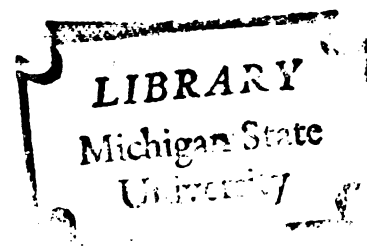


USE OF SOIL MANAGEMENT GROUPS AND SOIL YIELD
POTENTIAL SALE PRICE RATIOS IN EVALUATION
OF AGRICULTURAL CROPLAND

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ABSTRACT

USE OF SOIL MANAGEMENT GROUPS AND SOIL YIELD POTENTIAL SALE PRICE RATIOS IN EVALUATION OF AGRICULTURAL CROPLAND

By

Terence H. Cooper

The accurate valuation of agricultural cropland has had a great deal of attention in recent years. Many studies have found that assessors tend to over value low value properties and under value high value properties. The use of net income or productivity indexes based on soil resources and their related information have been used to correct this bias in assessments.

The purpose of this study was to compare a method of arriving at farm-land values based on the ability to produce net income with a new method based on soil yield potential to sale value ratios. The new method is outlined in the Soil Manual for Appraisers and is referred to as the S.M.A. procedure. The S.M.A. procedure was also revised by adjusting the soil yield potentials used to net soil yield potentials by subtracting a cost of production from the potentials. The S.M.A. values were compared with sale values to determine how well they determined the true cash value of agricultural cropland as required by present Michigan tax laws.

One method used for comparison was to calculate values for individual soil management groups for the S.M.A., revised S.M.A. and Net Income procedures. Another method was to compare sale values of farms composed largely of one soil management group with the computed values. Finally, 25 farms in Eaton County were selected to compare their computed values with sale values and also their assessed values with sale values.

The results of this study showed that the computed values for three soil management groups compared favorably with sale values of farms composed largely of these groups. The sale values, however, tended to show less response to the productivity of the soils than the net income values predict.

The comparison of the Net Income values with the S.M.A. values and revised S.M.A. values showed that the intermediate value groups had generally similar values while the low and high value groups had considerable range in the values. The revised S.M.A. values showed less variation in the low and high value groups and, therefore, tended to produce less of a bias of over valuation of low value groups and under valuation of high value groups when compared with Net Income values.

The comparisons of soil yield potentials and computed values with sale values for the 25 farms studied showed high, significant correlations. When the per acre soil yield

potentials and per acre computed values were compared with per acre sale values, the correlations were significant but lower than those obtained for total values. This reduction in correlation was felt to be due to the influence of size of farms. Farms of large acreage tended to have higher sale values per acre than farms of lower acreage, even though the average soil yield potentials per acre were similar. The lower correlation for the revised S.M.A. procedure with per acre sale values than that obtained for total values was felt to be due to the size factor of the parcel, and also a misconception of buyers in the cropland market that values do increase directly with yields, because the cost of producing the crop commonly contains fixed per acre costs not proportional to yields.

When the total assessed cropland values were compared with sale values the correlation was significant but lower than that obtained for the computed values with sale values. However, when the per acre assessed values were compared with per acre soil yield potentials and per acre sale values the correlations were non-significant.

The conclusions reached in this study were that the S.M.A. and revised S.M.A. procedures were satisfactory in determining true cash value of cropland and were superior to the assessed values. The revised S.M.A. was also slightly better correlated with Net Income values. It was felt that the use of soil and crop yield information are musts if

accurate, reliable and reproducible cropland values are to be obtained. The bias of under-valuation of high value property and the over-valuation of low value property could be eliminated with either the Net Income or the revised S.M.A. procedure, particularly the farmer. It was also concluded that minor revisions of the S.M.A. procedure could be made so that it would be more accurate and could be used throughout the southern part of Michigan.

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THE PURPOSE

The purpose of this study was to compare a known method of arriving at farmland values, based on ability to produce net income, with a new method, based on a soil yield potential to sale price ratio. The new method was also to be compared with the sale values and assessed values of properties so that its use as a method of estimating farmland values for tax assessment could be evaluated. The new method was to be scrutinized closely so that additions and revisions could be made for increased simplicity or accuracy. The new method's values should be so readily reproducible (in such a manner) that township assessors will want to incorporate this procedure into their process of evaluations to give more equitable valuations of farm real estate.

REVIEW OF THE LITERATURE

Interest in land values has been increasing rapidly as the land prices rise. Much of the interest has centered around how real estate property can best be appraised equitably. The concept of value implies a capacity to satisfy wants (9). The ability of a given tract of land to satisfy these wants, or its potential to have value depends on: a) its inherent physical and chemical qualities; b) its location; and c) the interaction of capital, labor, and management with this land to produce income.

Two major factors contribute to land value, the first is the scarcity of land and the second is the fact that land yields income. The second factor has been a paradox in the agricultural sector, for farm real estate values have risen steadily over the last decade despite a lack of supporting trends in commodity prices (10). Thus while the farmer has had to pay more for his land and pay more taxes on it because of its higher value, he has received less for his labors due to the stable or declining value per unit of farm output, even though his yields have increased.

It has been assumed in the past that changes in farm land values over time reflect changes in the demand for farm products while geographic differences in farm land values reflect differences in net productivity (17). The recent trends of continued increases in farm real estate prices and strong geographical price differences have been assumed to be in part caused by non-farm influences acting directly on the land market. The direct competition between farm and non-farm uses for agricultural land has increased its value in most areas beyond which it would have increased if the agricultural value were the only influence.

It has been this increase in farm real estate values that has brought about much of the interest in their accurate evaluation and equitable assessment for property tax purposes.

Much criticism has been raised against the property tax in the past. According to Shapiro the property tax is sometimes called the most inefficiently administered tax in the U. S. (19). It is difficult to administer primarily because the tax is levied on property values that are to a considerable extent based upon the judgement of local assessors. In many instances these individuals have little information to guide their judgement and the resulting tax inequities are inevitable.

The principal need in administration of the property tax is an equitable assessment of individual real estate

properties (7). The use of equalization procedures to equalize assessments between districts and counties is not an easy way out according to Jensen (6). He states that there is no possibility of equalizing unequal individual assessments by means of a blanket increase or decrease. The only way to equalize assessments is to make them comparable in the first place.

In Michigan the major source of revenue for local governments is the general property tax (22). Property taxes comprise the largest single source of the combined tax revenues for school district, county, city, and village governments.

The increasing demand for public facilities and services, even in rural areas, has placed a heavy burden upon the local tax base. Despite the recognized faults of the property tax, however, it seems certain that local governments will continue to rely heavily upon property tax revenues in the foreseeable future. Thus it is essential that the weakness of the existing property tax system be corrected insofar as possible so that equitable and uniform treatment of all property owners is obtained (22).

The Michigan Constitution requires that all general property taxes be levied in a "uniform" manner. This has the effect that all classes of property must be taxed at the same rate and also necessitates that the assessment of all taxable property be at the same percentage of

actual market or cash value. Cash value was defined in a 1969 amendment to mean the usual selling price which could be obtained in a private sale.

Most state laws in general specify that all property is to be assessed at, or at a percentage of, the actual market value. It has been noted consistently that lower value properties are assessed at a higher proportion of their sale price than the properties of higher values. This condition has been pointed out by studies conducted in Iowa, South Carolina, Georgia, Montana, Nebraska, and Michigan (13). This indicates that assessors do not have equitable evaluations upon which to apply their tax rates.

Methods to correct this bias in evaluations of farmlands have dealt with trying to find a true basis upon which to evaluate land. In California each soil type and phase are rated according to the Storie Index (21), so as to give a value for agricultural purposes. These ratings were based solely on the character and conditions of the soil.

This is also true in Nebraska (12), where soil productivity differences are the principal reasons for differences in land values. The method developed there by Ottoson and others, is principally that of finding the economic productivity of soil types or the ability of a tract of land to produce net income. This method

requires a soils map to be made if one is not available. A net income rating is then prepared for each soil based on the cropping system, yields, and costs of production. By measuring the acreages of each soil type on a tract used for a particular cropping system a weighted economic rating for the tract can be determined. From this economic rating an estimate of the value of the land can be determined. Location of the tract with respect to distances to schools, market centers, hard surfaced roads and railroads was considered but was found to be a minor factor in setting values.

A similar method to improve tax assessments in Iowa by Aandahl and others also consists of determining economic ratings for soil mapping units or a combination of similar units shown on soil maps (1). Economic ratings were calculated by the conversion of net income into a percentage rating. The best soils were rated 100% and the remaining soils were rated accordingly. The total economic rating of the soils on a farm were calculated and then divided by the number of acres to obtain an economic rating per acre for the farm. These economic ratings for farms were compared with adjusted sale prices per acre (sale price minus assessed value of buildings divided by the number of acres) for farms sold in five different years. The nearness of these regression lines to the origin and their statistical significance indicated in

general good agreement between the economic ratings and sale prices. When the sale prices were adjusted for the different years the regression was still significant and the line passed through the origin with a simple correlation of .61.

Soil ratings developed through a series of approximations using both soil characteristics and soil qualities were compared to sale prices of farmland in Brookings County, South Dakota (8). Those soil ratings are essentially a productivity index combined with management factors. All sales were adjusted to a base year of 1962 by the index numbers in "Farm Real Estate Market Developments," U.S.D.A. Assessed values of buildings were subtracted from farm sale prices. The straight line correlation between sale prices per acre and soil ratings was statistically significant. The simple correlation was .55.

The success of any procedure is how well the results conform with the state law. The objective of the assessment system is the uniform relationship of assessment to sale value (11). A perfect correlation, however, would not necessarily be ideal because sale values themselves are not consistent. Some forces in the determination of farmland prices can be considered economic, but many others fall beyond the scope of economic analysis. These would include certain attitudes, beliefs, and subjective

values (18). Thus while sale values must be used as a means to substantiate the accuracy of the various appraising procedures in determining farmland values, in keeping with the laws requirement of true "cash value," they themselves will have considerable variation even for very similar properties reflecting the judgements of pairs of sellers and buyers.

The previously mentioned procedures, however, have found statistically significant relationships between sale values and soil ratings. The major difference between these procedures have been in the determination of the soil ratings. It is of prime importance that the assessor arrive at valuation estimates which are comparable and readily substantiated (16). Thus when dealing with farm real estate these valuations have been shown to be best obtained by using a procedure with some type of economic soil rating because of the apparent relationship of these ratings with the sale values.

PROCEDURES

Soil Yield Potential-Sale Value Ratio Procedure

The use of a new procedure for appraising agricultural cropland has been underway in several Michigan Counties by their equalization departments. This method is outlined in the booklet Soil Manual for Appraisers (20).

The essential steps of the method are:

1. Determine the number of acres of tillable cropland of the parcel being studied;
2. From available soil survey data total the acreages of individual soil types of the cropland;
3. Convert the acreages of soil types into soil management groups;
4. Multiply the acreage of each soil management group by its soil productivity rating, or soil yield potential;
5. Add the total ratings from all soil management groups for the total soil yield potential;

6. Make an agricultural sales analysis by listing those sales of agricultural lands which are being sold for agricultural purposes and their year of sale;
7. Deduct from the total sale price the values assigned to buildings and to those portions of land (including the farmstead) not considered tillable, this leaves a residual cropland value;
8. Total the residual cropland value for all sales obtained and also the soil yield potentials for the same properties;
9. Divide the total residual cropland value by the total soil yield potential;
10. The resulting quotient is a ratio relationship between sale value and soil yield potential; and
11. To obtain a dollar valuation of croplands on other properties multiply their total soil yield potential rating by the ratio obtained in steps 6-10.

Selection and Description of Area for Study

Eaton County was selected as the county in which to look at the results of the new evaluation method. Francis Moss, Eaton County Equalization Department Director, was

one of the co-authors of the new procedure. The availability of Mr. Moss's files and records as an aid in the study was one factor for the selection of Eaton County. Another factor was that a study conducted by Thomas Priest in 1960 (13), using the net income procedure for evaluating farmland was also available for comparison in this county.

Eaton County is located in the central part of the southern half of Michigan's lower peninsula. Dairy and general farming predominate in the area. Dairy and crops grown are feed crops of hay, corn, and oats. Important cash crops are wheat, corn, and beans. The growing season ranges from 140-160 days. The soils of the area vary greatly from loamy sands to sandy loams, silt loams and clay loams textures with excessive to inadequate natural drainages and with low to high fertility.

The soil survey of the county was made in 1930 and published in 1933. It was made on the scale of one inch to the mile and without the use of aerial photographs. Today approximately one-half of the county has a new soil survey at four inches to the mile on aerial photographs. This survey is being conducted cooperatively by the Soil Conservation Service of the U. S. D. A. and the Michigan Agricultural Experiment Station of Michigan State University.

Explanation of Priest's Procedure
and Updating of the Values

Thomas Priest conducted a study evaluating farm-lands in Eaton County in 1960. The procedure he used is essentially that of Ottoson et al. (12). The essential steps in this procedure are:

1. The soils represented in an area are assigned to soil management groups;
2. The most common land uses for each soil management group and slope class is determined;
3. The acreage of each soil management group is recorded;
4. The average per acre yield of each soil management group and slope class for each use is determined;
5. The total value of production per acre on each soil management group for each use is determined;
6. The cost of production per acre for each land use of each soil management group and slope class is determined;
7. The net income per acre for each soil management group, land use, and slope is determined;

8. Income for a tract is determined by multiplying the expected net income per acre for all soil management groups by their respective number of acres; and
9. The total net income is capitalized at a rate consistent with sale prices of farmland.

Priest et al. concluded that the computed land values obtained in his study, by use of soil management groups and related information, compared favorably with both the Michigan State Tax Commissions' appraised land values and with the farmer's estimates of the value of their land.

Assuming the method used by Priest is satisfactory for obtaining values for farm real estate, then those values can be used currently by updating them to current market values. This can be done by updating Priest's 1955 values with use of the index numbers of farmland values published by U. S. D. A. (4). For example, the index number for Michigan for 1955 was 83 and for 1967 it was 170. Thus there had been an increase in farmland values of $(170/83 \times 100)$ 205% from 1955 to 1967.

There are three limitations in using these index numbers to update farmland values. First the state as a whole is used, and not specific counties, in calculating indexes. Second, the property must remain the same size.

Third, the known price of property must be a reasonably good measure of its true value (14).

In checking whether land values in Eaton County had increased in value the same as the state-wide average, farmers estimates of their land value were collected from Michigan State University Tel-Farm records for Eaton County. These value estimates were obtained for 1964-1969 and converted into index numbers so that they could be compared with those published by the U.S.D.A. These index values were then averaged for the parcels studied for the six-year period and compared statistically with the published index numbers. The differences were found to be nonsignificant at the 5% level. It was concluded that the index numbers in Farm Real Estate Market Developments could be used to update values in Eaton County. The indexes used are shown in Table I. The magnitude of these indexes show that there has been considerable change in farmland values from 1955 to the years in which the analyses were conducted.

Soil Management Groups

Soil management groups are basic interpretive groupings based on similar soil properties to a depth of 3.5 to 5.5 feet. These soil properties are grouped to provide units having similar adaptations or management requirements. Examples of soil properties most generally

considered include the texture of the profile, reaction of the profile, thickness of the profile, and the natural drainage. The soil management groups can be subdivided on the basis of surface texture, slope, degree of erosion or stoniness, into management units or land capability units.

This grouping of soils provide for natural combinations of many soils into a convenient number of units which will express the main differences in productivity and so be useful as the basis for land evaluations. This grouping has been worked out cooperatively by the Michigan Agricultural Experiment Station, the U.S.D.A. Soil Conservation Service, and the Michigan Cooperative Extension Service (5).

In the development of a system of nomenclature or identification of these soil management groups, a combination of letters and numbers is used. The numbers indicate the relative coarseness of the mineral materials from which the soils were formed; from 0 for the finest textured clays, to 5 for the coarsest textured sands. The small letters immediately following the numbers or capital letters indicate the natural drainage under which the soil developed--"a" for the better drained, "b" for the imperfectly drained, and "c" for the more poorly drained conditions.

When capital letters are the first part of the symbol they represent important soil characteristics or conditions as follows: M for mucks and peats and L for lowland soils subject to seasonal overflow. Where another letter follows the small letter which indicates the natural drainage and is separated from it by a dash, it indicates other characteristics of the soils important to their use. For example, a small "a" after a dash represents very acid subsoils; "c" indicates soils calcareous or limy at the surface; and "h" indicates subsoils which are hard and cemented.

For soils where the texture of the upper layer differs from the lower layer, a fraction is used instead of a whole number. For example, 4/1 is for loamy sand 18 to 42 inches thick over clays; 5/2 is for sand 42 to 66 inches thick over loams or clays. Where bedrock is within 18 to 42 inches of the surface, a capital "R" is shown as the denominator.

The soil management groups for the various soil series in Michigan are found in the Appendix of the Michigan State University Extension Bulletin E-550 (5). They may also be found in soil surveys that have been recently published.

Soil Yield Potentials

Soil yield potentials are used to rate the various soil management groups. By totaling the soil yield

potentials of a farm (by multiplying the number of acres of the various soil management groups by their respective soil yield potentials) a number can be obtained to use for obtaining a ratio between the sale price of cropland and the total soil yield potentials.

The soil yield potential is a long time average, 5 years or more average yield, of a specific crop on a particular soil when very good soil management practices are used on each soil type or soil management group (15). The yield potentials are basically then the average yields from the highest yielding field experimental plots located on each soil management group. These yields also are essentially the same as those reported by the better farmers in the state who have these soil management groups on their farms. These yields assume that adequate drainage has been supplied on soils of the "b" and "c" management groups.

The soil yield potentials of a given soil management group are subject to change with time. As more research is completed the yield potentials tend to increase with the use of new crop varieties or better control of erosion, insects, and diseases.

The soil yield potentials which are used in the procedure outlined in the Soil Manual for Appraisers are those given for corn in Table II, Michigan State University Extension Bulletin E-550.

Calculation of Sale Values and Assessed Values

Sale values of properties were obtained from the farm sales analysis conducted by the Eaton County Equalization Department. These were sales of farm real estate for agricultural purposes. The sale price of the properties had deducted from them the appraised value of buildings and the value of the acres of non-tillable land including the homestead. This results in a sale price of the remaining tillable cropland. These values were for various years ranging from 1965 to 1969. The average year of sale was 1967. All sale values were corrected to 1967, for comparison purposes, by the index numbers in Farm Real Estate Market Developments.

Assessed values of properties were obtained from the records of the Eaton County Equalization Department. Since the assessed values are based on a percentage of the true cash value of the property, they had to be multiplied by a factor to obtain total assessed values. Assuming property is assessed at 50% of its true cash value, a factor of 2 was used. From the total assessed value the appraised value of buildings and nontillable cropland was subtracted. This enabled the assessed value of cropland to be obtained for comparison purposes.

Revised Soil Yield Potential-Sale
Value Ratio Procedure

It was felt that since most of the procedures of evaluating farmlands use a net income approach, a revision of the procedure outlined in the Soil Manual for Appraisers could be made so that it too would use a net income approach of rating soils.

The soil yield potential ratings used in the above procedure are the suggested corn yields in Table II, Michigan State University Extension Bulletin E-550. By subtracting from these ratings the costs of production in bushels for each soil management group, a net income rating for the soil management groups can be obtained.

To determine what the cost of production for corn should be on the different soil management groups, data collected by the Michigan Cooperative Extension Service was used (2). The cost of production cannot be a fixed factor for it will vary with amount and kind of management required on the different soil management groups. It was determined that the cost to grow and harvest corn varies from \$75.00 to \$100.00 per acre. This can be broken into fixed and variable costs per acre in bushels (assuming an average price is \$1.00 per bushel for corn). Fixed costs were determined at 34 bushels per acre and the remaining costs were $.23x$, where x is the soil yield potential from Bulletin E-550. Thus if the soil yield

potential was 110 then the relative cost of production would be $34 + .23(110)$ or 59. The net soil yield potential would then be $110 - 59$ or 51.

Using the net soil yield potential ratings to calculate values of cropland requires the use of cropland sale price-net soil yield potential ratios. These new ratios were calculated as outlined in the Soil Manual for Appraisers for the sale price-soil yield potential ratios. By using these new ratios, calculated values of cropland can be obtained by multiplying the total net soil yield potential of a property by the appropriate ratio.

RESULTS

The purpose of this study was to investigate a procedure of evaluating agricultural cropland as used by the Eaton County Equalization Department and outlined in the Soil Manual for Appraisers. This procedure shall be referred to hereafter as the S.M.A. Procedure. Tests of the accuracy of this procedure include comparisons with: (1) Priest's net income approach to land evaluation updated, (2) sale values, and (3) assessed values. A revision of the S.M.A. Procedure was also compared with the above three.

The computed values for individual soil management groups by the S.M.A. procedure and the Revised S.M.A. procedure were compared with updated values obtained by the net income procedure used by Priest. These results are given in Table II for three townships and shown graphically in Figure 1 for two townships. The S.M.A. value for soil management group 4c averaged 221% of the Net Income Procedure values. The S.M.A. value for soil management group 2c averaged 77% of the Net Income values. The Revised S.M.A. procedure values were 151% and 87% of the Net Income procedure values for soil management groups 4c and 2c respectively. Thus both the S.M.A. and Revised S.M.A. values when compared with net income values tend to over value the low value property

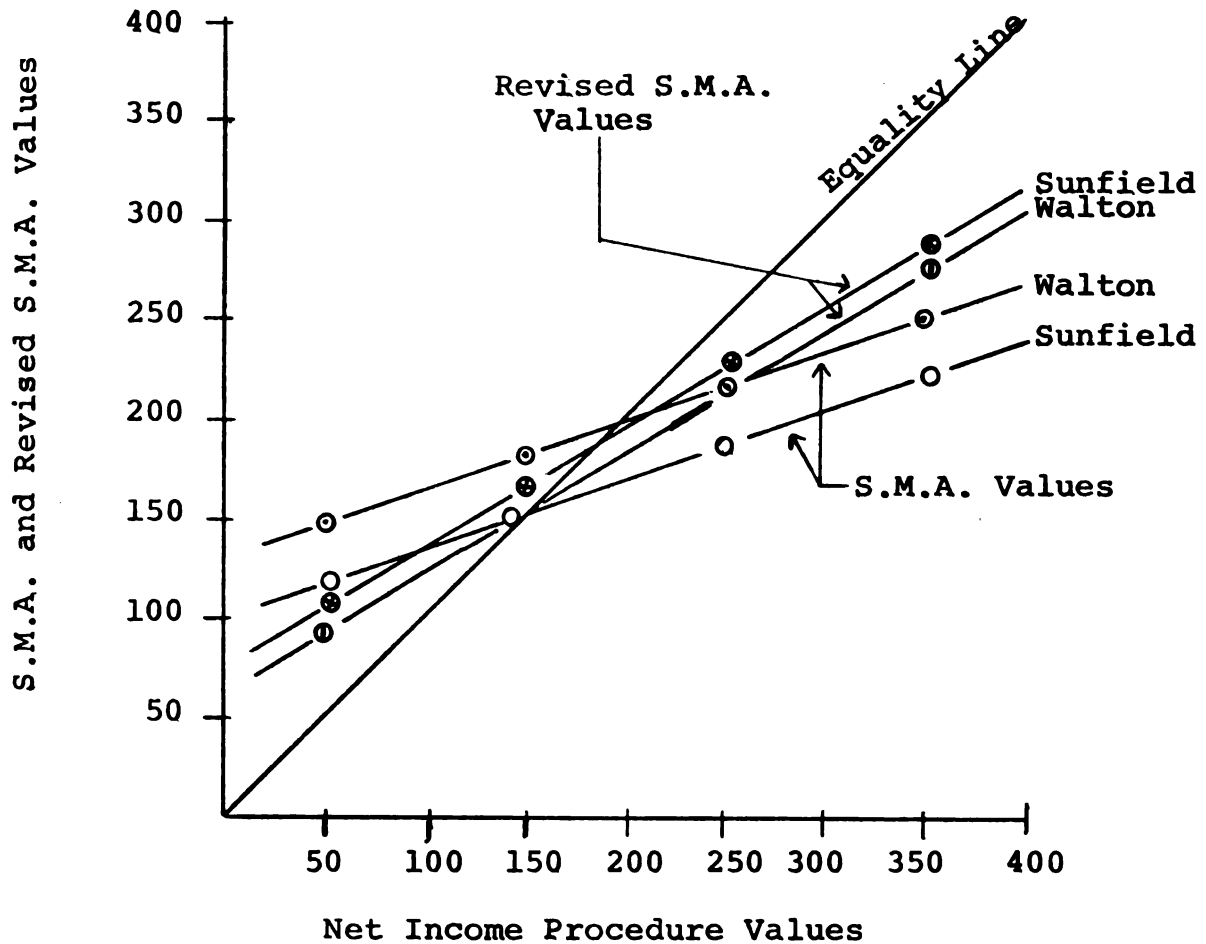


Figure 1. Relationship of the S.M.A. and Revised S.M.A. Values to the Net Income Values for Soil Management Groups in Walton and Sunfield Townships, Eaton County, Michigan.

and under value the high value property. The Revised S.M.A. values, however, tend to produce less of this bias. The regression lines for the Revised S.M.A. values approach closer to the equality line than the lines for the S.M.A. values, as shown in Figure 1.

The average value for the S.M.A. procedure for all soil management groups was 90% of the Net Income procedure average value, and the average for the Revised S.M.A. procedure for all soil management groups was 92% of the Net Income Procedure values. A correlation coefficient of .97 was determined for the comparison of S.M.A. procedure values for all soil management groups and Net Income procedure values. The correlation coefficient for the Revised S.M.A. and Net Income values for soil management groups was also .97.

To compare current sale values of some soil management groups, farms composed largely of one soil management group that were used in the farm sales analyses of the Eaton County Equalization Department were used. To compare sale values with the computed values of the soil management groups, all values were corrected to the base year 1967, since this was the average year of sale of farms in the farm sales analysis.

For the two selected properties with greater than 75% of the cropland composed of soil management group 2b the sale value ranged from \$272 to \$288, per acre. The upper range of the S.M.A. and Revised S.M.A. values are in this range. The Net Income Procedure values are somewhat higher.

%Soil management group composition of cropland on selected farm	Range of sale value per acre	Range of S.M.A. value per acre	Range of Revised S.M.A. value per acre	Net Income Procedure value per acre
>75% 2b	\$272-288	\$246-276	\$251-276	\$306
>75% 2a	255-306	220-253	204-252	225
>75% 3a	196-203	177	181	171

The soil management group 2a had four farms with greater than 75% of the cropland soils in this group. Their range in sale values was from \$255 to \$306 per acre. The computed values were all in part within the sale value range. For the two farms with greater than 75% of the soils in soil management group 3a the range in sale values was from \$196 to \$203 per acre. The computed values for this soil management group all fall below this range.

From the range of sale values for both the low and high value soil management groups, it can be seen that these sale values show less response to the productivity of the soils than the net income values predict.

For comparisons of the S.M.A., Revised S.M.A., and Net Income values to sale values and assessed values, data for 25 farms from five townships in Eaton County were used as shown in Table III. All values and crop yield potentials on a per acre basis were calculated by dividing the total yield potential or total value for the individual farm's cropland by the acres of tillable cropland.

To compare total values of cropland with actual sale values, data were obtained for the 25 farms from the farm sales analysis conducted by the Eaton County Equalization Department. These were adjusted to the year 1967 and compared with the Net Income Procedure values for cropland which were also corrected to 1967. These values are shown in Table IV columns 2 and 5 and graphically in Figure 2. The average Net Income value for cropland was 92% of the sale value. There was considerable range in the individual cropland values. The correlation coefficient was .87.

Comparisons were made between the total soil yield potentials for the tillable cropland of the 25 farms studied with their respective sale values of cropland corrected to a base year of 1967. These values are shown in Table V column 2, Table IV column 2, and graphically in Figure 3. The correlation coefficient was .96 and the prediction equation by linear regression was $y = -623 + 2.35x$. Therefore 92% of the variability in total sale value of cropland can be explained by variation in total soil yield potential.

The revised total soil yield potentials were compared with the 1967 sale values of croplands and the values obtained are shown in Table IV, column 2, Table V, Column 4, and Figure 4. The correlation coefficient was .92 and the prediction equation was $y = 40.8 + 4.6x$. Therefore 85% of the variability is in the revised soil yield potential.

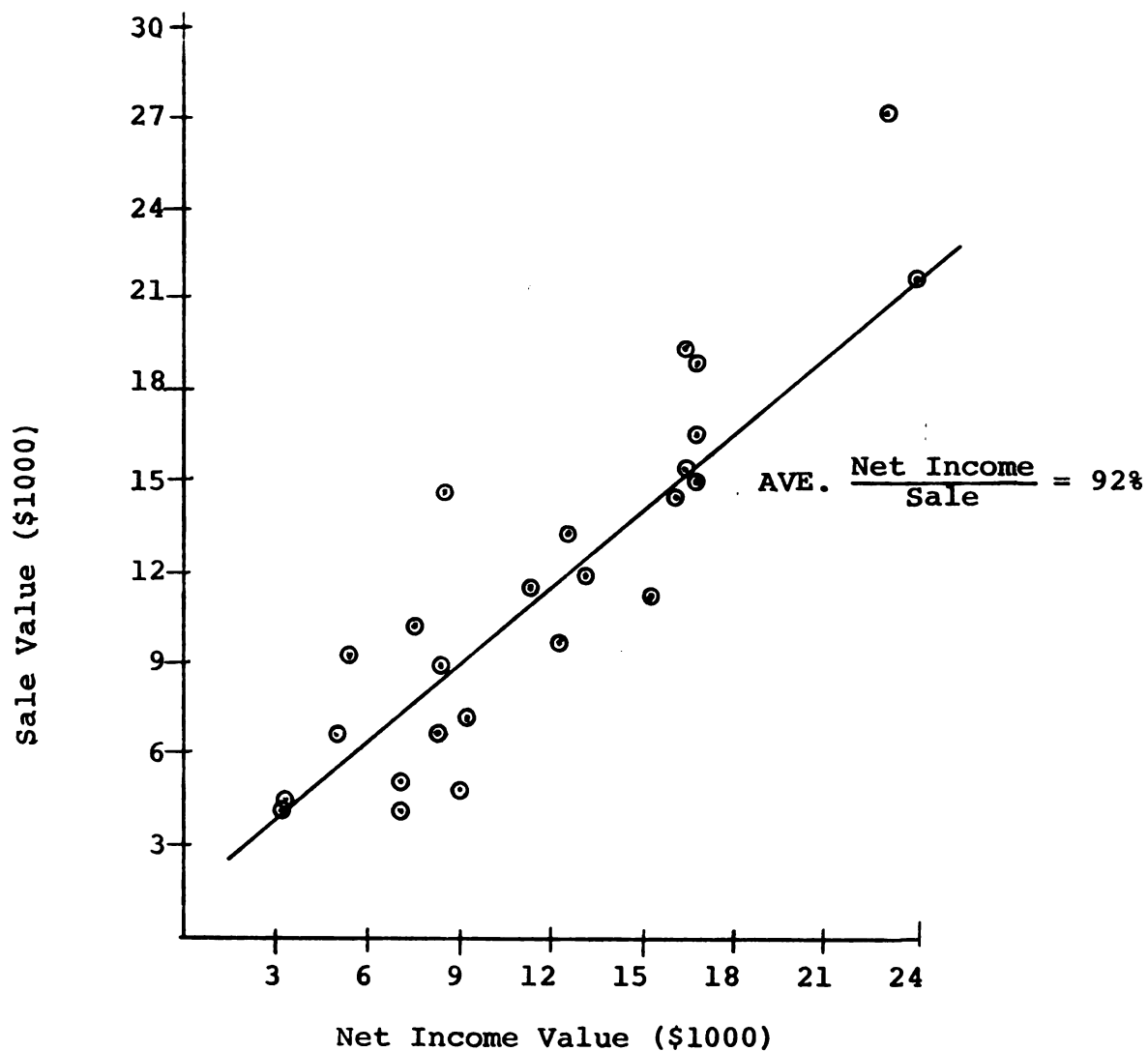


Figure 2. Relationship of the Sale Value of Cropland to the Net Income Procedure Value for 25 Farms in Eaton County, Michigan.

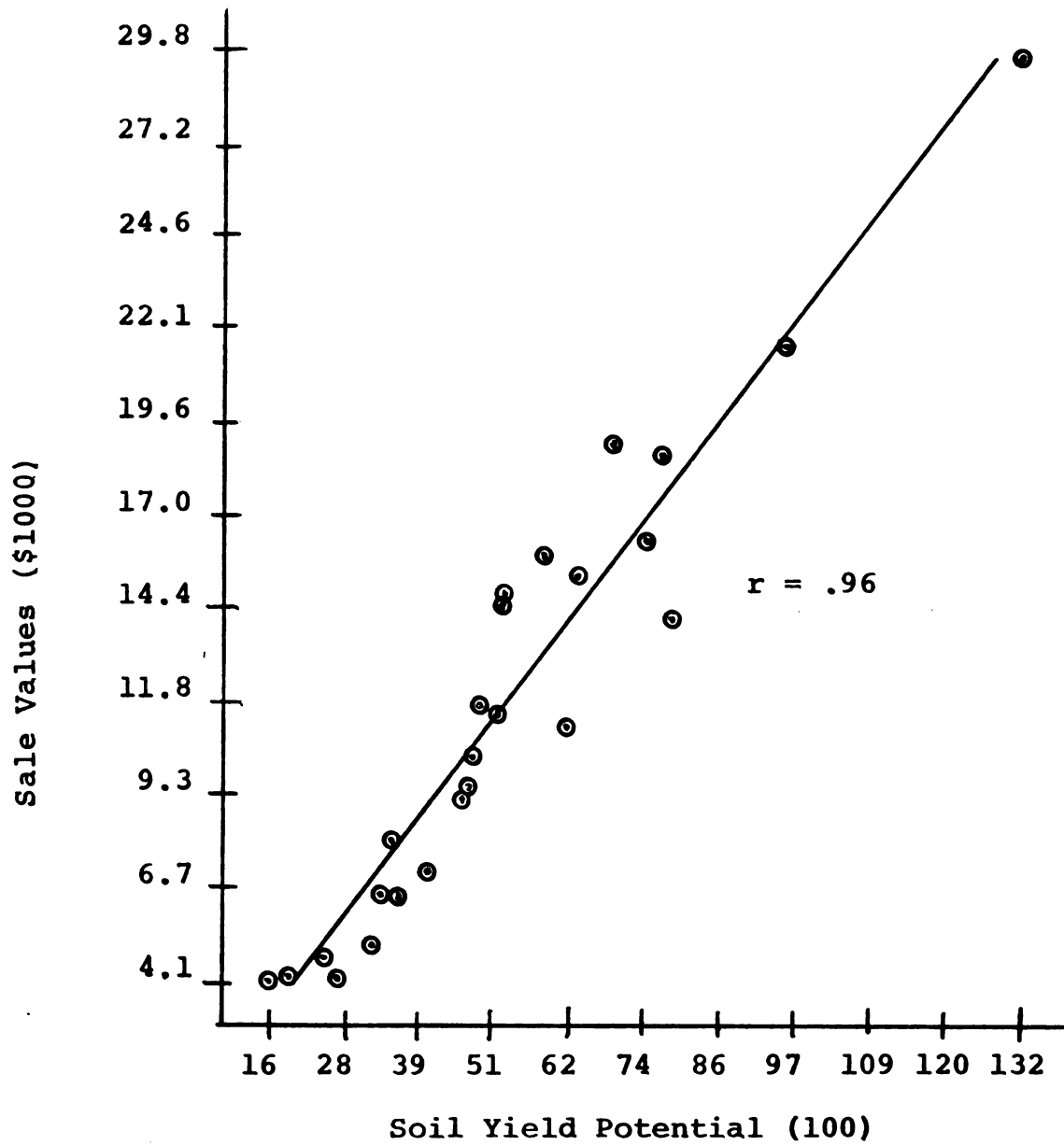


Figure 3. A Graph Showing the Relationship of the Sale Value of Cropland to the Total Soil Yield Potential of 25 Farms in Eaton County.

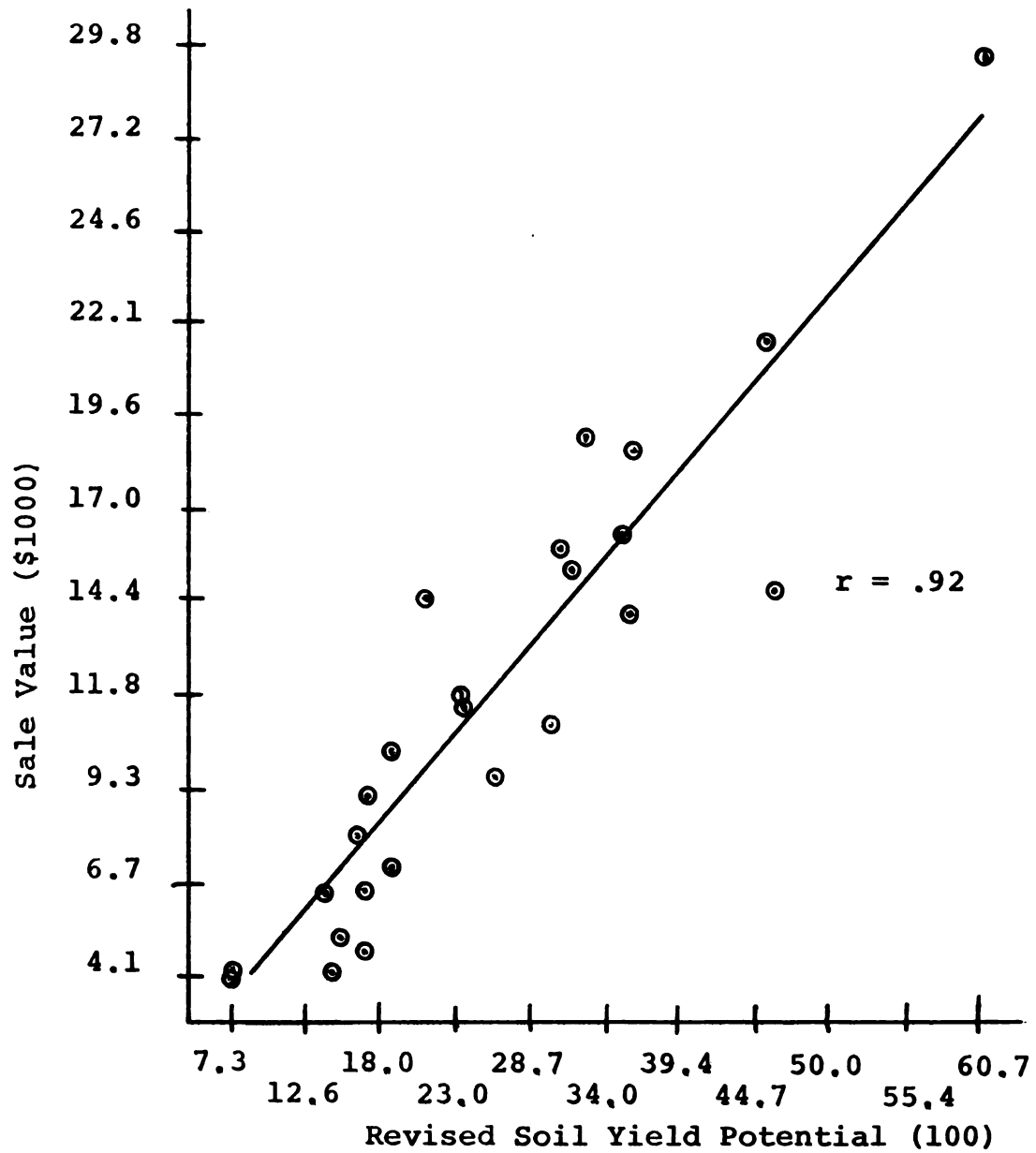


Figure 4. A Graph Showing the Relationship of the Sale Value of Cropland to the Revised Soil Yield Potential on 25 Farms in Eaton County.

These two prediction equations were deemed satisfactory predictors by having the observed F ratio exceeding the 5% F value by greater than 4 times (3). Thus from the 25 farms studied the data was suitable in arriving at prediction equations for calculation of sale values for the five townships by knowing the total soil yield potential or total revised soil yield potential.

The total value of cropland as computed by the S.M.A. Procedure was compared with the sale value of the cropland. The values obtained were corrected to a base year for comparison and are shown in Table IV, columns 2 and 3. The graphical representation is Figure 5. The correlation coefficient was .97. This means that 94% of the variability in total sale value of cropland can be explained by variability in the S.M.A. computed value. The average of the computed S.M.A. value was 90% of the sale value.

The Revised S.M.A. procedure total values for cropland for the 25 farms studied were compared with the sale values. Again all values were adjusted to the year 1967. These results are Table IV, columns 2 and 4, and are shown graphically in Figure 6. The correlation coefficient was .92 or 85% of the variability in sale value of cropland can be explained by variability in the Revised S.M.A. computed values. The average of the Revised S.M.A. value was 99% of the sale value for cropland.

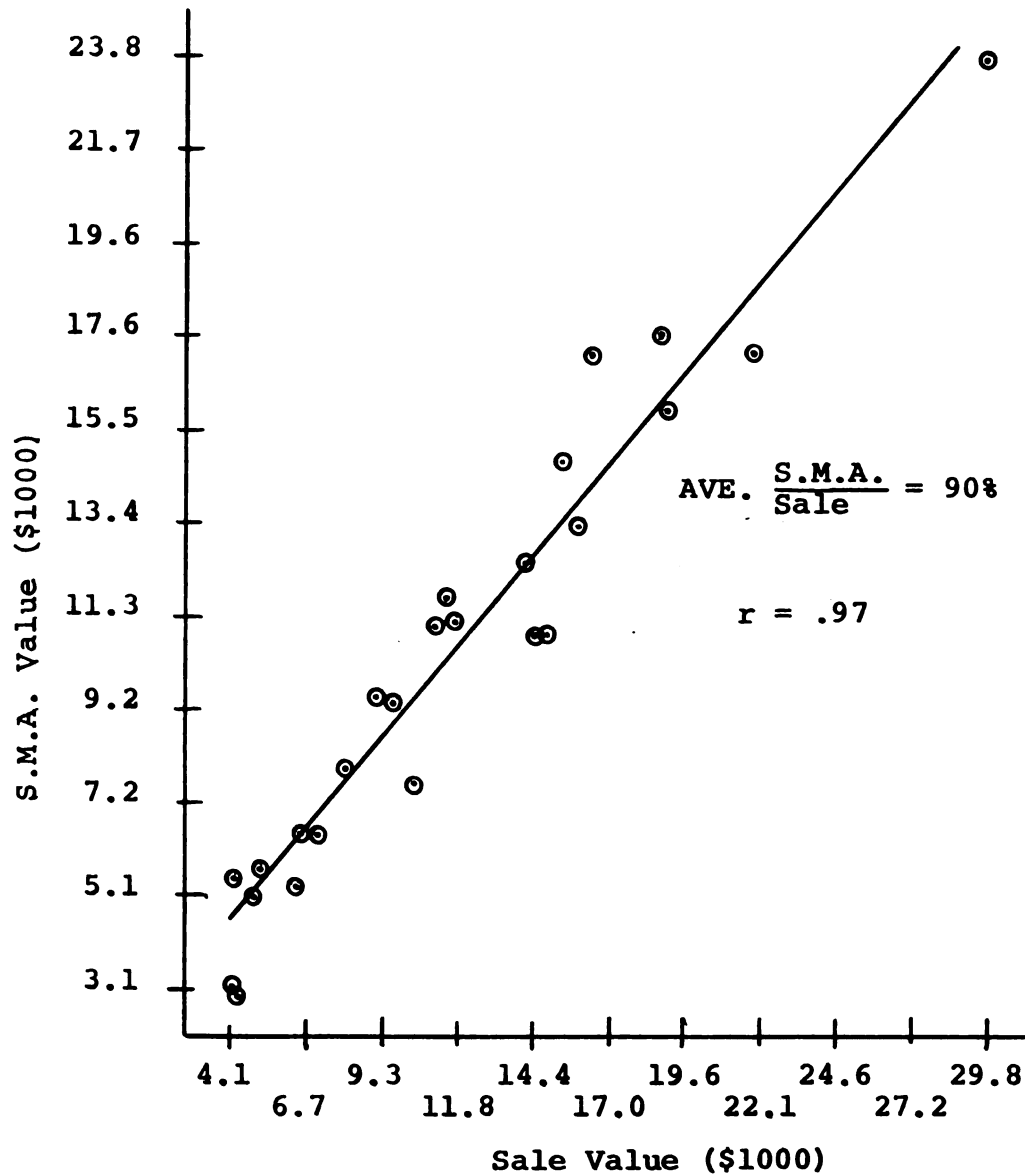


Figure 5. A Graph Showing the Relationship of the Computed S.M.A. Value to the Sale Value of Cropland For 25 Farms in Eaton County.

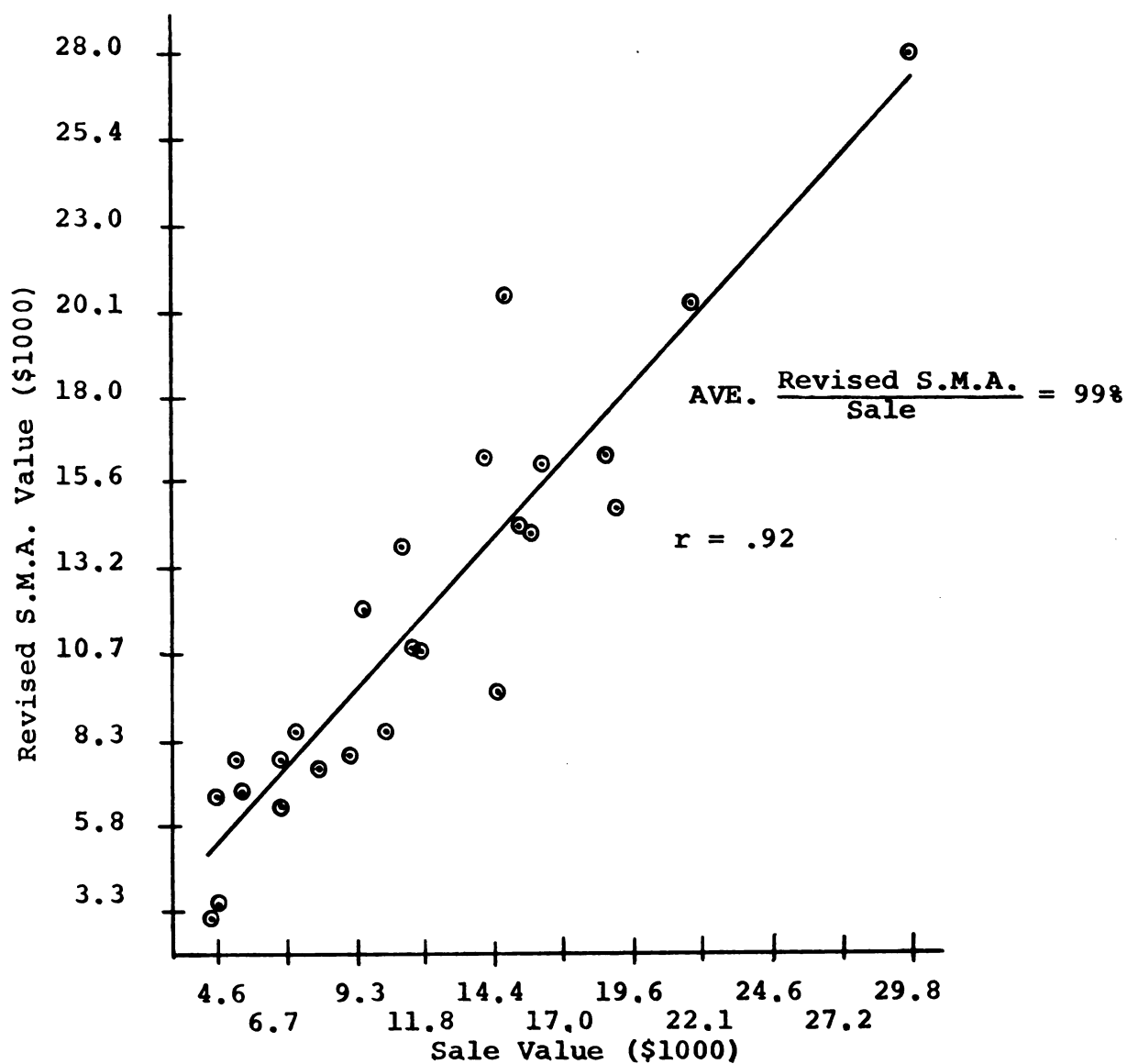


Figure 6. A Graph Showing the Relationship of the Computed Revised S.M.A. Values to the Sale Values of Cropland for 25 Farms in Eaton County.

Comparisons were made between the average per acre soil yield potential for the 25 farms studied and the average per acre sale price of cropland. These are shown in Table IV, column 6 and Table V column 3, and graphically in Figure 7. The correlation coefficient was .60 which means that 36% of the variability in the average per acre selling price could be explained by variability in the average per acre soil yield potential. Comparisons were also made with the average revised soil yield potential per acre and average sale value per acre. These are shown in Table IV, column 6, Table V column 5, and graphically in Figure 8. The correlation coefficient was .24 and was only significant at the 20% level.

The values per acre computed by the S.M.A. procedure were compared with the per acre sale values. All values were corrected to the base year 1967. The values obtained are given in Table IV, columns 6 and 7, and shown graphically in Figure 9. The correlation coefficient was .78. This correlation was greater than that obtained for per acre soil yield potential comparisons with per acre sale values. This is due in part to the fact that computed values are figured on individual townships, and in this way, the location effect on varying sale price was taken into account. The average value per acre for the S.M.A. computed value was 92% of the sale price value per acre.

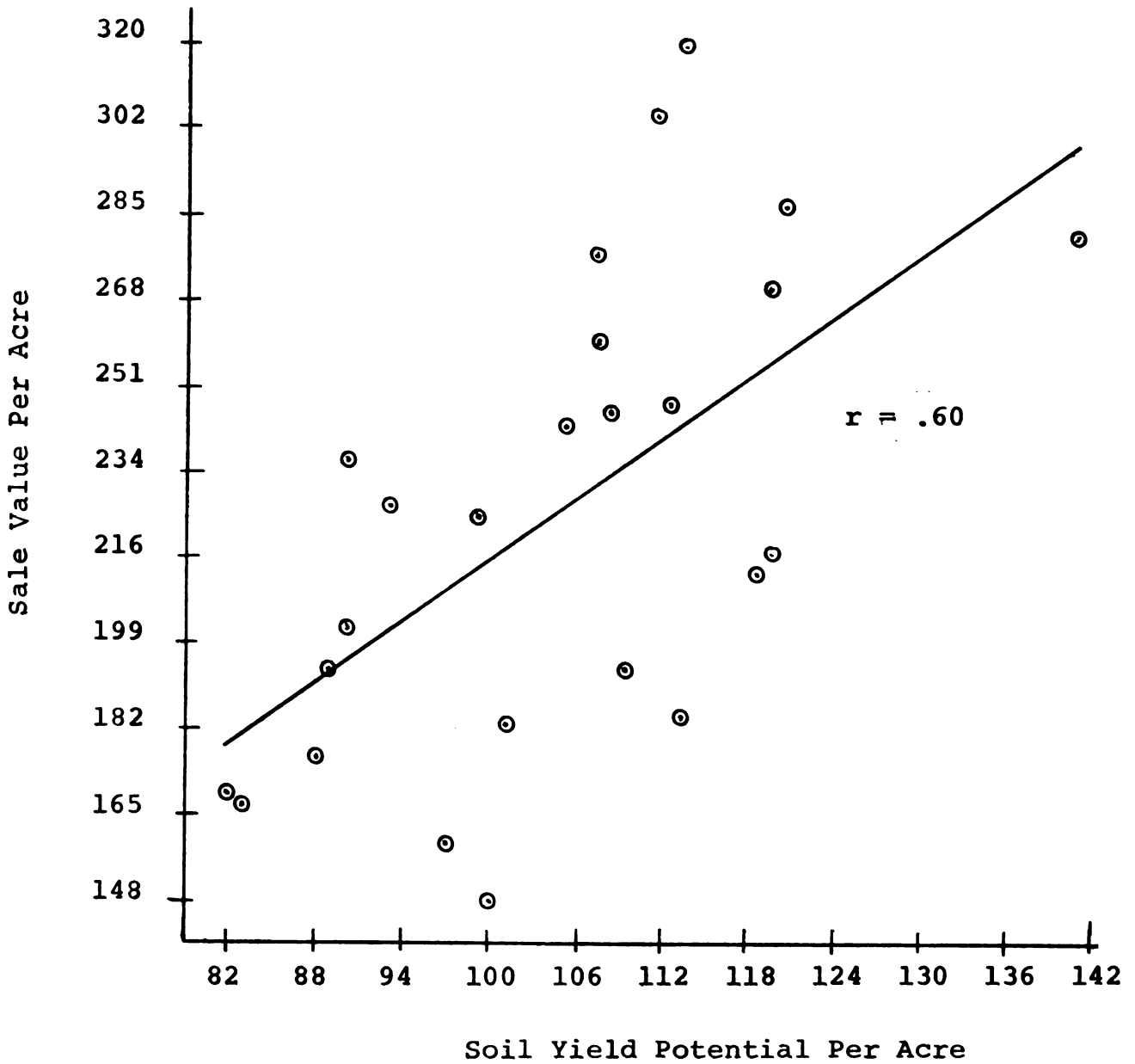


Figure 7. A Graph Showing the Relationship of the Sale Value Per Acre for Cropland to the Average Soil Yield Potential Per Acre for 25 Farms in Eaton County.

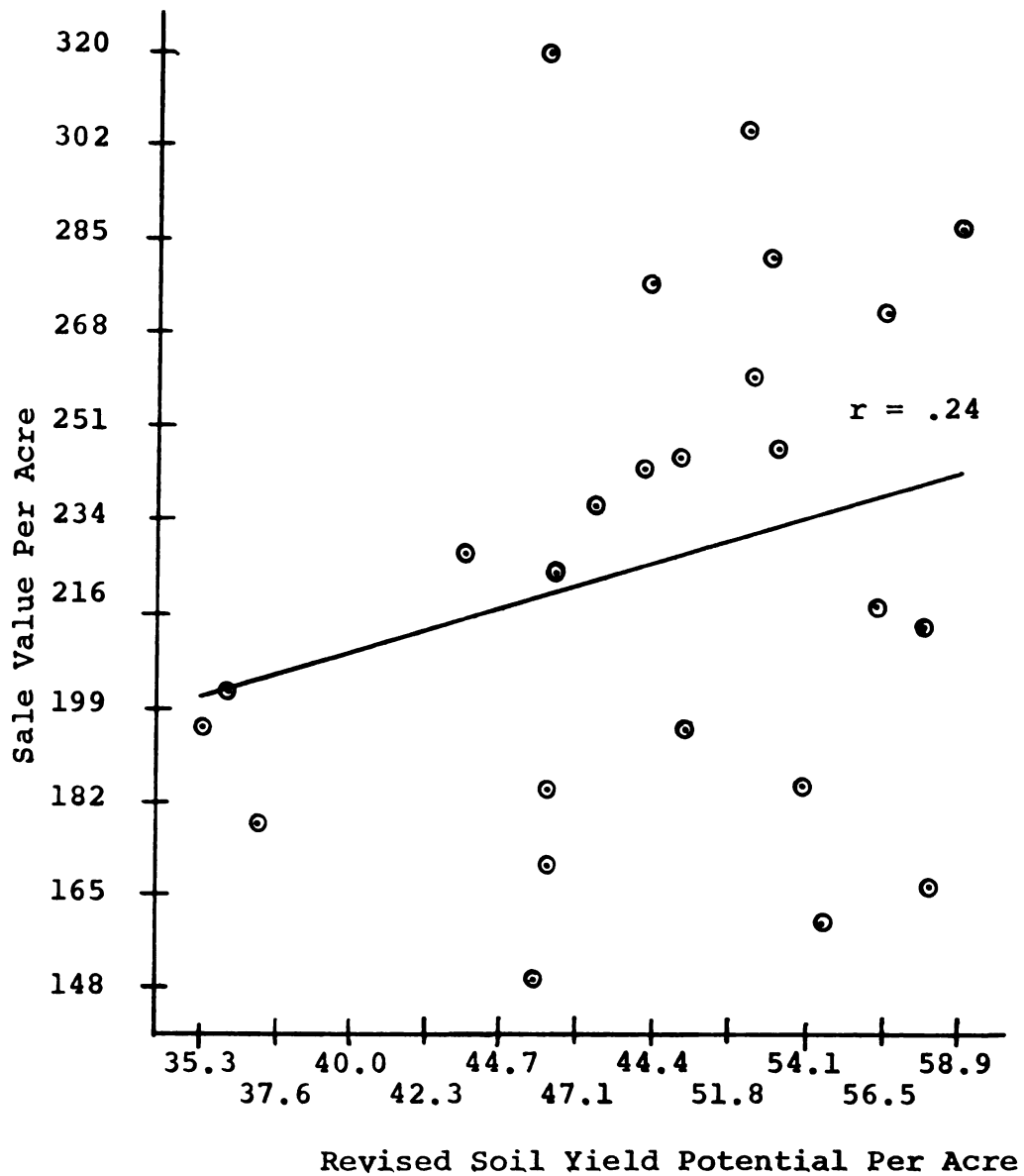


Figure 8. A Graph Showing the Relationship of the Sale Value Per Acre for Cropland to the Average Revised Soil Yield Potential Per Acre for 25 Farms in Eaton County.

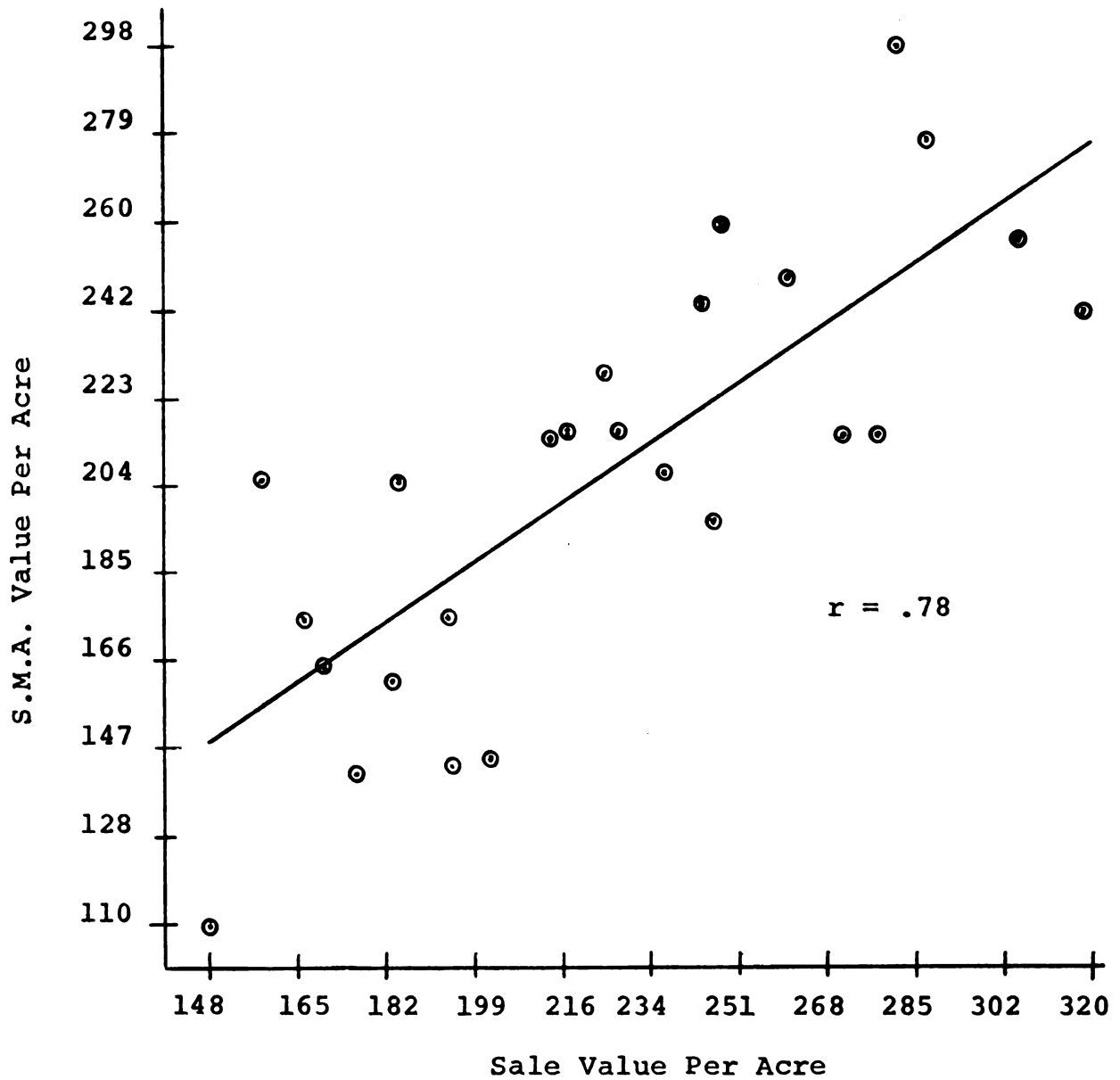


Figure 9. A Graph Showing the Relationship of the Sale Value Per Acre and to S.M.A. Values Per Acre of Cropland for 25 Farms in Eaton County.

The Revised S.M.A. values per acre were also compared with the sale price per acre. These results are in Table IV, columns 6 and 8, and Figure 10. The correlation coefficient was .24 and the average value per acre for the computed value was 99% of the average sale price per acre.

The assessed values of the 25 properties studied, as determined by the townships assessors and the Eaton County Board of Review, were obtained from the Eaton County Equalization Department. The average assessed value over sale value ratio was .45, or total assessed values average 45% of total sale values.

As explained previously, the total assessed values of tillable cropland for the 25 farms studied was obtained and compared with the total sale values of the cropland. The assessed values are shown in Table III and graphically in Figure 11. The correlation was significant at the 5% level and the correlation coefficient was .83. Thus 68% of the variability in total sale value was explained by variation in assessed value. The average assessed over sale value ratio for cropland was .41. When the assessed over sale value ratio is determined for those farms with cropland value greater than \$10,000, it is found to be .37, and for farms with cropland value less than \$10,000 it is .48. Thus the assessed values tend to over value the low value cropland and under value the high value cropland.

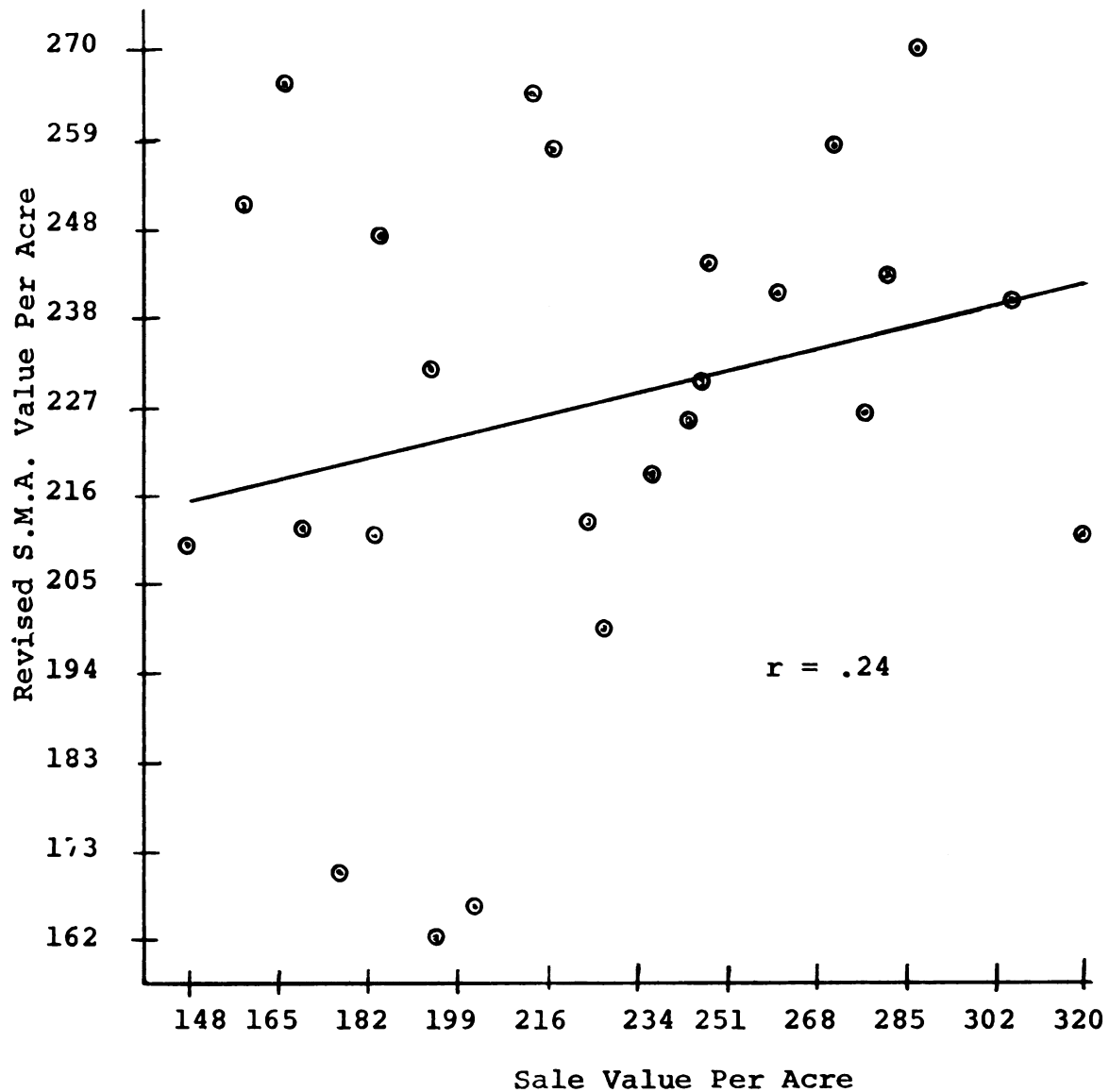


Figure 10. A Graph Showing the Relationship of the Sale Values Per Acre to the Revised S.M.A. Values Per Acre for Crop-land of 25 Farms in Eaton County.

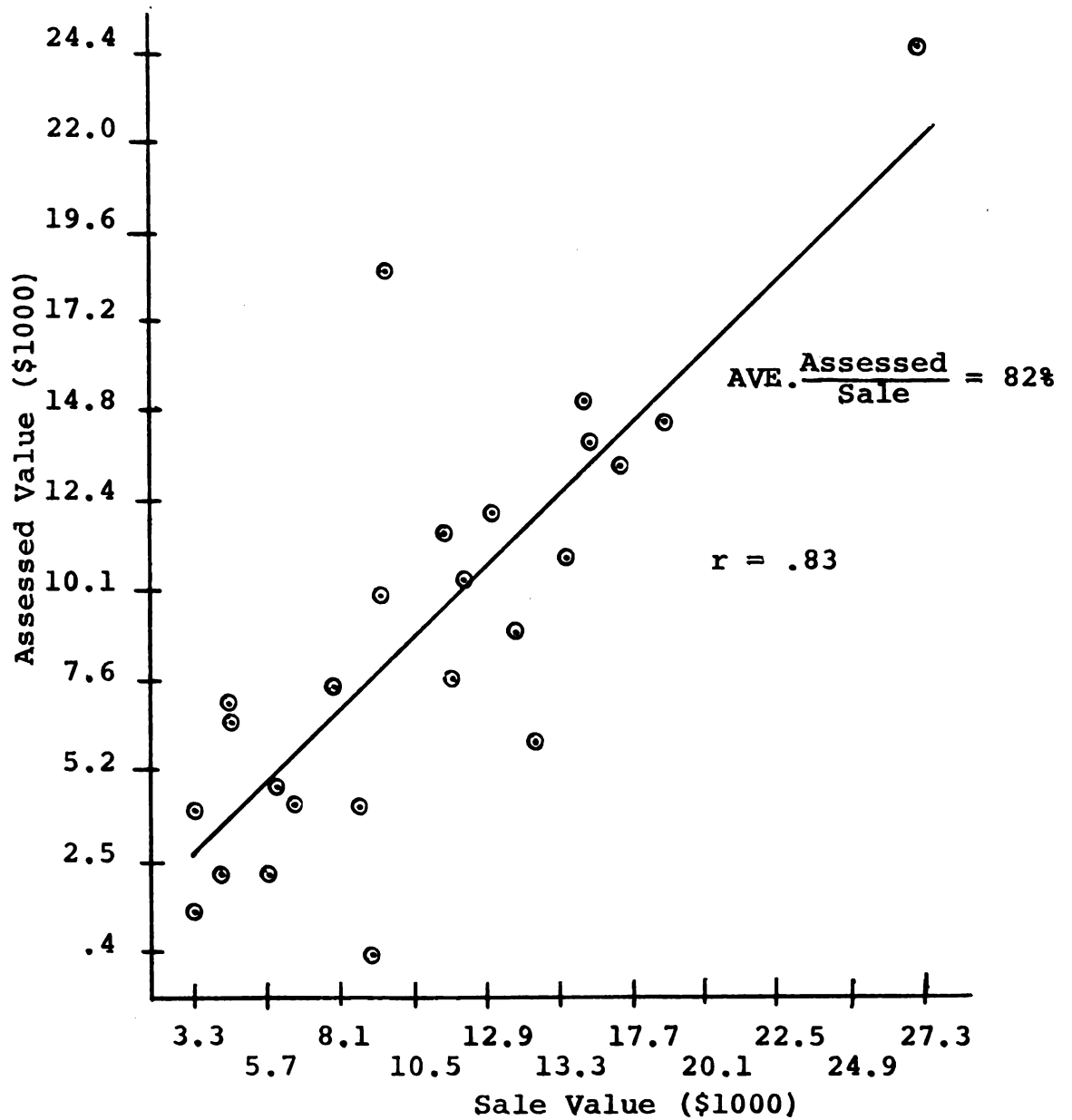


Figure 11. A Graph Showing the Relationship of the Assessed Value for Cropland to the Sale Values for 25 Farms in Eaton County.

When the assessed values on a per acre basis for the 25 farms studied are compared with the sale values per acre the correlation is nonsignificant. The same is true when assessed value per acre are compared with the per acre soil yield potentials. Thus there is no relationship between assessed value per acre and the average soil yield potential per acre or the sale price per acre.

Since most of the relationship for assessed values is with the amount of cropland or size of farm, it seems that the S.M.A. procedures and the Net Income procedure are preferable ways of appraising farmland for assessment purposes.

Discussion

A method of evaluating tillable cropland by use of a soil yield potential-sale value ratio was presented along with a revision of this procedure. The present soil yield potential was determined from the soil management groups present and their respective soil yield potentials. This procedure was used to evaluate the tillable cropland of a number of farms in Eaton County, Michigan. Tests were conducted to determine the accuracy of these evaluations.

Values were computed for individual soil management groups which occurred on the farms studied by the above procedures. When these values were compared with values obtained by a net income procedure, wide variations occurred for the low and high value soil management groups. Intermediate value soil management groups had similar values for

both procedures. The average S.M.A. values were 90% of the Net Income values. The correlation coefficient was .97. Similar results were obtained with the Revised S.M.A. Procedure.

The correlation coefficient was the same and the average Revised S.M.A. values were 92% of the Net Income values. Both the S.M.A. and Revised S.M.A. values tend to overvalue low value cropland and undervalue high value cropland when compared with the Net Income values. The variation between Revised S.M.A. values and Net Income values were less for both the high and low value soil management groups, as compared to the S.M.A. values. Thus the Revised S.M.A. Procedure seems to compare more favorably with the Net Income Procedure. This is evident in Figure 1 where the regression lines for the Revised S.M.A. values approach closer to the equality line than the lines for the S.M.A. values.

Comparisons between computed values for three soil management groups were made with per acre sale values of farms where each group made up more than 75% of the farm. These comparisons showed that the S.M.A. and Revised S.M.A. values were generally within the range of the sale values. The computed Net Income values were within the sale value range for one soil management group. Thus from the comparisons made even though the number of farms with a large percentage of one management group present is small and

all are not equally composed of the same other soil management groups the S.M.A. and Revised S.M.A. computed values do occur close to or within the range of the sale values for the respective soil management groups. The sale values, however, tended to show less response to productivity than the Net Income values predicted.

When the adjusted 1967 sale values of cropland were compared with the Net Income procedure values for the 25 Eaton County farms studied, the individual farm values obtained showed some wide deviations. The average Net Income values were 92% of sale values, with a simple correlation of .87.

Comparisons between the total soil yield potential and cropland sale values of the farms studied showed a high correlation of .96. This significant relationship validates the S.M.A. procedure relating sale values and soil yield potentials. The total revised soil yield potential correlation with sale values was slightly lower at .92.

The S.M.A. total values showed a correlation of .97 when compared with sale values. They also averaged 90% of the sale values. The Revised S.M.A. values had a correlation of .92 with sale values and the average value was 99% of sale value. Thus the significant relationship between total sale values and total soil yield potentials for cropland remains when the soil yield potentials are converted into computed sale values. The difference between the

correlations of the S.M.A. and the Revised S.M.A. values with sale values is non-significant.

The significantly lower correlation of the net income procedures values and the slightly lower correlation of the Revised S.M.A. procedure's values (which are obtained by using a net income productivity rating) with sale values, as compared to the correlation of the S.M.A. values, may be due to a lack of understanding of the buyers in the cropland market. Buyers may have a tendency to generally over value poorer cropland and under value better cropland much the same as assessors tend to do, as was discussed in the literature review. This may be due to a lack of understanding that land values do not increase directly with yields, because the cost of producing the crop commonly contains fixed per acre costs not proportional to yields. Thus the revised productivity ratings may not yet be recognized by buyers as economically significant. These revised productivity ratings may be better, even if they are not statistically significantly better correlated, because they are logically better founded and just as easy to apply.

When the per acre sale values of the farms studied were compared with the average per acre soil yield potentials and per acre S.M.A. values the correlations were .60 and .78 respectively, and were significant at the 5% level. This lower correlation than that obtained for total value can

be explained in part by looking at the farms in order of increasing number of acres of cropland. As farms increase in acres of cropland they generally tend to receive a larger sale price per acre for the same soil yield potential per acre than farms with fewer cropland acres. This effect lowers the correlation so that 61% of the variation in sale price per acre can be associated with variation in S.M.A. value per acre.

The comparison of the Revised S.M.A. values per acre and revised soil yield potentials per acre with sale values resulted also in lower correlations than those obtained for the totals due to the previously mentioned misunderstanding of buyers and the effect of the number of cropland acres in a parcel on sale prices.

Assessed value-sale value ratios for the 25 farms studied was typical of the previously mentioned bias in the literature review and as discussed for Figure 1. Farms of low value were assessed proportionately more than were farms of high value. When the assessed value of cropland was compared with the sale value only 68% of the variation in total assessed value could be explained by variation in assessment. As previously stated the S.M.A. total values could explain 94% of the variability in sale values and thus the superiority of the S.M.A. procedure over the assessors procedures in determining true cash value of cropland is seen.

This superiority is also seen when the assessments per acre are compared with the sale values per acre or the soil yield potentials per acre. The correlations is non-significant even at the 80% level. Thus there is no apparent relationship for the 25 farms studied between the assessed value per acre and sale values per acre or between sale value per acre and soil yield potential per acre or revised soil yield potential per acre.

In the S.M.A. procedure soil areas with slopes of 6 to 18% have productivity reduced by a percentage figure based on the appraisers judgement. Since all modern soil surveys have the slope class designated for the mapping unit it was felt a more accurate way of determining the amount of reduction in soil yield potential could be made. The reductions proposed here are those used by Priest (15).

It is known that yield is generally reduced in direct relation to the amount of topsoil lost from a given soil, (23) and that the effect of erosion is less for coarser textured soils and as vegetative cover becomes more effective in stopping erosion. Table VI gives the corrected soil yield potentials for C and D slopes that would be required for the respective management groups.

Inadequate drainage or needed protection from over-flow also reduces the total soil yield potential for a given area. In the S.M.A. procedure these totals are reduced a certain

percentage depending on the appraisers judgement. Since soil productivity differences will vary considerably from area to area, no previously determined percentage reduction can be made for the different soil management groups that are inadequately drained. The following guidelines are proposed to aid in determining the percent reduction required for inadequately drained (i.e. somewhat poorly drained, and poorly drained) soils:

- (1) Determine the proportion of years that crop growth is reduced due to high water table or surface flooding. (For example: 1 out of 5 years = .20).
- (2) Determine what proportion of the expected crop growth in the inadequately drained field is lost in years when high water table or flooding occurs.
 - a. If the total crop is lost, then the reduction in productivity is the percent of years in which the high water table or flooding occurs.
 - b. If only a proportion of the crop is lost then the percent reduction in soil yield potential equals the percent of years times the percent loss. (For example: if damage occurs 2 out of 5 years and affects 50% of the crop, then then the percent reduction equals 20%).

Additional Research Needs

The accuracy of the Soil Manual for Appraisers procedure in determining cropland value depends on the accurate

delineation of the various soil types, and the determination of the soil yield potentials for the respective soil management groups. It is therefore necessary that accurate soil survey information be made available in areas where this procedure is used. It is also necessary that additional research be conducted in determining yields on the various soil management groups so that the soil yield potential determinations will represent the continued influences of new technology and management.

Additional research needs to be conducted in determining the influence of farm size on its selling price. From the farms in this study there seemed to be a trend for the larger properties to have higher per acre values than smaller properties. If this were to be true in most areas, research needs to be conducted so proper corrections for this size influence could be made.

Research also needs to be conducted in determining other crops to use in the S.M.A. procedure, for determining the soil yield potential in areas where crops other than corn are dominant.

Since the S.M.A. procedure does not provide a method for evaluating pasture lands, orchards, and woodlots by soil productivity, research should be conducted so that ratings for these specific land uses could be derived. Once these ratings are obtained they could be related directly to sale values or net income values.

Research also needs to be conducted for soils that have low natural productivity ratings, but may have greatly increased ratings with improved technology, for example if irrigation or asphalt soil barriers are installed. Since most of these modifications are expensive, it would be the net increase in productivity that would be significant.

In some areas of the country for example, New Jersey, farmland is being assessed on its net income potential and not its true cash value, which is related to sale values. There have been proposals that this type of system be incorporated into the Michigan tax laws. If this type of procedure becomes law, additional research should be conducted in the use of the Revised S.M.A. procedure which would be preferable because it does use a net productivity index for arriving at a value. Since high level productivity ratings are used in the S.M.A. procedures research needs to be conducted to determine the actual average productivity ratings so that the average net incomes can better be determined.

CONCLUSIONS

On the basis of the results of this study the following conclusions seem warranted:

- (1) the Soil Manual for Appraisers, S.M.A., procedure was satisfactory in determining the true cash value of cropland in Eaton County;
- (2) the Revised Soil Manual for Appraisers, Revised S.M.A., procedure was satisfactory in determining the true cash value of cropland and was also slightly better correlated with the Net Income procedure values than the S.M.A. procedure in Eaton County;
- (3) the use of soils and crop yield information are musts if accurate, reliable, and reproducible values are to be obtained;
- (4) the use of the S.M.A. or the Revised S.M.A. procedures, particularly the latter, would tend to eliminate the bias of under-valuation of high value properties and overvaluation of low value properties that commonly occur in assessments;
- (5) revisions can be made in the S.M.A. procedure so that it can be more accurate and can be used throughout the southern part of Michigan;

(6) other situations probably needing revisions of the S.M.A. procedure for farmland evaluations in Michigan are:

- (1) areas where crops other than corn are dominant;
- (2) areas where orchard and woodlots are numerous,
- (3) areas where pastures are numerous,
- (4) situations where soils of low natural productivity have it increased by new technologies such as irrigation or asphalt barriers.

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APPENDICES

TABLE I.--Year of Soil Mapping, Year of Sales Analysis, Soil Yield Potential-Sale Value Ratios, and Indexes used to Update Net Income Values for Selected Townships in Eaton County, Michigan.

Township	Year of Mapping	Year of Farm Sales Analysis	Soil Yield Potential-Sale Value Ratio	Indexes Used to Update Net Income
Benton	1965-1968	1968	2.15	1.77
Brookfield	1933	1969	2.10	1.89
Carmel	1965-1968	1969	1.75	1.89
Chester	1933	1968	2.15	1.89
Eaton Rapids	1965-1968	1969	2.00	1.77
Hamlin	1965-1968	1969	2.00	1.89
Kalomo	1933	1967	1.75	1.77
Oneida	1965-1968	1968	2.15	1.77
Roxand	1933	1968	2.15	1.63
Sunfield	1933	1969	2.30	1.77
Walton	1933	1967	1.60	1.53
Windsor	1965-1968	1967	1.80	1.53
Eaton	1965-1968	1969	2.25	1.89

TABLE II.--Cropland Value Per Acre by Soil Management Groups for Walton, Kalomo, and Sunfield Townships, Eaton County, using Three Different Procedures.

Soil Mgm't. Group	Net Income Procedure	S.M.A. Procedure	Revised S.M.A. Procedure
Walton Township			
4a	\$ 56	\$120	\$ 89
4c	128	144	132
3a	147	152	147
3b	230	168	176
3c	234	176	191
2a	194	176	191
2b	263	192	219
2c	292	208	249
Sunfield Township			
4a	65	172	114
4c	145	207	170
3a	171	218	188
3b	261	241	275
3c	272	253	243
2a	225	253	243
2b	306	276	280
2c	339	299	317
Kalomo Township			
4a	65	120	97
4c	145	144	145
3a	171	152	161
3b	261	168	192
3c	272	176	208
2a	225	176	208
2b	306	192	239
2c	339	208	271

TABLE III.--Cropland Sales and Assessed Values from Farm Sales Analysis of the Eaton County Equilization Department.

Township and Farm No.	Total Acres	Acres Tillable Cropland	Sale Year	Sale Price	Value of Buildings and Non-cropland	Value of Cropland Year of Sale	Total Assessed Value	Assessed Value of Cropland Times 2
Walton								
1	50	37	1966	15,000	8,384	6,616	6,500	4,616
2	40	37	1963	12,500	7,247	3,308	4,500	1,753
4	80	53	1964	17,500	8,801	8,699	6,600	4,399
5	160	77	1965	25,000	12,791	12,209	11,600	10,409
7	32	21	1963	10,000	6,580	3,420	5,400	4,220
Sunfield								
A	36.3	33	1967	11,500	3,461	8,039	5,500	7,539
B	95.3	81.9	1965	25,000	8,872	16,128	12,000	15,128
C	80	62	1966	28,000	10,566	17,434	12,000	13,434
D	67.5	45.1	1967	24,000	12,225	11,775	10,000	7,775
E	110	66	1967	31,350	14,991	16,359	14,500	14,009
F	55	53.3	1967	16,000	640	15,360	5,900	11,160
J	80	51.4	1967	14,000	2,435	11,565	7,000	11,565
K	80	64.4	1965	14,000	818	13,182	6,500	12,182
Eaton Rapids								
C	80	56.6	1967	12,000	2,371	9,629	10,500	18,629
E	24	15.0	1967	5,000	854	4,146	1,800	2,746
Windsor								
2	60	52	1965	10,000	400	9,600	5,200	10,000
3	38	30	1966	7,000	1,000	6,000	3,000	5,000
4	80	80	1965	27,000	8,243	18,757	11,400	14,577
5	158	121	1965	36,500	9,153	27,347	16,800	24,447
6	40	28	1966	11,500	7,044	4,456	7,100	7,156
Brookfield								
B	40	26.8	1968	5,500	953	4,547	2,800	6,647
C	60	29	1969	10,000	4,317	5,683	3,500	2,683
E	125	52	1968	19,500	5,528	13,972	7,300	9,072
F	60	45.5	1967	24,500	9,920	14,580	8,000	6,080
G	40	32.3	1967	15,900	6,774	9,126	3,600	426

TABLE IV. ---Sale Values and Computed Values for 25 Farms in Eaton County, Adjusted to the Year 1967, Values Computed by the Soil Manual for Appraisers Procedure, the Revised S.M.A. Procedure, and the Net Income Procedure.

Township and Farm No.	Cropland Sale Value 1967	S.M.A. Value	Revised S.M.A. Value	Net Income Procedure	Sale Value Per Acre	S.M.A. Value Per Acre	Revised S.M.A. Value Per Acre
Walton							
1	7,215	7,585	7,770	9,250	195	205	210
2	6,660	6,300	5,735	5,180	180	170	155
4	10,335	9,010	8,215	7,685	195	170	155
5	14,245	14,630	16,555	15,980	185	190	215
7	4,305	3,570	3,150	3,150	205	170	150
Sunfield							
A	8,805	8,575	8,050	8,580	245	260	245
B	18,837	18,361	16,790	16,789	230	215	205
C	19,220	15,750	15,750	16,120	310	250	250
D	11,726	11,726	11,275	13,079	260	260	250
E	16,500	17,160	16,830	17,820	250	260	255
F	15,457	14,910	14,910	16,474	290	280	280
J	11,565	11,797	11,308	11,565	225	230	220
K	15,134	15,778	14,490	16,744	235	245	225
Eaton Rapids							
C	9,622	10,471	11,037	12,452	170	185	195
E	4,200	3,204	3,054	3,204	280	215	205
Windsor							
2	11,180	13,000	13,000	15,273	215	250	250
3	6,600	7,500	7,350	8,292	220	250	245
4	21,600	20,000	23,600	24,394	270	250	295
5	30,250	27,225	26,015	27,297	245	225	215
6	5,180	6,720	6,720	7,288	185	240	240
Brookfield							
B	4,288	5,092	5,494	7,274	160	190	205
C	4,964	4,818	6,278	9,019	170	165	215
E	13,234	10,120	10,120	12,630	253	195	195
F	14,560	10,233	8,872	8,518	320	225	195
G	9,225	9,044	9,044	5,593	285	280	280

TABLE V.--Soil Yield Potential Ratings and Revised Soil Yield Potential Ratings and Their Average Ratings Per Acre for 25 Farms Studied in Eaton County, Michigan.

Township and Farm No.	Total Soil Yield Potential	Average Per Acre Soil Yield Potential	Revised Total Soil Yield Potential	Revised Per Acre Soil Yield Potential
Walton				
1	4065	109.9	1864	50.4
2	3308	89.4	1372	37.1
4	4775	90.1	1872	35.3
5	7840	101.8	3553	46.1
7	1915	91.2	759	36.1
Sunfield				
A	3495	106	1619	49.1
B	7698	93.9	3568	43.6
C	6931	111.8	3236	52.2
D	4885	108.3	2365	52.4
E	7466	113.1	3510	53.2
F	6450	121	3139	58.9
J	5129	99.8	2387	46.4
K	5826	90.5	3065	47.6
Eaton Rapids				
C	4716	83.3	2618	46.2
E	1604	107.6	733	49.2
Windsor				
2	6210	119.4	3004	57.8
3	3600	120.0	1689	56.3
4	9575	119.6	4515	56.4
5	13205	109.1	6070	50.2
6	3202	114.4	1513	54.0
Brookfield				
B	2632	98.2	1471	54.8
C	2453	84.0	1693.6	58.0
E	5246	101.0	2734	52.7
F	5205	114.4	2091	46.0
G	4591	142	1708	52.9

TABLE VI.--Soil Yield Potential for Soil Management Groups
with the Reduction Percentages Required for C
and D Slopes.

Soil Mgm't. Groups	Soil Yield Potential	% Reduction for Slope
Clays		
Oc	90	
1a	95	22%
1b	110	
1c	120	
Clay loams		
1.5a	105	22%
1.5b	115	
1.5c	125	
Loams		
2.5a	110	22%
2.5b	120	
2.5c	130	
Sandy loams over clay or loams		
3/2a	105	17%
3/1b or 3/2b	115	
3/1c or 3/2c	120	
Sandy loams		
3a	95	17%
3b	105	
3c	110	
3/Ra	85	
Loamy sands over clay or loam		
4/2a	95	17%
4/2b-4/1b	100	
4/2c-4/1c	105	
Loamy sands		
4a	75	17%
4b	80	
4c	90	
4/Ra or 4/Rb	55	
Sands		
5.0a	50	14%
5b	60	
5c	80	

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