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SOCIOECONOMIC IMPACTS ON AGRICULTURAL LAND USE IN THE NORTHEAST

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Joad said, "You're bound to get idears if you go thinkin' about stuff."

John Steinbeck, *The Grapes of Wrath*

Past agricultural programs encouraged the withdrawal of cropland from agricultural production. With the removal of crop acreage restrictions and despite the favorable relationships of the 1972-1974 period, all of this land has not been immediately activated into crop production. Some programs encouraged shifts of cropland to pasture, timber production, or to soil improvement uses. Land converted to these alternatives is potentially available for crop production, but whether or at what rate it will be reemployed remains problematic.

These resources may not necessarily revert back to former uses for several reasons. Some of this land should not have been brought into crop production initially, while other tracts have been incorporated into livestock operations. Immature or profitable timber stands have been established on other lands. Small, fragmented tracts of potential cropland are difficult to crop with the larger machinery and equipment now being used. Patterns of land ownership and off-farm employment practices have also affected the way in which land is used. Land speculators and developers are usually not interested in the highest-value agricultural return from the land resource because of different ownership objectives. These forces affect the supply of land available to agriculture. Information is needed as to which of these factors are important and how changing economic, demographic, technological, and institutional conditions influence the employment of resources in agriculture.

The purpose of this paper is to explore several facets of agricultural land use change in the Northeast farm production region (Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, Pennsylvania, New Jersey, Delaware, Maryland). A composite index of land use change is developed which is in turn related to variables both exogeneous and endogeneous to agriculture. As our results will show, several popularly hypothesized relationships are surprisingly weak; most notable is the weak relation between density and agricultural land use change.

THE REGION AND COUNTY GROUPINGS

Land in agricultural uses in the Northeast has been steadily declining through recent times (See Table 1). Approximately 25 percent of this total land area is in farms with roughly 15 percent in cropland and 10 percent in harvested cropland. Comparing the two subregions (Mid Atlantic and New England) reveals a marked difference in agricultural land use change over time. While harvested cropland acreage for the Mid Atlantic subregion has been on the increase, its New England counterpart has been steadily decreasing. Additionally, the proportion of total land currently in agricultural land use categories is substantially higher in the Mid Atlantic subregion.

Initial analyses indicated that further delineation would be useful for the purposes of this paper. Counties were grouped according to the predominate type of agricultural enterprises and two such groups (Dairy and Crop) were chosen for additional analysis. Dairy counties (n = 43) have dairy sales which comprise at least 70 percent of total agricultural sales while the Crop counties (n = 44) have crop sales which comprise at least 50 percent of the total. These definitions were chosen arbitrarily so that the number of counties was approximately equal for both groups, given the constraint of predominate agricultural enterprise. The groups are mutually exclusive. Further, for a county to be considered for inclusion in our analysis, at least 5 percent of the total land area had to be in farms (1974). This criterion excluded 28 "timber" and "urban" counties (Figure 1).

Summary statistics for socioeconomic and land-use characteristics for the five "populations" are presented in Table 2 and some interesting variations are evident. Additionally, these summary statistics lend credence to our delineations. The actual counties contained in the Dairy and Crop groups are shown in Figure 1.

THE MODEL

Previous research has identified socioeconomic, policy and agricultural economic factors which have significant impact on land use patterns (Dill and Otte, Otte, Raup, Zeimetz). However, unlike most traditional research, a mathematical tool which allows increased data control is used in the regression estimates. Through a factor analysis of six land use measures, a parsimonious, composite index was created (Baldwin, Frisbie and Posten, Rummel, Sullivan). This index in turn serves as the dependent variable in a multiple regression model designed to estimate structural relationships between agricultural land use changes and socioeconomic (both on and off farm) characteristics.

Agricultural Land Use Change Index

A review of past research reveals that several readily available measures of land use exist. Primarily attention has focused on (1) acreages in various uses, (2) proportions of land in various uses, and (3) percent change, over time, of land in designated uses. By choosing a single indicator from this list, a substantial loss of information and accuracy normally occurs in that "the two or three indicators that are thrown out are likely to have some validity and their addition may produce a more correct

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TABLE 1.
Land Use in the Northeast Farm Production Region and Subregions

Region	Land Use	% Change 49-74	% Change 64-74	% Change 69-74	Acreage 1974	% of All Land
NORTHEAST REGION	Land In Farms	−45.4	−25.0	−7.7	26,891,159	24.4
	Total Cropland	−34.5	−12.5	−5.6	16,063,398	14.6
	Harvested Cropland	−30.4	−13.2	5.1	11,775,617	10.7
MID ATLANTIC SUBREGION	Land In Farms	−40.1	−21.8	−6.7	21,988,534	31.3
	Total Cropland	−31.3	−10.8	−5.2	13,957,294	19.9
	Harvested Cropland	−26.8	−11.4	6.2	10,342,112	14.7
NEW ENGLAND SUBREGION	Land In Farms	−60.9	−36.6	−12.3	4,902,625	12.2
	Total Cropland	−50.0	−22.1	−8.2	2,106,104	5.2
	Harvested Cropland	−48.9	−24.1	−1.7	1,433,505	3.6

representation of the construct'' (Sullivan). One alternative would be to perform identical analyses with each single indicator of land use. The problem with the latter approach lies with the interpretation of the numerous results.

In this paper, we offer yet another alternative which does not compromise the integrity of analysis for interpretive ease. Multiple indicators of both proportion and percentage change in land use patterns are utilized to account for both the cross-sectional and temporal aspects of the problem. The land use patterns chosen for inclusion in this paper are: (1) land in farms; (2) total cropland; and (3) harvested cropland. We omitted acreages from our indicators of land use because of the inherent bias associated with varying county sizes in the Northeast (16,000 to 4,365,440 acres).

Through its data reduction capabilities, factor analysis enables us to discern whether or not an underlying pattern of relationships exist among an identified set of variables. The original variables are recombined on the basis of their linear dependence on each other. Through this technique, an objective procedure for the development of our prime concept — land use change — is derived.

The empirical examination of intercorrelations among a battery of items provides a means by which their commonalities can be expressed. Through a reduction of inter-item correlations, underlying themes or dimensions are enumerated. The six variables used in the creation of this index were: (1) proportion of land in farms (portfarm); (2) proportion of land that is cropland (portcrop); (3) proportion of land that is harvested

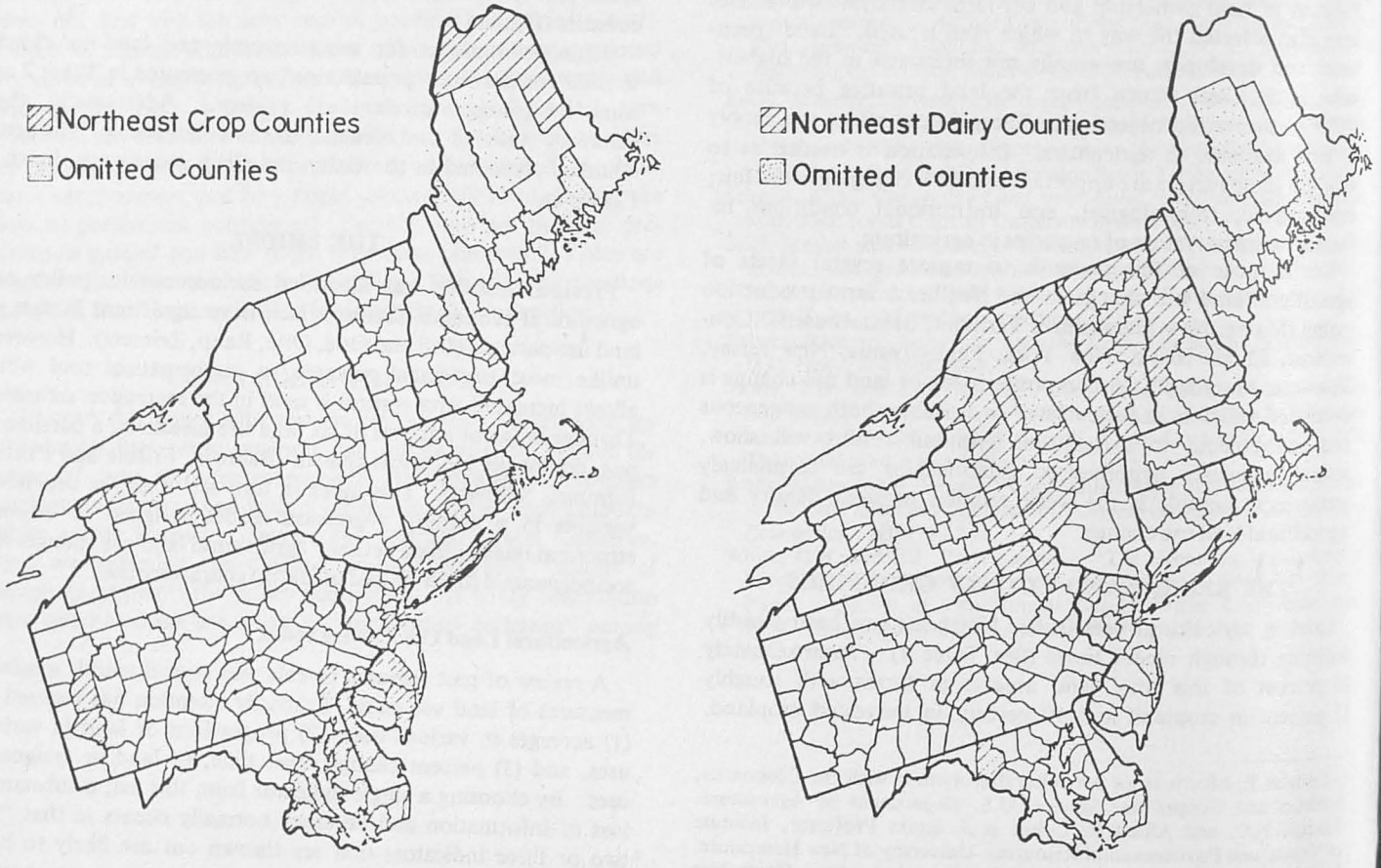

FIGURE 1 — Crop and Dairy County Groupings

TABLE 2.

Summary Statistics for Selected Socioeconomic Characteristics.

Number of Counties	Northeast 215		Middle Atlantic 156		New England 59		Dairy 43		Crop 44	
	Arithmetic Means (Standard Deviations)									
Population (1970)										
Total (000's)	169	(238)	163	(226)	185	(270)	58	(52)	330	(379)
Per square mile	316	(473)	306	(470)	341	(483)	72	(63)	681	(745)
Percent urban	46	(27)	45	(26)	50	(28)	31	(21)	61	(28)
Percent rural nonfarm	49	(24)	50	(23)	46	(25)	61	(18)	36	(25)
Percentage change 1960-1970	12	(16)	12	(17)	13	(13)	8	(11)	21	(19)
Worked Outside of County (1970)										
Percent	22	(13)	23	(13)	19	(13)	19	(12)	24	(15)
Property Taxes (1967)										
Dollars per capita	118	(47)	108	(49)	145	(31)	123	(29)	137	(48)
Average Farm Size										
Acres	172	(60)	167	(51)	186	(77)	240	(40)	141	(60)
Value of Land and Buildings										
Dollars per acre	496	(480)	506	(502)	470	(419)	221	(131)	911	(667)
Class 1-5 Farms										
Percent of all farms	63	(11)	63	(11)	63	(11)	70	(9)	65	(11)
Part-time Farms										
Percent of all farms	23	(7)	23	(8)	22	(7)	19	(7)	21	(8)
Farm Operators										
Percent residing on farm	82	(6)	82	(5)	82	(7)	86	(3)	77	(6)
Percent working 100 days or more off farm	41	(8)	41	(8)	40	(8)	33	(7)	41	(8)
Farm Product Sales										
Average per acre	128	(101)	118	(96)	155	(108)	76	(19)	158	(119)
Dairy Sales										
Percent of total farm product sales	43	(25)	43	(24)	43	(26)	78	(5)	15	(11)
Average per farm	11,316	(6,407)	10,559	(6,186)	13,317	(6,602)	19,617	(3,440)	5,447	(4,167)
Crop Sales										
Percent of total farm product sales	28	(23)	29	(22)	24	(23)	6	(4)	65	(12)
Average per farm	8,724	(9,905)	8,415	(9,099)	9,542	(11,823)	1,630	(1,042)	23,657	(12,211)
Land in Farms										
Percent of county area	32	(18)	36	(17)	19	(13)	37	(16)	29	(20)
Percentage change 1964-1969	−20	(11)	−16	(8)	−29	(11)	−22	(8)	−16	(11)
Percentage change 1964-1974	−27	(13)	−23	(12)	−38	(11)	−29	(11)	−24	(12)
Percentage change 1969-1974	−9	(12)	−8	(11)	−12	(15)	−10	(9)	−9	(8)
Total Cropland										
Percent of county area	18	(13)	22	(13)	8	(7)	19	(11)	18	(15)
Percentage change 1964-1969	−11	(13)	−7	(11)	−20	(14)	−6	(10)	−12	(12)
Percentage change 1964-1974	−17	(15)	−14	(13)	−27	(14)	−11	(11)	−20	(13)
Percentage change 1969-1974	−7	(11)	−7	(10)	−9	(12)	−6	(8)	−8	(10)
Harvested Cropland										
Percent of county area	14	(11)	17	(12)	5	(5)	13	(8)	14	(13)
Percentage change 1964-1969	−20	(11)	−18	(10)	−26	(12)	−23	(8)	−14	(13)
Percentage change 1964-1974	−17	(15)	−14	(15)	−27	(13)	−21	(10)	−12	(16)
Percentage change 1969-1974	3	(13)	4	(13)	0	(12)	3	(9)	3	(11)

Note: Unless otherwise noted, all data refer to 1969.

Source: **County and City Data Book, 1972** and **Census of Agriculture, 1969 and 1974**, U.S. Bureau of the Census, Washington, D.C.

cropland (portharv); (4) percentage change in land in farms, 1964-1974 (△LIF); (5) percentage change in total cropland, 1964-1974 (△TC); and (6) percentage change in harvested cropland, 1964-1974 (△HC).

The factor score coefficient matrix is defined as follows:

(1) $F = (A^TA)^{-1}A^T$ where A is the rotated factor pattern matrix; A^T is the transpose of A; and F is the factor score coefficient matrix.

For each county observation, a composite score (LU) is calculated by multiplying F times a vector of standardized values (Z) of the six variables included in the factor analysis:

(2) $LU = FZ$

In this paper, LU is the agricultural land use change index. Its interpretation follows that which is normally ascribed to other standardized indices. For example, counties exhibiting a high positive LU score are those counties experiencing a relatively high agricultural land.

The Hypothesized Regression Model

The agricultural land use change index (LU) is hypothesized to be a function of an "endogeneous to agriculture" variable subset (A_j) and an "exogeneous to agriculture" variable subset (NA_k) in the following model:

(3) $LU = f(A_j, NA_k)$

This model facilitates structural analysis of factors affecting changes in agricultural land use in the Northeast. The inclusion of both A_j and NA_k in the model allows the relative importance of both groups of variables to be assessed. It is expected **a priori** that the variable subset A_j should prove to be the more important of the two, contrary to popular current dialogue.

To be sure, at the urban fringe, variables included in the NA_k subset may very well be the most important. However, for the Northeast as a whole, the general agricultural economic conditions would appear to play the more dominant role. To aid this comparison, equation (3) will be estimated using only one variable subset at a time in addition to the total variable set.

THE RESULTS

Composite scores were calculated for the 215 counties included in the study. The range of zero order correlations among the six land use variables was .50 (△HC • portfarm) to .98 (portcrop • portharv). The mean inter-item correlation was .72. Principal factor analysis substantiated the assumption of a common underlying relation among these six land use change indicators. Roughly 80 percent of the total variance associated with the land use variables is accounted for by the derived factor. Those counties whose land use index score (LU) was positive are shown in Figure 2. The 101 Mid Atlantic and 5 New England counties comprising this set can be identified as counties which have exhibited a relative propensity for "overall" positive changes in agricultural land use patterns. The heavy concentration of the counties in the Mid Atlantic subregion would be expected given the information from Table 1. A further subdivision, also shown in Figure 2, reveals those counties with a composite index greater than 1.0. These 35 counties, approximately 15% of the total, represent those experiencing the most positive agricultural land use change patterns. Thus, factor analysis has allowed the incorporation of six different, but related, measures of land use into one composite meausre.

The second phase of our analysis entails estimating a structural relationship between the agricultural land use index and socioeconomic characteristics. The analysis is admittedly crude

TABLE 3.

Regression Estimates for Equation 3; Land Use Change Index, the Dependent Variable, a Function of the Indicated Independent Variables by Region and Subregion.

NORTHEAST			MIDDLE ATLANTIC			NEW ENGLAND		
Independent Variable	Regression Coefficient	Beta	Independent Variable	Regression Coefficient	Beta	Independent Variable	Regression Coefficient	Beta
TAXES	−0.02002**	−0.29329	CLASS15	0.02604**	0.31553	CLASS15	0.03690**	0.60904
FPOPCHG	0.00644	0.07878	LANDAREA	−0.00224**	−0.55767	URBAN4	−0.01975**	−0.41720
CLASS15	0.02355**	0.25986	FARMSZ10	−0.05566**	−0.33674	NETMIGRN	0.01942**	0.33186
LANDAREA	−0.00063**	−0.25684	FARMPOP	0.00010**	0.29850	DAIRY1	0.00002*	0.23658
FARMSZ10	−0.06502**	−0.38369	FMSZ1000	0.30451**	0.30033	UNEMPLOY	0.07688	0.11999
OPFARRES	−0.04323*	−0.24113	NETMIGRN	−0.01867**	−0.27941	URBAN5	−0.01895	−0.12035
FARMPOP	0.00007**	0.19563	MEDFARMY	0.00010**	0.21320	TAXES	−0.00968	−0.10339
HOUSE6	−0.04431*	−0.10886	MEDAGE	−0.04852*	−0.16353	BIGFM2	−0.00753	−0.10074
URBAN5	−0.03606*	−0.09937	POULTI	0.00002*	0.13816	CROP1	0.00001	0.09069
MEDFARMY	0.00006**	0.12875	HOUSE5	−0.16163	−0.10152	(CONSTANT)	−2.92796	
FMSZ1000	0.12723*	0.12664	HEALTH	−0.02747	−0.08470			
WORKOUT	0.00429	0.05657	HIGHWAYS	0.01599	0.07004			
(CONSTANT)	3.48269		FARMPOOR	0.01182	0.06189			
			(CONSTANT)	−0.05980				
	$R^2 = .54$			$R^2 = .55$			$R^2 = .68$	

Note: Variable definitions see Appendix 1
**Significant at = .01 level
*Significant at = .05 level

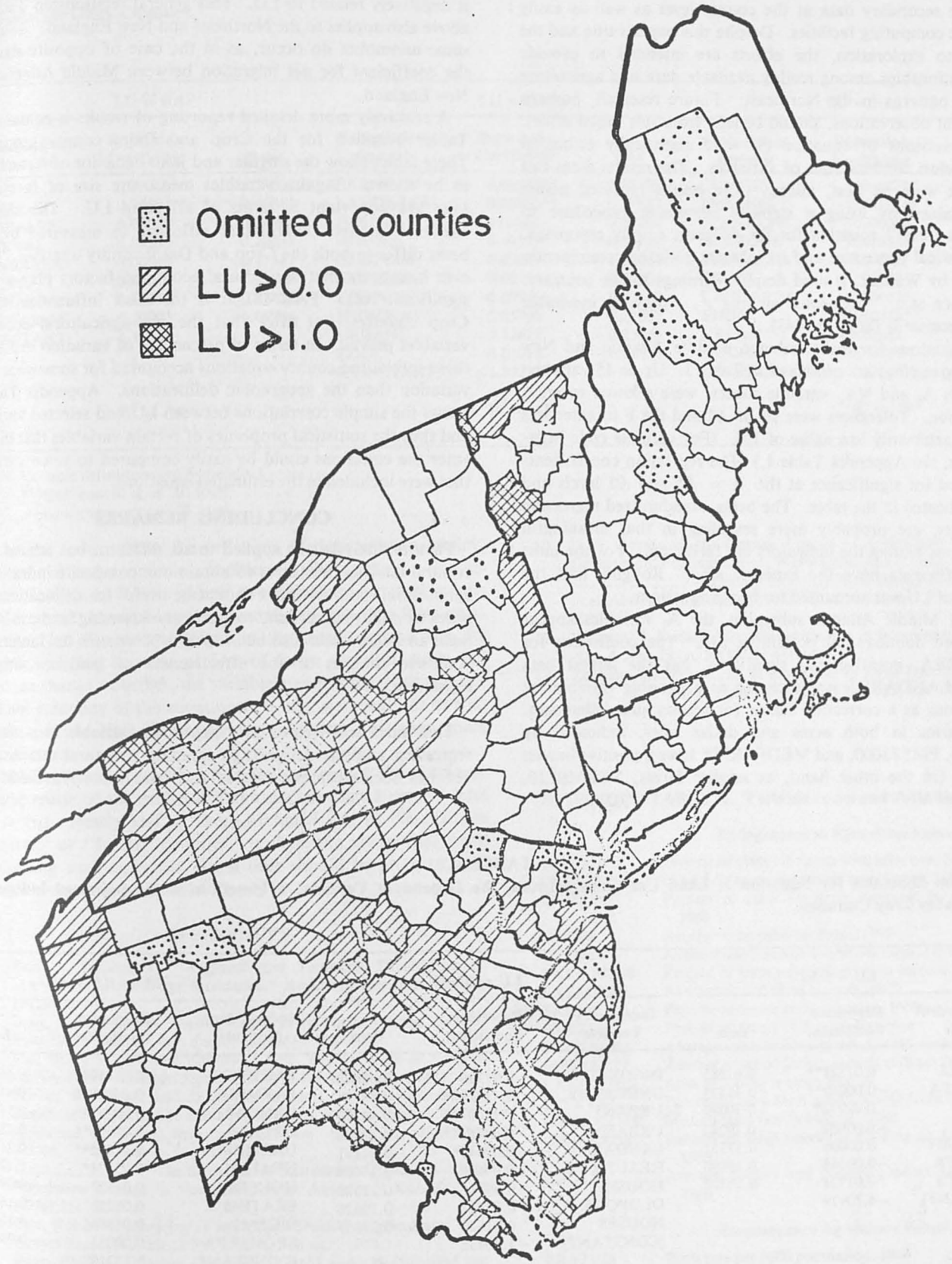

FIGURE 2.
Positive Agricultural Land Use change Index Counties

and should be judged exploratory in nature. The crudeness is attributable to both our predilection for the use of easily accessible secondary data at the county level as well as easily accessible computing facilities. Despite this paper's title and the allusion to exploration, the efforts are intended to provide inital relationships among readily available data and agriculture land use patterns in the Northeast. Future research, perhaps using point observations, should benefit from this initial effort.

Many versions of equation (3) were statistically estimated using **a priori** combinations of variables. The results from this procedure were, at best, mixed. The results reported herein were obtained by using a stepwise regression procedure to estimate a "best" equation for the different county groupings. This statistical procedure and its inherent pitfalls, preeminently discussed by Wallace, is used despite warnings to the contrary. As Wallace said, "occasional sinning . . . may be inevitable but not necessarily fatal" (p. 443).

The equations for the Northeast, Middle Atlantic and New England groupings are presented in Table 3. Up to 15 variables from both A_j and NA_k variable subsets were allowed to enter the equation. Tolerances were set at .65 and the F to enter was set at an arbitrarily low value of 1.0. (For variable code interpretations, see Appendix Table 1.) The regression coeefficients were tested for significance at the $\alpha = .05$ and .01 levels and are so indicated in the table. The betas, standardized regression coefficients, are probably more revealing in that meaningful comparisons among the indicators are facilitated. For the most part, coefficients have the expected sign. Roughly half the variation of LU was accounted for by the equations.

For the Middle Atlantic subregion, the A_j variables appear to be more dominant in explaining LU. The coefficient for LANDAREA, negative and significant, has the largest beta (−.56). LANDAREA was included as a possible variable for all equations as a correction factor for county size differences. Larger farms in both acres and dollar sales, indicated by CLASS15, FMSZ1000, and MEDFARMY have a positive impact on LU. On the other hand, as smaller farms, FARMSZ10, increase by 1 standard deviation LU decreases by .34 standard deviations. In terms of non-agricultural influence, net migration is negatively related to LU. This general relationship discussed above also applies to the Northeast and New England. However, some anomolies do occur, as in the case of opposite signs on the coefficient for net migration between Middle Atlantic and New England.

A relatively more detailed reporting of results is contained in Tables 4 and 5 for the Crop and Dairy county groupings. These tables allow the singular and joint behavior of A_j and NA_k to be shown. Again, variables measuring size of farms and sales are important in terms of affecting LU. The included variables in their concomitant influence as measured by their betas differ in both the Crop and Dairy county analyses. However it appears that agricultural economic factors play a more significant role. FARMSIZE is the most influential for the Crop counties, but after that the non-agricultural economic variables prevail. In terms of percentage of variation explained, these specialized county equations accounted for somewhat more variation than the geographic delineations. Appendix Table 2 shows the simple correlations between LU and selected variables and thus the statistical properties of certain variables that did not enter the equations could be easily compared to some variables that were included in the estimated equations.

CONCLUDING REMARKS

Factors analysis was applied to six different but related agricultural land use measures to obtain one composite index. This agricultural land use index should be useful for delineation purposes by policy makers and researchers addressing land use issues. Such an index could also be used as a barometer for monitoring land use changes or the effectiveness of land use oriented legislation.

This index was treated as a dependent variable in a multiple regression analysis designed to estimate structural relationships between socioeconomic factors and land use. This additional

TABLE 4.

Regression Estimates for Equation 3; Land Use Change Index, the Dependent Variable, a Function of the Indicated Independent Variables for Crop Counties.

LU = f(A)			LU = f(NA)			LU = f(A, NA)		
Independent Variable	Regression Coefficient	Beta	Independent Variable	Regression Coefficient	Beta	Independent Variable	Regression Coefficient	Beta
FARMSIZE	0.01121**	0.61385	INGOVREN	0.01736	0.22648	FARMSIZE	0.01210**	0.66281
LANDAREA	−0.00062**	−0.35473	UNEMPLOY	0.44229**	0.44434	FARMPOP	0.00028**	0.44929
CLASS15	0.02972*	0.30386	URBAN5	−0.11367**	−0.41200	LANDAREA	−0.00091**	−0.51873
CORPF	−0.07054	−0.19262	URBAN3	−0.04461**	−0.38208	URBAN5	−0.07756**	−0.28113
MEDFARMY	0.00006	0.17351	LANDAREA	−0.00043*	−0.24181	UNEMPLOY	0.21422**	0.21522
FPDVALPA	−0.00148	−0.15980	HEALTH	−0.04652	−0.14665	HEALTH	−0.05474*	−0.17257
OPFARRES	0.01924	0.10452	HOUSE5	−0.39816	−0.21389	HOUSE8	0.01527	0.09917
(CONSTANT)	−4.70979		OLDPOOR	−0.03427	−0.19626	BRATE68	0.08258*	0.16912
			HOUSE8	0.01522	0.09885	BIGFM2	0.01685*	0.13652
			(CONSTANT)	−1.30436		FPDVALPA	−0.00053	−0.05762
						(CONSTANT)	−5.17210	
	$R^2 = .57$			$R^2 = .64$			$R^2 = .89$	

Note: Variable definitions see Appendix 1
**Significant at = .01 level
*Significant at = .05 level

TABLE 5.

Regression Estimates for Equation 3; Land Use Change Index, the Dependent Variable, a Function of the Indicated Independent Variables for Dairy Counties.

LU = f(A)			LU = f(NA)			LU = f(A, NA)		
Independent Variable	Regression Coefficient	Beta	Independent Variable	Regression Coefficient	Beta	Independent Variable	Regression Coefficient	Beta
CLASS15	0.05369**	0.58608	FARMPOP	0.00037**	0.93489	CLASS15	0.04082**	0.44557
FMSZ1000	−0.30881**	−0.40363	LANDAREA	−0.00202**	−0.77847	FMSZ1000	−0.34161**	−0.44651
FPDVALPF	0.00002	0.08308	HOUSE4	0.01061	0.09994	FPDVALPF	0.00004	0.18632
LSTKVAL	0.07593	0.20273	HOUSE5	0.40337*	0.38498	OLDPOOR	0.02855	0.17046
LANDAREA	−0.00045	−0.17387	OLDPOOR	0.03021	0.18039	FPDVALPA	0.00295*	0.23321
CROP1	0.00017	0.21549	EXPERCAP	0.00196	0.20904	CROP1	0.00011	0.14214
FPDVALPA	0.00155	0.12283	EPOPCHG	−0.00948	−0.15430	LANDAREA	−0.00057*	−0.21922
MEDFARMY	−0.00007	−0.09735	HIGHWAYS	−0.03790	−0.21987	EDUC	−0.02215*	−0.20776
(CONSTANT)	−4.15452		URBAN3	−0.12627	−0.15665	URBAN	−0.00685	−0.17778
			EDUC	−0.01019	−0.09555	HOUSE2	−0.00837	−0.13155
			(CONSTANT)	−1.89259		(CONSTANT)	−2.55646	
	R^2 = .74			R^2 = .68			R^2 = .79	

Note: Variable definitions see Appendix 1
**Significant at α = .01 level
*Significant at α = .05 level

use of the index allows the influence of demographic, policy, institutional and economic conditions to be assessed. For instance, insights have been gained into some land use implications of the current thrust of interest in small and part-time farm operations. Not discussed at length in the results section was the negative relation between percent of farms under 10 acres and land use change. Further, the variable measuring part-time farms did not enter any of the equations. It may well prove to be that small and part-time farms are not panaceas for open space enhancement.

Another observation from our analysis entails the dominant characteristic of the excluded counties (less than 5 percent land in farms). Nearly half of those excluded can be classified as "timber" or "forest" counties. It therefore seems that when addressing land use issues, equal time should be given to both people and trees or at least the "bush."

REFERENCES

1. Baldwin, Stephen E. "Regional and Temporal Dimensions of Metropolitan Area Wage Structures." *Annals of Regional Science,* 12 (1978): 1-13.
2. Beale, Calvin L. "A Further Look at Nonmetropolitan Growth Since 1970." *Am. J. Agr. Econ.,* 58 (1976): 954-958.
3. Dill, Henry W., Jr. and Robert C. Otte. *Urbanization of Land in the Northeastern United States.* USDA, ERS-485, August 1971.
4. Frisbie, W. Parker and Dudley L. Posten, Jr. "Components of Sustenance Organization and Nonmetropolitan Population Change: A Human Ecological Investigation." *Am. Soc. Rev.,* 40 (1975): 773-84.
5. _____ ."The Structure of Sustenance Organization and Population Change in Nonmetropolitan America." *Rur. Soc.* 41 (1976):354-70.
6. Otte, Robert C. *Farming in the City's Shadow.* Agricultural Economics Report No. 250, ERS, USDA, February 1974.
7. Raup, Philip M. "Urban Threats to Rural Lands: Background and Beginnings." *AIP Journal.* pp. 371-378, November 1975.
8. Rummel, R. J. "Understanding Factor Analysis." *J. Conflict Resolution,* 11(1967):444-79.
9. Sullivan, John L. "Multiple Indicators: Some Criteria of Selection." pp. 243-249 in Blalock (ed.), *Measurement in the Social Sciences: Theories and Strategies.* Chicago: Aldine Press, 1974.
10. U. S. Bureau of the Census. *Census of Agriculture: 1974.* U. S. Government Printing Office, Washington, D.C., 1972.
11. _____ . *County and City Data Book, 1972.* (A Statistical Abstract Supplement). U. S. Government Printing Office, 1973.
12. Wallace, T. Dudley. "Pretest Estimation in Regression: A Survey." *Am. J. Agr. Econ.* 59(1977): 431-443.
13. Zeimetz, Kathryn A., *et. al. Dynamics of Land Use in Fast Growth Areas.* Agricultural Economics Report No. 325, ERS, USDA, April 1976.

APPENDIX TABLE 1. Variable codes and definitions

Endogeneous to Agriculture Subset (A_j)

BIGFM2	Percent of class 1-5 farms with sales over $40,000, 1969
CLASS15	Class 1-5 farms, percent of total farms, 1969
CORPF	Percent of class 1-5 farms operated by corporations, 1969
CROP1	Average crop sales per farm, 1969
DAIRY1	Average dairy product sales per farm, 1969
FARMPOOR	Percent of farm population below income level, 1969
FARMSIZE	Average size of farm in acres, 1969
FARMSZ10	Percent of farms under 10 acres, 1969
FMSZ1000	Percent of farms 1000 acres and over
FPDVALPA	Average value of farm products sold per acre, 1969
FPDVALPF	Average value of farm products sold per farm, 1969
LANDAREA	Area of county in acres (000's)
LSTKVAL	Percent of total farm products sold from livestock, 1969
MEDFARMY	Median farm family income, 1969
OPFARRES	Percent of farm operators residing on farm operated, 1969
POULT1	Average poultry and poultry product sales per farm, 1969

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BRATE68	Birth rate per 1000 population, 1968
EDUC	Local government direct expenditures for education, percent of 1967 total
EXPERCAP	Local government direct general expenditures per capita, 1967
FARMPOP	Farm population, 1969
FROPCHG	Percentage change in farm population, 1960-1970

HEALTH	Local government direct expenditures for health and hospital services, percent of 1967 total
HIGHWAYS	Local government direct expenditures for highways, percent of 1967
HOUSE2	Percent change in year-round units, 1960-1970
HOUSE4	Percent in structures built prior to 1950, 1970
HOUSE5	Home owner vacancy rate, 1970
HOUSE6	Rental vacancy rate, 1970
HOUSE8	Percent of units, owner occupied, 1970
INGOVREN	Percent of local revenue from intergovernmental sources, 1967
LANDAREA	Area of county in acres (000's)
MEDAGE	Median age in years, 1970
NETMIGRN	Percent change in netmigration, 1960-1970
OLDPOOR	Percent of person 65 years and over below low income level, 1969
TAXES	Percent of general revenue raised by taxes, 1967
UNEMPLOY	Unemployment rate, 1970
URBAN	Urban population, percent of 1970 total
URBAN3	Urban land in communities inside of urbanized areas, percent of total land, 1970
URBAN4	Other urban land in urbanized areas, percent of total land, 1970
URBAN5	Urban land outside of urbanized areas, percent of total land, 1970
WORKOUT	Percent of workers who worked outside county of residence, 1970

APPENDIX TABLE 2.

Zero order correlation coefficients for selected variables with agricultural land use index (LU) region and county groupings.

	NE	MA	New Eng.	Dairy	Crop
Variable	**— Correlation Coefficients —**				
Density (1970)	−.21	−.23	−.23	−.15	−.43
Density change (1960-70)	−.04	−.06	.17	.10	−.17
Netmigration (1960-70)	−.06	−.09	.13	.11	−.17
Urban population (1970)	−.27	−.25	−.32	−.03	−.53
Taxes (% of 1967 general revenue)	−.50	−.24	−.24	−.47	−.48
Property taxes (per capita, 1967)	−.34	−.20	−.17	−.32	−.41
Farmland value (per acre, 1969)	−.09	−.11	−.18	.08	−.32
Value of farm production (per acre, 1969)	−.07	.06	−.14	.35	−.09
Median farm income (1967)	.11	.15	.12	.23	.01