The Resource and Agricultural Policy System (RAPS): Upgrade and Documentation

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Abstract

The Resource and Agricultural Policy System (RAPS) is upgraded and documented in this technical report. RAPS was developed to estimate the environmental impacts of farming practices and policy in 128,591 National Resources Inventory (NRI) sites in the Central United States (the Corn Belt, Lake States, and Northern Plains). This modeling system integrates the effects of soils, climate, crops, and management practices on several environmental indicators including nitrate runoff and leaching, pesticide runoff and leaching, water and wind erosion, and soil organic carbon. RAPS can be used to provide timely information on the nation's environmental health as it is impacted by agriculture and by changes in agricultural and resource policies.

Key Words*:* Agricultural policy, carbon sequestration, conservation practices, environmental effects, integrated modeling systems, nitrate water pollution, soil erosion.

THE RESOURCE AND AGRICULTURAL POLICY SYSTEM (RAPS): UPGRADE AND DOCUMENTATION

1. Introduction

In the past 15 years, U.S. agricultural policy has experienced significant changes. Prominent among these were the advent of the Food Security Act (FSA) of 1985 and the Federal Agriculture Improvement and Reform Act (FAIR) of 1996. The FSA of 1985 created the Conservation Reserve Program (CRP), the Conservation Compliance, and the Swampbuster and Sodbuster. As of January 1997 the CRP had retired about 34 million acres of cropland from active production nationwide at an annual cost of approximately $1.7 billion. The Conservation Compliance requires farmers participating in government commodity programs to implement approved soil and water conservation plans on highly erodible land. Swampbuster denies commodity program benefits to farmers who crop designated wetlands, and the Sodbuster denies program benefits to farmers who bust highly erodible grasslands. All these conservation programs were continued in the subsequent farm bills. The establishment of these conservation provisions in the FSA of 1985 signaled that resource conservation had become an important objective of U.S. agricultural policy.

The FAIR Act of 1996 ended more than 60 years of planting restrictions and commodity-specific subsidies for seven "program crops." It also put greater emphasis on environmental stewardship. In addition to the continuation of the CRP, Conservation Compliance, Swampbuster, and Sodbuster, the FAIR Act also launched several new environmental initiatives including the Environmental Quality Incentives Program (EQIP) and whole-farm conservation plans. The focus on obtaining the greatest environmental benefits per dollar and geographical targeting also created opportunities to improve the environmental performance of farm programs (Kuch and Ogg 1996).

In addition to these major federal legislations, many state and local policies targeting soil erosion and water quality also have been implemented since 1985. These policy changes, along with increased environmental awareness, have resulted in significant changes in farming practices. Although many studies have evaluated specific farming practices and policies at field or watershed levels, very few have systematically analyzed the environmental effects of agricultural practices and policy at the regional or national level.

The primary objective of this technical report is to document the Resource and Agricultural Policy System (RAPS). This integrated modeling system was developed to analyze the environmental effects of agricultural practices and policy in the central United States (the Corn Belt, Lake States, and Northern Plains). In recent years, low agricultural commodity prices combined with the FAIR Act's lessening of farm sector reliance on government programs have raised fundamental questions about the ultimate goals of U.S. agricultural policy. As the debate over future agricultural policy continues, it is important to provide timely information about how changes in agricultural practices and policy affect the environment.

This paper is organized as follows. Section 2 provides a literature review on the effect of agricultural practices on environmental quality. Section 3 describes the study region. Section 4 presents the modeling system to evaluate the environmental effects of agricultural production. Section 5 discusses the data that was used to develop the system. Section 6 discusses the estimation results that are detailed in Appendixes A, B, and C. Section 7 offers concluding remarks.

2. Literature Review

It has long been recognized that agricultural practices can affect environmental quality and the effect is influenced by agricultural policies (Just and Bockstael 1991; Wu and Segerson 1995). Nitrate-N is the most commonly detected agricultural chemical in groundwater. The soil erosion and agricultural chemical runoff have caused surface water pollution in many local rivers and stream. The environmental impacts of agricultural practices are not limited to the local level. The delivery of eroded nitrogen and other nutrients by the Mississippi River system to the Gulf of Mexico has contributed to a hypoxic zone that poses a threat to the aquatic environment and fisheries in the region. Nearly one-third of the annual nitrogen inputs to the Mississippi-Atchafalaya River basin results from fertilizer loss from agricultural lands in the Mississippi River basin. The annual net release of carbon from agriculture has been estimated at 0.8x 0.8×10^{15} g, or about 14 percent of current fossil fuel emission (Schlesinger 1995), contributing to global climate changes. The drainage of wetland and the conversion of grassland to agricultural production have caused damages to wildlife and ecosystems in many areas.

Reflecting the increased awareness of the scope and diversity of nonpoint-source pollution, several national inventories have been conducted to determine the status, trend, or spatial patterns of nitrate concentrations in groundwater or surface water. The results of these inventories have been summarized in several reports (Smith et al. 1987; Mueller et al. 1995). Although only a few studies have evaluated groundwater contamination potential from nitrogen use at the regional or national levels (Nielsen and Lee 1987; Kellogg et al. 1992), many have examined the impact of farming practices on nitrate water pollution at the field, farm, or watershed levels (e.g., De Roo 1980; Pionke and Urban 1985; Noss 1988; Gilliam and Hoyt 1987; Grady and Weaver 1988; Grady 1989). These studies have linked nitrate water pollution to land use, nitrogen application rates, management practices, and hydrogeologic settings. These studies, however, tend to focus on the effect of cropping patterns and farming practices on water quality, without examining how the decisions that led to those cropping patterns and farming practices were made. Thus, they cannot be used to assess the effectiveness of alternative incentive-based policies in reducing agricultural pollution.

Several studies have systematically modeled the process from land use decisions to water quality. These systematic studies can be categorized into two groups: conceptual studies or empirical/simulation studies. The conceptual dimensions of land use and water quality have been explored in several studies, including Hochman and Zilberman (1978), Griffin and Bromley (1982), Shortle and Dunn (1986), Just and Antle (1990), and Opaluch and Segerson (1991). These studies show that agricultural and resource policies can affect agricultural production at both the intensive margin (changes in input use and management practices) and the extensive margin (changes in cropping patterns), and the resulting effects on water quality depend on physical attributes. These studies, however, do not provide quantitative estimates of the effects.

The empirical studies that model both land use decisions and their impact on water quality also can be classified into disaggregate models and aggregate models. The disaggregated models are generally site-specific and model micro-unit decisions and the water quality effect of those decisions at the farm or watershed levels (e.g., Johnson et al. 1991; Taylor et al. 1992; Helfand and House 1995). Because these studies are site-specific, regional and/or national policy impacts cannot easily be derived from these studies without conducting similar analyses over other resource settings and aggregating to a larger scale.

The aggregate models can be further classified into two groups. One group integrates an aggregate economic model (usually a regional or national linear programming model) with a physical model to analyze the impact of agricultural practices and policies on water quality (e.g., Piper et al. 1989; Mapp et al. 1994; Wu et al. 1995). The aggregate economic model predicts the impact of alternative policies on crop acres and input uses, and the physical model estimates the impact of crop production on water quality. The second group of aggregate models examines policy impacts at the regional or national level while incorporating site-specific land characteristics (e.g., Wu and Segerson 1995; Wu et al. 1996).

3. Study Region

The study region included 12 states in the Corn Belt, the Lake States, and the Northern Plains (Figure 1). The region accounted for 57 percent of the nation’s cropland in 1992 (USDA/Soil Conservation Service 1994) and produced 89 percent of the nation’s corn, 81 percent of the nation’s soybeans, 56 percent of the nation’s sorghum, and 56 percent of the nation’s wheat in 1991. The total nitrogen and phosphate use in the study region was 6.12 and 2.41 million nutrient tons, respectively, in 1993, or 54 percent of total U.S. application (USDA/Economic Research Service 1994).

This study focuses on nonpoint-source pollution from production of corn, soybeans, sorghum, wheat, and alfalfa. These five crops and summer fallow account for approximately 90 percent of cropland in the study region according to the 1992 National Resources Inventory (NRI). Corn and soybeans are the major crops in the Corn Belt and Lake States, accounting for 72 percent of cropland. In the Northern Plains, wheat and corn are the major crops, accounting for 51 percent of cropland. The nonpoint-source pollution indicators considered in this study include water erosion, wind erosion, nitrogen runoff, and nitrogen leaching.

Fourteen major crop rotations were identified using the 1992 NRI (Table 1). The most commonly used rotation in the Corn Belt and Lake States was corn-soybean, whereas the most commonly used rotations in the Northern Plains were wheat-fallow and wheat-sorghum-fallow. About 17.4 percent of cropland was cultivated with conservation tillage, and 10.6 percent was cultivated using conservation practices such as contouring, terracing, and strip-cropping (Table 2). Irrigation is another major factor influencing nutrient leaching. In 1992, 6.7 percent of the region’s cropland was irrigated, with most of these irrigated acres located in Nebraska and Kansas.

4. The Resource and Agricultural Policy System

In this section, we first provide an overview of the RAPS and we then discuss each of the modeling components in detail.

An Overview of the Resource and Agricultural Policy System

The RAPS has two major modeling components (see Figure 2): the Acreage Response Modeling System (ARMS) and the Site-specific Pollution Production modeling system (SIPP). The ARMS projects crop choices, crop rotation, and conservation practices given the natural resource base, climate conditions, commodity prices, and government policies at more than 160,000 NRI sites in the central United States. The SIPP estimates the environmental impacts of the projected crop choice and management practices at each of the NRI sites. The SIPP provides multiple environmental indicators, including nitrate runoff and leaching, pesticide runoff and leaching, water and wind erosion, and soil organic carbon.

The RAPS relies heavily on the U.S. Department of Agriculture (USDA) NRI database. The NRI provides detailed information about farming practices and land characteristics at more than 160,000 NRI sites in the central U.S. This and other information is used to develop the RAPS, which is then used to predict how farmers will respond to new farm legislation and the resulting changes in economic returns and environmental indicators. In addition, NRI points were selected using statistical techniques (e.g., stratification, area sampling, and clustering) that allow estimates to be aggregated to different levels (e.g., state, regional, or subregional levels). The special features of the RAPS are summarized in Table 3.

The Acreage Response Modeling System

The ARMS consists of three econometric models for each of the three major production regions (the Corn Belt, Lake States, and Northern Plains). The first econometric model predicts farmers' crop choice at each NRI site based on the expected yields, production risks, input and output prices, government commodity program provisions, cropping history, soil properties, and weather conditions at the point. Because no one can predict farmers' choice with certainty, the ARMS estimates the probability that a particular site is planted to corn, soybeans, wheat, sorghum, hay, or other crops using a multinomial logit model:

$$P_{ijt} = \frac{\exp(X'_{ijt}\beta_i)}{\sum_{k=1}^{N}\exp(X'_{kjt}\beta_k)}, \quad i = 1,\ldots,N, \tag{1}$$

where

P_{ijt} = the probability that site j is planted to crop i in year t,

X_{ijt} = a vector of independent variables (e.g., input and output prices, policy variables, cropping history, soil properties, weather conditions), and

β_i = parameters to be estimated.

This specification can be justified in two ways. First, it can be justified based on the utility maximization assumption. If farmers are assumed to maximize their perceived utility and the perceived utility has some errors because of the imperfect information or perception, and the researchers cannot incorporate variation in tastes across farmers into the analysis, then the farmers' probability to choose alternative crops can be derived as a multinomial logit model under the same assumptions about the error terms.

Alternatively, the multinomial logit model can be treated simply as a specification of function form. The logit model has been shown to outperform other flexible functional forms, such as the Almost Ideal Demand System (AIDS) and the translog (Lutton and LeBlanc 1984). In addition, the design of the model ensures that the sum of the predicted probabilities to choose alternative crops is one. Because of these desirable properties, the multinomial logit model has been widely used in economic analyses, including studies of the choice of transportation modes, occupations, asset portfolios, and the number of automobiles demanded. In agriculture, the model has been used to analyze farmers' land allocation and irrigation technology choice decisions (Caswell et al. 1990; Lichtenberg 1989; Wu and Segerson 1995).

The coefficients in a multinomial logit model are difficult to interpret. So the marginal effects of explanatory variables are often derived. These marginal effects are

$$h_s \equiv \frac{\partial P_s}{\partial Z} = P_s \left[\gamma_s - \sum_{i=1}^{M} P_i \gamma_i \right]. \qquad (2)$$

The sign and magnitude of the marginal effect have no direct relationship with any specific coefficient. They depend on the sign and magnitude of many coefficients.

The other two econometric models predict farmers' choices of tillage (no-till, reduced tillage, or conventional tillage) and conservation practices (contour farming, terracing, surface drainage, grassed waterways, or no conservation tillage), respectively. These choices were also modeled using a multinomial logit model.

After the ARMS predicts probabilities for each NRI site, it assigns one of the six crops to each NRI site based on the predicted probabilities and the state-level acreage estimates from the National Agricultural Statistics Service (NASS) County Crops Data. The ARMS also assigns each NRI site to one of the three tillage systems using the tillage probabilities and crop acreage estimates for conservation tillage in each state from the Conservation Tillage Information Center (CTIC). Finally, the ARMS assigns each NRI site to one of the five conservation practices (contour farming, terracing, surface drainage, grassed waterways, or no conservation tillage) using the predicted conservation probabilities. The ARMS maintains the 1992 NRI assignments for irrigation.

The Site-specific Pollution Production Modeling System

The SIPP uses eight environmental production functions (metamodels) to predict the generation of nitrate runoff and leaching, water and wind erosion, changes in soil organic carbon, and Atrazine runoff, leaching, and volatilization at each NRI site based on crop management practices, soil characteristics, and climatic factors. Levels of these pollutants serve as environmental indicators, measures of the site-specific environmental effects of crop production. When crop choices and management practices change, the local environmental impacts change as well. The accumulation of local environmental impacts affects the overall environmental quality of the region.

The SIPP uses the Erosion Productivity Impact Calculator (EPIC) (Sharpley and Williams 1990) and the Pesticide Root Zone Model (PRZM) (Mullins et al. 1993) to develop its environmental production functions. The methodology used to develop the nitrate leaching and runoff production functions is described in Wu and Babcock (1999). Methodologies used to develop carbon sequestration and atrazine leaching production functions, similar to those currently used in SIPP, are described in Mitchell at al. (1997) and Bouzaher et al. (1993), respectively. Application of the nitrate leaching and runoff production functions for the north central United States is given in Wu and Babcock (1999) for two alternative scenarios relative to a 1992 baseline: 1) a shift in crop rotations, and 2) a 25 percent reduction in nitrogen fertilizer applications. Results of applying the production functions are also reported in Babcock et al. (1997) and Gassman et al. (1998).

To apply SIPP, the NRI and SOIL-5 database provides soil and climate data, and the ARMS assigns the crop management practices (crop rotation, tillage system, conservation practices) used at each NRI site. The SIPP then uses this information to calculate the potential environmental impacts of crop production at each NRI site. These impacts are then aggregated to the county, state, and regional levels using the NRI expansion factors.

5. Data

In this section, we describe the data that was used in estimating the ARMS. Several types of data were used including:

- crop choice, tillage, and conservation practices at each NRI point;
- input and output prices and government commodity programs;
- expected yields and production risks; and
- site characteristics at each NRI point (soil properties, topographic features, weather conditions).

Crop Choice, Tillage, and Conservation Practice Data

The crop choice, tillage, and conservation practice data were derived from the 1982, 1987, and 1992 NRIs. The NRI is conducted every five years by the Natural Resource Conservation Service—at more than 800,000 sites (fields) across the continental United States—to determine the status and condition of and trends in the nation's soil, water, and other related resources. Each NRI site is assigned a weight (called the expansion factor) to reflect the acreage the site represents. For example, the summation of expansion factors for all sites planted to corn in a region gives an estimate of corn acreage in the region. The sampling design ensures that inferences at the national, regional, state, and substate levels are made in a statistically reliable manner.

In our study region, there were 128,591 NRI points growing corn, soybeans, sorghum, wheat, or legume hay. Of these points, 55,024 were in the Corn Belt, 21,600 in the Lake States, and 51,967 in the Northern Plains. The Lake States contained fewer sample points because the region has fewer states and has extensive nonagricultural areas. Also, NRI reduced the sampling density in areas of relatively homogeneous resources. For each NRI site, information on nearly 200 attributes was collected. The information included land use and cover, cropping history, tillage and conservation practices, topography, hydrology, and soil type. Because the NRI also includes information about cropping history in the previous three years at each NRI site, we were able to determine land use/crop choice at each NRI site for 12 years from the three NRI surveys. Pooling these time-series and cross-sectional data resulted in a large number of observations for each region. To make the estimation computationally feasible, 10 percent of the NRI sites were randomly selected and used in the estimation of the crop choice model. Specifically, we first divided the NRI sites in each Major Land Resource Area defined by the USDA into different groups according to crop, crop rotations, irrigation, and tillage and conservation practices; we then drew 10 percent of the sample sites from each group.

This procedure guaranteed that the subsamples were representative of the whole sample in terms of crop acreage and management practices. To ensure that the subsamples were also representative in terms of soil properties, the frequency distribution of four important soil properties (clay percentage, bulk density, pH, and organic matter percentage) for the selected sample was compared with that of the population and was found essentially identical, indicating that the subsamples were also representative in terms of soil properties.

Price and Policy Variables

Time-series data on input and output prices and government commodity programs are also needed. Specifically, we need to model the impact of government commodity programs on farmers' price expectation. Much research has focused on the effect of government commodity programs on acreage responses (e.g., Lidman and Bawden 1974; Houck and Ryan 1972; Chavas and Holt 1990; Chavas et al. 1983; Wu and Segerson 1995), but these studies have used several different specifications. Lidman and Bawden (1974) derived an empirical acreage response equation that used program provisions directly as independent variables. Houck and Ryan (1972) developed a weighted support price to reflect both government price supports and acreage restrictions and then used it along with diversion payment rates as independent variables in their acreage response model. Gardner (1976) and Just and Rausser (1981) argued in favor of using futures prices in acreage response analysis on rational expectation grounds and forecasting accuracy. Chavas and Holt (1990) used adaptive expectations and the lagged market price to model farmers' expected prices, and they included a dummy variable to account for the effect of the payment-in-kind (PIK) program offered in 1983. Chavas et al. (1983) examined the role of futures prices, lagged market prices, and support prices in acreage response analysis. They found that because futures prices and lagged market prices are highly correlated and reflect similar market information, using both in supply equations may lead to multicollinearity, whereas deleting one of the two makes little empirical difference. Shumway (1983) defined the expected price as the higher of current weighted support price and a geometric lagged function of market prices in the previous seven years. Wu and Segerson (1995) specified expected prices for program crops as the higher of the current target price and a linear function of previous years' market prices.

All of the studies discussed here except Chavas and Holt (1990) and Wu and Segerson (1995) covered government commodity programs in the 1960s and 1970s. Over time, numerous changes have been made to government commodity program provisions. In 1973, the support prices were replaced by target prices. In 1982, the Acreage Reduction Program (ARP) was established for commodity-specific acreage control. The PIK Program and the Acreage Diversion Program (ADP) were offered only in 1983.

Based on previous studies, the following approach was used to incorporate government commodity programs in our study period. The expected market price for corn was specified as a weighted average of target price and lagged market price, and the weights were selected to minimize the sum of the prediction error. The higher of the expected market price and the weighted target price was specified as the farmers' expected price for corn, where the weighted target price is calculated by multiplying the target price by the portion of corn base permitted for corn planting (i.e., 1-ARP rate for corn). The expected price for soybeans was specified as the average futures price in the planting season, which was estimated as the average of the first and second Thursday closing prices in March at the Chicago Board of Trade (CBOT) for November soybeans.

The government commodity program data including target prices and the ARP rates were taken from Green (1990) and the USDA (*Agricultural Statistics* 1971 to 1997). Input prices including the wage rate and the prices paid by farmers for agricultural chemical, seeds, and fuel (index number) were taken from the USDA. All prices were normalized by the index of prices paid by farmers for all inputs including interest, taxes, and wages (USDA).

Expected Yields and Production Risks

Expected yields and production risks for corn and soybean production in each county were estimated using the NASS County Crop Data from 1975 to 1992. Specifically, following Chavas and Holt (1990), a trend model of $y = \alpha + \beta t + \varepsilon$ was estimated for both corn and soybeans in each county using the NASS data. The resulting predictions were taken as expected yields. The estimated residuals were used to generate the variances of yield and covariance between price and yield. For simplicity, both the variance of yield and the correlation between price and yield were assumed to be constant over time.

Physical Variables

Each NRI sample site is linked to the NRCS's SOILS5 database, providing detailed soil profile information from soil surveys. From the data, average measures of soil properties for topsoil layers were estimated and included in the crop choice model. These included average organic matter percentage, clay percentage, soil pH, and permeability. The data also included information about soil texture and land capability class. Historical weather data from 1975 to 1992 were obtained from the Midwestern Climate Center. The mean and variance of maximum daily temperature and precipitation during corn and soybean growing seasons were estimated from these weather data and included in the crop choice model.

6. Estimation Results

Estimation results of the ARMS for the three major production regions (Corn Belt, Lake States, and Northern Plains) are presented in Appendixes A to C. Tables A.1, B.1, and C.1 show the estimated coefficients for the logistic crop choice models for the three regions. Overall, the models fit the data well; most of the coefficients are significant at the 1 percent level. Table 4 shows the prediction accuracy of the crop choice models and the tillage practice choice model. The crop choice models correctly predict farmers' crop choice at 66 percent, 66 percent, and 53 percent of the sample points in the Corn Belt, Lake States, and Northern Plains, respectively.

Tables A.2, B.2, and C.2 show the marginal effects of alternative parameters on crop choice. The results suggest that what is planted in the previous season has a significant effect on farmers' current crop choice decisions. For example, the coefficients on cropping history variables in Table A.2 show that in Ohio, if a field is planted to corn in the previous season, it is more likely to be planted to soybeans and less likely to be planted to wheat and hay in the current year. Similarly, if a field is planted to hay in the previous season, it is likely to be planted to corn or hay in the current year. The effect of crop rotation on crop choice in other states can be derived similarly by adjusting these coefficients by the interaction terms between the cropping history variables and state dummy variables.

Tables A.3, B.3, and C.3 show the elasticities of probabilities to choose alternative crops with respect to the independent variables. Decisions to plant corn are more responsive to changes in corn prices in the Lake States than in the Corn Belt or Northern Plains. A 1 percent increase in the expect price for corn increases the probability to plant corn by 1.29 percent in the Lake States, but only by 0.31 and 0.27 percent in the Corn Belt and Northern Plains, respectively. An increase in agricultural chemical prices reduces the probability to plant corn in every region, but the effects of agricultural chemical prices on other crops are inconsistent across regions. The physical variables measure a field's comparative advantage in producing a crop rather than its absolute advantage. For example, land with higher available water capacity is more suitable to corn than other crops.

Tables A.4, B.4, and C.4 show the estimated coefficients for the conservation tillage adoption models for the three regions. The models correctly predict the conservation tillage adoption at 75 percent, 89 percent, and 80 percent of the sample (Table 4). The marginal effects shown in tables A.4, B.4, and C.4 suggest that the higher the expected yield for corn in a county, the more likely that conservation tillage is adopted in the county. However, an increase in chemical prices reduces the likelihood of conservation tillage adoption.

Tables A.5, B.5, and C.5 show the estimated coefficients for the multinomial logit model of conservation practices adoption for the three regions. The marginal effects of independent variables on the adoption of alternative conservation practices estimated using the coefficients are presented in Tables A.6, B.6, and C.6. These conservation practice adoption models, together with the crop choice and tillage practice adoption models, allow us to predict farmers' choices of crop and management practices at each of the NRI points under alternative price and policy scenarios. By feeding these predictions into the SIPP, the environmental impacts of agricultural practices under these price and policy scenarios can be estimated.

7. Concluding Comments

In recent years, low prices for key farm commodities, combined with the FAIR Act's lessening of farm sector reliance on government programs, have raised fundamental questions about the ultimate goals of U.S. agricultural policy. As the debate over future agricultural policy direction continues, it is important for policymakers and other interest groups to have timely information on the nation's environmental health as impacted by agriculture and by changes in agricultural and resource policies. The Resource and Agricultural Policy System was developed to provide such information.

Table 1. Cropland distribution by cropping systems in the U.S. Midwest, 1982 and 1992

State	Year	Cropland	CCC	SSS	WWW	GGG	C-S	CCS	CSW	SSC	W-F	WGF	W-S	W-G	AAA	C-A	OTH	CRP
		(100 acres)	-- percent ---															
Ohio	1982	116402	14.99	5.79	1.13	0.02	14.40	9.26	28.73	6.90	0.01	0.00	1.11	0.00	6.72	2.04	8.89	0.00
	1992	122153	7.78	2.44	0.56	0.00	28.79	5.12	27.07	4.79	0.00	0.00	1.02	0.00	10.28	2.23	7.34	2.58
Indiana	1982	131955	25.47	3.11	0.30	0.00	24.80	15.26	15.93	7.85	0.00	0.00	0.33	0.04	2.86	0.95	3.09	0.00
	1992	138624	12.85	3.21	0.24	0.02	43.26	12.96	11.21	3.31	0.00	0.00	0.51	0.00	2.98	0.51	5.97	2.99
Illinois	1982	241837	14.50	2.31	0.28	0.03	38.00	14.66	15.76	7.88	0.01	0.00	0.38	0.02	2.63	1.42	2.12	0.00
	1992	247937	9.96	1.11	0.06	0.02	55.77	8.31	14.24	2.11	0.00	0.00	0.20	0.00	2.30	1.17	1.89	2.87
Iowa	1982	257792	18.09	0.69	0.07	0.03	59.16	7.52	0.51	1.92	0.00	0.00	0.01	0.00	6.88	1.84	3.28	0.00
	1992	269473	15.10	1.69	0.04	0.01	49.80	11.55	0.21	2.25	0.00	0.00	0.02	0.00	5.86	1.98	3.73	7.77
Missouri	1982	134546	4.34	14.28	1.06	0.58	16.25	6.97	27.03	10.63	0.06	0.00	1.17	0.34	5.46	0.79	11.04	0.00
	1992	147720	2.96	9.99	1.14	0.53	17.88	5.00	21.76	4.84	0.00	0.00	1.09	0.30	7.18	0.83	15.64	10.85
Michigan	1982	85186	28.17	2.57	4.05	0.06	4.63	6.17	10.73	2.41	0.52	0.00	1.13	0.08	13.85	2.64	22.98	0.00
	1992	92075	23.03	2.00	1.81	0.10	12.23	5.50	10.97	2.25	0.02	0.00	0.79	0.00	16.05	2.15	20.33	2.77
Wisconsin	1982	107516	37.30	0.46	0.32	0.05	2.18	1.43	0.65	0.61	0.00	0.00	0.04	0.00	34.24	7.84	14.88	0.00
	1992	114431	24.97	0.93	0.31	0.11	4.58	2.94	1.11	0.72	0.00	0.00	0.10	0.00	30.67	11.93	15.81	5.81
Minnesota	1982	221060	13.82	1.79	11.42	0.04	24.02	4.66	8.27	3.81	0.86	0.00	1.98	0.07	9.36	2.97	16.93	0.00
	1992	231139	10.20	2.31	8.52	0.03	28.73	4.70	7.31	3.65	0.44	0.00	1.66	0.00	8.78	2.85	12.99	7.83
Kansas	1982	283690	5.87	0.89	20.29	0.19	1.18	0.00	0.00	0.00	16.73	26.15	4.97	16.48	2.84	0.22	4.20	0.00
	1992	294026	4.84	0.88	15.54	0.12	2.34	0.00	0.00	0.00	16.66	24.49	6.13	13.00	2.25	0.29	3.72	9.74
Nebraska	1982	197752	34.56	0.83	3.19	0.26	13.56	0.00	0.00	0.00	10.02	12.32	1.70	8.48	7.24	1.99	5.83	0.00
	1992	205786	29.01	1.16	3.43	0.57	18.44	0.00	0.00	0.00	7.86	5.94	2.28	8.09	6.77	1.65	8.17	6.62
S. Dakota	1982	187033	14.34	0.42	11.95	1.84	7.19	0.00	0.00	0.00	9.58	7.97	0.90	2.41	10.64	1.23	31.52	0.00
	1992	181585	11.38	1.37	9.58	0.62	16.10	0.00	0.00	0.00	8.61	7.43	7.41	2.21	11.48	1.25	12.87	9.68
N. Dakota	1982	265172	2.57	0.20	17.96	0.04	0.10	0.00	0.00	0.00	29.30	20.15	1.66	0.08	5.38	0.32	22.23	0.00
	1992	276365	2.83	0.50	25.48	0.04	0.59	0.00	0.00	0.00	16.66	9.95	4.89	0.12	4.99	0.25	23.20	10.50
Region	1982	2206747	15.95	2.24	7.56	0.26	18.99	5.09	7.18	3.07	7.49	7.56	1.50	3.13	7.65	1.71	10.61	0.00
	1992	2321314	11.75	2.01	7.12	0.17	23.81	4.42	6.24	1.73	5.51	5.40	2.52	2.57	7.50	1.82	10.22	7.22

Note: CCC=continuous corn, SSS=continuous soybeans, WWW=continuous wheat, GGG=continuous sorghum, C-S=corn-soybeans rotation, CCS=corn-corn-soybeans, CSW=corn-soybeans-wheat, SSC=soybeans-soybeans-corn, W-F=wheat-fallow, WGF=wheat-sorghum-fallow, W-S=wheat-soybeans, W-G=wheat-sorghum, AAA=continuous alfalfa, C-A=corn-corn-alfalfa-alfalfa-alfalfa, OTH=other cropping systems, CRP=CRP lands.

Table 2. Percentages of cropland cultivated using alternative practices in the U.S. Midwest, 1982 and 1992

State	Year	Irrigated	Conserve. Tillage	Contour	Strip Cropping	Terracing
Ohio	1982	0.3	7.1	2.2	1.4	0.0
	1992	0.4	11.4	1.3	1.4	0.0
Indiana	1982	1.2	17.5	1.2	0.0	0.3
	1992	1.3	23.5	0.3	0.0	0.2
Illinois	1982	0.7	16.1	1.5	0.2	0.7
	1992	0.8	24.4	1.5	0.2	0.5
Iowa	1982	0.6	15.9	8.4	0.6	4.6
	1992	0.6	40.4	8.6	0.5	5.2
Missouri	1982	5.7	10.8	2.4	0.1	7.2
	1992	7.5	12.3	2.1	0.2	8.1
Michigan	1982	4.2	9.2	0.1	0.2	0.0
	1992	5.3	13.4	0.1	0.2	0.0
Wisconsin	1982	3.1	3.8	4.1	7.1	0.2
	1992	3.6	9.6	3.6	7.7	0.3
Minnesota	1982	1.9	5.5	1.5	1.5	0.3
	1992	2.1	7.3	1.0	1.1	0.3
Kansas	1982	12.0	25.1	2.3	1.1	23.8
	1992	13.1	18.1	4.3	1.7	27.7
Nebraska	1982	34.4	31.1	2.5	3.6	9.3
	1992	38.8	19.5	2.4	3.2	10.8
South Dakota	1982	2.8	20.1	0.4	4.4	0.9
	1992	2.9	14.0	0.5	4.4	0.9
North Dakota	1982	0.9	13.9	0.1	11.7	0.0
	1992	1.0	3.3	0	8.4	0.0
Study region	1982	6.0	16.0	2.4	2.9	5.1
	1992	6.7	17.4	2.4	2.5	5.7

Table 3. Special features of RAPS

- ❖ Incorporates the site-specific information on cropping systems:
  - crop choice
  - crop rotations
  - tillage
  - conservation
  - irrigation
  - nitrogen management alternatives
  - weed control strategies
- ❖ Incorporates the site-specific resource characteristics:
  - soil profile properties
  - topographical features
  - hydrological properties
  - weather
- ❖ Provides multiple environmental indicators
  - soil erosion
  - nutrient runoff and leaching
  - pesticide runoff and leaching
  - soil organic carbon
  - livestock manure pollution
- ❖ Provides economic indicators
  - crop acreage
  - total production
  - production costs
  - farm net returns
- ❖ Evaluates the economic and environmental impacts of alternative farming practices
- ❖ Evaluates both targeted and uniform policies
- ❖ Presents results in a GIS framework

Table 4. The performance of the ARMS models

	Crop Choice Model		Conservation Practice Adoption Model		Tillage Choice Model
Region	**% Correct Prediction**	**% Choices Predicted as the 1st or 2nd Choice**	**% Correct Prediction**	**% Choices Predicted as the 1st or 2nd Choice**	**% Correct Prediction**
Corn Belt	66	92	67	87	75
Lake States	66	90	68	79	89
Northern Plains	53	80	76	94	80

Figure 1. The Study Region.

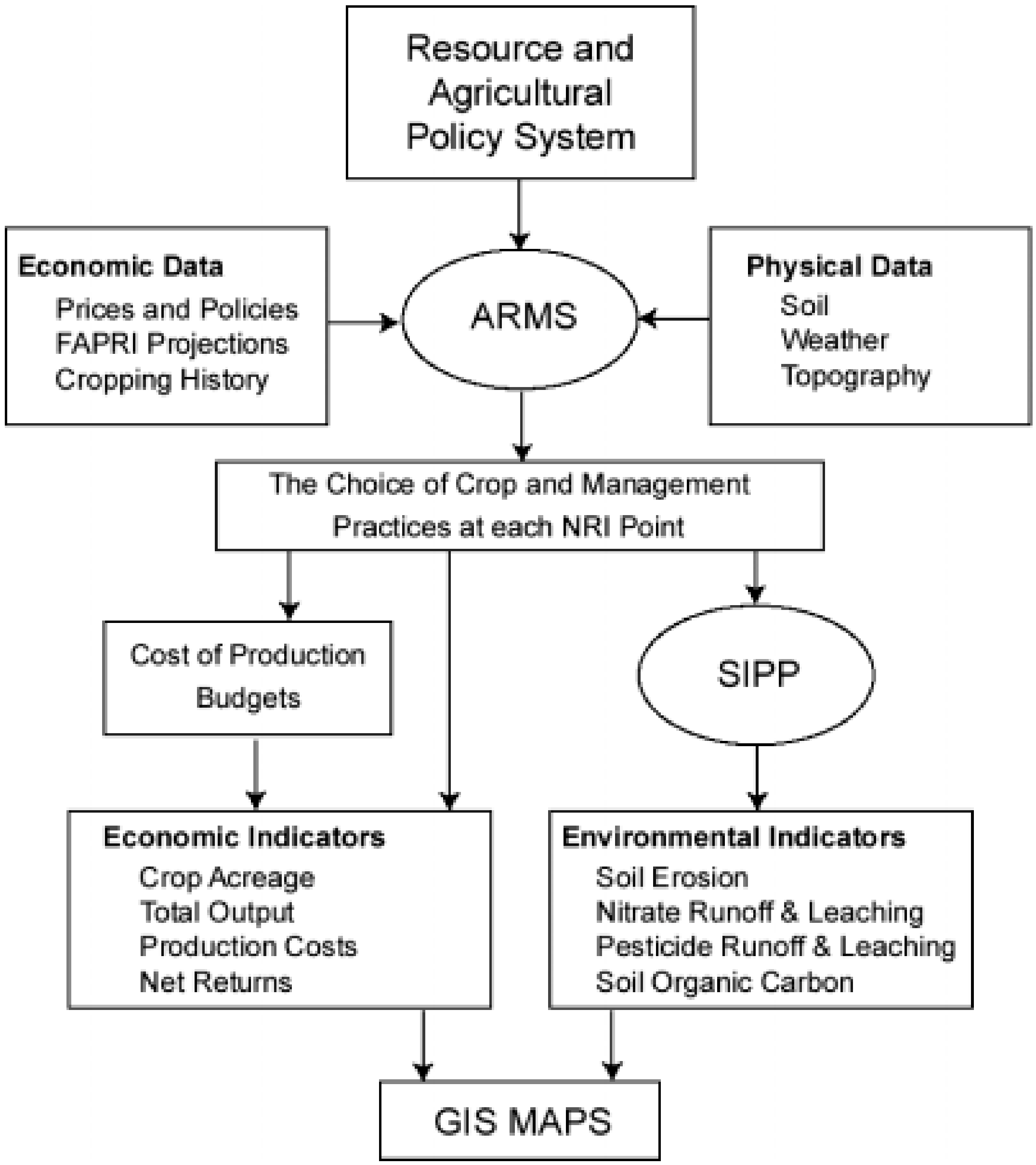

Figure 2. The Resource and Agricultural Policy System.

Appendix A

ARMS Models for the Corn Belt

Table A.1. Coefficient estimates for the Multinomial Logit Crop Choice Model for the Corn Belt

	Corn		Soybeans		Wheat		Hay	
Variables	**Coef.**	**t-statistic**	**Coef.**	**t-statistic**	**Coef.**	**t-statistic**	**Coef.**	**t-statistic**
Constant	-1.0920	-0.51	-6.9959	-3.21	-9.7454	-3.41	6.0356	1.92
Cropping History								
Previous year's crop is corn	4.6374	31.93	5.4641	37.46	3.6421	19.20	1.6656	7.08
Previous year's crop is soybeans	5.3944	31.91	4.7004	27.36	5.6742	29.39	1.6924	5.54
Previous year's crop is wheat	5.3408	24.45	3.6396	15.73	3.1397	11.06	4.6952	20.04
Previous year's crop is hay	4.2716	27.98	2.6613	14.23	2.3560	7.77	5.4937	36.57
Interactions between what was grown in the previous season and state dummy variables								
IA*corn	-1.0189	-6.45	-1.1730	-7.36	-2.5992	-7.26	-0.9022	-3.41
IA*soybeans	-0.3375	-1.75	-2.0847	-10.30	-3.7188	-10.08	-0.9079	-2.46
IA*wheat	-2.2962	-3.75	-1.3956	-2.01	1.9581	2.87	-3.2563	-3.62
IL*corn	-0.1561	-0.94	-0.3611	-2.16	-0.2966	-1.34	-0.1284	-0.45
IL*soybeans	0.0819	0.41	-1.0567	-5.19	-0.5154	-2.38	-0.2410	-0.64
IL*wheat	-0.5982	-2.12	-0.1378	-0.46	0.0605	0.17	-1.4151	-4.34
IL*hay	0.2624	0.78	0.7929	2.11	1.1624	2.31	0.6872	2.06
MO*corn	-0.4658	-2.32	-1.1777	-5.96	-0.0356	-0.14	-1.3250	-2.70
MO*soybeans	-2.1042	-11.29	-1.8033	-9.62	-2.5356	-11.99	-1.2379	-3.37
MO*wheat	-2.4912	-9.87	-0.9253	-3.60	-0.2450	-0.79	-2.6776	-8.90
MO*hay	-0.8535	-2.41	0.3222	0.92	0.7243	1.64	1.2447	4.12
IN*corn	0.3893	2.19	-0.3818	-2.16	-0.0616	-0.28	-0.5763	-1.66
IN*soybeans	-0.1256	-0.62	-0.9127	-4.36	-0.9085	-4.23	-0.6072	-1.44
IN*wheat	-0.8727	-3.03	-0.1819	-0.60	-0.0056	-0.02	-1.4883	-4.56
IN*hay	-0.1028	-0.28	0.2708	0.62	0.6946	1.24	0.6790	1.89

[continued]

Table A.1. Continued

Price and Policy Variables								
Expected price for corn	47.8585	1.55	3.6481	0.12	1.5238	0.04	28.0860	0.61
Expected price for soybeans	-18.0660	-1.82	13.2156	1.31	-58.1556	-4.40	-19.4007	-1.33
Futures price for wheat	25.2237	3.20	11.0075	1.38	39.8419	3.94	3.8308	0.33
Expected price for hay	-0.6628	-1.91	-0.4016	-1.14	-0.5828	-1.36	-0.8278	-1.69
ARP rate for wheat	0.0081	1.50	0.0026	0.48	-0.0084	-1.15	-0.0007	-0.09
Fuel price	0.3042	2.00	0.0576	0.37	1.0447	5.19	0.0508	0.23
Chemical price	-1.2447	-1.69	-1.1753	-1.59	-0.1866	-0.19	-0.9207	-0.85
Expected Yield and Yield Variation of Corn								
Expected yield of corn	0.0136	6.41	0.0071	3.31	-0.0004	-0.15	-0.0036	-1.21
Expected variation of corn yield	0.0002	1.06	0.0007	4.02	-0.0007	-2.55	0.0003	1.16
Land Characteristics								
Good land	0.0849	1.73	0.1664	3.35	0.1506	2.35	0.0692	0.97
Bad land	-0.2895	-2.69	-0.6673	-5.38	-0.1279	-0.78	-0.2886	-2.07
Slope	-0.0053	-8.25	-0.0105	-14.86	-0.0025	-2.53	0.0007	0.87
Available water capacity	3.9501	5.26	0.3142	0.42	-3.9244	-4.08	0.0868	0.08
Organic matter	0.0002	0.02	-0.0026	-0.28	0.0064	0.41	-0.0245	-1.17
Soil pH	0.1068	2.65	0.1052	2.59	0.0930	1.81	-0.1381	-2.30
Coarse-textured soil	0.0894	1.80	0.3451	6.91	-0.0425	-0.60	-0.0727	-0.95
Fine-textured soil	0.1470	1.56	0.1291	1.38	-0.1623	-1.42	-0.1102	-0.73
Weather Conditions								
Mean max temperature-corn	-0.0164	-1.46	0.0642	5.60	0.0425	2.75	-0.0556	-3.49
Mean precipitation-corn	-1.8318	-0.59	-5.4115	-1.70	-12.8410	-3.06	2.4819	0.53
St. deviation of precipitation-corn	-0.3311	-0.25	3.6233	2.68	5.9471	3.32	-2.0005	-0.99
Mean of precipitation-wheat	-0.1528	-0.22	-1.4251	-1.93	-0.2701	-0.27	-2.9340	-2.77
St. deviation of precipitation-wheat	-0.6304	-0.73	0.5230	0.60	-1.1325	-0.95	3.0069	2.50

[continued]

Table A.1. Continued.

Dummy Variables for Major Land Resource Areas								
MLRA100	-1.2690	-3.02	-0.1440	-0.35	0.2434	0.47	-1.9353	-2.97
MLRA103	-0.5646	-5.30	0.3423	3.20	-1.3907	-1.88	-0.4475	-2.37
MLRA105	0.3807	3.35	-1.4564	-8.91	-0.3960	-0.74	0.3447	2.38
MLRA107	0.1403	1.56	0.5552	6.11	1.0535	5.57	0.0162	0.11
MLRA109	-0.2954	-2.75	0.1476	1.38	0.9068	4.66	-0.2335	-1.56
MLRA110	-0.3921	-2.78	0.0326	0.23	-0.8864	-3.09	-0.7390	-2.95
MLRA111	-0.2853	-2.68	0.1665	1.53	1.3245	7.92	-0.2939	-1.99
MLRA112	-0.6673	-3.89	-0.2139	-1.39	2.0850	10.13	-0.9481	-4.08
MLRA113	-0.1362	-1.14	0.6573	5.63	2.1755	12.80	-1.0238	-5.49
MLRA114	-0.2099	-1.78	0.1808	1.51	1.1631	6.64	-0.5203	-3.21
MLRA115	-0.1363	-1.44	0.3331	3.50	1.6362	10.93	-0.6354	-4.47
MLRA116B	-1.4540	-5.14	-0.3568	-1.71	1.4523	5.64	-0.7258	-2.76
MLRA120	-0.1580	-0.67	-0.3455	-1.37	1.0774	3.27	-0.3790	-1.21
MLRA121	-0.0531	-0.19	-0.6489	-2.11	1.1120	2.98	0.1951	0.63
MLRA122	0.4000	1.38	-0.6783	-1.99	1.6399	4.14	-0.1683	-0.44
MLRA124	-0.2472	-1.01	-1.9404	-5.83	1.1124	3.19	-0.0612	-0.23
MLRA126	-1.1530	-2.07	-2.1191	-2.67	-0.6206	-0.54	0.4925	1.08
MLRA131	-1.0861	-6.46	-0.3623	-2.33	1.4430	6.48	-3.1827	-5.66
MLRA134	-0.1379	-0.42	0.0538	0.17	2.2364	6.03	-1.8757	-2.27
MLRA139	-0.3833	-2.10	-0.3927	-1.99	0.8927	3.44	-0.2115	-0.97
MLRA95B	0.0865	0.51	-0.4229	-2.39	-1.8491	-3.03	0.0647	0.28
MLRA98	-0.2704	-1.23	-0.3034	-1.33	-0.9377	-1.95	-0.4121	-1.21
MLRA99	-0.4351	-2.34	0.3828	2.06	1.9428	8.37	-0.3986	-1.62
LOG OF LIKELIHOOD FUNCTION	-46033							

Note: The 1 percent, 5 percent, and 10 percent critical values for the t-statistics are 2.58, 1.96, and 1.65, respectively

Table A.2. The marginal effects of alternative variables on crop choice in the Corn Belt

	Corn	Soybeans	Wheat	Hay	Other
Constant	0.7500	-0.8667	-0.3254	0.2659	0.1762
Cropping History					
Previous year's crop is corn	0.0739	0.2648	-0.0308	-0.0608	-0.2471
Previous year's crop is soybeans	0.2494	0.0193	0.0607	-0.0705	-0.2589
Previous year's crop is wheat	0.3745	-0.1201	-0.0446	0.0351	-0.2448
Previous year's crop is hay	0.3049	-0.1443	-0.0417	0.0842	-0.2031
Interactions between what was grown in the previous season and state dummy variables					
IA*corn	0.0302	-0.0197	-0.0776	-0.0005	0.0676
IA*soybeans	0.2824	-0.2261	-0.1305	-0.0037	0.0779
IA*wheat	-0.2372	0.0299	0.1745	-0.0605	0.0932
IL*corn	0.0232	-0.0339	-0.0040	0.0012	0.0135
IL*soybeans	0.1530	-0.1688	-0.0077	-0.0014	0.0249
IL*wheat	-0.0689	0.0553	0.0214	-0.0341	0.0264
IL*hay	-0.0833	0.0726	0.0341	0.0104	-0.0338
MO*corn	0.0763	-0.1260	0.0314	-0.0267	0.0450
MO*soybeans	-0.0844	0.0064	-0.0384	0.0098	0.1065
MO*wheat	-0.2849	0.1622	0.0660	-0.0385	0.0952
MO*hay	-0.2243	0.1309	0.0461	0.0490	-0.0016
IN*corn	0.1236	-0.1019	-0.0043	-0.0216	0.0042
IN*soybeans	0.1143	-0.1126	-0.0233	-0.0098	0.0313
IN*wheat	-0.1096	0.0817	0.0254	-0.0317	0.0342
IN*hay	-0.0762	0.0393	0.0293	0.0199	-0.0124
Price and Policy Variables					
Expected price for corn	7.5547	-5.1830	-1.1360	0.1029	-1.3386
Expected price for soybeans	-3.0914	5.3376	-2.5216	-0.3059	0.5813
Futures price for wheat	2.2014	-1.8728	1.1062	-0.4119	-1.0229
Expected price for hay	-0.0440	0.0278	-0.0040	-0.0120	0.0323
ARP rate for wheat	0.0013	-0.0004	-0.0006	-0.0002	-0.0002
Fuel price	0.0223	-0.0443	0.0412	-0.0053	-0.0139
Chemical price	-0.0644	-0.0349	0.0414	-0.0016	0.0596

[continued]

Table A.2. Continued

	Corn	Soybeans	Wheat	Hay	Other
Expected Yield and Yield Variation of Corn					
Expected yield of corn	0.0016	-0.0004	-0.0004	-0.0004	-0.0004
Expected variation of corn yield	-4.0E-05	1.0E-04	-4.8E-05	3.2E-06	-1.8E-05
Land Characteristics					
Good land	-0.0089	0.0138	0.0022	-0.0005	-0.0067
Bad land	0.0339	-0.0694	0.0125	-0.0001	0.0231
Slope	0.0003	-0.0010	0.0002	0.0002	0.0003
Available water capacity	0.7498	-0.3426	-0.2812	-0.0544	-0.0717
Organic matter	0.0006	-0.0004	0.0004	-0.0008	0.0002
Soil pH	0.0067	0.0037	0.0004	-0.0068	-0.0040
Coarse-textured soil	-0.0222	0.0462	-0.0098	-0.0057	-0.0083
Fine-textured soil	0.0164	0.0071	-0.0130	-0.0063	-0.0042
Weather Conditions					
Mean max temperature-corn	-0.0105	0.0118	0.0014	-0.0020	-0.0008
Mean precipitation-corn	0.5616	-0.4513	-0.4754	0.1619	0.2033
St. deviation of precipitation-corn	-0.5851	0.5308	0.2296	-0.0900	-0.0853
Mean of precipitation-wheat	0.1909	-0.1881	0.0201	-0.0799	0.0569
St. deviation of precipitation-wheat	-0.1933	0.1579	-0.0531	0.1025	-0.0141
Dummy Variables for Major Land Resource Areas					
MLRA100	-0.1827	0.1324	0.0464	-0.0401	0.0441
MLRA103	-0.1007	0.1472	-0.0577	-0.0049	0.0161
MLRA105	0.2404	-0.2734	-0.0031	0.0145	0.0216
MLRA107	-0.0642	0.0547	0.0370	-0.0069	-0.0205
MLRA109	-0.0865	0.0440	0.0474	-0.0051	0.0002
MLRA110	-0.0412	0.0706	-0.0321	-0.0156	0.0183
MLRA111	-0.0955	0.0391	0.0667	-0.0080	-0.0022
MLRA112	-0.1260	0.0136	0.1189	-0.0214	0.0149
MLRA113	-0.1344	0.0905	0.0963	-0.0377	-0.0147
MLRA114	-0.0766	0.0368	0.0575	-0.0161	-0.0015
MLRA115	-0.0904	0.0453	0.0757	-0.0226	-0.0080
MLRA116B	-0.2373	0.0916	0.1092	-0.0002	0.0367

[continued]

Table A.2 Continued

	Corn	Soybeans	Wheat	Hay	Other
MLRA120	-0.0065	-0.0531	0.0610	-0.0091	0.0077
MLRA121	0.0376	-0.1182	0.0644	0.0091	0.0071
MLRA122	0.1146	-0.1824	0.0801	-0.0101	-0.0022
MLRA124	0.1575	-0.3013	0.0914	0.0121	0.0402
MLRA126	0.0494	-0.1984	0.0325	0.0477	0.0688
MLRA131	-0.1330	0.0633	0.1046	-0.0826	0.0477
MLRA134	-0.0525	-0.0019	0.1109	-0.0606	0.0041
MLRA139	-0.0392	-0.0324	0.0580	0.0003	0.0133
MLRA95B	0.1059	-0.0467	-0.0821	0.0065	0.0165
MLRA98	0.0155	0.0014	-0.0321	-0.0051	0.0204
MLRA99	-0.1597	0.0813	0.0958	-0.0113	-0.0060

Table A.3. Estimated elasticities of probabilities to choose alternative crops in the Corn Belt

	Corn	Soybeans	Wheat	Hay	Other
Price and Policy Variables					
Expected price for corn	0.3100	-0.2693	-0.3274	0.0224	-0.1722
Expected price for soybeans	-0.3034	0.6634	-1.7381	-0.1596	0.1788
Futures price for wheat	0.1130	-0.1217	0.3988	-0.1124	-0.1646
Expected price for hay	-0.0465	0.0371	-0.0297	-0.0673	0.1067
ARP rate for wheat	0.0403	-0.0144	-0.1328	-0.0242	-0.0170
Fuel price	0.2429	-0.6119	3.1568	-0.3084	-0.4739
Chemical price	-0.4375	-0.3002	1.9747	-0.0595	1.2680
Expected Yield and Yield Variation of Corn					
Expected yield of corn	0.4289	-0.1381	-0.8174	-0.5097	-0.3375
Expected variation of corn yield	-0.0429	0.1400	-0.3650	0.0184	-0.0602
Land Characteristics					
Good land	-1.4E-02	2.8E-02	2.4E-02	-3.8E-03	-3.3E-02
Bad land	0.0024	-0.0061	0.0061	0.0000	0.0051
Slope	0.0247	-0.1005	0.1009	0.0727	0.0834
Available water capacity	0.3051	-0.1766	-0.8038	-0.1176	-0.0914
Organic matter	0.0025	-0.0022	0.0122	-0.0183	0.0029
Soil pH	0.1053	0.0748	0.0421	-0.5726	-0.1965
Coarse-textured soil	-0.0159	0.0418	-0.0493	-0.0218	-0.0187
Fine-textured soil	0.0028	0.0016	-0.0159	-0.0058	-0.0023
Weather Conditions					
Mean max temperature-corn	-2.0445	2.9265	1.8886	-2.0272	-0.4817
Mean precipitation-corn	0.1782	-0.1814	-1.0599	0.2732	0.2023
St. deviation of precipitation-corn	-0.4546	0.5224	1.2532	-0.3720	-0.2078
Mean of precipitation-wheat	0.0465	-0.0580	0.0345	-0.1036	0.0435
St. deviation of precipitation-wheat	-0.1268	0.1312	-0.2444	0.3574	-0.0289

Table A.4. Estimated coefficients for the Conservation Tillage Model for the Corn Belt

Parameter	Estimate	t-statistic	dP/dX
Constant	218.5750	11.66	37.1002
Crop grown in the field in current season (dummy variables)			
Corn	0.9988	10.31	0.1695
Soybeans	0.8244	8.33	0.1399
Wheat	0.8751	6.99	0.1485
Hay	0.3057	2.18	0.0519
Crop grown in the field in previous season (dummy variables)			
Corn	1.1901	12.30	0.2020
Soybeans	0.9649	9.83	0.1638
Wheat	0.8790	6.87	0.1492
Hay	0.3643	2.63	0.0618
Input prices			
Fuel price	8.2472	10.37	1.3999
Chemical price	-91.4572	-11.47	-15.5237
Expected yield and yield variation of corn			
Expected yield of corn	0.0056	2.78	0.0009
Expected variation of corn yield	0.0001	0.36	0.0000
Land Characteristics			
Good land	-0.0104	-0.21	-0.0018
Bad land	-0.0771	-0.59	-0.0131
Slope	0.0026	3.76	0.0004
Clay percentage	0.0006	0.15	0.0001
Available water capacity	0.3744	0.43	0.0636
Organic matter	-0.0048	-0.56	-0.0008
Soil pH	-0.1094	-2.74	-0.0186
Soil permeability	0.0363	2.35	0.0062
Coarse-textured soil	0.1829	3.83	0.0310
Fine-textured soil	0.0512	0.53	0.0087
Weather Conditions			
Mean max temperature-corn	-0.0681	-6.05	-0.0116
Mean precipitation-corn	13.0334	4.82	2.2123
St. deviation of precipitation-corn	-7.0831	-5.75	-1.2023
Mean max temperature-wheat	0.0082	1.21	0.0014
Mean of snow-wheat	0.3504	2.12	0.0595

[continued]

Table A.4. Continued.

Parameter	Estimate	t-statistic	dP/dX
St. deviation of snow-wheat	-0.2939	-2.63	-0.0499
Mean precipitation-wheat	-6.0933	-2.16	-1.0343
St. deviation of precipitation-wheat	4.5106	2.71	0.7656
Dummy variable for Major Land Resource Areas			
MLRA100	-1.4976	-2.40	-0.2542
MLRA103	0.2215	1.94	0.0376
MLRA105	0.9127	6.43	0.1549
MLRA107	0.6375	5.90	0.1082
MLRA108	0.3779	3.80	0.0641
MLRA109	-0.1355	-0.95	-0.0230
MLRA110	0.1239	0.97	0.0210
MLRA111	-0.2530	-2.36	-0.0429
MLRA112	-0.8329	-2.97	-0.1414
MLRA113	-0.3339	-2.25	-0.0567
MLRA114	0.1762	1.40	0.0299
MLRA115	-0.0494	-0.43	-0.0084
MLRA120	0.6757	3.10	0.1147
MLRA121	-0.5538	-1.81	-0.0940
MLRA122	0.8643	3.17	0.1467
MLRA124	-0.0276	-0.10	-0.0047
MLRA126	-2.0866	-2.01	-0.3542
MLRA131	0.0953	0.47	0.0162
MLRA134	-0.7604	-1.35	-0.1291
MLRA139	-0.5110	-2.40	-0.0867
MLRA98	0.1098	0.59	0.0186
MLRA99	-0.3837	-2.42	-0.0651
MLRA95B	0.0323	0.21	0.0055
Log of Likelihood Function	-9021		
R-SQUARED	0.13		
Percent of Correct Prediction	75%		

Table A.5. Parameter estimates for the Multinomial Logit Model of Conservation Practices in the Corn Belt

	Contour farming		Terracing		Surface drainage		Grassed waterways	
Variables	**Coef.**	**t-Stat**	**Coef.**	**t-Stat**	**Coef.**	**t-Stat**	**Coef.**	**t-Stat**
Constant	42.7166	0.78	273.1490	5.02	-4.8863	-0.23	65.6811	2.33
Crop grown in the field in current season (dummy variables)								
Corn	1.4482	5.20	0.6695	3.22	0.6878	6.60	0.4638	3.58
Soybeans	1.2762	4.47	0.2021	0.93	0.6764	6.41	0.3905	2.94
Wheat	1.2932	3.29	0.6590	2.10	0.7955	6.16	0.7183	4.37
Hay	0.7652	2.19	0.2110	0.73	0.1065	0.62	0.0019	0.01
Crop grown in the field in previous season (dummy variables)								
Corn	0.6611	2.68	0.2980	1.45	0.5946	5.71	0.4055	3.20
Soybeans	0.5332	2.10	0.1745	0.83	0.5932	5.72	0.3710	2.88
Wheat	0.8951	2.58	0.3580	1.13	0.5637	4.23	0.5797	3.49
Hay	0.5332	1.70	-0.0701	-0.24	0.2550	1.54	0.7249	4.38
Input prices								
Fuel price	1.8715	0.80	11.6925	5.06	-0.3345	-0.36	2.6627	2.20
Chemical price	-19.2445	-0.83	-122.7970	-5.29	2.3217	0.25	-28.2130	-2.34
Expected yield and yield variation of corn								
Expected yield of corn	0.0108	1.92	-0.0230	-4.31	0.0183	8.28	0.0106	3.77
Expected variation of corn yield	-0.0003	-0.62	-0.0002	-0.42	-0.0013	-6.65	0.0008	3.37
Land Characteristics								
Good land	-0.3475	-2.64	0.1053	0.78	-0.1430	-2.39	-0.0826	-1.15
Bad land	-0.3590	-1.27	-1.3517	-3.52	-0.3909	-1.59	-0.4571	-2.68
Slope	0.0108	7.51	0.0122	8.23	-0.0295	-20.98	0.0080	9.09
Clay percentage	0.0180	1.40	0.0098	0.67	0.0109	2.69	0.0340	5.64
Available water capacity	1.5670	0.58	7.2152	2.38	0.5822	0.60	4.4784	3.38
Organic matter	0.0669	1.29	-0.1204	-2.03	0.1064	6.74	0.0731	2.86
Soil pH	-0.3879	-3.50	-0.2645	-2.27	0.4812	10.53	-0.1129	-1.86
Soil permeability	0.0359	0.68	-0.2357	-1.94	-0.0302	-1.78	-0.0778	-2.22

Table A.5. Continued

Coarse-textured soil	-0.1145	-0.86	0.2515	1.93	0.6074	10.99	-0.2425	-3.16
Fine-textured soil	-2.0138	-3.17	-1.1633	-1.89	0.3409	3.62	-0.7033	-3.24
Weather Conditions								
Mean max temperature-corn	-0.0210	-0.69	0.0768	2.31	-0.0625	-5.26	-0.0284	-1.83
Mean precipitation-corn	10.7615	1.53	7.8326	0.90	-9.2116	-3.11	-25.7795	-5.89
St. deviation of precipitation-corn	-5.1038	-1.65	7.2527	1.74	1.7503	1.47	8.1677	4.33
Mean max temperature-wheat	-0.0225	-1.03	0.1365	4.14	-0.0066	-1.05	-0.0324	-3.89
Mean of snow-wheat	-0.1424	-0.23	0.6173	0.89	0.7434	4.14	0.9962	4.24
St. deviation of snow-wheat	0.1123	0.26	-0.0165	-0.03	-0.5962	-5.02	-0.6835	-4.12
Mean precipitation-wheat	0.7194	0.31	-108.7190	-7.22	0.8603	1.37	-4.2855	-1.22
St. deviation of precipitation-wheat	0.2409	0.11	21.8068	3.54	-0.3423	-0.52	2.1852	1.04
Dummy variable for Major Land Resource Areas								
MLRA102	3.8490	9.32	1.6514	3.36	-1.5335	-3.32	0.6834	1.45
MLRA103	-0.1548	-0.33	0.6685	1.45	-0.8104	-6.29	-1.1024	-3.95
MLRA104	0.8582	2.26	0.8684	1.91	-0.3444	-2.50	0.0167	0.07
MLRA105	1.0767	3.17	0.5023	1.19	-1.3252	-4.52	0.7048	3.78
MLRA107	2.4599	8.02	1.3857	4.26	-1.0595	-8.44	0.4854	2.87
MLRA108	0.4239	1.34	-0.1562	-0.46	-0.8272	-8.06	0.1612	1.07
MLRA109	0.9646	2.62	-0.2336	-0.68	-0.4977	-2.76	0.2012	1.14
MLRA110	-0.5801	-0.87	-0.0715	-0.10	-0.6712	-5.18	0.4743	2.50
MLRA111	-0.7264	-1.77	-0.5411	-0.82	0.1158	1.44	0.4847	3.31
MLRA113	-0.1020	-0.25	-0.7986	-1.96	-0.9549	-5.91	0.6585	4.38
MLRA114	-0.1505	-0.43	-0.4646	-0.94	-0.9752	-8.33	0.2316	1.49
MLRA115	0.2496	0.82	0.1873	0.63	-0.7987	-8.01	-0.2216	-1.50
MLRA95B	0.4267	0.93	0.2606	0.39	-1.3858	-8.26	0.3266	1.54
LOG OF LIKELIHOOD FUNCTION	-14878							

Table A.6. Estimated marginal effects of alternative variables on the adoption of conservation practices in the Corn Belt

	Contour farming	Terracing	Surface drainage	Grassed Waterway	Other
Constant	0.1427	6.0184	-2.4572	4.1547	-7.8587
Crop grown in the field in current season (dummy variables)					
Corn	0.0287	0.0090	0.0808	0.0181	-0.1365
Soybeans	0.0260	-0.0012	0.0820	0.0146	-0.1215
Wheat	0.0239	0.0081	0.0920	0.0364	-0.1604
Hay	0.0170	0.0028	0.0117	-0.0046	-0.0270
Crop grown in the field in previous season (dummy variables)					
Corn	0.0117	0.0027	0.0722	0.0187	-0.1052
Soybeans	0.0091	0.0003	0.0732	0.0169	-0.0994
Wheat	0.0165	0.0031	0.0644	0.0316	-0.1156
Hay	0.0096	-0.0056	0.0221	0.0499	-0.0759
Input prices					
Fuel price	0.0080	0.2583	-0.1201	0.1683	-0.3144
Chemical price	-0.0697	-2.7097	1.1014	-1.7693	3.4473
Expected yield and yield variation of corn					
Expected yield of corn	0.0002	-0.0006	0.0024	0.0006	-0.0025
Expected variation of corn yield	-5.4E-06	-2.9E-06	-1.9E-04	8.4E-05	1.2E-04
Land Characteristics					
Good land	-0.0077	0.0038	-0.0174	-0.0033	0.0246
Bad land	-0.0025	-0.0281	-0.0420	-0.0237	0.0963
Slope	0.0003	0.0003	-0.0042	0.0010	0.0026
Clay percentage	0.0003	0.0001	0.0009	0.0023	-0.0035
Available water capacity	0.0032	0.1482	-0.0118	0.3067	-0.4462
Organic matter	0.0013	-0.0034	0.0135	0.0041	-0.0154

[continued]

Table A.6. Continued

Soil pH	-0.0095	-0.0060	0.0692	-0.0141	-0.0396
Soil permeability	0.0017	-0.0052	-0.0025	-0.0049	0.0108
Coarse-textured soil	-0.0043	0.0054	0.0864	-0.0283	-0.0591
Fine-textured soil	-0.0430	-0.0207	0.0661	-0.0492	0.0467
Weather Conditions					
Mean max temperature-corn	-0.0004	0.0021	-0.0082	-0.0014	0.0079
Mean precipitation-corn	0.3412	0.2517	-0.9061	-1.8810	2.1942
St. deviation of precipitation-corn	-0.1677	0.1517	0.1098	0.5911	-0.6849
Mean max temperature-wheat	-0.0007	0.0033	-0.0007	-0.0027	0.0008
Mean of snow-wheat	-0.0102	0.0099	0.0849	0.0631	-0.1478
St. deviation of snow-wheat	0.0066	0.0027	-0.0710	-0.0432	0.1049
Mean precipitation-wheat	0.2905	-2.4995	0.4377	-0.0252	1.7965
St. deviation of precipitation-wheat	-0.0530	0.4970	-0.1327	0.1076	-0.4189
Dummy variable for Major Land Resource Areas					
MLRA102	0.0882	0.0304	-0.2351	0.0590	0.0576
MLRA103	0.0007	0.0209	-0.0945	-0.0730	0.1459
MLRA104	0.0189	0.0187	-0.0518	0.0014	0.0128
MLRA105	0.0256	0.0100	-0.1961	0.0695	0.0910
MLRA107	0.0556	0.0271	-0.1626	0.0417	0.0382
MLRA108	0.0122	-0.0032	-0.1163	0.0243	0.0829
MLRA109	0.0239	-0.0071	-0.0733	0.0207	0.0359
MLRA110	-0.0129	-0.0001	-0.0971	0.0487	0.0613
MLRA111	-0.0175	-0.0124	0.0117	0.0391	-0.0208
MLRA113	0.0003	-0.0179	-0.1383	0.0678	0.0881
MLRA114	-0.0002	-0.0087	-0.1351	0.0347	0.1094
MLRA115	0.0084	0.0062	-0.1067	-0.0058	0.0979
MLRA95B	0.0124	0.0073	-0.1960	0.0444	0.1320

Appendix B

ARMS Models for the Lake States

Table B.1. Coefficient estimates for the Multinomial Logit Crop Choice Model for the Lake States

	Corn		Soybeans		Wheat		Hay	
Variables	**Coef.**	**t-statistic**	**Coef.**	**t-statistic**	**Coef.**	**t-statistic**	**Coef.**	**t-statistic**
Constant	-4.2097	-2.00	-6.1975	-2.25	-0.9407	-0.30	0.9360	0.33
Cropping History								
Previous year's crop is corn	3.9595	34.79	4.0513	21.93	1.7389	10.01	1.1112	4.95
Previous year's crop is soybeans	3.8510	21.35	4.0621	17.35	3.4717	16.39	0.3953	0.64
Previous year's crop is wheat	2.6960	15.46	2.9970	12.47	1.3989	5.29	1.8173	6.05
Previous year's crop is hay	3.5208	11.17	2.9193	6.28	2.1679	5.06	6.9353	21.98
Interactions between what was grown in the previous season and state dummy variables								
MN*Corn	-1.3329	-9.48	-0.5768	-2.73	-0.2974	-1.29	-1.7099	-6.38
MN*Soybeans	-0.2037	-0.97	-1.7989	-6.74	-1.1204	-4.31	-1.5186	-2.22
MN*Wheat	-0.7599	-3.30	-0.4366	-1.52	-0.6272	-2.14	-2.2125	-5.41
MN*Hay	-0.0346	-0.10	-0.8045	-1.51	-1.3764	-2.50	-2.5364	-7.09
WI*Corn	-1.2644	-9.02	-1.6601	-6.39	-1.3310	-4.02	-1.6168	-6.45
WI*Soybeans	-0.4816	-1.32	-0.0248	-0.06	-1.2830	-2.32	-1.0132	-1.13
WI*Wheat	-1.3714	-3.42	-0.0676	-0.14	0.9802	1.94	-1.8507	-3.46
WI*Hay	0.0649	0.19	-1.4499	-2.16	-0.9042	-1.48	-2.9536	-8.63
Price and Policy Variables								
ARP rate for wheat	0.0201	2.92	0.0006	0.06	0.0143	1.01	0.0002	0.02
Fuel price	-0.4499	-2.61	-0.1011	-0.46	-0.0230	-0.08	-0.3508	-1.58
ARP rate for wheat	0.0201	2.92	0.0006	0.06	0.0143	1.01	0.0002	0.02
Fuel price	-0.4499	-2.61	-0.1011	-0.46	-0.0230	-0.08	-0.3508	-1.58
ARP rate for wheat	0.0201	2.92	0.0006	0.06	0.0143	1.01	0.0002	0.02
Fuel price	-0.4499	-2.61	-0.1011	-0.46	-0.0230	-0.08	-0.3508	-1.58
Chemical price	-1.0808	-2.84	-0.9035	-1.79	-1.6790	-2.44	-0.4028	-0.82
Wage rate	53.6066	2.08	-32.4369	-0.83	46.0995	0.82	-44.8472	-1.34

[continued]

Table B.1. Continued.

Expected Yield and Yield Variation of Corn								
Expected yield of corn	0.0112	5.05	0.0371	12.25	-0.0061	-1.96	-0.0082	-2.99
Expected variation of corn yield	0.0003	1.25	0.0021	6.57	-0.0007	-1.58	0.0006	1.63
Land Characteristics								
Good land	0.2417	4.10	0.1396	1.86	0.3515	3.55	0.0467	0.63
Bad land	0.0427	0.35	-0.4760	-2.11	-0.4523	-1.72	-0.0153	-0.11
Slope	-0.0029	-3.66	-0.0079	-6.63	0.0007	0.41	-0.0023	-2.57
Available water capacity	2.3504	2.99	3.0675	3.08	1.3733	0.96	2.7882	2.76
Organic matter	-0.0120	-2.87	-0.0229	-3.56	-0.0032	-0.40	-0.0132	-2.59
Soil pH	0.0548	1.08	0.1651	2.42	0.3216	3.13	-0.0637	-1.02
Coarse-textured soil	0.0032	0.04	0.0199	0.25	0.3181	3.19	0.0380	0.35
Fine-textured soil	0.0183	0.24	-0.3617	-3.62	0.0139	0.12	-0.1023	-1.05
Weather Conditions								
Mean max temperature-corn	0.0340	3.10	0.0176	1.26	0.0490	2.92	0.0114	0.84
Mean precipitation-corn	1.4843	0.28	-0.3686	-0.05	-37.1972	-4.07	10.1975	1.55
St. deviation of precipitation-corn	1.7253	0.92	-0.6437	-0.28	5.5818	1.80	-3.0008	-1.23
Dummy Variables for Major Land Resource Areas								
MLRA561	-1.4218	-5.40	2.3775	2.30	1.9658	5.34	-1.6584	-5.39
MLRA571	-0.5228	-1.71	1.9073	1.73	1.7311	4.36	-0.5007	-1.59
MLRA881	-0.8099	-2.05	1.8885	1.50	1.5746	3.69	-0.2901	-0.89
MLRA901	0.6368	2.92	1.8785	1.81	-2.2990	-2.15	1.0036	4.33
MLRA911	0.5064	2.30	2.3033	2.22	0.0877	0.18	0.4999	2.11
MLRA971	0.2063	0.91	1.9599	1.91	0.2179	0.53	-0.8489	-2.92
MLRA981	0.4595	2.15	2.4282	2.37	1.1474	3.21	-0.7526	-2.87
MLRA991	-0.0236	-0.11	2.1906	2.14	0.6344	1.71	-1.7369	-5.57

[continued]

Table B.1. Continued.

MLRA1031	0.4677	1.96	2.7085	2.61	0.8010	1.88	0.4358	1.61
MLRA1041	0.5329	2.06	2.4988	2.40	-0.2680	-0.44	0.2021	0.64
MLRA1051	0.6400	2.84	0.7776	0.75	-1.3467	-1.94	1.1375	4.67
MLRA1101	0.9192	3.05	3.0987	2.93	1.7007	3.37	0.2422	0.54
MLRA1111	0.5109	1.92	2.5911	2.50	1.1437	2.71	-1.1529	-2.97
MLRA94A1	0.4736	1.83	2.9294	2.77	0.0621	0.13	-0.2119	-0.74
MLRA95A1	0.9696	4.57	1.6171	1.52	-0.2500	-0.52	1.3498	6.14
MLRA95B1	0.8775	4.12	1.7726	1.71	0.7733	1.91	1.2689	5.60
MLRA1021	0.1791	0.75	2.6760	2.58	1.9493	4.89	-0.1257	-0.44
MLRA1021	0.5635	1.99	2.8075	2.68	-1.9838	-1.81	0.6928	2.02
LOG OF LIKELIHOOD FUNCTION	-20051							

Note: The 1 percent, 5 percent, and 10 percent critical values for the t-statistics are 2.58, 1.96, and 1.65, respectively.

Table B.2. Estimates of the marginal effects on crop choice in the Lake States

	Corn	Soybeans	Wheat	Hay	Other
Constant	-0.3212	-0.3121	0.0689	0.2521	0.3123
Cropping History					
Previous year's crop is corn	0.3335	0.1070	-0.0215	-0.0960	-0.3229
Previous year's crop is soybeans	0.3154	0.1053	0.0528	-0.1451	-0.3284
Previous year's crop is wheat	0.1675	0.0898	-0.0103	0.0054	-0.2524
Previous year's crop is hay	0.1073	-0.0005	-0.0035	0.3215	-0.4248
Interactions between what was grown in the previous season and state dummy variables					
MN*Corn	-0.1189	0.0435	0.0165	-0.0628	0.1217
MN*Soybeans	0.1610	-0.1453	-0.0255	-0.0855	0.0952
MN*Wheat	-0.0066	0.0230	-0.0054	-0.1186	0.1076
MN*Hay	0.1653	-0.0544	-0.0434	-0.1648	0.0973
WI*Corn	-0.0222	-0.0584	-0.0190	-0.0519	0.1515
WI*Soybeans	-0.0226	0.0439	-0.0425	-0.0475	0.0687
WI*Wheat	-0.1735	0.0863	0.0658	-0.0763	0.0977
WI*Hay	0.2345	-0.1253	-0.0197	-0.1955	0.1060
Price and Policy Variables					
Expected price for corn	29.7314	-12.1691	2.0807	-9.6169	-10.0261
Expected price for soybeans	-6.8049	2.8340	-2.5127	5.0040	1.4795
Futures price for wheat	-0.1546	-0.4556	0.2823	-2.1018	2.4296
Expected price for hay	0.0470	-0.1351	-0.0066	0.0688	0.0259
ARP rate for wheat	0.0032	-0.0014	0.0003	-0.0008	-0.0012
Fuel price	-0.0562	0.0222	0.0074	-0.0064	0.0329
Chemical price	-0.0828	-0.0002	-0.0447	0.0216	0.1061
Wage rate	12.3313	-6.9035	1.4384	-5.0739	-1.7923
Expected Yield and Yield Variation of Corn					
Expected yield of corn	-0.0002	0.0029	-0.0007	-0.0011	-0.0009
Expected variation of corn yield	-0.0001	0.0002	-0.0001	0.0000	-0.0001
Land Characteristics					
Good land	0.0247	-0.0056	0.0096	-0.0075	-0.0212
Bad land	0.0467	-0.0454	-0.0155	0.0005	0.0138
Slope	0.0001	-0.0006	0.0001	0.0000	0.0003
Available water capacity	0.0673	0.1160	-0.0091	0.0845	-0.2587
Organic matter	0.0000	-0.0013	0.0003	-0.0003	0.0014
Soil pH	-0.0042	0.0101	0.0113	-0.0079	-0.0092
Coarse-textured soil	-0.0070	-0.0008	0.0127	0.0016	-0.0065
Fine-textured soil	0.0312	-0.0359	0.0033	-0.0062	0.0076

[continued]

Table B.2. Continued.

	Corn	Soybeans	Wheat	Hay	Other
Weather Conditions					
Mean max temperature-corn	0.0034	-0.0010	0.0013	-0.0007	-0.0031
Mean precipitation-corn	0.4484	0.1012	-1.5671	0.7339	0.2837
St. deviation of precipitation-corn	0.3676	-0.2078	0.2149	-0.2815	-0.0932
Dummy Variables for Major Land Resource Areas					
MLRA56	-0.3689	0.3177	0.0881	-0.0740	0.0372
MLRA57	-0.2245	0.2086	0.0656	-0.0266	-0.0230
MLRA88	-0.2778	0.2264	0.0631	-0.0009	-0.0108
MLRA90	-0.0217	0.1517	-0.1203	0.0421	-0.0519
MLRA91	-0.0892	0.1857	-0.0226	0.0050	-0.0789
MLRA97	-0.0679	0.1774	-0.0068	-0.0745	-0.0282
MLRA98	-0.0739	0.1982	0.0237	-0.0819	-0.0661
MLRA99	-0.0951	0.2158	0.0142	-0.1283	-0.0065
MLRA103	-0.1313	0.2223	0.0043	-0.0014	-0.0939
MLRA104	-0.0812	0.2067	-0.0382	-0.0163	-0.0710
MLRA105	0.0337	0.0374	-0.0734	0.0534	-0.0510
MLRA110	-0.0868	0.2237	0.0319	-0.0357	-0.1331
MLRA111	-0.0609	0.2122	0.0226	-0.1118	-0.0621
MLRA94A	-0.1095	0.2516	-0.0261	-0.0449	-0.0711
MLRA95A	0.0088	0.0871	-0.0403	0.0490	-0.1046
MLRA95B	-0.0297	0.1010	0.0020	0.0438	-0.1171
MLRA102A	-0.1742	0.2324	0.0573	-0.0315	-0.0839
MLRA102B	-0.0897	0.2453	-0.1125	0.0190	-0.0622

Table B.3. Elasticities of probabilities to grow alternative crops in the Lake States

	Corn	Soybeans	Wheat	Hay	Other
Price and Policy Variables					
Expected price for corn	1.2872	-1.2722	0.6650	-0.8418	-0.8199
Expected price for soybeans	-0.7045	0.7085	-1.9206	1.0475	0.2893
Futures price for wheat	-0.0087	-0.0617	0.1169	-0.2384	0.2575
Expected price for hay	0.0477	-0.3312	-0.0498	0.1413	0.0497
ARP rate for wheat	0.1003	-0.1075	0.0658	-0.0505	-0.0749
Fuel price	-0.6461	0.6162	0.6325	-0.1477	0.7146
Chemical price	-0.7339	-0.0037	-2.9237	0.3869	1.7757
Wage rate	0.8637	-1.1676	0.7438	-0.7185	-0.2371
Expected Yield and Yield Variation of Corn					
Expected yield of corn	-0.0397	1.5510	-1.1023	-0.5040	-0.3854
Expected variation of corn yield	-0.0879	0.4014	-0.3390	0.0410	-0.0995
Land Characteristics					
Good land	0.0404	-0.0222	0.1158	-0.0247	-0.0656
Bad land	0.0043	-0.0101	-0.0105	0.0001	0.0024
Slope	0.0097	-0.1136	0.0839	-0.0028	0.0516
Available water capacity	0.0261	0.1088	-0.0261	0.0664	-0.1898
Organic matter	0.0003	-0.0271	0.0159	-0.0058	0.0219
Soil pH	-0.0748	0.4355	1.4823	-0.2857	-0.3116
Coarse-textured soil	-0.0037	-0.0011	0.0501	0.0017	-0.0065
Fine-textured soil	0.0211	-0.0587	0.0164	-0.0085	0.0097
Weather Conditions					
Mean max temperature-corn	0.6652	-0.4682	1.9142	-0.2777	-1.1207
Mean precipitation-corn	0.1331	0.0725	-3.4340	0.4404	0.1590
St. deviation of precipitation-corn	0.2738	-0.3738	1.1817	-0.4239	-0.1312

Table B.4. Estimated coefficients for the Conservation Tillage Model for the Lake States

Parameter	Estimate	t-statistic	dP/dX
Constant	108.2080	2.5835	9.4598
Crop grown in the field in current season (dummy variables)			
Corn	0.9603	5.9569	0.0840
Soybeans	0.8958	4.9795	0.0783
Wheat	0.9614	4.4719	0.0841
Hay	0.6176	2.8598	0.0540
Crop grown in the field in previous season (dummy variables)			
Corn	0.7452	4.7167	0.0651
Soybeans	0.6678	3.8132	0.0584
Wheat	0.8821	3.9936	0.0771
Hay	0.0585	0.2860	0.0051
Input prices			
Fuel price	4.5095	2.5257	0.3942
Chemical price	-49.5026	-2.7560	-4.3276
Expected yield and yield variation of corn			
Expected yield of corn	0.0173	3.8362	0.0015
Expected variation of corn yield	-0.0011	-2.3464	-0.0001
Land Characteristics			
Good land	-0.4439	-1.5338	-0.0388
Bad land	0.1526	1.3637	0.0133
Slope	0.0036	2.4654	0.0003
Clay percentage	0.0002	0.0214	0.0000
Available water capacity	5.1773	2.9337	0.4526
Organic matter	-0.0236	-2.0044	-0.0021
Soil pH	-0.1337	-1.3785	-0.0117
Soil permeability	0.0414	1.6587	0.0036
Coarse-textured soil	-0.0438	-0.3271	-0.0038
Fine-textured soil	-0.3347	-2.2351	-0.0293
Weather Conditions			
Mean max temperature-corn	0.0338	1.5270	0.0030
Mean precipitation-corn	-17.0100	-1.7637	-1.4871
St. deviation of precipitation-corn	13.7535	3.9811	1.2024

[continued]

Table B.4. Continued.

Parameter	Estimate	t-statistic	dP/dX
Mean of snow-wheat	1.8019	3.9178	0.1575
St. deviation of snow-wheat	-1.1833	-3.3874	-0.1034
Mean precipitation-wheat	5.9892	1.0747	0.5236
St. deviation of precipitation-wheat	-3.9267	-0.9919	-0.3433
Dummy variable for Major Land Resource Areas			
MLRA561	0.8437	2.3058	0.0738
MLRA571	1.0689	2.1514	0.0934
MLRA881	0.7253	0.8737	0.0634
MLRA901	-0.1344	-0.3758	-0.0117
MLRA911	-0.1653	-0.4509	-0.0144
MLRA961	2.0770	4.1676	0.1816
MLRA971	0.5244	1.3907	0.0458
MLRA981	1.0987	3.2283	0.0961
MLRA991	0.6512	1.6951	0.0569
MLRA1031	-0.6191	-2.6870	-0.0541
MLRA1041	-0.4381	-1.3335	-0.0383
MLRA1051	0.5163	1.7064	0.0451
MLRA1101	-0.5714	-0.8498	-0.0499
MLRA1111	0.7779	2.1534	0.0680
MLRA94A1	0.8860	1.6037	0.0775
MLRA95A1	0.3299	0.7557	0.0288
MLRA95B1	0.4784	1.3943	0.0418
MLRA1021	-0.2747	-0.9774	-0.0240
LOG OF LIKELIHOOD FUNCTION		-2235	
PERCENT CORRECT PREDICTIONS		89%	

Table B.5. Parameter estimates for the Multinomial Logit Model of Conservation Practices in the Lake States

Variables	Contour farming		Terracing		Surface drainage		Grassed waterways	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Constant	-113.6780	-1.01	116.9020	1.44	68.7828	0.75	16.5411	0.47
Crop grown in the field in current season (dummy variables)								
Corn	0.1007	0.30	0.7756	2.58	0.6474	2.18	0.1101	1.02
Soybeans	0.3672	0.78	0.5557	1.53	-0.8964	-1.33	0.1715	1.41
Hay	0.7827	1.99	0.6575	1.91	0.9356	2.95	0.0638	0.37
Crop grown in the field in previous season (dummy variables)								
Corn	1.5659	3.71	0.5715	1.81	1.0299	3.17	-0.0522	-0.45
Soybeans	1.0888	1.89	0.1338	0.36	-0.2437	-0.39	0.1193	0.95
Wheat	0.8505	0.78	-0.9507	-0.90	0.7307	0.67	0.1178	0.74
Hay	0.8285	1.88	0.8227	2.49	1.2137	3.75	-0.1867	-1.09
Input prices								
Fuel price	-4.2387	-0.87	5.0758	1.46	2.6919	0.69	1.0796	0.72
Chemical price	43.8243	0.90	-54.2403	-1.55	-28.0942	-0.71	-11.2843	-0.75
Expected yield and yield variation of corn								
Expected yield of corn	0.0076	0.67	-0.0059	-0.75	-0.0040	-0.37	0.0086	3.05
Expected variation of corn yield	0.0002	0.20	0.0017	1.99	0.0046	3.48	-0.0039	-10.85
Land Characteristics								
Good land	0.3556	0.70	0.1142	0.26	-0.1146	-0.26	-0.3628	-1.59
Bad land	0.4033	1.57	-0.1505	-0.71	0.6088	2.83	0.0522	0.52
Slope	0.0097	3.89	0.0053	2.29	0.0062	2.81	-0.0568	-18.90
Clay percentage	-0.0108	-0.62	-0.0039	-0.26	0.0201	1.51	0.0439	8.56
Available water capacity	16.8150	3.91	22.5607	7.66	-8.2137	-2.31	13.1302	8.34

[continued]

Table B.5. Continued.

Variables	Contour farming		Terracing		Surface drainage		Grassed waterways	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Organic matter	-0.0887	-1.54	-0.2469	-4.02	-0.2531	-2.75	-0.0081	-1.28
Soil pH	-0.2120	-0.97	-0.2094	-1.11	-0.3026	-1.47	0.8518	9.70
Soil permeability	0.0765	1.30	0.1442	2.95	-0.2056	-2.81	0.1285	5.82
Coarse-textured soil	0.4794	1.10	1.3334	5.03	-0.7785	-1.65	-0.0803	-0.79
Fine-textured soil	0.2655	0.65	0.6082	1.74	-0.8632	-1.63	-0.0211	-0.17
Weather Conditions								
Mean max temperature-corn	0.0176	0.31	0.0021	0.05	-0.1394	-3.30	0.0034	0.20
Mean precipitation-corn	-6.2087	-0.27	-18.6727	-1.05	66.4404	3.43	42.6126	5.21
St. deviation of precipitation-corn	8.5712	0.97	7.1741	1.07	-20.3090	-2.43	-21.5105	-7.44
Mean of snow-wheat	-6.7636	-0.88	3.0168	2.27	-0.6012	-0.24	1.0469	2.45
St. deviation of snow-wheat	0.9651	0.45	-2.5334	-3.45	-2.4784	-2.10	-0.4972	-1.82
Mean precipitation-wheat	-13.4786	-0.57	-43.2783	-4.04	-62.8866	-2.89	-30.5857	-5.23
St. deviation of precipitation-wheat	3.1536	0.28	33.5660	4.47	36.5973	3.83	21.2469	6.33
Dummy variable for Major Land Resource Areas								
MLRA901	1.4402	2.63	0.1423	0.33	0.0559	0.10	-0.8549	-3.09
MLRA911	1.1643	1.97	-0.6934	-1.06	-0.7143	-0.64	-1.1907	-4.09
MLRA1031	-0.4698	-0.87	-0.4651	-1.53	-0.4114	-0.66	0.6687	4.98
MLRA1051	1.5996	3.42	0.7097	2.32	2.2969	5.37	-2.5104	-5.77
MLRA95A1	2.4116	4.30	1.4457	3.36	-0.1363	-0.16	-0.3951	-2.17
MLRA95B1	1.4747	2.90	0.4600	1.21	1.5321	3.19	-0.7204	-4.17
MLRA1021	-1.2017	-1.09	0.6015	1.63	-1.1862	-1.03	-0.8706	-4.03
LOG OF LIKELIHOOD FUNCTION		-4296						

Table B.6. Estimated marginal effects of alternative variables on the adoption of conservation practices in the Lakes States

	Contour farming	Terracing	Surface drainage	Grassed waterway	Other
Constant	-1.8086	2.6464	1.3611	1.6677	-3.8666
Crop grown in the field in current season (dummy variables)					
Corn	-0.0005	0.0163	0.0116	0.0102	-0.0377
Soybeans	0.0058	0.0140	-0.0205	0.0186	-0.0180
Hay	0.0086	0.0124	0.0168	0.0044	-0.0422
Crop grown in the field in previous season (dummy variables)					
Corn	0.0195	0.0098	0.0177	-0.0095	-0.0375
Soybeans	0.0152	0.0022	-0.0072	0.0126	-0.0229
Wheat	0.0114	-0.0247	0.0157	0.0148	-0.0171
Hay	0.0088	0.0163	0.0223	-0.0251	-0.0223
Input prices					
Fuel price	-0.0687	0.1139	0.0516	0.1137	-0.2105
Chemical price	0.7130	-1.2179	-0.5355	-1.1849	2.2252
Expected yield and yield variation of corn					
Expected yield of corn	0.0001	-0.0002	-0.0001	0.0010	-0.0009
Expected variation of corn yield	-2.2e-06	0.0000	0.0001	-0.0005	0.0003
Land Characteristics					
Good land	0.0053	0.0035	-0.0030	-0.0424	0.0366
Bad land	0.0047	-0.0053	0.0123	0.0056	-0.0173
Slope	0.0002	0.0002	0.0001	-0.0066	0.0060
Clay percentage	-0.0002	-0.0002	0.0004	0.0051	-0.0050
Available water capacity	0.2118	0.4919	-0.2526	1.4484	-1.8995
Organic matter	-0.0006	-0.0051	-0.0046	-0.0001	0.0104
Soil pH	-0.0030	-0.0062	-0.0061	0.0992	-0.0839
Soil permeability	0.0011	0.0034	-0.0048	0.0145	-0.0143
Coarse-textured soil	0.0066	0.0323	-0.0196	-0.0126	-0.0068
Fine-textured soil	0.0045	0.0157	-0.0196	-0.0036	0.0031
Weather Conditions					
Mean max temperature-corn	0.0005	0.0003	-0.0029	0.0005	0.0017
Mean precipitation-corn	-0.2116	-0.6724	1.4013	4.9258	-5.4431
St. deviation of precipitation-corn	0.1628	0.2546	-0.4366	-2.4942	2.5133
Mean of snow-wheat	-0.0963	0.0753	-0.0085	0.1195	-0.0900
St. deviation of snow-wheat	0.0202	-0.0535	-0.0475	-0.0502	0.1310
Mean precipitation-wheat	-0.0160	-0.7868	-1.1764	-3.3666	5.3457
St. deviation of precipitation-wheat	-0.0667	0.6486	0.6727	2.3398	-3.5945

[continued]

Table B.6. Continued.

	Contour farming	Terracing	Surface drainage	Grassed waterway	Other
Dummy variable for Major Land Resource Areas					
MLRA901	0.0204	0.0040	-0.0009	-0.1003	0.0768
MLRA911	0.0189	-0.0128	-0.0145	-0.1362	0.1445
MLRA1031	-0.0060	-0.0112	-0.0073	0.0790	-0.0546
MLRA1051	0.0199	0.0166	0.0453	-0.2943	0.2125
MLRA95A1	0.0324	0.0325	-0.0094	-0.0513	-0.0043
MLRA95B1	0.0181	0.0079	0.0290	-0.0866	0.0316
MLRA1021	-0.0145	0.0198	-0.0234	-0.1001	0.1182

Appendix C

ARMS Models for the Northern Plains

Table C.1. Coefficient estimates for the Multinomial Logit Crop Choice Model for the Northern Plains

	Corn		Soybeans		Wheat		Hay		Sorghum	
Variables	**Coef.**	**t-stat**	**Coef.**	**t-stat**	**Coef.**	**t-stat**	**Coef.**	**t-stat**	**Coef.**	**t-stat**
Constant	11.9919	3.00	2.9508	0.62	-7.3488	-2.91	-9.0456	-1.09	-10.4410	-1.81
Cropping History										
Previous year's crop is corn	2.7421	53.27	3.1304	38.42	-0.7614	-12.83	0.7811	5.40	1.1276	12.37
Previous year's crop is soybeans	3.5369	39.12	3.1104	28.21	0.9881	10.99	1.0782	4.65	3.1980	29.34
Previous year's crop is sorghum	0.4681	5.63	2.2137	23.83	-0.4895	-8.69	-0.1497	-0.70	3.1902	43.81
Previous year's crop is wheat	-0.2709	-4.58	0.9972	12.01	-0.2777	-9.74	-0.3918	-2.91	0.9940	14.60
Previous year's crop is hay	1.9322	13.47	1.6509	7.57	-0.6124	-3.79	6.8877	51.58	1.4406	6.67
Price and Policy Variables										
Expected price for corn	24.7808	1.28	-68.8251	-3.07	8.1948	0.60	-0.5339	-0.01	80.4844	3.53
Expected price for soybeans	-2.1867	-0.15	11.1117	0.63	-42.4498	-4.40	-40.4845	-1.29	-52.4995	-2.58
Futures price for wheat	3.9803	0.31	12.8079	0.84	15.3211	1.82	29.0876	1.06	45.2392	3.37
Expected price for hay	-1.4591	-4.32	-0.7687	-1.95	0.7300	3.35	1.4036	1.99	0.2304	0.57
Expected price for sorghum	97.0073	2.02	54.2836	0.94	-34.6462	-1.14	-90.5606	-0.92	71.1025	0.88
ARP rate for wheat	0.0252	1.94	0.0105	0.69	-0.0078	-0.98	-0.0212	-0.81	0.0281	1.38
Fuel price	-0.4785	-1.03	0.2621	0.48	0.4454	1.54	1.0510	1.10	0.0605	0.09
Chemical price	-1.4612	-1.51	0.0263	0.02	-0.2073	-0.34	2.0988	1.06	-0.5036	-0.34
Wage rate	-15.6491	-0.62	15.3320	0.51	8.1991	0.47	-10.0534	-0.19	40.2058	1.24
Expected Yield and Yield Variation of Corn										
Expected yield of corn	0.0158	17.48	0.0092	7.84	-0.0059	-9.96	-0.0035	-1.92	0.0013	1.39
Expected variation of corn yield	-0.0011	-7.71	0.0008	5.96	-0.0002	-4.19	-0.0010	-4.09	-0.0006	-6.47

[continued]

Table C.1. Continued.

	Corn		Soybeans		Wheat		Hay		Sorghum	
Variables	**Coef.**	**t-stat**	**Coef.**	**t-stat**	**Coef.**	**t-stat**	**Coef.**	**t-stat**	**Coef.**	**t-stat**
Land Characteristics										
Good land	0.3158	6.51	0.0409	0.71	0.1802	5.60	0.0534	0.52	-0.0105	-0.21
Bad land	-0.2326	-2.54	-0.3341	-2.91	-0.2664	-4.08	0.4792	3.07	0.1531	1.66
Slope	-0.0008	-1.04	-0.0042	-4.66	-0.0084	-12.88	-0.0027	-1.77	-0.0066	-6.83
Available water capacity	0.4530	0.58	8.7050	8.84	-0.4726	-0.77	-2.6342	-1.72	-0.9751	-1.06
Organic matter	-0.0892	-5.52	-0.0042	-0.22	-0.0060	-0.59	-0.0999	-2.92	0.0308	1.37
Soil pH	-0.2579	-5.62	-0.4392	-8.24	-0.0496	-1.35	-0.1483	-1.52	-0.2064	-4.12
Coarse-textured soil	0.0090	0.18	0.4652	8.60	-0.0147	-0.39	-0.0978	-0.91	0.2266	4.17
Fine-textured soil	0.3115	4.35	0.5594	6.32	-0.1913	-3.73	0.1774	1.24	0.2354	3.03
Weather Conditions										
Mean max temperature-corn	-0.1102	-12.21	-0.1556	-13.50	0.0896	13.49	-0.0380	-1.92	0.0773	6.59
Mean precipitation-corn	6.6992	1.60	3.0277	0.62	21.7246	7.66	28.2513	3.14	22.7493	5.08
St. deviation of precipitation-corn	5.3836	3.23	15.9528	8.47	-8.9613	-7.96	-1.5999	-0.46	-2.2169	-1.18
Mean of precipitation-wheat	49.4095	7.50	158.0720	20.27	-36.5730	-8.39	21.4508	1.64	14.2187	1.93
St. deviation of precipitation-wheat	-18.6442	-8.15	-50.7841	-18.25	20.5450	13.48	-8.0472	-1.76	-4.2110	-1.57
Mean of snow-wheat	-0.9805	-1.67	-0.1957	-0.30	0.5053	1.10	3.4182	2.82	-0.0150	-0.02
St. deviation of snow-wheat	0.5570	2.40	-0.0186	-0.06	-0.4027	-2.09	-1.8166	-3.57	0.0942	0.32
State Dummies										
North Dakota dummy	-1.3656	-7.97	-1.9160	-8.89	0.3349	2.69	-1.9464	-5.49	-3.9417	-9.72
South Dakota dummy	0.2916	1.78	-1.5070	-7.88	-0.8706	-7.52	-0.5639	-1.65	-0.9830	-5.09
LOG OF LIKELIHOOD FUNCTION	-51382									

Note: The 1 percent, 5 percent, and 10 percent critical values for the t-statistics are 2.58, 1.96, and 1.65, respectively.

Table C.2. Estimates of the marginal effects on crop choice in the Northern Plains

	Corn	Soybeans	Wheat	Hay	Sorghum	Other
Constant	1.3038	0.1120	-1.2023	-0.1397	-0.6820	0.6082
Cropping History						
Previous year’s crop is corn	0.1683	0.1187	-0.2588	-0.0022	0.0314	-0.0573
Previous year’s crop is soybeans	0.1752	0.0534	-0.0442	-0.0101	0.1183	-0.2925
Previous year’s crop is sorghum	-0.0365	0.0932	-0.2034	-0.0094	0.2035	-0.0475
Previous year’s crop is wheat	-0.0513	0.0594	-0.0774	-0.0063	0.0686	0.0070
Previous year’s crop is hay	0.1016	0.0359	-0.2280	0.0899	0.0662	-0.0656
Price and Policy Variables						
Expected price for corn	2.7120	-5.6834	-0.4494	-0.1475	5.7905	-2.2221
Expected price for soybeans	1.2406	1.8855	-5.5399	-0.3649	-2.5322	5.3108
Futures price for wheat	-0.9229	-0.0550	0.9631	0.2703	2.4864	-2.7419
Expected price for hay	-0.1345	-0.0252	0.1510	0.0239	0.0197	-0.0350
Expected price for sorghum	7.5580	0.7418	-10.0970	-1.7194	4.2343	-0.7178
ARP rate for wheat	0.0019	-0.0001	-0.0026	-0.0004	0.0018	-0.0005
Fuel price	-0.0630	0.0192	0.0751	0.0149	-0.0064	-0.0399
Chemical price	-0.1271	0.0415	0.0035	0.0373	-0.0155	0.0603
Wage rate	-2.3465	0.7601	0.4690	-0.1889	2.5787	-1.2724
Expected Yield and Yield Variation of Corn						
Expected yield of corn	0.0013	0.0002	-0.0015	-0.0001	0.0000	0.0000
Expected variation of corn yield	-0.0001	0.0001	-3.4e-06	-9.8e-06	0.0000	0.0001
Land Characteristics						
Good land	0.0228	-0.0073	0.0222	-0.0011	-0.0096	-0.0269
Bad land	-0.0103	-0.0134	-0.0402	0.0090	0.0233	0.0316
Slope	0.0003	-0.0001	-0.0011	8.6e-06	-0.0002	0.0010

[continued]

Table C.2. Continued.

	Corn	Soybeans	Wheat	Hay	Sorghum	Other
Available water capacity	-0.1347	0.5302	-0.1639	-0.0484	-0.1509	-0.0324
Organic matter	-0.0076	0.0017	0.0006	-0.0011	0.0035	0.0029
Soil pH	-0.0083	-0.0171	0.0092	-0.0001	-0.0050	0.0212
Coarse-textured soil	-0.0121	0.0255	-0.0142	-0.0023	0.0110	-0.0078
Fine-textured soil	0.0150	0.0257	-0.0524	0.0010	0.0114	-0.0007
Weather Conditions						
Mean max temperature-corn	-0.0087	-0.0086	0.0173	-0.0003	0.0060	-0.0055
Mean precipitation-corn	-0.3315	-0.5413	2.6818	0.2676	0.8434	-2.9200
St. deviation of precipitation-corn	0.3258	0.9679	-1.7337	-0.0296	-0.1479	0.6175
Mean of precipitation-wheat	1.1685	8.5711	-9.5931	0.0207	-0.3630	0.1959
St. deviation of precipitation-wheat	-0.8135	-2.8031	4.5854	-0.0452	-0.0587	-0.8649
Mean of snow-wheat	-0.1059	0.0006	0.0952	0.0515	-0.0056	-0.0358
St. deviation of snow-wheat	0.0643	-0.0077	-0.0742	-0.0269	0.0134	0.0312
State Dummies						
North Dakota dummy	-0.0296	-0.0411	0.2215	-0.0162	-0.2413	0.1067
South Dakota dummy	0.0941	-0.0745	-0.1023	-0.0027	-0.0309	0.1162

Table C.3. Elasticities of probabilities to choose alternative crops in the Northern Plains

	Corn	Soybeans	Wheat	Hay	Sorghum	Other
Price and Policy Variables						
Expected price for corn	0.2686	-1.1696	-0.0249	-0.0322	0.9235	-0.1361
Expected price for soybeans	0.2948	0.9310	-0.7372	-0.1909	-0.9690	0.7804
Futures price for wheat	-0.1156	-0.0143	0.0675	0.0745	0.5015	-0.2123
Expected price for hay	-0.2970	-0.1154	0.1867	0.1162	0.0702	-0.0478
Expected price for sorghum	0.7708	0.1572	-0.5767	-0.3860	0.6954	-0.0453
ARP rate for wheat	0.1435	-0.0223	-0.1117	-0.0706	0.2140	-0.0211
Fuel price	-1.6704	1.0607	1.1153	0.8718	-0.2732	-0.6543
Chemical price	-2.6146	1.7748	0.0408	1.6874	-0.5136	0.7668
Wage rate	-0.4068	0.2738	0.0455	-0.0721	0.7200	-0.1364
Expected Yield and Yield Variation of Corn						
Expected yield of corn	0.6224	0.2394	-0.3903	-0.1095	-0.0221	0.0141
Expected variation of corn yield	-0.2225	0.3954	-0.0043	-0.0496	-0.1193	0.0844
Land Characteristics						
Good land	0.0774	-0.0516	0.0423	-0.0086	-0.0528	-0.0566
Bad land	-0.0032	-0.0086	-0.0070	0.0062	0.0116	0.0061
Slope	0.0464	-0.0160	-0.0964	0.0029	-0.0433	0.0983
Available water capacity	-0.1375	1.1251	-0.0937	-0.1088	-0.2481	-0.0204
Organic matter	-0.1016	0.0484	0.0043	-0.0327	0.0751	0.0240
Soil pH	-0.3611	-1.5486	0.2245	-0.0092	-0.3497	0.5731
Coarse-textured soil	-0.0164	0.0715	-0.0108	-0.0069	0.0239	-0.0065
Fine-textured soil	0.0131	0.0467	-0.0257	0.0019	0.0161	-0.0004

[continued]

Table C.3. Continued.

	Corn	Soybeans	Wheat	Hay	Sorghum	Other
Weather Conditions						
Mean max temperature-corn	-4.2487	-8.7190	4.6969	-0.3679	4.6622	-1.6513
Mean precipitation-corn	-0.2396	-0.8128	1.0852	0.4256	0.9815	-1.3047
St. deviation of precipitation-corn	0.6094	3.7619	-1.8160	-0.1218	-0.4456	0.7142
Mean of precipitation-wheat	0.5118	7.8006	-2.3530	0.0199	-0.2560	0.0531
St. deviation of precipitation-wheat	-1.1053	-7.9130	3.4886	-0.1353	-0.1285	-0.7266
Mean of snow-wheat	-0.0498	0.0006	0.0251	0.0533	-0.0042	-0.0104
St. deviation of snow-wheat	0.1646	-0.0411	-0.1064	-0.1518	0.0552	0.0493

Table C.4. Estimated coefficients for the Conservation Tillage Model for the Northern Plains

Parameter	Estimate	t-statistic	dP/dX
Constant	28.1849	14.92	4.0527
Crop Grown in the Field in Current Season (dummy variables)			
Corn	0.7408	9.39	0.1065
Soybeans	0.5207	5.25	0.0749
Wheat	0.3275	5.74	0.0471
Sorghum	0.5146	5.96	0.0740
Hay	-0.8228	-3.37	-0.1183
Crop Grown in the Field in Previous Season (dummy variables)			
Corn	0.6684	8.47	0.0961
Soybeans	0.3230	3.16	0.0464
Wheat	0.4000	7.04	0.0575
Sorghum	0.5133	5.82	0.0738
Hay	-0.5629	-2.37	-0.0809
Input Prices			
Fuel price	-1.7358	-15.60	-0.2496
Chemical price	-6.4221	-19.68	-0.9234
Expected Yield and Yield Variation of Corn			
Expected yield of corn	0.0183	15.32	0.0026
Expected variation of corn yield	0.0001	1.17	0.0000
Land Characteristics			
Low-quality land	-0.0553	-1.00	-0.0080
High-quality land	-0.0610	-0.56	-0.0088
Slope	-0.0047	-4.36	-0.0007
Clay percentage	0.0137	3.23	0.0020
Available water capacity	7.0222	5.27	1.0097
Organic matter percentage	0.0177	0.81	0.0025
Soil pH	0.1963	3.22	0.0282
Soil permeability	0.0658	3.88	0.0095
Coarse-textured soil	-0.1246	-1.85	-0.0179
Fine-textured soil	-0.0215	-0.24	-0.0031

[continued]

Table C.4. Continued.

Parameter	Estimate	t-statistic	dP/dX
Weather Conditions			
Mean max temperature-corn	-0.0978	-7.56	-0.0141
Mean precipitation-corn	-12.1833	-2.62	-1.7519
St. deviation of precipitation-corn	-1.8317	-0.93	-0.2634
Mean max temperature-wheat	0.0870	9.33	0.0125
Mean of snow-wheat	-6.4879	-8.68	-0.9329
St. deviation of snow-wheat	2.8924	9.49	0.4159
Mean precipitation-wheat	-31.5962	-4.52	-4.5432
St. deviation of precipitation-wheat	4.5573	1.72	0.6553
Dummy Variables for Major Land Resource Areas			
MLRA1021	-0.7590	-3.49	-0.1091
MLRA1021	-0.1714	-1.45	-0.0246
MLRA1061	-0.3153	-2.72	-0.0453
MLRA1071	0.0233	0.13	0.0034
MLRA1121	1.3750	9.70	0.1977
MLRA53B1	-0.9080	-3.92	-0.1306
MLRA53C1	0.2777	1.23	0.0399
MLRA541	-0.9149	-2.20	-0.1316
MLRA55A1	-1.7119	-6.35	-0.2462
MLRA55B1	-0.5199	-2.69	-0.0748
MLRA55C1	0.4302	2.34	0.0619
MLRA561	-1.8719	-8.43	-0.2692
MLRA63A1	-0.2650	-0.47	-0.0381
MLRA63B1	0.6648	2.72	0.0956
MLRA651	0.1148	0.31	0.0165
LOG OF LIKELIHOOD FUNCTION	-7359		
R-SQUARED	0.22		
PERCENT CORRECT PREDICTIONS	80%		

Table C.5. Parameter estimates for the Multinomial Logit Model of Conservation Practices in the Northern Plains

	Contour farming		Terracing		Surface drainage		Grassed waterways	
Variables	**Coef.**	**t-Stat**	**Coef.**	**t-Stat**	**Coef.**	**t-Stat**	**Coef.**	**t-Stat**
Constant	1.5077	0.33	3.8516	0.88	-12.3529	-5.64	-19.2311	-4.23
Crop Grown in the Field in Current Season (dummy variables)								
Corn	0.0997	0.48	-1.3973	-4.22	-0.2270	-2.00	0.1541	0.75
Soybeans	0.5078	2.39	-2.3208	-2.29	0.2677	2.40	0.3528	1.74
Wheat	0.5106	2.94	0.3318	2.98	0.3976	6.14	0.0784	0.64
Sorghum	0.1727	0.74	-0.3528	-1.39	0.2110	2.29	-0.6605	-1.50
Hay	-0.1927	-0.49	-0.6914	-1.63	-0.3896	-1.61	-1.4614	-2.41
Crop Grown in the Field in Previous Season (dummy variables)								
Corn	0.0133	0.06	-1.8250	-5.08	-0.7829	-6.65	0.5361	2.62
Soybeans	0.2688	1.28	-2.3014	-2.27	0.0294	0.27	0.7303	3.43
Wheat	0.3283	1.91	0.1002	0.89	0.2314	3.60	-0.0343	-0.27
Sorghum	0.3387	1.50	0.2182	0.93	0.1902	2.06	0.1993	0.52
Hay	0.4128	1.09	-0.4986	-1.16	-0.5844	-2.43	0.7232	1.32
Input Prices								
Fuel price	0.3005	1.12	0.0445	0.18	0.3606	2.90	0.2215	0.83
Chemical price	2.1160	2.82	0.7910	1.13	1.7787	5.22	0.3088	0.43
Expected Yield and Yield Variation of Corn								
Expected yield of corn	-0.0138	-4.78	-0.0125	-5.15	-0.0009	-0.82	0.0022	0.85
Expected variation of corn yield	0.0019	7.85	-0.0023	-5.69	0.0012	13.10	0.0021	8.08

[continued]

Table C.5. Continued.

Variables	Contour farming Coef.	Contour farming t-Stat	Terracing Coef.	Terracing t-Stat	Surface drainage Coef.	Surface drainage t-Stat	Grassed waterways Coef.	Grassed waterways t-Stat
Land Characteristics								
Low-quality land	-0.1040	-0.73	-0.0769	-0.61	-0.1018	-1.69	0.6916	4.26
High-quality land	-0.7866	-2.77	-0.7818	-2.81	-0.6052	-4.77	0.1231	0.39
Slope	0.0122	5.53	0.0012	0.44	0.0199	17.49	-0.0514	-10.35
Clay percentage	0.0071	0.59	-0.0128	-1.45	0.0258	4.75	0.0510	5.88
Available water capacity	-0.5329	-0.18	-2.0261	-0.65	3.4082	2.29	-5.1415	-1.68
Organic matter percentage	-0.0582	-1.23	-0.0785	-1.89	-0.0662	-2.20	-0.0377	-1.29
Soil pH	-0.2920	-2.28	-0.7690	-4.98	-0.5216	-8.52	0.8157	5.33
Soil permeability	-0.0302	-0.50	-0.0431	-1.29	-0.2062	-5.00	-0.0230	-0.56
Coarse-textured soil	0.3136	2.39	-0.1686	-0.72	0.1581	2.38	0.8850	6.35
Fine-textured soil	-1.4864	-4.14	1.0597	5.89	-0.8163	-6.56	0.9297	4.93
Weather Conditions								
Mean max temperature-corn	-0.0475	-1.79	0.0531	2.02	0.1634	11.39	-0.1715	-7.59
Mean precipitation-corn	34.7054	3.88	7.6760	0.76	1.7852	0.44	68.2017	6.61
St. deviation of precipitation-corn	-7.8785	-2.40	-19.3969	-4.53	-5.3434	-3.38	-16.0134	-4.18
Mean max temperature-wheat	-0.1450	-6.17	-0.0310	-1.37	-0.1158	-9.90	0.2486	9.28
Mean of snow-wheat	-0.6624	-0.40	-3.7528	-1.80	-5.7340	-7.30	-3.6493	-0.91
St. deviation of snow-wheat	-1.2977	-1.82	2.3934	2.88	2.1642	6.05	0.0111	0.01
State Dummies								
North Dakota dummy	-0.3386	-1.42	0.0065	0.03	-0.7336	-8.13	1.2256	3.69
South Dakota dummy	1.4947	6.62	0.2702	1.61	-0.8203	-3.60	-2.7917	-12.87
LOG OF LIKELIHOOD FUNCTION			-10192					

Table 6C. Estimated marginal effects of alternative variables on the adoption of conservation practices in the Northern Plains

	Contour farming	Terracing	Surface drainage	Grassed waterway	Other
Constant	0.1230	0.1423	-1.3568	-0.4446	1.5361
Crop Grown in the Field in Current Season (dummy variables)					
Corn	0.0042	-0.0344	-0.0222	0.0049	0.0474
Soybeans	0.0106	-0.0590	0.0319	0.0095	0.0070
Wheat	0.0091	0.0070	0.0395	0.0009	-0.0565
Sorghum	0.0030	-0.0089	0.0240	-0.0159	-0.0022
Hay	-0.0011	-0.0151	-0.0379	-0.0337	0.0877
Crop Grown in the Field in Previous Season (dummy variables)					
Corn	0.0058	-0.0438	-0.0823	0.0152	0.1052
Soybeans	0.0065	-0.0581	0.0066	0.0189	0.0261
Wheat	0.0061	0.0018	0.0232	-0.0014	-0.0297
Sorghum	0.0065	0.0047	0.0179	0.0042	-0.0332
Hay	0.0133	-0.0115	-0.0669	0.0182	0.0469
Input Prices					
Fuel price	0.0045	-0.0001	0.0374	0.0046	-0.0464
Chemical price	0.0371	0.0141	0.1799	0.0034	-0.2344
Expected Yield and Yield Variation of Corn					
Expected yield of corn	-0.0003	-0.0003	0.0000	0.0001	0.0005
Expected variation of corn yield	0.0000	-0.0001	0.0001	0.0000	-0.0002

[continued]

Table 6C. Continued.

	Contour farming	Terracing	Surface drainage	Grassed waterway	Other
Land Characteristics					
Low-quality land	-0.0020	-0.0021	-0.0113	0.0167	-0.0013
High-quality land	-0.0141	-0.0177	-0.0597	0.0047	0.0868
Slope	0.0002	8.6e-06	0.0022	-0.0013	-0.0011
Clay percentage	0.0000	-0.0004	0.0028	0.0012	-0.0035
Available water capacity	-0.0319	-0.0558	0.3922	-0.1256	-0.1789
Organic matter percentage	-0.0009	-0.0017	-0.0067	-0.0007	0.0100
Soil pH	-0.0035	-0.0183	-0.0547	0.0208	0.0556
Soil permeability	0.0007	-0.0005	-0.0224	-0.0002	0.0224
Coarse-textured soil	0.0059	-0.0054	0.0146	0.0209	-0.0360
Fine-textured soil	-0.0299	0.0284	-0.0845	0.0232	0.0628
Weather Conditions					
Mean max temperature-corn	-0.0021	0.0010	0.0184	-0.0043	-0.0130
Mean precipitation-corn	0.7620	0.1272	-0.1457	1.6028	-2.3463
St. deviation of precipitation-corn	-0.1348	-0.4553	-0.4639	-0.3571	1.4111
Mean max temperature-wheat	-0.0027	-0.0006	-0.0121	0.0062	0.0092
Mean of snow-wheat	0.0250	-0.0754	-0.6134	-0.0761	0.7398
St. deviation of snow-wheat	-0.0451	0.0543	0.2409	-0.0039	-0.2462
State Dummies					
North Dakota dummy	-0.0036	0.0014	-0.0805	0.0304	0.0523
South Dakota dummy	0.0412	0.0104	-0.0972	-0.0662	0.1118

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