**Additionality in Conservation Easements Programs: Grassland Easements in the Prairie Pothole Region**

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## Introduction

Conversion of native sod (grassland) to cropland in the Prairie Pothole Region (PPR) is threatening important breeding habitats for migratory birds. About 50 percent of North American ducks are produced in the grasslands of the PPR, even though this habitat accounts for only ten percent of duck breeding territory. Once lost, native grassland habitats are difficult to reconstruct.

To protect these habitats, the U.S. Fish and Wildlife Service (FWS) holds permanent easements prohibiting grassland-to-cropland conversion or wetland drainage on more than 3.5 million acres. The USDA also holds easements against grassland conversion.

Additionality is an important measure of conservation program performance. Easements are "additional" only if the landowners who receive them would have converted grassland to another use (primarily cropland) or drained wetlands in the absence of the easement payment. Non-additional easements provide no extra environmental benefits while depleting financial resources available for easement purchases.

## Objective

We estimated the additionality of grassland easements purchased in Montana, North Dakota, and South Dakota from 1997—2010. Higher additionality implies that a larger proportion of eased grasslands would have been converted to another use in the absence of the easement. Using propensity score models, our estimate of additionality for all easements is 3.4 percent for the years 1997-2010. For relatively high quality land, which is more likely to be converted, our estimate of additionality is 6.4 percent. When measured over longer periods, additionality will higher because more of the eased land would have been converted to another use.

## Research Methodology and Data

Once an easement has been purchased it is no longer possible to observe how the land would have been managed without the easement. We estimate the probability that land under easement would have been converted to another use by looking at the conversion rate for "matching" parcels that are not under conservation easement. Additionality is measured as the percentage of these "matching" parcels that have been converted to another use, averaged across all eased parcels. Propensity score matching (PSM) has been used in previous studies of conservation programs in the U.S. (e.g., Mezzatesta, et al.; Liu and Lynch) and Europe (e.g., Pufahl and Weiss).

Land use data for 1982-2010 is obtained from the National Resources Inventory (NRI). NRI points under easement are identified by linking them to spatial polygons provided by FWS and USDA-NRCS. The study area covers 80 counties in Montana, North Dakota, and South Dakota where grassland easements intersect with NRI points, We consider a total of 4,553 NRI parcels that were classified as rangeland in 1982 and 1992. While rangeland is not necessarily native sod, native sod is typically classified as rangeland. Native sod is not identified by NRI or any other source of land use data. Grassland easement purchases began in the mid-1990s and easements are observed on 490 NRI parcels by 2010. Of the remaining parcels, 371 had been converted to another land use by 2010. The 371 converted parcels represent just over seven percent of total acres in the sample.

Propensity scores (the probability of obtaining an easement) for each NRI point were estimated using data on economic conditions, soils, topography, and other landscape features that could affect both agricultural returns and habitat value. For each NRI point, data on potential habitat value is developed using spatially explicit data on habitat quality and program administration obtained from FWS. Data on cropland and grassland revenue, production costs, crop insurance and other farm program payments for 1997—2010 is based on methods used by Claassen et al. Site-specific data on land quality and the composition of the surrounding landscape is used to capture variations in production potential that affect the profitability of cropland and grassland.

Propensity scores are matched using inverse-probability weighting. Estimates of the average treatment-effect-on-the-treated (ATT) are calculated with and without survey weights.

**Results and Discussion**

For all easements, our estimate of the ATT is 0.034. On average, we estimate that in the absence of the easement 3.4 percent of eased land would have been converted to another use by 2010. To put that number in context, we estimate that 1.56 percent of all rangeland in the Prairie Pothole Region was converted to cropland from 1997—2010. For relatively high quality land (LCC = 2) our estimate of ATT is 0.064. (LCC 2 can support crop production without excessive soil erosion but low soil productivity or climate may limit profitability.) By 2010, we estimate that 6.2 percent of uneased high quality rangeland was converted to another use.

Covariate balancing tests indicates statistically insignificant potential for bias in our estimates. Using mean-comparison t-tests, we find all covariates are balanced ($p<0.10$) between the easement group and the no easement group. Using $p<0.05$, the proportion of relatively low quality land (LCC = 7) is under-represented in the control group.

The easement programs target high quality habitat. More than 80 percent of easements are located on land with highest priority habitat while 12 percent are on medium priority habitat and only 8 percent are on relatively low quality habitat. Targeting higher quality land within those high priority habitats could improve the cost-effectiveness of the program. Over 720,000 acres of high quality land (LCC = 2) are in high priority habitats and remain in uneased rangeland. Easements on these lands may be more difficult or more expensive to obtain, when compared with lower quality land, because of potential for conversion.

Our estimates are based on a limited time series. All easements were purchases between 1995 and 2010. The permanent easements, however, will continue to protect grassland against conversion in perpetuity. Assuming that grassland conversion continues at a constant annual rate (equal to 3.4 percent of 1997 rangeland every 13 years), then our estimate implies that 13 percent of all eased land would have been converted over the next 50 years. On relatively high quality land (LCC=2), our simple extrapolation implies that 25 percent of eased land would have been converted in the absence of the easement.

**References**


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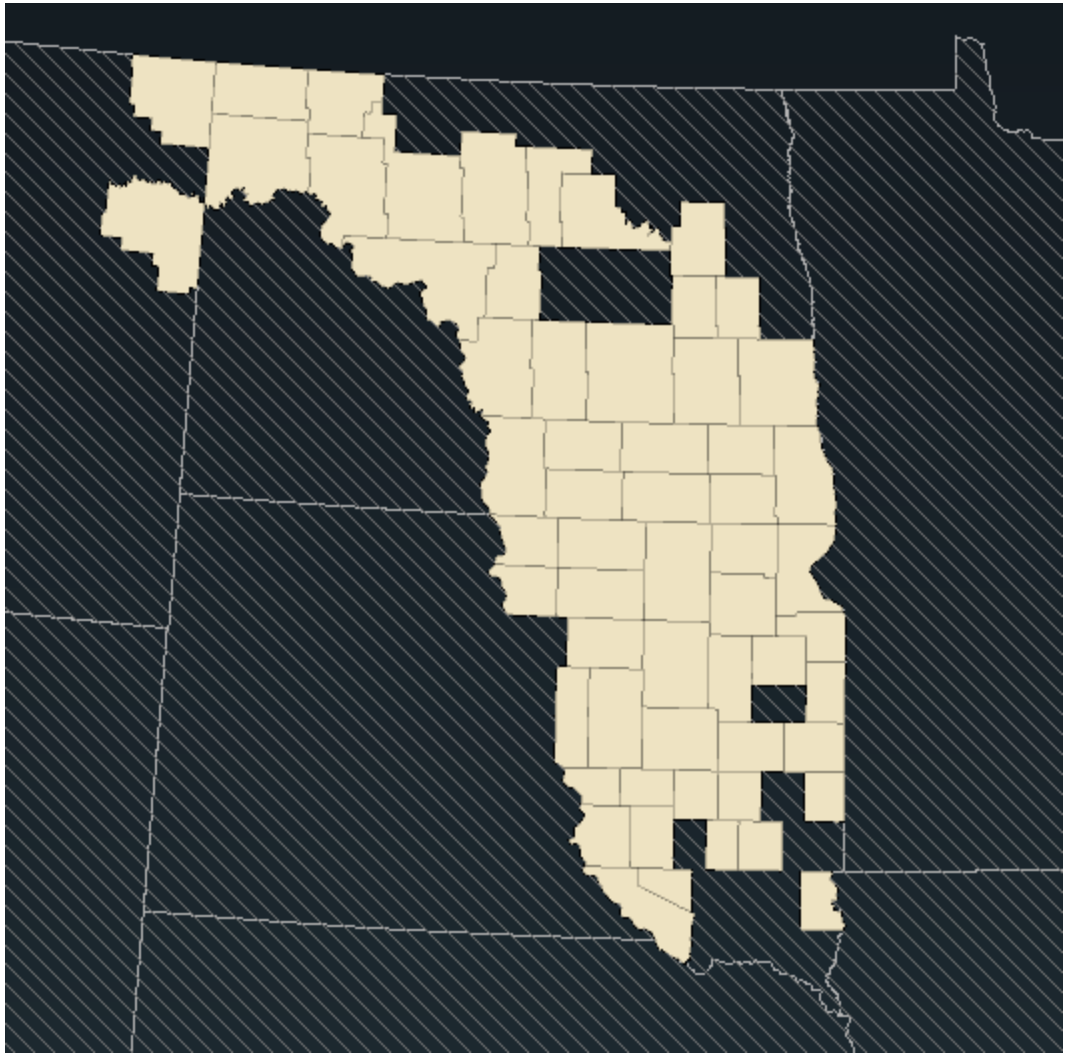

**Figure 1 Counties with Grassland Easements that Intersect NRI Points**

**Table 1 Descriptive Statistics by the Full Sample, Grassland Tracts with and without Easements, 2010, for Montana, North Dakota, and South Dakota**

| | | No Easement (N=4,063) | | Easement (N=490) | | Total (N=4,553) | |
|---|---|---|---|---|---|---|---|
| Variable | Definition of Variables | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| grassland | Classified as range in 2010 | 0.919 | 0.273 | 0.986 | 0.117 | 0.926 | 0.262 |
| *Explanatory variables* | | | | | | | |
| wetland index | (wetland area x wetland count)/tract area | 1.189 | 2.227 | 3.279 | 5.931 | 1.403 | 2.905 |
| SlopeMean | Mean slope based on difference in elevation on 90 meter grid | 2.087 | 1.342 | 1.905 | 0.944 | 2.069 | 1.308 |
| SlopeSTD | Std. deviation of slope based on 90 meter grid | 1.150 | 0.737 | 1.054 | 0.556 | 1.140 | 0.721 |
| relative return | Net return to cropland less net return to rangeland ($) | 24.25 | 36.24 | 31.38 | 39.21 | 24.97 | 36.61 |
| GBird CArea | = 1 if Grassland Bird Conservation Area | 0.604 | 0.489 | 0.834 | 0.373 | 0.628 | 0.483 |
| LCC = 2 | Land Capability Classification 2 | 0.449 | 0.497 | 0.381 | 0.486 | 0.442 | 0.497 |
| LCC = 3 | | 0.151 | 0.358 | 0.0923 | 0.290 | 0.145 | 0.352 |
| LCC = 4 | | 0.110 | 0.313 | 0.178 | 0.383 | 0.117 | 0.321 |
| LCC = 5 | | 0.00122 | 0.0349 | 0.00543 | 0.0735 | 0.00165 | 0.0406 |
| LCC = 6 | | 0.174 | 0.379 | 0.191 | 0.393 | 0.176 | 0.381 |
| LCC = 7 | | 0.111 | 0.314 | 0.145 | 0.352 | 0.114 | 0.318 |
| LCC = 8 | | 0.00449 | 0.0669 | 0.00797 | 0.0890 | 0.00485 | 0.0695 |
| Priority zone = 1 | Highest Priority Habitat | 0.546 | 0.498 | 0.818 | 0.386 | 0.574 | 0.495 |
| Priority zone = 2 | Medium Priority Habitat | 0.254 | 0.435 | 0.124 | 0.330 | 0.241 | 0.428 |
| Priority zone = 3 | Low Priority Habitat | 0.200 | 0.400 | 0.0579 | 0.234 | 0.185 | 0.389 |

**Table 2 Estimated Coefficients from a Probit Model to Compute Propensity Scores**

| | Full Sample | | LCC = 2 | |
|---|---|---|---|---|
| Dependent Variable, easement | Estimated Coeff. | Std. Error | Estimated Coeff. | Std. Error |
| LCC = 3 | -0.306*** | (0.0205) | | |
| LCC = 4 | 0.180*** | (0.0188) | | |
| LCC = 5 | 0.980*** | (0.1042) | | |
| LCC = 6 | -0.0135 | (0.0181) | | |
| LCC = 7 | -0.0029 | (0.0239) | | |
| LCC = 8 | 0.234** | (0.0771) | | |
| priority zone = 2 | -0.446*** | (0.0168) | -0.643*** | (0.0277) |
| priority zone = 3 | -0.616*** | (0.0225) | -0.904*** | (0.0369) |
| GBird CArea | 0.633*** | (0.0154) | 0.799*** | (0.0234) |
| wetland index | 0.0683*** | (0.00218) | 0.0672*** | (0.0047) |
| SlopeMean | 0.023* | (0.0101) | 0.408*** | (0.0233) |
| SlopeSTD | -0.124*** | (0.0172) | -0.769*** | (0.0377) |
| rel_return | 0.00429*** | (0.000182) | 0.00124*** | (0.00033) |
| Constant | -2.695*** | (0.0190) | -1.718*** | (0.0319) |
| Pseudo $R^2$ | 0.1250 | | 0.1522 | |

* p<0.05, ** p<0.01, *** p<0.001

**Table 3 Estimated Additionality (ATT)**

| | Full Sample | LCC = 2 |
|---|---|---|
| ATT | 0.0334*** | 0.0642*** |
| | (0.00155) | (0.00194) |
| Average Potential Outcome | 0.955*** | 0.935*** |
| | (0.00108) | (0.0019) |

*** p<0.001

**Table 4 Covariate Balancing Tests Using t-Tests**

| | Group Means | | |
|---|---|---|---|
| | Easement | No Easement | p-value for difference |
| LCC = 2 | 0.42 | 0.47 | 0.144 |
| LCC = 3 | 0.12 | 0.13 | 0.802 |
| LCC = 4 | 0.13 | 0.12 | 0.420 |
| LCC = 5 | 0.00 | 0.00 | 0.811 |
| LCC = 6 | 0.16 | 0.17 | 0.688 |
| LCC = 7 | 0.15 | 0.11 | 0.069 |
| LCC = 8 | 0.01 | 0.01 | 0.794 |
| GBird CArea | 0.64 | 0.63 | 0.947 |
| priority zone = 1 | 0.59 | 0.57 | 0.544 |
| priority zone = 2 | 0.24 | 0.24 | 0.953 |
| priority zone = 3 | 0.17 | 0.19 | 0.543 |
| wetland index | 1.49 | 1.30 | 0.136 |
| SlopeMean | 2.00 | 2.04 | 0.636 |
| SlopeSTD | 1.08 | 1.12 | 0.345 |
| relative return | 25.10 | 25.85 | 0.765 |