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CROP YIELDS AND NET INCOME ON PRIME FARMLAND IN NEW YORK

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ABSTRACT

USDA-defined prime farmland is a highly visible component of Federal policy for rural land. The definition is based on the physical and chemical properties of soil. This study estimates crop yield and net income for prime New York farmland. The USDA prime designation detracts from economic distinctions to be drawn among soils in the New York case. Prime criteria are restrictive and exclude nearly 30 percent of the State's productive cropland. Although yields are correlated with net income, it is also shown that a substantial amount of prime farmland generates low income at current costs and prices.

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A basic premise of U.S. land policy is that the Nation must have sufficient land to meet its future food and fiber requirements. After several decades of plentiful commodity supplies, the question of agricultural land sufficiency again came under close scrutiny during the 1970s when unanticipated shortfalls in production for domestic and export markets were encountered for some farm commodities. The re-emergence of concerns about U.S. production capacity puts a premium on up-to-date information which policymakers can use to assess the qualitative features of the Nation's land resources and patterns of rural land use.

To improve the information base and to help guide the formation of policy at the Federal level, the USDA's Soil Conservation Service (SCS) accelerated its programs to define and inventory "prime" farmland. Information on SCS-defined prime farmland first became available when SCS completed the 1977 Natural Resource Inventory (NRI).

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The prime farmland definition is now well embedded in Federal land use policy. However, the definition of prime land is a derivative of land classification systems used by SCS since the 1930s and traces to interpretations of the physical and chemical properties of soil. The correspondence of these physical and morphological features to the numerous economic factors that influence the decisions farmers make on the use of their land has not been investigated. This correspondence, or lack of it, will take on increasing importance as public policies for land use at all levels of government are expanded and refined.

This report deals with the economic features of land defined as prime farmland by the USDA for New York State. The specific objective is to estimate land productivity and net income for cropland designated as prime. The estimates allow a comparison of crop yields and budgeted annual returns to land which falls within and outside the USDA prime farmland definition. A discussion of procedures used and the study results is prefaced by a section which provides some background on the current Federal effort to classify farmland according to its superiority for an agricultural use.

USDA-Defined Prime Farmland

In 1975, the SCS announced a plan to improve the data base on land quality with an inventory of the Nation's "prime" farmland. The definition selected was based on nine physical and morphological characteristics of an individual soil unit; included are moisture supply, soil temperature, soil acidity, water table in relation to root zone, soil conductivity, frequency of flonding, soil erodibility, soil permeability and size of rock fragments in the soil (USDA, 1975b).

For purposes of interpretation, SCS advises that:

> Prime farmland is land best suited for producing food, feed, forage, fiber, and oilseed crops, and is also available for those uses (the land could be cropland, pastureland, rangeland, forestland, or other land but not built-up land or water). It has the soil quality, growing season and moisture supply needed to produce sustained high yields of crops economically when treated and managed, including water management, according to modern farming methods.

To take into consideration the fact that some lands falling outside the parameters established for prime are at least "good" for farming purposes, SCS gave state and local officials the opportunity to augment the comprehensive and nationally consistent inventory planned for prime farmland with inventories of land they might choose to define as being of "statewide importance" or of "local importance." Finally, opportunities for locating "unique" farmland were acknowledged by SCS. By SCS definition (USDA, 1975b):

> Unique farmland is land other than prime farmland that is used for the production of specific high-value food and fiber crops. It has the special combination of soil quality, location, growing season and moisture supply needed to produce sustained high quality and/or high yields of a specific crop when treated and managed according to modern farming methods.

Taken together, these four categories -- prime, unique, lands of statewide importance, and lands of local importance -- were defined by SCS as the Nation's "important farmlands". Full implementation of inventories encompassing all categories of important farmland has not yet been accomplished. As of January 1983, maps of important farmland were available for 830 of 3,111 counties in the U.S. (USDA, 1983).

However, data on prime farmland became available with the completion of the 1977 Natural Resource Inventory. This was feasible because the physical and morphological criteria defining prime farmland could be applied to existing soil survey data (USDA, 1975a).

The USDA inventories of prime farmland -- and the definitions embedded in them -- have quickly become an integral part of Federal land use policies and programs. A recently completed National Agricultural Lands Study, cosponsored by the USDA and the President's Council on Environmental Quality, incorporated USDA-defined prime farmland into an assessment of U.S. production capacity, trends in land use and policy measures designed to intervene in private decisions to convert farmland to irreversible uses. Prime farmland inventories were incorporated into an appraisal of land and water resources made by the USDA under the 1977 Soil and Water Resources Conservation Act (USDA, 1981). Similarly, the USDA definition of prime farmland is included in the Secretary of Agriculture's Statement on Land Use Policy.

Most importantly, the definition is an integral part of new legislation designed to minimize Federal activities that contribute to farmland conversions and to facilitate compliance with State and local policies for preserving farmland. These objectives are spelled out in the Farmland Protection Policy Act (Subtitle I of Title XV, P.L. 97-98, the Agriculture and Food Act of 1981). This Act, and newly promulgated rules for its implementation (Federal Register), defines farmland in accordance with the USDA definition.

Despite its visibility in current deliberations over land policy at the Federal level, the correspondence of prime farmland to conventional measures of land productivity, and the economic relationships associated with the use of land for crop production is not entirely clear. A literal reading of the prime definition allows one to infer that prime farmland quite simply is the best land for farming. In sharp contrast, some observers have noted that the USDA prime farmland criteria -- based solely on physical and morphological properties of an individual soil mapping unit -- do not provide for recognition of productivity differences among soils and among producing regions. Measures of soil productivity, along with consideration of cost/return relationships in crop production, are also required for precision in deliberations over public policies for agricultural land (Fenton; Reganold and Singer; Skold; Wood; Wood, 1976).

The available literature, then, suggests that the relationship between prime farmland, land productivity and the economic returns from crop production is an open empirical question. The apparent confusion over these relationships may trace to the definitional ties between prime farmland and a previously devised classification of "land capability". The latter refers to a generalized soil survey interpretation developed nearly 50 years ago so that SCS could carry out a mandate to promote land conservation measures (Salter). To this end, a land classification system was developed to categorize soils according to various management hazards. Initially, the focus was on susceptibility to erosion, but the system has been refined and expanded over time to encompass a variety of hazards including erosivity, wetness, stoniness, and shallowness. This interpretation provides for grouping soils into eight capability classes arranged according to those properties that determine the ability of land to stay in production permanently (Hochensmith). Operationally, individual soils are grouped "primarily on the basis of their capability to produce common cultivated crops and pasture plants without deterioration over a long period of time" (Klingebiel and Montgomery).

The SCS prime farmland designation is related to the SCS land capability designation in a specific way. Namely, prime farmland generally includes "all land in capability class I (class I soils are free of management hazards), most of class II, and class IIIW (W signifies a water-related crop management hazard) that has an adequate water management system" (USDA, 1975a). However, land capability classes do not necessarily reflect the productive capacity of a soil (USDA, 1975a; Fenton, et al., 1971; Conklin and Bryant). Estimated crop yields at a specified level of management among individual soils in a land capability unit are said to vary up to 25 percent (Fenton).

Variations in crop yields of this magnitude obviously can affect the economic costs and returns obtained when a soil is utilized for crop production. Accordingly, it is ambitious to assert that prime farmland is the Nation's best farmland or that such lands produce the most food, feed, fiber, forage and oilseed crops with the least amount of fuel, fertilizer and labor. These determinations clearly turn on soil productivity -- crop yield under specified assumptions on management -- and the costs and returns from crop production given prevailing prices for farm commodities and for production inputs.

Surprisingly, published evidence on expected crop yields and the profitability of prime farmland for food and fiber production is not readily available. For example, the recent USDA national appraisal of the Nation's soil and water resources concluded that prime farmland is more productive than nonprime farmland based on differential corn and soybean yields in a single Iowa county (USDA, 1980, p. 70). More comprehensive data, arranged in sufficient detail to cover a large cropland acreage, would shed more light on the prime farmland designation as an indicator of farmland suitability.

Fortunately, such information is readily available in a few cases. For example, land classifications which reflect the productivity of soil units in specific uses have been developed for California (Storie) and Iowa (Fenton, et al.). In New York estimates of productivity and cost/return are available for each of the approximately 1200 soil mapping units found in the State (NYS Department of Agriculture and Markets; NYS Department of Equalization and Assessment). The information is stored and up-dated each year to assist local officials in the administration of a New York law which allows landowners to apply for a use-value farmland assessment.

These detailed data for New York soils allow one to investigate the correspondence between the USDA prime farmland designation, soil productivity, and net income. In the absence of previous empirical work, one's hypothesis would be that the USDA prime farmland definition designates New York's superior farmland based on expected yields on net income.

Study Procedures and Sources of Data

Soil productivity and cost/return estimates generated for New York soils were applied to soils found in the 1977 NRI data file. The NRI was designed to provide base data at national, regional and state levels on erosion, land use, soils, management practices and the adequacy of conservation treatment (USDA, 1981). The NRI is based upon a stratified random sample of the Nation's land area based on primary sampling units (PSU) which were generally 160 acres in size. Three points were selected at random in each PSU. An SCS technician visited each sample point and recorded information on a work sheet; additional information was assembled from published soil surveys or soil survey field sheets by locating each PSU on a soil map or an aerial photograph. The point sample data were then tabulated to compute regional and national acreage totals. The expansion factors are based on the probability of each sample point's selection in the 1977 NRI sample.

NRI results for New York, expanded to encompass the State's 30.6 million acre land area, are shown in Table 1. The NRI data used in this study are confined to 1,149 sample points for (a) land currently used for crop production or (b) land rated as having a medium or high potential for conversion to a crop use in the foreseeable future (referred to hereafter as "potential cropland"). When expansion factors are applied, the State's cropland base is estimated at just under 6.0 million acres; 1.7 million acres are potential cropland (Table

1).[1] The State's potential cropland base is now idle, used for livestock pasture, or has forest cover.

Table 1 -- Cropland potential by major land use for New York, 1977

Land use	Total	Cropland potential[a]		Not Rated
		Medium/high	Zero/unlikely	
		Acres (1,000)		
Federal land	229	--	--	229
Nonfederal land	30,360	1,710	14,042	14,608
Cropland	5,969	--	--	5,969
Pastureland	2,286	726	1,378	182
Forestland	15,445	444	10,851	4,150
Other farmland	824	234	544	46
Urban and built-up	2,994	--	--	2,994
Transportation	603	--	--	603
Water	257	--	--	257
All other land	1,982	306	1,269	407
Total	30,589	1,710	14,042	14,837

-- = Not applicable.
[a] Prospects for conversion to cropland in the foreseeable future (10-15 years), based on local committee judgements on 1976 commodity prices, development costs, production costs and patterns of conversion on similar land during the past three years.
Source: 1977 Natural Resource Inventory.

Soil productivity is gauged with an index of total digestible nutrient (TDN) production for livestock. The TDN index is based on estimated yields, under prudent management, of hay and corn silage crops and is appropriate in New York because about two-thirds of the State's harvested cropland is used to produce livestock feed. New York has one of the Nation's largest dairy herds and more than 70

[1] NRI estimates are reasonably comparable to Census data. The 1978 Census of Agriculture, conducted one year after the NRI, reported 6.2 million acres of cropland for New York (U.S. Department of Commerce).

percent of all cash receipts from farm marketings are due to the sale of livestock and livestock products (New York Crop Reporting Service).

The index is based on annual TDN production from a corn-hay rotation. For example, consider a soil with expected yields of 20 and 5 tons, respectively, of corn silage and alfalfa hay. Using TDN as a unit of measure and assuming a 50 percent corn-hay rotation:

Crop	Yield (tons)	TDN	Rotation	TDN/acre
Corn silage	20	.2	.5	2.00
Hay	5	.5	.5	1.25
			Total	3.25

TDN computed for each soil unit depends upon expected yields of corn and hay and the corn-hay rotation selected. The yield and rotation values incorporated into this study were obtained from data developed at Cornell University for use by the NYS Department of Equalization and Assessment (E&A, 1981). E&A rotations range from 100 percent hay (on poor soils) to 70 percent corn (on better soils). The E&A index for TDN has a base of 4.54 tons per acre.

Soil productivity data must be linked to gross receipts and production costs before the economic factors governing cropland use can be examined. Following E&A procedures, production costs for each soil are based on crop budgets developed by farm management specialists at Cornell University (E&A, 1982). Since production costs are less variable among soil units than gross receipts, production costs are calculated for 8 soil groups and 2 lime classes (Table 2). Expenses are expressed as a five-year average for the period 1976-80 so that yearly variations in input costs are smoothed. Production expenses --

the sum of variable costs for growing and harvdsting, fixed costs, interest on operating capital and charges for labor and management — range from $173 to $217 per acre for corn silage; expenses for hay range from $52 to $169 per acre (see Table 2). Production costs per acre per year for each soil group were computed according to the occurrence of hay and corn in a 10-year rotation.

Table 2 -- Expenses for producing corn silage and hay by soil productivity group, New York, 1976-80

Soil group	Lime class	Soil productivity index[a]	Production expenses, 1976-80[b]	
			Corn silage	Hay
			Dollars per acre	
1	High	90-100	217.00	169.35
	Low		225.25	177.55
2	High	80- 89	211.20	162.30
	Low		219.45	170.55
3	High	70- 79	203.50	150.25
	Low		211.75	158.45
4	High	60- 69	197.75	133.65
	Low		206.35	141.85
5	High	50- 59	189.60	120.20
	Low		197.80	128.40
6	High	40- 49	179.05	100.95
	Low		187.25	109.20
7	Low	25- 39	173.35	103.70
8	Low	24 or less	--	51.50

[a] 4.54 tons TDN/acre = 100.
[b] Five-year average annual production cost. Includes growing expenses (seed, fertilizer, lime, chemicals, and power and equipment), harvesting expenses (power and equipment), interest on operating capital, labor charge, management charge, fixed expenses (power and equipment, machinery storage) and property taxes.
Source: NYS Board of Equalization and Assessment.

On the receipts side, returns to crop production are calculated after adjusting prudent management yields to average harvested yields. The E&A adjustment factors are comprised of three components:

harvesting loss, field size loss, and conversion from prudent to average management. Average harvested yields for corn silage ranged from 72 to 75 percent of prudent management yields, depending upon soil quality; average harvested yields for hay crops ranged from 48 to 67 percent of the yield expected under prudent management. Average harvested yield was multiplied by crop price to provide an estimate of gross receipts for each soil unit. Prices used are the five-year (1976-80) average, $16.30 per ton and $57.50 per ton, respectively, for corn silage and hay.

NRI and E&A data were merged by matching soil names for each of the 1,149 NRI sample points. This allows crop yields and net returns to be associated with soils represented in New York's cropland base. Since the relation between each sample point and the cropland universe is known, NRI expansion factors are used to estimate acre-weighted yields and net returns. This calculation is particularly useful because one can gauge the relative importance of an individual soil unit in the State's total cropland base.

Results

The 1977 NRI shows that New York has 4 million acres with the requisite physical and morphological properties to meet the SCS criteria for prime farmland. Of this amount, 2,767,000 acres are currently used for cropland or rated as potential cropland (Table

3).[2] Almost 40 percent of all New York cropland meets the prime farmland criteria; little more than one-fourth of the State's potential cropland by USDA definition is classified as prime farmland.

Table 3 -- Prime cropland and prime potential cropland for New York, 1977

Land type	Total		Prime		Not prime	
	Acres (1,000)	Percent	Acres (1,000)	Percent	Acres (1,000)	Percent
Cropland	5,969	100.0	2,286	38.3	3,683	61.7
Potential cropland	1,710	100.0	481	28.1	1,229	71.9
Total	7,679	100.0	2,767	36.0	4,912	64.0

Source: 1977 Natural Resource Inventory.

Prime Farmland and Soil Productivity

By matching NRI sample data to State files showing yields and expanding the results, we gauged the productivity differentials for prime and nonprime cropland. Average crop yields for sample points identified as cropland and potential cropland are shown in Table 4. From this point of reference, soils designated as prime farmland are clearly superior. Prime soils produce 3.3 tons of TDN on the average while soils falling outside the prime designation yield only 2.1 tons. The superiority traces to higher expected yields, under average management, for corn silage and dry hay (Table 4). This result reinforces data previously reported on yield differentials for corn

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2 The remaining prime farmland (1,233,000 acres or 31 percent) was judged by SCS field personnel to have a low or zero potential for conversion to a cropland use in the near term (10-15 years). The judgements are based on an evaluation of physical impediments to conversion, development costs, and previous patterns of land use on similar land (USDA, 1977).

grain and soybeans for soils found in a single Iowa county (USDA, 1980).

Table 4 -- Simple average crop yields for 1,149 NRI cropland sample points[a]

Average yield	Total	Prime	Not Prime
		Tons per acre	
TDN equivalent[b]	2.6	3.3	2.1
Corn silage	17.5	21.1	15.3
Dry hay	3.8	4.8	3.2

[a] Includes sample points in crop production and points identified as having a high or medium potential for conversion to a crop use in the near future.

[b] Based on a ten-year rotation of corn silage and hay; the average percent of hay in rotation is 63 percent (all soils), 51 percent (prime soils) and 70 percent (nonprime soils).

However, data on average yields for individual soils provide a very limited and somewhat stilted perspective on soil quality. First, reducing yield data to an average, like any other measure of central tendency, masks information on the dispersion of expected yields among the universe of all soil units. Second, a simple average yield does not reflect the amount of each soil making up the entire sample. Only an average weighted by acreage can be referenced to the total cropland base.

Both of these limitations were overcome in this study. Each soil unit identified for an NRI sample point was assigned a TDN index value so that its expected average crop yield could be compared with other soil units on a consistent basis. The point sample data were adjusted by the NRI acreage expansion factor so that the relative importance of each soil type in the State's total cropland pool could be ascertained.

As before, results arranged for New York's 7.7 million acre cropland base show a striking correspondence between prime farmland and soil productivity (Table 5). About 95 percent of the State's prime cropland acreage has a soil productivity rating of 50 or more. Only 144,000 acres or 5 percent of total cropland in the prime category is rated low in terms of yields expected in the production of livestock forage.

Table 5 -- Soil productivity for prime and nonprime cropland in New York[a]

Soil productivity index[b]	Total		Prime		Not prime	
	Acres (1,000)	Percent	Acres (1,000)	Percent	Acres (1,000)	Percent
90-100	141	1.8	141	5.1	0	0.0
80- 89	1,060	13.8	1,001	36.2	59	1.2
70- 79	921	12.0	739	26.7	182	3.7
60- 69	1,202	15.7	421	15.2	781	15.9
50- 59	1,446	18.8	321	11.6	1,125	22.9
40- 49	1,604	20.9	72	2.6	1,532	31.2
25- 39	882	11.5	47	1.7	835	17.0
24 or less	314	4.1	0	0.0	314	6.4
*	109	1.4	25	0.9	84	1.7
Total	7,679	100.0	2,767	100.0	4,912	100.0

*Not suited to corn and hay production.

a Includes actively cropped land and land with a medium or high potential for conversion to a cropland use.

b 4.54 tons TDN = 100.

On the other hand, the results also demonstrate that the USDA prime farmland criteria are restrictive enough to exclude substantial acreages of relatively productive New York farmland. More than 2.1 million acres -- 28 percent of the State's total cropland pool -- are not prime but are indexed for forage production at a value of 50 or more.

Prime Farmland and the Economics of Crop Production

The restrictiveness of the prime designation, reflected in the fact that a substantial amount of New York cropland is used productively by farmers but is not prime farmland, may or may not be important from an economic point of view. Economic distinctions between soils largely turn upon the cost/return relationships encountered when the resource is used for crop production. One expects net income to be closely, but not perfectly, associated with soil productivity because of variations in the quantity of production inputs required to sustain crop yield.

On the other hand, net income seems to be a particularly useful vantage point for viewing soil quality because net proceeds from production have much to do with the decisions owners make on the use of their land. Favorable returns greatly influence the decision to use land for farming and tend to be capitalized into the value of farm real estate.

Productivity and Net Income Comparisons: Data available for this study allow net returns from crop production to be compared with the productivity of soils. As expected, net returns expressed in dollars per acre are positively, but not perfectly, correlated with TDN production. The simple correlation coefficient (r) between these two variables, for the 1977 NRI cropland sample points, is 0.843 (a coefficient of 1.0 signals a perfect, positive correlation between two variables). This means that 71 percent (r2) of the variability in per acre net returns can be attributed to variations in expected crop yield.

Since it was shown previously that the USDA prime designation captures soils with superior crop yields, one expects prime farmland to exhibit superior per acre net returns on the average. This relationship is clearly reflected in the New York data (Table 6). The mean net income is $25.78 per acre. Mean net income on prime cropland is $44.58, or more than three times the amount expected on soils that fall outside the USDA prime farmland definition.

Table 6 -- Average net returns for 1,149 NRI cropland sample points[a]

Soil quality	Average net return[b]
	Dollars per acre
Prime	44.58
Not prime	14.67
Total	25.78

a Includes sample points in crop production and points identified as having a high or medium potential for conversion to a crop use in the near future.
b Based on average prices paid and received by New York farmers for the 1976-80 period.

Once again, looking at the dispersion of net income among soils and expanding the NRI sample data to gauge the importance of each soil in the total cropland base allows net incomes of New York cropland to be accurately compared. To preserve the earlier contrast with soil productivity, net returns per acre are also indexed, using the soil unit with the highest net income as a base. This leads to a useful distinction between prime farmland, soil productivity and annual net income (Table 7).

Table 7 -- Expected TDN production and net income for prime and not prime New York cropland[a]

Net income	Total	Prime: High TDN[b]	Prime: Low TDN	Not prime: High TDN	Not prime: Low TDN
			Acres (1,000)		
High[c]	2,200	1,787	0	400	13
Low	5,479	816	164	1,750	2,749
Total	7,679	2,603	164	2,150	2,762
			Percent		
High	28.6	23.3	0.0	5.2	0.2
Low	71.4	10.6	2.1	22.8	35.8
Total	100.0	33.9	2.1	28.0	36.0

a Includes NRI sample points in crop production and points identified as having a high or medium potential for conversion to a crop use in the near future.

b High TDN soils have a productivity index rating of 50 or more (4.54 tons TDN = 100).

c Soils with a high net income have a net income index rating of 50 or more ($78.60 = 100).

The distinctions to be drawn for New York data, however, are not without problems in interpretation. The results show that 2.2 million cropland acres (29 percent of the total) are superior from the standpoint of net annual returns. However, more than one-fifth of this acreage is not prime, i.e., is not qualitatively superior based on the USDA definition of prime farmland. For the most part, the acreage with relatively high net income exhibits relatively high soil productivity. Conversely, almost 5.5 million acres of New York cropland are relatively inferior in regard to net income, but just under 1.0 million acres are designated as prime.

The net income and soil productivity data, considered together, lend considerable support to the notion that the USDA prime farmland designation detracts from the qualitative distinctions to be made between cropland resources in New York. Assessments of the State's capacity to sustain the production of agricultural commodities, it appears, are distorted. Both the direction and the magnitude of the distortion depend upon one's perspective on the general issue of farmland quality. From the standpoint of soil productivity, one concludes that more than 60 percent of the State's cropland base is relatively productive (TDN production is 50 percent or more of the State's best soil), but the prime farmland designation captures little more than half of this acreage. Thus, the inference is that the USDA tends to underrate the quality of New York's cropland resources.

However, in reference to net income, it seems clear that the prime farmland definition leads to an unjustifiably robust qualitative assessment of the State's cropland pool. Based on 1976-80 prices, more than one-third of New York's prime cropland is inferior in the sense that expected per acre net income is less than 50 percent of the State's highest income soil resources.

The Effect of Prime Farmland on Net Income: The previous section shows that USDA-defined prime farmland does not always discriminate between New York soils based upon the net income expected from their use in crop production. Yet, "primeness" clearly makes a difference in an economic sense. It is reasonable to ask, at this stage, how much difference "primeness" makes after controlling for the several variables that also influence the generation of annual net income.

A method for partitioning out the effect of prime farmland while controlling for other influences involves the use of a regression model making net income per acre for each NRI sample point dependent upon several variables including the attribute of primeness. The model used takes the form:

$$Y = a + b_1x_1 + b_2x_2 + \ldots b_4x_4 + u$$

where Y is net income per acre; x_1 is TDN produced in tons per acre; x_2 is an interaction term defining TDN production on prime farmland in tons per acre; x_3 is a 0,1 (dummy) variable distinguishing between high lime and low lime soils; x_4 is the percent hay in a ten-year, corn-hay crop rotation; u is an error term measuring the variation in Y that is unaccounted for by the independent variables x_1 through x_4.

We expect TDN production (x_1) to exhibit a strong positive correlation with net income (the simple correlation coefficient, discussed earlier, between these two variables is 0.843). Since corn and hay prices are fixed in the crop enterprise budgets, variations in per acre gross revenues stem from variations in crop yield measured in terms of TDN. The inclusion of an interaction term (x_2) allows for the contribution of TDN produced on soils defined as USDA prime farmland. This variable allows the intercept of the regression model to shift for TDN production on prime soils and conforms with the assertion that prime soils exhibit higher productivity in crop use. Again, the expected sign on this coefficient is positive. The variable x_3 is also an intercept shifter identifying crop production on acid soils. It is included in regression to take the added costs of lime application into account. The expected sign on this coefficient is negative. The final variable (x_4) is the percentage of corn in crop rotation. Recall that calculations of TDN production involve the assignment of a corn-hay rotation to each soil and hence to each NRI sample point. The rotation selected affects per acre net income to the extent that production of corn or hay, alternatively, is relatively more profitable on a per acre basis. The rotations used in the study are those employed to administer New York's provisions for use-value farmland assessment, and presumably reflect judgements about preferred conservation practices (corn is a row crop and is more conducive to soil erosion than a sod crop) and the enterprise combinations typically selected by New York farmers. There is, however, no strong a priori basis for predicting the direction of the relationship between net income and crop rotation.

The regression results, using 1,149 NRI sample points as units of observation, are shown in Table 9. The variables included in regression are components of the net income calculations and, as expected, account for a high percentage of the variability in per acre net returns ($R^2 = .896$). Standard errors are relatively low on each regression coefficient; each independent variable is statistically significant at a 95 percent level of confidence. A cross-correlation matrix was examined, and it shows little evidence of the bias that might be introduced by multicolinearity among the independent variables included in regression.

Based on these considerations, the regression equation appears to effectively partition out the individual effects of the several factors which influence the generation of net returns on New York cropland. Thus, the influence of the USDA designation prime farmland in a relatively strict economic sense can be analyzed with some precision. First, consider the impact of crop yield -- measured in terms of TDN

Table 9 -- Ordinary least squares estimates of variables influencing net income per acre for 1,149 NRI sample points, New York

Variable		Parameter estimate (bi)[1]	Mean
Y:	Net income per acre	(Dependent variable)	25.78
x_1:	TDN per acre	25.83* (.465)	2.55
x_2:	TDN per acre (prime farmland)	3.07* (.191)	1.23
x_3:	Lime (0,1)	-10.56* (.568)	0.79
x_4:	Rotation	0.70* (.023)	63.20
	Constant term	-79.52 R^2 = .896	

[1] Standard errors are listed in brackets for each regression coefficient.
* Significant at a 95 percent level of confidence.

-- upon net income. Differentiating the equation with respect to TDN per acre:

$$\frac{\partial Y}{\partial x_1} + \frac{\partial Y}{\partial x_2} = \$28.90$$

Thus, at the mean net income ($25.78 per acre) for all NRI sample points, an additional one-tenth ton of TDN production (equivalent to an additional 0.5 ton of corn silage, 0.2 ton of dry hay, or some combination of the two crops) increases annual net returns on a per acre basis by $2.89. A fraction of this amount is attributable to crop production situated on soils which have the requisite physical and chemical properties to meet the prime farmland definition. This amount is:

$$\frac{\partial Y}{\partial x_2} = \$3.07 \text{ or } \$0.31 \text{ for an added 0.1 ton of TDN.}$$

The sign and the size of the standard error relative to the parameter estimate confirms the hypothesis that ordering soils according to their "primeness" by USDA definition has a positive and statistically significant influence on net returns. However, one should also note that the "primeness" effect on net returns, when other things are equal, is relatively small. Omitting the variable x_2 from regression reduces R^2 by roughly 1 percent, i.e., the prime farmland variable makes a very small contribution to an explanation of variability in net returns on New York soils.

In a more practical vein, the model results imply that New York farmers who produce crops on USDA prime farmland receive what amounts to just over a $3 per acre net income premium on an annual basis. Alternatively, one might argue that this annual premium is expected in perpetuity and most likely is fully capitalized into the value of farm real estate. Following this argument, with the interest rate used by E&A to estimate farmland use-value during the 1982 property tax year (9.1 percent), the income differential on prime cropland translates into a land value differential of $33.74 per acre. To put this amount into some perspective, the average value of land and buildings reported for New York in the 1978 Census of Agriculture amounted to $670 per acre; about 65 percent of this amount ($35.50) is attributable to land (USDA, 1982). Thus, one can ascribe, perhaps, roughly 8 percent ($34/435.50) of the value of New York's farmland to the presence of cropland resources which meet the USDA's definition of the

Nation's best farmland.[3] This view of "primeness" is distinctly different from the one obtained from the unequivocal assertion that prime farmland is quite simply the State's best farmland. Rather, the position supported by this analysis is that "primeness" does indeed have something to do with the economic worth of the State's cropland resources -- but not all that much.

Summary and Discussion

Prime farmland, defined on the basis of nine physical and morphological properties by the Soil Conservation Service, USDA, is the only nationally consistent measure of soil quality in use today. This study has examined the assertion that prime farmland is the Nation's "best" farmland. Results obtained for 7.7 million acres of cropland and potential cropland in New York State do not support the position that the prime definition discriminates with precision among soils according to economic returns in crop production. From the standpoint of productivity, the prime definition is somewhat restrictive, excluding a substantial amount of productive New York cropland. From the standpoint of annual net income, a substantial amount of prime

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3 Capitalized net returns are a familiar way to estimate the value of farm real estate, but several assumptions are required. The results obtained look realistic in this case. For example, capitalizing the mean net income computed for cropland (see Table 9) at 9.1 percent yields a cropland value estimate of $283 per acre. As noted above, average farmland value is about $435.50 per acre. A difference in value of $152.50 per acre ($435.50 compared with $283, the value of cropland capitalized at 9.1 percent) seems reasonable in an urban state like New York. Numerous nonfarm factors probably influence farmland values too.

farmland cannot generate adequate returns at current costs and prices. These results probably apply broadly to forage crop production elsewhere in the Northeast as well.

These findings can serve a more constructive purpose than pointing out conflicts in definition. They also point up the perils inherent in assigning more than one objective to a single land classification scheme. Confusion of at least three kinds has resulted. The first source of confusion in land classification has to do with the appropriate content of a classification system for use at the national level. The prime farmland definition now used dwells on physical and morphological soil properties required to grow crops. No claim should be made for this definition in terms of economic viability for continued agricultural production since the important aspects of an economic assessment of land quality are not considered. An implication of this study is that physical, chemical and economic features of land do not always coincide. This lack of correspondence can translate into tangible differences in prescriptions for public land policy. In the New York situation, surely the 816,000 acres of prime New York cropland producing low net incomes should be treated differently than prime land producing high incomes in any farmland retention program devised by the State or by local jurisdictions of government.

Second, the prime farmland definition arose out of an effort on the part of the USDA to broadly identify the Nation's important agricultural soil resources. Policy objectives enunciated at the national level may not (and need not) be identical with objectives established by state and localities to make informed decisions on land use.

Recognition of this aspect of public land policy is manifested in more recent efforts by the Soil Conservation Service to design and test a Land Evaluation and Site Assessment System (LESA) for local use as a land planning tool (Dunford and Roe; Wright). Further experimentation with state and local farmland retention programs will surely accentuate the need to take factors other than soil characteristics into account when decisions are made on the utilization of individual land parcels.

Finally, confusion arises from the time horizon inherent in a soil classification system. The prime farmland definition is based on physical and chemical factors that are relatively independent of foreseeable changes in demand for food and fiber, agricultural technology, and competing demands for land. On the other hand, an economic classification of farmland cannot escape dependence on prevailing costs and prices and is accordingly limited to the current period. An economic analysis of long-term future resource adequacy must depend on projections of prices and costs.

At present, prime farmland is the centerpiece of Federal deliberations about U.S. productive capacity and policy measures to encourage retention of farmland in its current use. The 1981 Farm Bill extends policy devised by the Secretary of Agriculture and provides for Federal activities to protect the Nation's farmland. Virtually all of the state legislatures are experimenting with programs designed to encourage farmland retention (Davies and Belden). Incorrect or inappropriate policies and programs can be averted if the scope, content and time horizon of the prime farmland definition are borne in mind. Further experimentation with the construction of soil classification schemes, particularly those which embody the economic aspects of farmland use, could be highly profitable.

This analysis is suggestive but not conclusive because the work is confined to a single state. The issue could be clarified and put into perspective if it had the benefit of further study. This seems feasible because the procedures developed herein to study the economic ramifications of the prime definition are very familiar ones and could be replicated elsewhere. Aside from replication in other regions, a logical extension of this study would be to test the sensitivity of the results to alternate assumptions on crop enterprise mix, input costs, and commodity prices. This would allow one to be more categorical about the economic capability of individual soil units, particularly those that fall within the USDA definition of prime farmland.

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