THE STRUCTURE OF CITIZEN PREFERENCES FOR GOVERNMENT SOIL EROSION CONTROL PROGRAMS

Jeffrey L. Jordan and Abdelmoneim H. Elnagheeb

Abstract

The 1990 Farm Bill contains several measures concerning soil erosion caused by U.S. farmers. Data from a nationwide survey of people concerning their attitudes toward agriculture were used to examine the structure of respondents' preferences for government support-policies to combat soil erosion. Estimates of the influence of socio-economic and demographic variables on policy preferences were computed using a multiple-indicator model. Results show more support for the regulation of soil erosion, including laws and fines, than for government financial support.

Key words: soil erosion, preferences measurement, linear structural relationship (LISREL) model, latent variables

One consequence of the environmental movement has been an increased concern about the impact of agriculture on water quality and soil resources. Soil conservation programs were an important part of both the 1985 and 1990 farm bills. The U.S. government has increased its spending and involvement in soil conservation programs to mitigate the increasing economic and social costs of erosion. One estimate puts the annual direct offsite damage from soil erosion at between $4 and $15 billion (Ribaudo). Conservation policies have consisted of providing farmers with technical and monetary incentives to invest in soil conservation practices. Under the Conservation Reserve Program for example, farmers must retire land from production for ten years in return for annual payments from the U.S. Department of Agriculture. Because of this program, expenditures by the U.S. Department of Agriculture for erosion control have increased from $379 million in 1986 to more than $1.1 billion (1982 dollars) in 1987 (Nielsen et al.).

This increasing governmental involvement is due in part to changing public attitudes toward environmental issues. Public participation in the environmental decision-making process is likely to increase in the future (Havlicek). Because agricultural policies, including soil conservation policies, represent significant costs to consumers and tax-payers, soil conservation is likely to be influenced by public input in the decision-making process. Therefore, it is useful to gauge the public's willingness to support soil erosion control programs. This support will depend, in part, on the public's awareness and perceptions of an erosion problem. Previous research has concentrated on the farmer's decision on adoption of soil conservation practices (Earle et al.; Ervin and Ervin; Lynne et al.; Norris and Batie). Empirical analyses of citizen perceptions of the erosion problem and preferences for conservation programs, however, are few. The aim of this study was to estimate the determinants of citizen perceptions of the erosion problem and preferences for soil erosion control policies, including governmental payment support.

Perceptions and preferences cannot be observed or directly measured. Such concepts are often referred to as latent variables; they are essentially hypothetical constructs to conceptualize intangible elements of the domain studied by a particular science (Mueller). Constructs were needed to measure perceptions and preferences. Responses to a single question will not be appropriate for deriving such constructs because of the measurement problem associated with survey data (Kalton and Schuman). Most previous empirical analysis of public preferences, however, were based on responses to a single question (Ferris 1983, 1985; Gramlich and Rubinfeld; Hewitt; and Schokkaert). In this study, observed responses to multiple questions were modeled as imperfect indicators of the true constructs (perception of soil erosion and preferences for soil erosion control policies). Hopefully, this approach will reduce the measurement problem. The underlying constructs are then related to the observed socioeconomic and demographic characteristics of the respondents.

DATA AND VARIABLES

The analysis in this paper is based on data from a nationwide survey conducted in 1986 by the S-198 Regional Research Project, "Socioeconomic Dimen-

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sions of Agricultural Change, Natural Resource Use and Agricultural Structure." The survey's goal was to determine public views of changes in the structure of U.S. agriculture. After pretesting, questionnaires were mailed to a stratified sample of 9,250 persons representing the U.S. population. The questionnaire was mailed three times with three reminder cards to improve the response rate. Bad addresses, deceased respondents, and completed questionnaires represent about 54 percent of the original sample. Completed questionnaires were available from 3,212 respondents. Because of missing observations the number of questionnaires used in the final analysis was 2,851.

The survey consisted of more than 150 questions about different farm issues and standardized questions to obtain socioeconomic and demographic background data. For this study, six statements related to soil erosion and soil conservation were analyzed. Table 1 summarizes the six statements and the corresponding responses. For the first five statements, respondents registered the intensity of their responses on a five-category Likert scale ranging from strongly agree to strongly disagree. The sixth statement related to partial payment for reducing soil erosion with the responses ranging from partial payment should be "increased" to partial payment should be "eliminated." Numerical values were assigned to the responses. Zero was assigned to "strongly agree," one to "agree," two to "undecided," three to "disagree," and four to "strongly disagree" for the first five statements. For the sixth statement, the assigned values ranged from zero assigned to "increased" to four assigned to "eliminated."

Some states were oversampled to produce state-level analyses. For the national analysis used in this paper, the data were weighted using national population censuses and number of respondents in the different regions. The statistical weighting procedure also counters the differential response by sex and race (Sonquist and Dunkelberg). Molnar provides a more detailed discussion on the development and administration of the questionnaire, data processing, weighting procedure, and response rate.

Exploratory Analysis

While soil erosion is the unifying concept underlying the six statements, the statements differ in wording, focus, and context. The six statements can be classified into three sets depending on the focus of each statement. The first two statements measure the respondent's awareness or perception of an erosion problem. A respondent who agreed with the first two statements did not perceive erosion to be a problem, while one who disagreed with the statements had a perception that erosion is a problem. Hence, the respondent's awareness or perception of

Table 1. Summary of Responses to Soil Erosion-Related Questions (n = 2,851)

	Frequency and percent						
Statement	S.A.[a]	A.	U.	D.	S.D	Skewness	Kurtosis
1.Given the economic realities, soil conservation programs are carried too far.	96 (3)[b]	589 (21)	838 (29)	1071 (38)	257 (9)	0.247	-0.631
2. Most farmers take good care of the soil.	146 (5)	1571 (55)	742 (26)	360 (13)	32 (1)	-0.730	0.089
3. Farmers who do not adopt the needed soil conservation practices should be fined.	160 (6)	1062 (37)	861 (30)	682 (24)	86 (3)	0.201	-0.728
4. Laws regulaitng excess soil erosion are badly needed	283 (10)	1339 (47)	945 (33)	249 (9)	35 (1)	0.436	0.156
5. The government should pay farmers to practice soil conservation	126 (4)	868 (30)	743 (26)	975 (34)	139 (5)	-0.067	-0.933
	Increased	Kept same	Don't Know	Decreased	Eliminated	Skewness	Kurtosis
6. Partial payments to farmers for the cost of reducing erosion should be -	864 (30)	976 (34)	502 (18)	217 (8)	292 (10)	0.805	-0.337

[a]S.A. = Strongly Agree, A. = Agree, U. = Undecided, D. = Disagree, S.D. = Strongly Disagree.
[b]Numbers in parenthesis represent percentages. Due to rounding error, percentages may not add to 100.

an erosion problem increases along the Likert scale. While 47 percent disagreed ("disagreed" in this section means either "strongly disagreed" or "disagreed") that soil conservation programs are carried too far, only 14 percent disagreed that "farmers take good care of the soil."

Statements three and four relate to the support of laws that may lead to less soil erosion, while statements five and six pertain to the support of government payments to help farmers adopt soil conservation practices. The support for laws and for payments decrease along the Likert scale. Table 1 shows that 57 percent of the respondents agreed ("agree" in this section means either "strongly agree" or "agree") that laws to regulate excess soil erosion are badly needed. A lesser percentage (43 percent) of the respondents agreed that farmers who do not adopt soil conservation practices should be fined. An even smaller percentage (35 percent) of the respondents agreed that the government should pay farmers to practice soil conservation and 30 percent stated that the partial payments to farmers for the cost of reducing erosion should be increased. The responses indicate more support for laws than for government payments.

The statements in Table 1 were hypothesized to be linked to three constructs (factors). Specifically, statements one and two were hypothesized to be linked to a construct called "perception of an erosion problem," henceforth referred to as "perception." Statements three and four were hypothesized to be linked to a construct called "laws support," and statements five and six to a construct called "payments support." These constructs are unobservable and are referred to as latent factors. Factor analysis is one of the statistical procedures that involves the relationship between observed variables (statements 1 to 6) and the underlying latent factors. Exploratory factor analysis has been used to help identify the factors that underlie a set of observed variables (Joreskog and Sorbom, 1979).

As a first step, a principal factor analysis was conducted on the correlation matrix of the responses to the six statements of Table 1. Results indicated that only three factors had eigenvalues greater than the average of all eigenvalues (Harman). These results were supported by a maximum likelihood factor analysis of the response correlation matrix. The maximum likelihood factor analysis rejected one-factor and two-factor models at the 5 percent level as inadequate with $\chi^2(9)$ of 553.54 and $\chi^2(4)$ of 20.05, respectively. No more than three factors can be extracted because the degrees of freedom will be exhausted (degrees of freedom = $[(n-m)^2 - (n+m)]/2$, where n= number of observed variables and m is the number of factors) (Bohrnstedt). Therefore, three factors were retained and a varimax rotation of the factors was implemented. The three factors explain about 97 percent of the common variance. Table 2 shows these results. The rotated factor pattern reveals a structure that is identical to the hypothesized construct structure. This structure is shown by the highest loadings of each statement on the three factors in Table 2. Each factor is linked to two statements related to one underlying concept.

Table 2. Factor Analysis Results after Varimax Rotation

Statement No.	Factor 1	Factor 2	Factor 3
1	0.074	0.197	0.308*
2	-0.014	0.091	0.337*
3	0.057	0.536*	0.177
4	0.371	0.405*	0.203
5	0.696*	0.049	0.006
6	0.680*	0.120	-0.003
Common variance percent	55.999	26.371	14.380

[a]The statement numbers correspond to those in Table 1.
*Denotes the highest factor loading for the item.

Determinants of Perception and Preferences

The first construct (perception) measures the respondent's perception of an erosion problem. The second (laws support) and third (payments support) constructs measure public preferences for certain governmental policies. The perceived benefits and costs from a policy determine an individual's true preferences (Lankford). Because people form perceptions after collecting and processing information, perceptions will vary across individuals depending on their socioeconomic and demographic characteristics. These factors can also simultaneously influence individual preferences. Previous studies have shown the importance of factors such as income, education, sex, age, political affiliation, and location of residence in policy preferences (Ferris 1983, 1985; Hewitt; Schokkaert). Table 3 presents the definitions and descriptive statistics of these and other variables expected to influence public perception of the soil erosion problem and public preferences for conservation policies.

ECONOMETRIC METHOD

Although the three hypothesized constructs are unobservable (i.e. latent variables), their effects on measurable (manifest) variables are observable and can be studied. A class of models that handles this type of variables is called latent variable models. A general model that involves multiple indicators of

Table 3. Definition and Description of Variables Used in Analysis[a]

Variable name	Description	Mean
Income		
INC	Midpoints of nine income categories ranging from less than $4,999 to $60,000 or more[b]	29586.1
Farm income		
FMINC	1 if respondents' family has income from farming, 0 otherwise	0.085
Age		
AGE	Age in years	45.85
Employment status (excluding category: employed full-time, employed part-time, student, or homemaker)		
UNEMPLOY	1 if unemployed, 0 otherwise	0.037
RETIRED	1 if retired or disabled, 0 otherwise	0.222
Sex		
FEMALE	1 if female, 0 otherwise	0.538
Race (excluded category: white)		
BLACK	1 if black, 0 otherwise	0.146
OTHER	1 if not black or white, 0 otherwise	0.024
Agricultural education		
AGEDN	1 if took high school or college agricultural course, 0 otherwise	0.156
Education (excluded category: less than high school or some high school)		
HSGRAD	1 if high school graduate, 0 otherwise	0.240
SOMECOLL	1 if had some college, 0 otherwise	0.299
COLLGRAD	1 if college graduate, 0 otherwise	0.226
POSTGRAD	1 if completed postgraduate degree, 0 otherwise	0.112
Political affiliation (excludied category: Republican)		
DEMOCRAT	1 if Democrat, 0 otherwise	0.374
INDEP	1 if Independent, 0 otherwise	0.361
Place of residence (excluded category: farm or ranch)		
LARCITY	1 if over 500,000 in population, 0 otherwise	0.222
MEDCITY	1 if between 50,000 and 500,000 in population, 0 otherwise	0.223
SMACITY	1 if between 10,000 and 50,000 in population, 0 otherwise	0.174
TOWN	1 if under 10,000 population, 0 otherwise	0.144
COUNTRY	1 if outside of town not on a farm, 0 otherwise	0.120
Region (excluded category: Midwest)		
NEAST	1 if from Northeast, 0 otherwise	0.212
SOUTH	1 if from South, 0 otherwise	0.340
WEST	1 if from West, 0 otherwise	0.201

[a]Means are weighted averages based on 2851 complete observations (see text). The standard deviations for the continuous variables INC and AGE are 17449.1 and 15.45, respectively.
[b]Values for the lower and upper open-ended categories were calculated using the range between midpoints of succeeding and preceding categories, respectively.

unobservable variables is the linear structural relationships (LISREL) model. It is used in this study (Joreskog and Sorbom 1985, 1986, 1989).

The LISREL model consists of two parts, the measurement model and the structural equation model. The former specifies how the unobservable (latent) variables relate to the observed variables (manifest or indicators), while the latter specifies the relationships among the latent variables. For the mathematical formulation, consider the linear structural simultaneous equation model:

$$(1)\ \eta = B^{\eta} + \Gamma \xi + \zeta$$

where $\eta' = (\eta_1, ..., \eta_L)$ are the dependent and $\xi'=(\xi_1, ..., \xi_M)$ the independent latent variables, and $\zeta' = (\zeta_1, ...,\zeta_L)$ is a vector of residuals representing both errors in equations and random disturbance terms. The matrices B (LxL) and Γ(LxM) are regression weights to be estimated. The two vectors of latent variables are related to two vectors of indicators by

(2) $y = \Lambda_y \eta + \varepsilon$ and
(3) $x = \Lambda_x \xi + \delta$

where $y' = (y_1, ..., y_q)$ and $x' = (x_1, ..., x_p)$ are mean-centered and considered indicators of the dependent and independent latent variables. The vectors ε and δ represent errors of measurement in y and x. The unknown matrices Λ_y (qxL) and Λ_x (PxM) contain regression weights of y on η and x on ξ, respectively. The following assumptions were made:

(a) $E(\zeta) = E(\varepsilon) = E(\delta) = 0$
(b) ε is uncorrelated with η, δ is uncorrelated with ξ, ζ is uncorrelated with ξ, and ζ, ε, and δ are mutually uncorrelated.
(c) $B^* = (I - B)^{-1}$ where (I - B) is non-singular.

The different variance-covariance matrices are defined below:

$E[\xi\xi'] = \Phi$ (MxM)
$E[\zeta\zeta'] = \Psi$ (LxL)
$E[\varepsilon\varepsilon'] = \theta_\varepsilon$ (qxq), and
$E[\delta\delta'] = \theta_\delta$ (pxp).

Given equations (1) to (3) and the above assumptions, the predicted covariance matrix of the x variables, $\sum_{xx}$, is given by

(4) $\sum_{xx} = \Lambda_x \Phi \Lambda'_x + \theta_\delta$.

Similarly, the predicted covariance matrices for y and for yx are given by

(5) $\sum_{yy} = \Lambda_y B^*(\Gamma\Phi\Gamma' + \Psi) B^{*\prime}\Lambda'_y + \theta_\varepsilon$, and

(6) $\sum_{yx} = \Lambda_y B^* \Gamma \Phi \Lambda'_x$.

Hence, the predicted covariance matrix of the observed variables, $\sum$, is given by

(7) $$\begin{bmatrix} \sum_{yy} & \sum_{yx} \\ \sum_{y}^{\prime x} & \sum_{xx} \end{bmatrix}$$

The above LISREL model can be estimated by full information maximum likelihood (FIML) by fitting Σ to the observed covariance matrix, S, of y and x (Joreskog and Sorbom 1985, 1986). The FIML method gives consistent and efficient estimates of the model's parameters B, Γ, Λ_y, Λ_x, Ψ,Φ, θ_ε, and θ_δ. Assumptions and hypothesized relations between variables can be specified as restrictions on the model's parameters.

The model used in this study is a special case of the above LISREL model. In particular, it was assumed that the explanatory variables are fixed. That is, x = ξ, and hence

$$\Lambda_x = I,\ \theta_\delta = O,\ E[xx'] = \Phi,$$

where I is an identity matrix of appropriate dimension.

Imposing the restrictions implied by the relationships between the indicators (y-variables) and the three constructs allows us to write Λ'_y in the following form:

(8) $$\Lambda_y' = \begin{bmatrix} \lambda_{11} & \lambda_{21} & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_{32} & \lambda_{42} & 0 & 0 \\ 0 & 0 & 0 & 0 & \lambda_{53} & \lambda_{63} \end{bmatrix}.$$

While B is assumed to have the form:

(9) $$B = \begin{bmatrix} 0 & 0 & 0 \\ B_{21} & 0 & 0 \\ B_{31} & B_{32} & 0 \end{bmatrix}.$$

Equation (1), which can now be rewritten as

(10) $\eta = B^{\eta} + \Gamma x + \zeta$,

is thus a recursive system of simultaneous equations. For model identification and to ease interpretation, the scales of the construct were fixed according to the restrictions: $\lambda_{11} = 1$, $\lambda_{32} = \lambda_{63} = -1$ while Ψ is assumed to be a diagonal matrix.[1] No restrictions were imposed on Γ and θ_ε.

[1] Given the numerical values assigned to the responses, perception increases, while law and payment supports decrease along the Likert scale. The restrictions $\lambda_{11}=1$, $\lambda_{32}=\lambda_{63}=-1$, therefore, were imposed to retrieve the definitions of the construct variables.

EMPIRICAL RESULTS

Full information maximum likelihood was used to estimate the free parameters of the model (Joreskog and Sorbom 1989).[2] Tables 4 - 5 present the parameter estimates and goodness-of-fit statistics for the model.

As shown inTable 4, the measurement structure fits well. All estimates of the construct loadings are statistically significant at the 1 percent level and the measurement R^2 is high, 0.907. Other goodness-of-fit statistics include the structural R^2 (0.548), the adjusted goodness-of-fit index (0.936), and root mean squared residual (0.020). Moreover, a simultaneous test of all the x-variables (see equation 10) in the full model (FM) against the null model (NM) was conducted. The NM restricts all coefficients on the x-variables equal to zero. The results show that these variables jointly have significant explanatory power as shown by a χ^2(NM-FM), with 69 degrees of freedom, of 460.03.

Table 5 shows the estimated coefficients of explanatory variables and their associated asymptotic t-statistics.[3] These coefficients represent the direct impact of the explanatory variables on the three constructs: perception of an erosion problem (perception), laws support, and payments support.[4] Due to the lack of a theoretical foundation, no *a priori* hypotheses were formulated about the direction of effects of the explanatory variables on perception (η_1).

Age, education, political affiliation, place of residence, and region were found to be statistically significant factors that influence the perception of erosion. Age had a negative effect on perception, while education's effect was positive. The awareness or perception increased with the level of education, as shown by the increasing coefficient on the education variables. Also, respondents who took a high school or technical college course in agriculture had a higher perception of the erosion problem than those who did not. Other studies have shown that younger and highly-educated respondents were more concerned about environmental problems than their counterparts (Hamilton 1985a,b). Democrats and Independents had higher perceptions relative to Republicans. Independents had the highest perception. All the residence variables except TOWN, had positive and statistically significant coefficients, concerning perceptions of an erosion problem (η_1). The result indicates that people living outside a farm or ranch had a higher perception than those living on a farm or ranch. Concerning region, residing in the South or West had about an equal impact on perception, but higher than the impact of the Midwest. Respondents from the Northeast exhibited the highest perception.

Table 4. Estimate of Construct Loading and Model Goodness-of-Fit Statistics

Parameter	Estimate	Asymptotic t
λ_{11}	1.000a	-
λ_{21}	0.834*	-13.009
λ_{32}	-1.000a	-
λ_{42}	-1.609*	-15.839
λ_{53}	-1.061	-22.165
λ_{63}	-1.000a	-

Number of observations = 2,851

Measurement R^2 = 0.907

Structural R^2 = 0.548

Goodness-of-fit index = 0.989

Adjustment goodness-of-fit index = 0.936

Root mean squared residual = 0.020

χ^2 for full model with 75 degrees of freedom = 468.64

χ^2 for null model with 156 degrees of freedom = 928.67[b]

[a]Construct loading is restricted for model identification (see footnote 1).
[b]The null model is obtained by restricting all elements in Γ equal to zero.
*Significant at the 1 percent level.

Table 5 also shows that age, employment status (RETIRED), race (BLACK), education, political affiliation (INDEP), and perception (η_1) were important factors that influence respondent's support of laws to encourage soil conservation. Significant factors that influence support for payments by the government included farm income, age, sex, agricultural education, political affiliation, place of residence (SMACITY and TOWN), region (SOUTH), perception (η_1), and support for laws (η_2). The co-

[2]Full information maximum likelihood estimation and inference assumes that the ys are independently and multivariate normally distributed given x. Univariate skewness and kurtosis within the range -1.0 to +1.0 (see Table 1) indicate that maximum likelihood results would be robust (Bentler and Chou; Muthen and Kaplan).

[3]The analysis was based than on the polychoric correlation matrix rather than the covariance matrix, $\sum$, (Babakus et al.). The coefficient estimates, therefore, are standardized and can be compared across variables (Saris and Stronkhorst).

[4]Because of the recursive nature of the model (see equation 10), the explanatory variables will have both direct and indirect effects on the dependent variables. The total effect is the sum of these two effects. Since $B_{12} = B_{13} = 0$ (see equation 9), the x-variables will have only direct effects on η_1.

Table 5. Coefficient Estimates of Explanatory Variables and Asymptotic t-Statistics[a]

	η_1[b]		η_2		η_3	
Variable	Coeff.	t	Coeff.	t	Coeff.	t
INC	-0.01676	-0.955	-0.00927	-0.535	-0.01458	-0.646
FMINC	0.01002	0.629	0.00139	0.088	0.05727**	2.799
AGE	-0.04627**	-2.242	0.05971**	2.825	-0.14677**	-4.086
UMEMPLOY	-0.00616	-0.403	0.01810	1.203	0.02822	1.367
RETIRED	-0.02086	-1.001	0.03618*	1.751	-0.03012	-1.001
FEMALE	-0.00386	-0.245	0.02060	1.330	0.03933*	1.836
BLACK	0.00993	0.632	-0.02983*	-1.917	0.02380	1.041
OTHER	-0.00557	-0.365	-0.00184	-0.123	0.01085	0.555
AGEDN	0.03414**	2.107	-0.01904	-1.162	0.04643**	2.030
HSGRAD	0.01179	0.510	-0.01552	-0.683	0.00363	0.120
SOMECOLL	0.10208**	4.182	-0.08087**	3.012	0.04529	0.945
COLLGRAD	0.15065**	6.077	-0.11783**	-3.904	0.06621	1.069
POSTGRAD	0.16195**	7.340	-0.12037**	-4.169	0.08986	1.451
DEMOCRAT	0.04692**	2.508	0.00863	0.452	0.09964**	4.088
INDEP	0.07824**	4.277	-0.04159**	-2.071	0.05726*	1.809
LARCITY	0.04905**	2.191	-0.02147	-0.947	-0.02153	-0.694
MEDCITY	0.06204**	2.648	-0.02604	-1.083	-0.04562	-1.355
SMCITY	0.04127*	1.857	-0.00912	-0.409	-0.04876*	-1.660
TOWN	0.01986	0.942	-0.00420	-0.202	-0.08544**	-3.129
COUNTRY	0.03797*	1.823	-0.02609	1.247	-0.02051	-0.699
SOUTH	0.03125*	1.677	-0.00854	-0.459	-0.04048*	-1.645
WEST	0.03264*	1.890	-0.02382	-1.371	-0.01425	-0.578
NEAST	0.05567**	3.237	-0.00593	-0.330	0.01898	0.811
η_1	–	–	0.92815**	7.140	-0.77583*	-1.917
η_2	–	–	–	–	1.41066**	4.419

[a]Single and double asterisks denote significance at the 10 percent and 5 percent levels, respectively.
[b]η_1, η_2, and η_3 denote "perception of an erosion problem," "laws support," and "payments support," respectively.

efficients on these variables, however, represent only the direct impact of the explanatory variables on η_2 and η_3.

To determine the total impact of the explanatory variables on laws support (η_2) and payments support (η_3), the indirect effects of these variables on η_2 and η_3 were calculated and added to the direct effects.[5] Table 6 presents those results. With few exceptions (income, black, other, high school graduates), all variables had a positive total effect on laws support (η_2). Support for laws increased as age, level of education, and level of urbanization increased. There was a stronger preference for laws support among unemployed and retired than among employed, student, and home-maker; and among females than males. Democrats and Independents showed a higher support for laws to encourage soil conservation than Republicans, while blacks and other races had less support for laws than whites. Respondents from the southern, western, and northeastern regions exhibited a higher support for laws than did those from the Midwest with such support reaching its maximum in the Northeast. Perception of soil erosion as a problem proved to be an important factor that positively influenced laws support.

The payments-support construct represents the preference of respondents for government support to farmers. It is possible that some respondents expected the financing of such a policy to be from taxes

[5] $\eta_2 = B_{21}\eta_1 + \Gamma_2 x$; $\eta_3 = B_{31}\eta_1 + B_{32}\eta_2 + \Gamma_3 x$; Γ_{2j} and Γ_{3j} are the direct impacts of the j^{th} variable on η_2 and η_3 respectively (Table 5), while $B_{21}(\partial\eta_1 / \partial x_j) = (B_{21}\Gamma_{1j})$ and $B_{31}\Gamma_{1j} + B_{32}(B_{21}\Gamma_{1j} + \Gamma_{2j})$ are the indirect impacts of the j^{th} variable on η_2 and η_3, respectively. The total impact is the sum of the direct and indirect impacts.

Table 6. Indirect and Total Effects of Explanatory Variables on the Constructs

Variable	Laws support η_2 Indirect effect	Laws support η_2 Total effect	Payment support η_3 Indirect effect	Payment support η_3 Total effect
INC	-0.01556	-0.02483	0.02202	-0.03660
FMINC	0.00930	0.01069	0.00730	0.06458
AGE	-0.04295	0.01676	0.05954	-0.08722
UMEMPLOY	-0.00571	0.01238	0.02224	0.05047
RETIRED	-0.01936	0.01682	0.03991	0.00979
FEMALE	-0.00358	0.01702	0.02700	0.06633
BLACK	0.00922	-0.02061	-0.03678	-0.01297
OTHER	-0.00517	-0.00701	-0.00557	0.00528
AGEDN	0.03168	0.01265	-0.00864	0.03779
HSGRAD	0.01094	-0.00457	-0.01560	-0.01197
SOMECOLL	0.09475	0.01388	-0.05962	-0.01433
COLLGRAD	0.13983	0.02200	-0.08584	-0.01963
POSTGRAD	0.15032	0.02994	-0.08341	0.00645
DEMOCRAT	0.04355	0.05217	0.03720	0.13684
INDEP	0.07262	0.03104	-0.01692	0.04034
LARCITY	0.04552	0.02405	-0.00413	-0.02565
MEDCITY	0.05758	0.03155	-0.00363	-0.04889
SMCITY	0.03830	0.02918	0.00915	-0.03962
TOWN	0.01844	0.01423	0.00467	-0.08077
COUNTRY	0.03524	0.00915	-0.01654	-0.03706
SOUTH	0.02900	0.02046	0.00462	-0.03587
WEST	0.03029	0.00647	-0.01619	-0.03044
NEAST	0.05167	0.04573	0.02133	0.04031
η_1	0.00000	0.92815	1.30930	0.53347
η_2	0.00000	0.00000	0.00000	1.41066

on income. In this context, there is considerable empirical evidence in the literature that individual policy preferences reflect self-interest (Deacon and Shapiro; Fisher; Hewitt). A pure self-interest model, therefore, implies a negative effect for income on payment support. The results show that income had both negative indirect and total effects on payment support. Support of payments also decreased as the level of education increased. Highly-educated respondents were likely to perceive government payment support to be financed by more taxes. The private benefit variable FMINC (indicating whether a respondent's family has farm income) had a positive total effect on payment support. The sign was expected because the variable (FMINC) identifies the potential beneficiaries of the policy. Although only two residence-variables (SMACITY and TOWN) were significant in explaining variations in payment support (η_3), all residence variables had negative total impacts on η_3. In light of the self-interest model, this result was expected because these dummy residence-variables contrast consumers and producers (farm residence is the excluded category) and hence have a private benefit interpretation. The preference for payment support was stronger for females than males and for Democrats and Independents than Republicans. The negative total impact of AGE on η_3 shows that older individuals were more likely to disapprove of policies that increase payments to farmers to practice soil conservation. While respondents from the South and West were less supportive of a government payment-support policy than those from the Midwest, respondents from the Northeast were more supportive of such a policy.

Although it had a positive total effect on payment support, perception of an erosion problem (η_1) had a negative direct effect on payment support. Only through laws support was the total effect of perception on payments support positive. This result indicates that although people might perceive erosion as a problem, they were not willing to support government's payments to farmers in the absence of laws enforcement. Moreover, the total effect of perception (η_1) on payments support was less than the total effect of η_1 on laws support. The result indicates that as people perceived soil erosion as more problematic, they had stronger preferences for laws than for government payments. Laws support (η_2) also had a positive total effect on payments support showing that a payment support policy cannot be a substitute for laws. Laws and payments supports were thus considered to be complementary rather than substitute policies.

CONCLUSIONS

In this study, data from a nationwide survey of people concerning their attitudes toward agriculture were used to estimate the structure of respondents' preferences for government soil erosion control programs. Because the response to a single question can be sensitive to the wording and position of a question in the questionnaire, responses to multiple statements were analyzed within the linear structural relationship (LISREL) framework. This approach helps control for the measurement error in responses and estimates the impact of socio-economic, demographic, and political variables hypothesized to influence citizen perceptions and preferences.

The results showed that age, education, political affiliation, place of residence, and region had significant impacts on citizen perception or awareness of an erosion problem. This perception increased with the level of education and decreased with age, implying the importance of educational programs in raising public awareness about environmental problems. Results showed that respondents from the South and West have higher perceptions of the problem of soil erosion than those from the Midwest, while perception was at its maximum for respondents from the Northeast.

The government policies considered in this study were laws and financial payments support to encourage soil conservation. Respondents acted in their self-interest in deciding their preferences for government payment-support policy in agriculture. These results hold even though soil erosion is a well recognized environmental problem. The results may also indicate that respondents felt that soil conservation is a farmer's responsibility.

The study also showed that the perception of an erosion problem was a significant factor that influenced preferences for government policies. As respondents became more aware of erosion, they exhibited more support for conservation policies. Respondents, however, tended to have more support for laws than for government payments to force farmers to adopt soil conservation practices. The support for payments was positively influenced by support for laws. This result indicates that respondents considered laws and government payments to be complementary rather than substitute policies.

An important policy issue arises from the results of this study concerning how agriculture deals with environmental issues. The respondents' preference for the use of laws over payments to force farmers to address erosion problems points to a possible shift in government policy. Historically, programs to change farmer behavior have relied on voluntary incentive programs. On the other hand, programs to address pollution in other industries have generally relied on command and control regulation. As the effect of agriculture on the environment becomes a topic of concern in the policy arena, farmers may be faced with command and control laws rather than incentive or payment programs. Although the nonpoint nature of much of agriculture's effect on the environment makes traditional environmental regulation difficult, the erosion example may foreshadow efforts by policy makers to enforce programs through laws rather than through compliance programs.

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