adoption decision.

Literature review

A variety of linear logit, probit, tobit, and multinomial logit probabilistic models, generally based on dichotomous choice data have been typically used to evaluate farm technology adoption decisions. Marra and Carlson (1987) found that double-cropping of

[4] For more information on the RCPP program, see the USDA website at: http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/farmbill/rcpp/.

[5] For more detailed information on USDA environmental objectives and markets, see the USDA-OEM website for "Understanding Environmental Markets," at: http://www.usda.gov/oce/environmental_markets/understanding.htm.