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USE OF SOIL SURVEYS IN LAND VALUATION FOR TAX ASSESSMENT

by

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INTRODUCTION

Our complex society has increasingly demanded more and better public services. The taxpayers are demanding better schools, hospitals, recreational facilities and other services that are needed to enhance our social and economic well-being. Better schools and improved roads account for the bulk of our local property tax expenditures (30). With increased demands for public services, the cost of local government is creating a situation of tax escalation and many of the service demands (for example, school district boundaries) are crossing taxing districts.

The tax assessor who is a local functionary of county and city governments is required by Iowa Law to place an assessed value on all real and personal property in his taxing district. The assessed value of the real and personal property should be equalized at two levels. First, if each property in a taxing district is to be treated equally, it is necessary to have equalization of tax assessment between properties. Second, revenue collected from two or more taxing districts may be used for a common cause such as for area schools or roads in which case just taxation can be achieved only through equalization of taxes in the different taxing districts. An additional reason for the necessity of between district equalization is that property tax relief in the form of state aid is based on a formula which includes the assessed values of the various taxing districts.

In obtaining an assessed value for each tract of land, the ultimate would be for all tracts of land to be sold at the beginning of each assessment period. Then the assessor would have the current value of all tracts of property in his taxing district at one particular incident of time. This sort of situation is unrealistic; therefore, a more subjective method of valuation must be used in order to obtain the values of the tracts not sold.

Several approaches have been used to estimate the value of land in the past. Assessors have used the net income or capitalization approach, the comparative value approach, and by the summation approach or a combination of these approaches. Each of these approaches requires many personal decisions by the appraisor and requires a transfer of historical data to the present situation and in many cases, the basic data required is not available in detail. The two most common approaches used by assessors are the capitalization (net income) and the comparative approach. For example, in the net income capitalization approach, the income of a particular tract may not be available and if it were available, there would be many factors contributing to the income of a tract in addition to the tract of land itself such as management, fertilizer, etc. Therefore, the appraisor must sort through these factors of income and make an estimate of the income for the particular tract of land at some arbitrarily defined level of management.

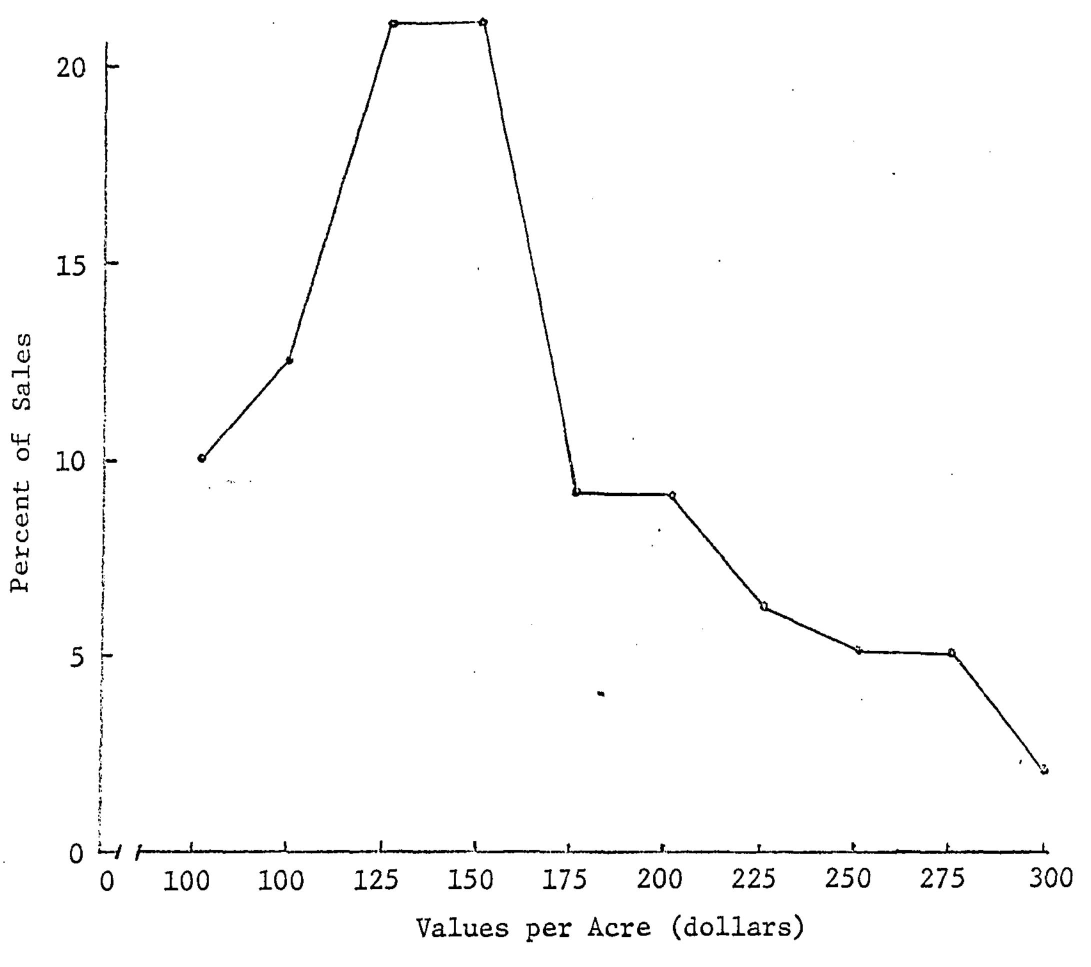
The comparative approach of placing a value on tracts of land is based on the principle of using the value of tracts recently sold to estimate the value of other tracts of comparable soils, buildings and other improvement. This type of an approach offers the possibility of introducing the soil survey discipline into land appraisal; soils can be delineated in terms of soil units and mapped. With known information with respect to soil conditions yield potentials for certain crops, intensity of use for particular crops and input requirements for the various soil types, comparisons can be made between tracts of land.

This study combines two major disciplines, Economics and Soil Science, to provide aid to the assessor in dealing with the assessment of parcels of rural property for assessment purposes. The study is designed to use the basic resource knowledge provided by the soil survey as a tool for land assessment and to combine this resource knowledge with the economic data provided from recent farm sales. This is possible for two reasons. First, the land in the area of study is almost exclusively used for agricultural purposes and secondly, soil classification is strongly plant behavior oriented and related directly to management inputs. The primary focus of the study is to provide aids or guides to the assessor which he can use in obtaining equalization of assessment of parcels of land within and between taxing districts. The taxing district in this study coincides with the county.

The Problems of Obtaining Land Values for Assessment Purposes

The county tax assessor is confronted with the problem of assigning values to tracts of land for tax assessment purposes. The legal framework within which the assessor must operate states that parcels of land be taxed at a percentage of their market value and be assessed proportionately to all other property (24). In a twelve township county, the smallest in the state, the assessor has by area approximately 7000 tracts of land to assess, but he may have recent sales data on a very small percent of the total number, some of which would have buildings and others with virtually no improvements. Therefore, one major problem faced by the assessor is to assign a market value for many individual parcels of land in the absence of actual market data for a specific tract. Actual sales data show there is a wide range of value per acre on the various tracts that have sold. This is indicated in Figure 1 which is based on data collected in Adams County, Iowa. Purchase price per acre of the various tracts in this county in 1966 ranged from less than \$75.00 per acre to more than \$300.00 per acre. Approximately one-half of the tracts were purchased for prices ranging from \$125.00 per acre to \$175.00 per acre. With such a wide range of sales values, the assessor is faced with the problem of classifying tracts of land in terms of similarity to the various tracts that have sold recently. He must consider the basic components of value of a particular tract such as the soil, buildings, and location in making these comparisons.

Figure 1. Distribution of value per acre of land sold in Adams County for 1966


20
15
10
5
0
Percent of Sales
0
100
100
125
150
175
200
225
250
275
300
Values per Acre (dollars)

Buildings can be valued in terms of replacement cost or their functionality through valuation proceedings currently accepted; however, the soils with varying potentials to produce income are very heterogenous within a tract and between tracts of land. The soil resources within a tract of land influence the present and future earning capacity of land and in turn have a direct influence on the value of the tract of land. Land value may be based on the visible evidence of productivity of the soil, but the problem arises as to whether the productivity is inherent to the soil or the management of the operator. This creates a need to transform the attributes of a tract of land via soils information into an economic framework enabling the assessor to make an orderly assessment of similar tracts.

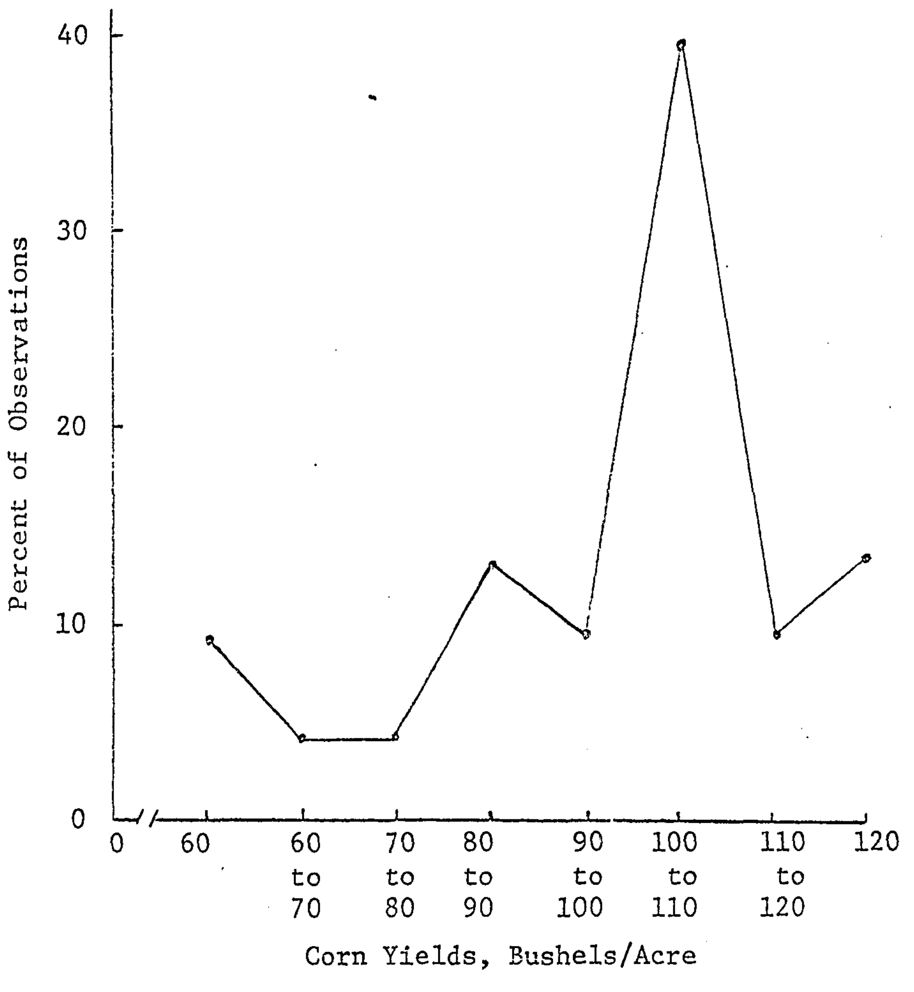
Use of Soil Survey in Land Valuation for Tax Assessment

The primary purpose of the soil survey is to classify and map soils, to determine their physical and chemical nature, and to determine their agricultural adaptation and use possibilities, as well as to identify the principal problems associated with the various soil types. This information provides an inventory of the soil resources of a particular area and makes possible an accurate prediction of potential agricultural production (56). Because soil properties can be interpreted in terms of agricultural potentials, it is possible to use soil survey data in economic studies.

The soil survey provides the assessor with quantitative and qualitative soils data of a tract of land. This enables him to compare one tract with another in terms of combinations of soil types, slope, and many other agronomic or use aspects. From this information, the assessor can ascertain the use potential of the soils in terms of productivity of various land use systems at different management levels and theoretically can arrive at a value for the tract. Which level of management to use becomes the question. Soil investigators know that the same soil type, same slope, same degree of erosion will have varying yields because of differences in management imposed upon the soil. Figure 2 shows this variation in yield for a Sharpsburg soil on a 7 percent slope, moderately eroded (13). In this example corn yields ranged from less than 60 bushels per acre to greater than 120 bushels per acre because of differences in management. In the absence of production records some average level of management is generally chosen and used in making estimates as to the value of one soil unit in relation to another.

The assessor then can assemble all the information about a tract, cast the data into an economic framework, and place a value on it for assessment purposes. Similarly, values for the approximately 7000 tracts of the county can be obtained. If this approach is used by the assessor, not only is a vast amount of technical data required but also a transfer of a set of technics from one discipline. This study deals with providing aids to the assessor to facilitate the transfer of soils and

Figure 2. Distribution of corn yields in Adams County on Sharpsburg soils, 7 percent slope, and moderate erosion



Source: Corn Yield Study (12)

agronomic data to the economic areas.

Objectives of the Study

The information gained through soil survey and related research is used to identify the productivity of soils and the alternative uses a soil might have. The soil survey provides an inventory of the soil resources classified into defined taxonomic units relating the important soil characteristics. It shows the geographic distribution of soils of a county or farm and offers the means to relate research to predict the suitability, input requirements, and expected output for soil use alternatives (1). The present study explores ideas and techniques that will facilitate the identification of feasible appraisal alternatives and aid in the solution of various appraisal problems.

The objectives of this study are:

1. To explore alternatives in using soil survey information as a basis for the appraisal of tracts of land for tax assessment purposes.

2. To develop a method that may be used in appraising land based on soil survey information and other data.

Hypotheses Guiding the Study

Hypotheses are statements of tentative relationships provisionally adopted for purposes of testing and explaining certain facts and relationships as guides for investigations of other facts. Hypotheses may serve several functions in scientific inquiry. First, hypotheses may be used to set bounds for an analysis in terms of delimiting the problem for study. Second, hypotheses may be used to identify possible causes of a problem in terms of a diagnosis hypothesis. Third, remedial hypotheses may be used in attempting to identify and test remedial measures to improve the present situation. The following hypotheses were formulated to guide this study.

Delimiting hypotheses

Delimiting hypotheses set "bounds" for the study. For this study, two problems that hinder the attainment of the objective of equalized tax assessment between tracts of land were delimited by the following hypotheses.

1) If the average current market value of tracts of land is the basis of tax assessment in the legal framework, then methods will have to be developed to transfer the sales data from tracts that have recently sold to comparable tracts that have not been exchanged over a long period of time. The assessor must place values on approximately 7000 tracts of land in the smallest Iowa counties with limited resources and limited sales data.

2) If recent sales data are to be used as a basis for valuating comparable tracts of land, then methods of comparison of one tract of land to another must be developed. One such method of comparison suggested might be made from soil survey interpretations in light of current economic theory and past

studies in the area.

Diagnostic hypotheses

In attempting to explain the causes of the problem delineated above, the following diagnostic hypotheses were proposed:

1) A mean value of soil mapping units or ratings of soil mapping units are identifiable in terms of current market value and are important in determining the value of tracts of land for tax assessment.

2) The value of land, buildings, location, and current use constitute the major value components in rural land values.

3) The assessor is limited in terms of resources and economic data which he can use in placing values on the large number of tracts of land in his district. Therefore, any system of land assessment must be simple, relatively low cost, and one that can be administered within the limitations of his resources.

Remedial hypotheses

Remedial measures for the problems delineated above can be hypothesized as follows:

1) If soil properties identified through soil survey interpretation are an indication of the land use alternatives and reflect present average value of a tract of land, then there are possibilities of using soil surveys in conjunction with other value components in the valuation of farm land for tax assessment purposes for counties where modern soil surveys are

completed.

2) If the average current market values can be assigned to identifiable components of value such as value of certain soils or value of ratings of soils in terms of the legal framework and accepted economic practices, then an equalization of assessment can be obtained within a taxing district as well as between taxing districts.

Methods Used in Testing the Hypotheses

Multiple regression techniques were used to estimate the various components of value for each of the tracts. The units of observation for the analyses were the soil mapping units fitted into corn suitability ratings or yield-slope categories, the assessed value of building, location of tracts in terms of dummy variables, and land use in terms of timber versus no timber. The dependent variable was sale value of farms over a 5-year period.

Two models were used, one a straight multiple regression model with a time series variable used to estimate the value of corn suitability ratings and the second was a curvilinear regression model used to estimate the yield-slope values for the various soils.

The conduct of the hypotheses testing stage of the study was divided into three stages which incorporated the interpretation of the soil survey into manageable forms that would fit into an economic framework and the regression models.

First, areas of study were selected from which a reasonable number of farm sales were available and modern soils survey data for the entire county were available.

The second stage was the preparation of the sample in terms of calculating mean values of the corn suitability ratings for the farms that sold for one approach and the arranging of soil mapping units into yield-slope categories for the other approach. The soil survey data which included acres of soils by type, slope, production potential and etc. was used in both approaches.

The third stage was the actual testing of the model and hypothesized theory by multiple regression techniques and the development of methods for assessment.

Details of these methods will be elaborated in the following chapters.

Selection of Study Area

The area of study was confined to Adams and Humboldt counties, Iowa. These counties were chosen because both were rural counties which eliminated the metropolitan influence in terms of land value. These counties also have a modern soil survey which provides detailed soils information, and the soils and types of farming are quite contrasting between the two counties. Another reason that they were studied is that both counties are currently using soils data in their assessment programs.

A more detailed description of the areas in terms of soils, topography, land use and economic data follow in a later chapter.

Plan of Report

This report consists of seven chapters. Chapter I is an introduction to the study and consists primarily of the introduction of the problem, the objectives of the study, the hypotheses guiding the study with a brief summary of methods used in testing the hypotheses. A brief discussion of the selection of study area as well as the plan of the report are found in Chapter I.

Chapter II consists of a review of relevant background material. It includes a review of economic theory relating to land values and appraisal systems as well as the legal basis and framework assessors must use for the assessment of taxes on farm land. This section also includes a section on soil surveys in terms of soil interpretation and areas in Iowa that have modern soil surveys in which similar studies might apply. Finally, this chapter includes a brief review of selected studies in land valuation.

A detailed description of the geographic areas studied is presented in Chapter III. Here Adams and Humboldt Counties are characterized in terms of their soil resources and economic productivity.

Chapter IV contains the methods for obtaining land values for assessment purposes and includes a discussion of sample treatment, the development of the regression models with a description of the variables, and a brief discussion of the statistical estimation procedures.

The application of methods to sample areas are presented in Chapter IV. The first half of this chapter deals with results using corn suitability ratings and the second half deals with the yield-slope groupings of the soil mapping units.

Chapter VI deals with the strength and weaknesses of the methods used to estimate the value of tracts of land for tax assessment. The summary and conclusions are presented in Chapter VII.

ECONOMIC, PHYSICAL AND LEGAL CONSIDERATIONS

The Theory of Land Values

Concept of land and soils

Webster (58) defines land as the solid part of the earth's surface. This is a broad definition because it only distinguishes the solid portion of the earth's surface from the sea. Barlow (7) defines land in an economic concept as the sum total of the natural and man-made resources over which possession of the earth's surface gives control. He considers land to mean any portion of the earth's surface over which ownership rights might be exercised and with these ownership rights in land go the tax responsibility.

Chryst and Timmons (8) have broadened the concept of land in terms of land resources to include all attributes of a particular tract of land encompassing it's natural, socially created, and economic attributes. The natural attributes of land would include, for example, the soil and climate of a soil resource. Location and publicly supplied improvements, such as highways, flood control, etc., would be socially created attributes. Investments in land of capital which become permanent fixtures, such as terraces and drainage systems, would be included in the economic attributes. Timmons (51) later defines land resources to include subsurface and supersurface resources in addition to the surface resources.

The term "land" in this study includes the broad concept of land proposed by Chryst and Timmons above but would exclude the value of buildings and location. The term "real estate" would include all the attributes of land, buildings, and location, and the term "farm" is used to denote the real estate holdings of an individual owner or tax payer and the farm may encompass several tracts of land.

The soil, one of the natural attributes of land, may be defined as a more or less continuous body covering that portion of land surface of the earth upon which plants grow (6). Soils have definite characteristics which vary from place to place. The differences in the characteristics of the various soils provided a basis for the classification of soils into soil series and further into soil types. The soil type is a group of soils having horizons similar in differentiating characteristics and arrangement in the soil profile and developed from a particular type of parent material. It is the combined expression of all those forces and factors that working together produce the medium in which plants grow.

Kellogg (27) defines a soil type as having its own elastic limit. Each soil type offers certain possibilities and definite limitations of production within the particular economic and social framework existing at any time. The techniques of soil use that man employs are basically designed to produce a relationship of soil to plant suitable to satisfy the aims of man both socially and physically. How a group of soils or land is used at any moment, with what techniques, and with what success depends upon the social and economic frame of references within which people work as well as the physical environment.

After soil types have been defined, knowledge regarding them can be accumulated and classified. This information can be recorded on a soil map. The soil map, according to Ableiter (2), is primarily a representation on paper of the distribution of the mapping units of a given landscape along with selected cultural and other physical features. The soil maps, by delineating those areas of soil that possess similar levels of productivity and similar physical characteristics which together influence the soils productivity, can be used to extend knowledge from one area to another easily and directly. As pointed out by Smith and Aandahl (44), the soil map is used to identify soils as a basis for applying resource and experimental results to individual tracts of land or even parts of fields.

In summary, land is made up of various soils which can be classified and mapped according to their various characteristics. Through the use of soil maps an inventory of soil resources of a tract of land or larger area may be obtained, thereby, offering a vehicle by which certain data may be easily and readily transferred.

Components and nature of land value

Value is not a characteristic inherent in an object (land) itself but depends upon the desires of man (4a). It varies from man to man and from time to time as the desires of an individual vary. An object such as real property or land cannot have value unless it has utility, and utility arouses a desire for possession. Utility alone does not give value; an object must be scarce or limiting. Therefore, utility plus scarcity are two elements that create value. According to Commons (9), economic value of land is a subjective concept dependent upon not only utility and scarcity but would also include futurity. Futurity in land is the basis for expected future income or satisfaction to land. Utility results from anticipated future flow of returns or satisfactions.

Reynolds (37) has conducted a study to identify the major factors affecting the value of farmland in the United States and to estimate their effect. He found that the following factors had a positive effect on farmland value. They were expected net farm income, government payments for land diversion, expected capital gains, farm enlargements, technological advance, and ratio of debt to equity. All these factors could be considered in terms of the present and future farm income.

Murray and others (31) hypothesize that valuation of farmland depends upon farm income which in turn depends upon crop yields, input cost, and farm prices. Yields reflect largely soils and climate; therefore, a careful measurement of soil productivity as determined by crop yields is a fundamental aspect of farm valuation. They suggest that soils may be given subjective productivity ratings that represent an average productive level of a soil type not what might be expected from a soil type on a given farm.

Other factors have been hypothesized as accounting for the strength of farm values. Renne (36) has hypothesized that generally favorable crop yields, optimism about the desirability of land as an investment, and desire of farmers to expand their existing holdings in order to utilize mechanization more fully have created a demand and strengthened the value of farmland. Tweeten (52) has hypothesized that the demand for larger acreages per farm has been the principal explanation for the recent rise in the value of farmland. Larger machinery and other technological advances make it possible for the farmer to handle larger acreages and may enable him to reduce his unit cost by spreading the overhead cost over many acres.

Value and price are considered to be equal under conditions of perfect competition. However, Weimer (59) points out that under actual conditions of the land market, price may be quite different from value. Weimer defines value as an estimate of the worth of a tract of land and reserves the term price as the actual amount of money a tract of land is exchanged for. The Iowa Legislature (25) defines value as the fair and reasonable exchange at a point in time between a willing buyer and willing seller, neither being under any compulsion to buy or sell and each being familiar with all facts relating to the particular property. Therefore, according to this definition, the value and price would be considered equal.

Land price is determined by the supply and demand forces operating in the market. According to Taeuber (50), the demand is formed by the buyer's consideration of the utility of the property for his future purposes. The supply is determined by the seller's consideration of the utility of the proceeds of the sale in respect to the utility of the present-property's value to him. Each has his own value of the property and the potential purchaser whose utility value is the highest buys the property provided he has the ability and willingness to pay the price. The marginal utility determines the economic importance of the property to the buyer and this estimate of marginal utility is a subjective value that creates a derived demand for land.

At this point, a distinction between the physical and economic concepts of supply and demand must be discussed. The physical supply of land refers to the physical existence of land (7). The economic supply of land is that quantity of land which will enter particular uses in response to price at a given time and a given place (36). The economic supply of land is only that part of the physical supply which man uses. It reflects the abundance or scarcity of land, it's relative accessibility and general use capacity. The economic supply of land can be contracted or expanded, and it is limited only by the physical supply.

The demand for land is the amount of land that users want and are willing to buy at various prices and arises from the various direct and indirect uses to which it can be put (36). The indirect demand is a derived type of demand. The derived demand results from the production potential of the land, its location or other advantages rather than the land itself (7). The direct demand for land results when land itself is used for consumption, such as residential or factory sites.

In this study, the economic supply and demand for land is of primary importance, and it is the interaction between the economic supply and demand operating in the market that determines the price. Price as summarized by Taeuber (50), would be the crystallization of a compound of the buyer's and seller's individual circumstances.

Characteristics of the land market

The land market does not have the usual characteristics of a purely competitive market. The purely competitive market is one where the product is homogeneous and there are many buyers and sellers in the market. The sale and purchase of each individual are small in relation to the total volume of transactions. There would be a free entry and exit from the market for both the buyer and seller. If it were a perfectly competitive market, it would differ from above because both buyer and seller would possess perfect knowledge in addition to the characteristics of the purely competitive market.

Reynolds (37) has pointed out in his study that the land market does not conform to purely competitive or perfectly competitive market in that:

1. Land is a very heterogeneous product.
2. There are generally a limited number of buyers and sellers present.
3. Free entry and exit to market may be restricted due to large amounts of capital required and the availability of credit.
4. Market is normally local, the seller only brings property to the attention of local buyers and sellers due to the fact that there is no national listing of property.
5. Fixed location of factor (land) demands that land be sold and used where it is physically located; this also tends to localize market.

The land market is further characterized by the fact that perfect knowledge of the factor (land) is not available. The local buyer normally has better knowledge of the product than an outsider, but in some cases, an outsider may gain knowledge of the product through some classification scheme such as a soil survey. However, in general, even the local people go into the transaction with far from perfect knowledge about the product.

Farm Appraisal System

The American Institute of Real Estate Appraisers (3) defines an appraisal as an estimate and opinion of value. It is usually a written statement of the market value or a value defined by the appraiser of an adequately described parcel of property and of a specified date. It is a conclusion which results from the analysis of facts.

The four methods of appraisal are capitalization, comparison, summation or a combination of two or more of these methods.

Capitalization method

The capitalization technique is one where anticipated net income is processed to indicate the capital amount of the investment which produces the net income. The capital amount is the sum of the anticipated annual income less the loss of interest until the time of collection. The sum of discounted value of future net returns or present value (V) may be expressed as (37, p. 30)

$$V = \frac{A_1}{(1+r)^1} \quad \frac{A_2}{(1+r)^2} + \ldots . + \frac{An}{(1+r)^n} \tag{2.1}$$

or equation 2.1 can be written as:

$$V = \sum_{i=1}^{n} \frac{Ai}{(1+r)^i} \tag{2.2}$$

where An represents the annual net return for the i-th year and the returns (1+r) continue for n years and r is the interest rate or capitalization rate.

If the annual net return (A) is an average income or the same each year, then the above expressions become a geometric series that can be expressed as:

$$V = \frac{A}{r}\left(1 - \frac{1}{(1+r)^n}\right) \tag{2.3}$$

and as n approaches infinity, Equation 2.3 reduces to:

$$V = \frac{A}{r}$$

the generally accepted capitalization formula, where V = present value of land, A = the average annual net returns, and r = the capitalization rate.

The reliability of this method depends upon four conditions: the reasonableness of the estimate of average net returns, the duration of net returns, the capitalization or discount rate, and the method of conversion (income to capital).

Fisher (14) points out that valuation is a process in which human foresight enters. The value of the net income is derived from an estimate of the future net returns that a tract of land will yield in relation to future prices and future cost and this net return will be translated to present value. Estimates of future income is generally based on recent past income of a property according to Babcock (5). He points out that income histories of property should be of limited usefulness because it is the future income that is discounted, but where net returns have been stable over a period of time, past net returns are the best data available. Therefore, at best, the future net income would be very subjective. Land has greater durability as a production factor than many goods; therefore, the future earning capacity of land becomes important for the purpose of valuation according to Renne (36). Theoretically, the market value of land should always equal the present worth of its future net returns. Barlow (7) points out the value of land should equal the sum of its future net returns discounted back to the present.

The capitalization rate or discount rate is normally the average rate of interest on farm mortgages. Hurlburt (19) indicates that this serves the purpose for general application as an expression of what the average buyer might be willing to accept as a rate of return on money invested in land. According to Hurlburt (18), the average rate of interest is not a sufficient guide for determining the actual factor price, but that one should determine the income earning opportunities within the firm. Then the operator can invest in land up to the point that the expected rate of return is the same as that on money invested in other factors.

Comparison method

The comparison method is an appraisal technique in which the market value estimate is predicted upon prices paid in actual market transaction and current listing (3). The prices paid in actual market transactions fix the lower limit of value in a static or advancing market price-wise and fix the higher limit or value in a declining market. The list price would fix the higher limit or value in any market. This method is a process of correlation and analysis of similar recently sold properties.

Reliability of the comparison method depends upon the degree of comparability of each property with the other property that is being appraised, the time of the sale, the verification of the sales data, and the absence of unusual conditions affecting the sale. The comparability of properties is difficult because land is a very heterogeneous product and several soil types will normally occur on a single property. However, a system that includes a comparison of two properties with the consideration of the various soil types and their productivity would overcome this problem of heterogeneity in terms of soils. The principles of the comparison method are the one employed in this study.

Summation method

The summation method is an appraisal technique in which the replacement cost less depreciation and obsolesence are used to determine the value. The value of the land is considered as a variant and is available for improvement. This value is estimated along with the depreciated replacement cost of the improvements to obtain the estimated value. This value is known as the depreciated replacement cost of the property and not the depreciated value (4a). The worth of this method lies in the fact that cost now tends to set the ceiling value. This method of appraisal is used primarily for buildings and does not lend itself to the valuation of land as readily as the capitalization or the comparison method.

Legal Basis for Land Appraisal for Tax Assessment Purposes

The Constitution of Iowa provides the machinery for taxation. The constitutional provisions relating to taxation do not operate as grants of power to tax but constitutes limitations upon such a power. The general assembly must authorize what property is to be taxed and prescribe the method to be followed for the imposition of the tax. No other method may be pursued, and the tax must not violate any constitutional limitations (10).

The Iowa Legislature has provided that the County Assessor, under the general supervision of the State Tax Commission, shall cause to be assessed all property, personal and real, in his county, except such as is exempt from taxation, or the assessment of which is otherwise provided for by law (22). The assessor shall value all property subject to taxation at its actual value which shall be entered opposite each item, and he shall assess the property at sixty percent of such actual value. The assessed value will then be taken as the taxable value of the property upon which the levy shall be made.

In arriving at the actual value according to the Iowa Code (22), the assessor shall take into consideration the property's productive and earning capacity, if any, past, present, and prospective, its market value, if any, and all other factors that affect its value. The Code also states (21), that all personal property, real estate, and buildings shall be taxed each year. Real estate shall be listed and valued in 1933 and every four years thereafter, and in each year in which real estate is not regularly assessed, the assessor shall list any real estate not included in previous assessments and it shall be added to the tax rolls.

Iowa Tax Law (21) further requires that the assessor assess tracts of land in parcels of no more than one town lot, or more than one-sixteenth part (40 acres) of a section or other smallest subdivision of land according to government surveys. Therefore, the farmland in Iowa is generally assessed by forty acre tracts or fractions thereof. After the assessor has arrived at the assessed value of the property of the county, he shall submit on or before May 1 of each year completed assessment rolls to the Board of Review (22). This assessment roll shall list every person in his county or city with the assessment of all the property therein, both personal and real, except such that is exempt or otherwise assessed.

All real or personal property which is not exempt, is subject to taxation. As this study deals with problems of assessing farm land, it will deal with real property only and exclude any discussion of personal property. Under the Iowa Code (20), certain real property is exempt from tax. A list of these real property exemptions under Iowa Code would include:

a. All lands owned by federal and state government except where taxation of federal property is authorized.

b. Property owned by counties, townships, cities, towns, school districts or military companies devoted to public use and not held for pecuniary profits.

c. Public grounds and cemeteries where no dividends or profits are derived therefrom.

d. Ground upon which fire equipment is housed.

e. Property or organizations of War Veterans which is devoted entirely to the organizations's use and is not held for profit.

f. Property used by cemetery associations for cemetery purposes.

g. Public libraries and art galleries and those privately owned for public use and not for profit.

h. Grounds and buildings used by literary, scientific, charitable, benevolent, agricultural and religious institutions and societies for their appropriate objects and not exceeding 320 acres and not leased or used for profit. If all or any portion of the property is leased and used regularly for commercial purposes for profit, it is assessed in the same manner as other property. No exemption may be granted to these groups upon any property which is the location of a federal retail liquor sales permit or federally licensed devices that are not lawfully permitted to operate in Iowa.

i. Real property of educational institutions not to exceed 160 acres per township.

j. Non-profit homes for soldiers.

k. Government lands, for the years in which entry, location, or purchase is made.

l. Public airport lands.

m. Public right-of-ways are not subject to tax.

There are further exemptions that may be granted under the Iowa Code (25) such as military service exemptions and homestead exemptions. The military service exemptions might be applied on real property are as follows:

For Veteran eligible for service in:	Exemption of property not to exceed:
Mexican War or War of the Rebellion	$3000.00 taxable value
Spain, Tyler Rangers, Colo. Volunteers in War of the Rebellion, 1861-1865, Indian Wars, Chinese Relief Expedition or Philippine Insurrection	1800.00 taxable value
World War I	750.00 taxable value
World War II, Army of Occupation in Germany 1918-1923, American Expeditionary Forces in Siberia 1918-1923, and Navy and Marines in Nicaragua or combatant ships 1926-33, second Haitian suppression of insurrection 1919, 1923, China 1937-39, Yangtze service 1926-27 and 1930-32.	500.00 taxable value
Korean Veteran for service between June 27, 1950 and July 27, 1953	500.00 taxable value

These exemptions are allowable to certain relatives of eligible veterans in the name of the veteran if the veteran does not claim them. They are made to the same extent on property of the eligible relative according to provision of sub-chapter 427.4, Iowa Code, (20). No more than one tax exemption is allowed in the name of a veteran.

Taxes may be suspended if a person, by reason of age or infirmity, is unable to contribute to the public revenue. The person must petition for this suspension and the tax suspended must be paid if the real estate is sold or passes by devise, bequest or inheritance to any person other than the surviving spouse or minor child.

In addition to the above exemptions, there are certain conditions for assessing fruit tree and forest reservations (22). Forest and fruit trees that have a stand of 200 or more growing trees per acre and occur in an area of two acres or larger, not including a building lot and protected from livestock, shall be assessed on a taxable valuation of four dollars ($4.00) per acre. Fruit tree reservations shall be assessed on a taxable base of four dollars ($4.00) per acre for a period of 8 years after planting. The owner is responsible to make application to the assessor for the fruit tree and forest reservation assessments.

The assessor at the time of making the assessment of property, informs the person assessed, in writing, of the valuation put upon his property, and notifies him, if he feels aggrieved, to appear before the Board of Review and show why the assessments should be changed.

The Iowa Code is specific as to the mechanics of assessment of real property in that the assessed value is equal to 60 percent of its "actual" value. However, "actual" value is an elusive term. According to court decisions and opinions of the

Attorney General (10), "actual" value and "market" value as employed in the law of taxation ordinarily mean the same thing; however, the market value of real estate is not the only factor to be considered in determining its actual value for the purposes of taxation.

The actual value is not the same as the market value as is evidenced by the assessment ratio (sales prices divided by assessed evaluation) which was 21.4 percent in 1966 for the state average on farm land and buildings (47). In other words, property is assessed at approximately 21 percent of its market value rather than 60 percent of its "actual" or "market" value.

However, the 1967 Iowa General Assembly has redirected the County Assessors to value all real and tangible personal property at its actual value and assess the property at 27 percent of its actual value as of January 1, 1968 (25). The actual value of the property shall be the fair and reasonable market value. Market value is defined as the fair and reasonable exchange in the year in which the property is listed and valued between a willing buyer and a willing seller, neither being under any compulsion to buy or sell and each being familiar with all facts relating to the particular property. Actual sales of property or the sales of comparable property by normal transactions along with the availability of buyers shall be taken into consideration in arriving at the market value. The General Assembly further directed that in assessing and placing a value on agricultural property the value shall be determined on the basis of its current use rather than potential use such as subdivisions or other specialized use.

In the event market value of a property cannot be readily established as outlined above, then the assessor may consider other factors in determining the fair and reasonable market value. The assessor may consider its productive and earning capacity, industrial conditions, its cost and all other factors which would assist in determining the market value, but the market value will not be determined by use of only one such factor.

In summary, from the legal standpoint, all Iowa farm land will be assessed at 27 percent of its "actual" value by forty acre tract or fractions thereof[7] by the County Assessor. The actual value being determined as outlined above.

SOIL SURVEYS

It has been hypothesized that soil properties identified through the soil survey are an indication of land value and that a value may be placed on the soil mapping unit which may be used in land valuation. Therefore, a discussion of soil surveys in terms of the nature and availability of soil surveys is included in this section.

The soil survey is an inventory of the soil resources of a geographic area. The soil map, a part of a soil survey, is designed to show the distribution of soil types or other soil mapping units in relation to the physical and cultural features of the earth's surface. The soil units may be shown separately or combined into soil associations named and defined in terms of taxonomic units. The definition of an individual soil would include the range of physical characteristics such as texture, color, slope, depth, etc., as well as chemical characteristics such as fertility, soil reaction, and other measureable features. The soil map would include combinations of all observable features relevant to the behavior and nature of the soils as named taxonomic units. The taxonomic unit would then be a natural body with distinct sets of soil characteristics (56).

One purpose of soil maps and soil survey reports is to serve as a basis for soil management and soil interpretations in a logical decision making process. "The soil survey includes those researches needed (1) to determine the important characteristics of the soil, (2) to classify soils into defined types and other classificational units, (3) to establish and plot on maps the boundaries among kinds of soil, and (4) to correlate and predict the adaptability of soils to various crops, grasses, and trees, their behavior and productivity under different management systems, and the yield of adapted crops under defined sets of management practices" (56, p. 23). Although the past emphasis of soil research has been for agricultural applications, soil research is increasingly being applied to engineering problems, economic research, as well as many other non-agricultural uses. Basically, soil classification serves as the basis for classifying, synthesizing, and reporting the results of research and experience and allows the user to make purposeful predictions.

There are literally thousands of different kinds of soils and many have unlike management requirements for sustained, economic production. In the past workers have learned as best they could through trial and error what worked best on certain fields or areas within a field on a farm. This knowledge was passed on from worker to worker within a limited area but could not be transferred from one area to another. With the development of modern technology through science, these findings can be transferred from one farm to another or from one area to another from predictions made using the soil survey data. In other words, the data may be synthesized for application to specific areas.

The degree of usefulness of the soil survey depends upon the stage in time at which the soil survey was completed. Progress in the development of the modern science of soil survey has been phenomenal during the past half century since the soil survey began in the United States. Therefore, only the more recent reports have up-to-date detailed data. The writer will not recount the evolution of soil surveys in that it is reported in several recent works by McCracken (29) and Oschwald (32) as well as the Soil Survey Manual (56).

In Iowa, the first county soil survey was of Bremer County and was published in 1917 (48). From 1917 through 1940, soil survey reports were completed in all Iowa counties except Adams, Allamakee, Cass, Humboldt, Iowa, Keokuk, Lucas, Monona, Shelby, Tama, and Taylor counties. These older soil surveys had maps published on a scale of 1 inch = 1 mile when published by the United States Department of Agriculture and scales of 1 inch = 2½ miles when published by the Iowa Experiment Station. These early soil survey reports were of a general nature and soil units defined and mapped were too broad for modern use in terms of soil management and interpretation. However, the modern soil survey reports (completed after World War II) are more detailed and the maps published on scales large enough to be useful in interpeting the management and use of soil by today's advanced standards. The priority of the modern survey has been to complete surveys in counties with no survey and to start resurveying counties with old type soil surveys. Jefferson and Polk Counties, Iowa have already been resurveyed and others are in progress.

The current status and availability of modern soil surveys for Iowa counties is as follows (12):

1. Counties with modern soil surveys and reports (Date of report given):

Tama (1950)	Iowa (1967)	Humboldt (1961)
Taylor (1954)	Lucas (1960)	Shelby (1961)
Allamakee (1958)	Jefferson (1960)	Van Buren (1962)
Monona (1959)	Polk (1960)	Adams (1963)

2. Counties with field work completed but report not published (Completion date of field work given. Field sheets can be inspected at County Soil Conservation Service Offices):

Bremer (1961)	Guthrie (1966)	Madison (1965)
Cass (1962)	Howard (1966)	Wayne (1963)
Clay (1962)	Fremont (1966)	Winneshiek (1961)
Crawford (1965)	Keokuk (1964)	Woodbury (1964)

3. Counties presently being surveyed (Some completion dates are scheduled. Many field sheets available for inspection at County Soil Conservation Service Offices):

Appanoose (1967?)	Linn	Webster (1967)
Fayette	Palo Alto	
Harrison	Plymouth	

4. Counties starting soil surveys in 1967:

   Lee Mitchell Worth

   Mahaska

From 1950 to date, the field mapping has been completed in 24 counties. Twelve of the 24 counties have published soil survey reports, and the completed field maps are available for use in the remaining 12 counties. There are another 11 counties as pointed out above that are in the process of being surveyed. The data for these counties are available as mapping is completed.

The results of the soil survey are often applied through an intermediate grouping of the soil types and phases called "land classification" (56, p. 28). One such special kind of land classification would be classifying the soils to determine the value of land as mortgage collateral or for tax assessment purposes. Social land units, mainly farms, are evaluated in terms of potential production within the institutional and legal environment. For accurate work, a basic detailed soil survey is required to indicate the relevant factors in relation to the soil boundaries and to provide a basis for adjustment from time to time as conditions change. When basic soil factors are recorded, regrouping or reinterpretation can be made in orderly fashion as changes occur (56).

The appraisal of a farm cannot be based on soil alone. Other factors such as location in respect to roads, markets, and other services must be considered in arriving at a value.

Buildings, fences, tile, and other permanent improvements need to be valuated in making the appraisal as well as the legal aspects that were dealt with earlier.

Review of Selected Studies in Land Valuation and Valuation for Tax Assessment

There are several guides available that outline assessment procedures of a macro nature and a few that deal with the micro nature of land evaluation. The following are a few selected references that deal with the land evaluation in general as well as land evaluation for tax assessment purposes.

One of the early studies in comparative farmland values in Iowa was made in 1926 by Henry Wallace (57). The Wallace study was based on county data from the 1925 Census of Agriculture and utilized a regression equation with four variables and the average value of the land. The variables were the 10-year average yield of corn, the percent of farm income, the percent of farmland in small grain, and the percent of farmland not plowable. These four variables explained 84 percent of county variation in Iowa farmland values.

The University of Illinois, in a cooperative project with the United States Department of Agriculture, developed a technique to approximate the value of farmland in Illinois before taking for highway right-of-ways (53). The guidelines for the approximate land value is based on 16,000 bona fide sales in Illinois over a 5-year period from April 1, 1952, through March

31, 1957. The sales data were separated into regions or levels of analysis at which regression equations were calculated. The four area levels at which the regression analysis were applied are (1) state as a whole, (2) type-of-farming areas, (3) crop-reporting districts, and (4) value zones.

The regression model used was:

$$X = a + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6$$

where X_1 = average price per acre

X_2 = average soil productivity rating

X_3 = average building assessment per acre

X_4 = average number of acres sold per year

X_5 = population change (thousands)

X_6 = percentage of non-cropland

All the variables in the regression equation were expressed in terms of township averages. This means that price per acre and soil productivity ratings are township averages, as are the other variables. This information allows the appraiser to determine the average value per acre of a tract of land located in a specific township but only gives guidelines in terms of value per acre for a specific farm within the township.

Reynolds (37) concluded in a recent study (1966) that the value of farmland in the United States is affected by a number of variables. During the period 1956-1964, the following variables had a significant positive effect on the value of farmland:

1. Expected net farm income.

2. Government payments both for land diversion and conservation payments.
3. Expected capital gains.
4. Farm enlargement (larger effect on land without buildings than land with buildings).
5. Technological advance.
6. Ratio of debt to equity.

On the other hand, Reynolds found that voluntary transfers of farmland, the capitalization rate, and the expected ratio of farm to non-farm earnings had a negative effect on the value of farmlands.

The three studies just reviewed are studies that consider the components of value on a macro level because they treat value of farmland in terms of averages at township, county, and national level. However, for assessment purposes, the comparison of value must be made at a much lower or micro level between farms and more exact between 40-acre tracts within a farm.

In order to localize and separate the components of value at the individual farm level there have been several studies that have attempted to classify tracts by productivity. Hanson (16) attempted to adjust tax assessments by the use of productivity ratings furnished by the AAA programs of the United States Department of Agriculture. These ratings were made by local AAA committees who judged the average yield of corn per acre by farms. Hanson found that these ratings did not correlate to assessed value of the real estate and ratings did not take into consideration enough of the factors of production nor enough of the other factors of value such as location, etc.

Keith (26) suggested a system of natural classification where appraisers would grade the tracts of land as Grade 1 through Grade 10 and attach a value to each grade as well as classify the land according to its use. This is a very subjective approach, and one of the real difficulties of the system was to find persons qualified to rate the land.

Soil surveys have been used previously in the valuation of farm land for tax assessment where the soils were rated in terms of their physical and chemical characteristics, and values were placed on each of the soil units. One of the pioneer works in this area where a system was developed was made by R. E. Storie in California and was called the Storie-Index (49). The Storie-Index for rating soils is a numerical expression of the relative agricultural value of soils and is computed by multiplying four factor values of A-profile characteristics, B-texture, C-slope, and X-miscellaneous (drainage, alkali, erosion, fertility level, and micro relief); e.g., Storie-Index = AxBxCxX. Each factor value had a rating of 0 to 100 percent depending upon the desirability of the soil in relation to each of the four factors.

Soils were then divided into 11 unit classes ranging from 0 to 10 and to arrive at a cash value of the land, the assessor assigned a basic valuation to a unit class 10 soil. This was based on the assumption that all unit class 10 soils have equal agricultural potential. For example, if unit class 10 soils have a value set at $250.00 per acre, the value per unit acre for all soils will be $25.00. Then the assessor can simply multiply the unit class rating of a particular soil times $25.00 and have the value of the soil type. The value of a tract of land can be obtained by adding the value of acres of each soil type occurring on the tract of land.

Another system for appraisal of rural land for assessment purposes has been developed from the study of soils and farm economics by Freeman in Saskatchewan that began in 1938 and was revised in 1950 (15). A comparative index rating was established for each soil association and type. The rating system used was a modification of the Storie multiplication system taking three factors--A, B, and C--each equal to 100 points for the ideal condition, multiplying these together and taking the first two figures of the product as the index. Factor A included the profile characteristics of the soil as sub-factors of texture, structure and native fertility. The B factor was topography and C factor was made up of the sub-factors of climate, salinity, stoniness and tendency to drift. From these factors a rating is calculated for each soil unit in the assessment district.

The next step in the Saskatchewan system was to determine a level of value for assessment purposes. This value was calculated by the capitalization method using the average net earnings that could be expected from a one-section farm of Regina heavy clay soils in the Regina Plains area and a capitalization rate of 5 percent. The value calculated was $32.00 per acre and was taken for the maximum value of Regina heavy clay and also the maximum assessment of land anywhere in the Province of Saskatchewan. A conversion factor or basic log was calculated by dividing the price per acre by the soil rating. In this case, it is 32/82 resulting in the figure of $0.39 which is the value of each point in the productivity rating. For example, if a parcel of land 160-acres in size had a soil index rating of 40, the base value of the parcel would be the 160-acres x 40 index x .39 log = $2,496.00. This would be the base value and other adjustments would be made in terms of brush, location, etc., in order to obtain the final value for the parcel.

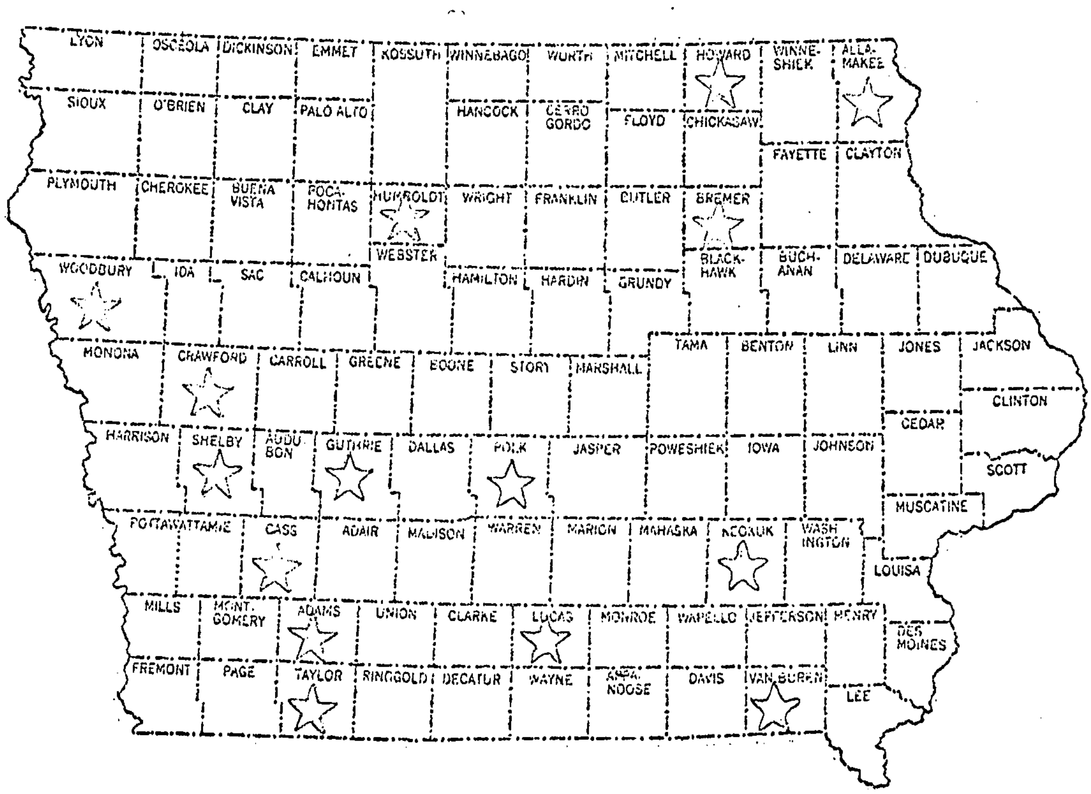
The soil survey data have been used in the past as part of an appraisal system using both soil economic ratings and soil productivity ratings. Each soil unit of a particular tract of land is measured and recorded; next, either an economic or productivity rating is determined for each soil unit from this data. The appraiser is able to rank each parcel of land and attach a base value. Aandahl (1) estimated soil productivity in relation to land values. In this study, using soil management systems, crop yield estimates, cost, and price data, Aandahl developed economic ratings for various crop systems on particular soil types. The techniques developed were used in the appraisal of Allamakee County, Iowa, for tax assessment purposes.

Ottoson, Aandahl and Kristjanson (34) in a later study suggested a systematic procedure that appraisers in a county can use to improve assessment of farm land. Where no systematic procedure has been used, farm land of higher value has been underassessed compared with land of lower value, and the procedure outlined in this study is designed to rate each soil in terms of its ability to produce net income. The system involves a soil survey of the area being assessed as well as the measurement of the acreages of each soil on each tract. A net income rating for each soil is estimated using an estimate of yields in respect to commonly used cropping and management systems used on each soil. From this data, calculated weighted average economic ratings are developed for each tract and the first approximation of sale value for the tract estimated. This first approximation of sales value would be the final estimate for land without the buildings. The final approximation of value would be the first approximation adjusted for farm building value and location of farmstead. This system places the assessment in a systematic valuation scheme. However, the system is very subjective in nature because estimated prices (both for products and factors of production) as well as yields and cropping systems are subject to change and create fluctuations in net income.

Scholtes and Riecken (41) reported the use of a detailed soil survey by the assessor in Taylor County, Iowa, for reassessment of rural land in 1949. Corn suitability ratings were provided for each of the soils in the county and dollar values were established by the assessor for each of the corn suitability ratings. The values for the tracts of land for assessment were obtained by adding the measured acreage of each soil in the tract times its dollar valuation. Certain deductions for such factors as waste, roads, and ditches are taken into consideration in determining the value of a tract. The corn suitability ratings for the soils in Taylor County were developed essentially employing techniques used to develop corn suitability ratings for the principal upland soils of Iowa reported in a paper by Riecken and Smith (39). The corn suitability reflects yield potential of a soil as well as certain soil properties as slope, subsoil permeability, workability, wetness, and erosion hazard, and other factors that influence the productivity of a particular soil.

From 1949 to the present, there have been fifteen counties in Iowa (see Figure 3) that have used or are in the process of using modern soil survey information in valuation of farm land for tax assessment purposes. For the most part, the valuation has been made by the assessor using modified corn suitability ratings. The difference in the modified suitability ratings is that soils are rated in terms of 100 to 0 with 100 being reserved for the few soils in the state that have the highest productive potentials. The remainder of the soil in a county are ranked in respect to these "model" soils. For example, the highest corn suitability rating in a particular county may be 90 rather than 100 because of some physical or natural limitations of the soils in the county. The appraised values for

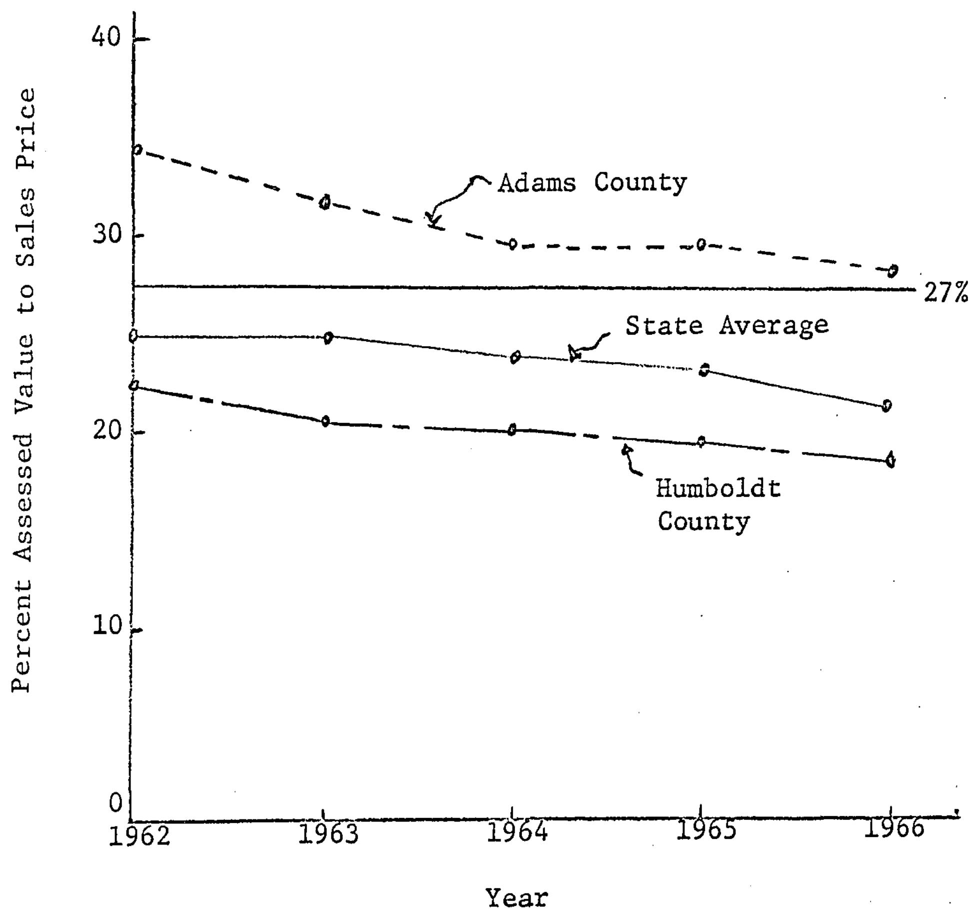
Figure 3. Iowa counties in which county assessors have used soil surveys for tax assessment



☆ Counties using soil surveys for tax assessment each corn suitability rating were made by the assessor as in the case of Taylor County study mentioned earlier, and the value of each tract has been computed in a similar fashion as in Taylor County. One of the advantages of appraisal system that uses the soil survey information is that it offers a systematic approach to the problem; the appraiser is able to obtain an accurate inventory of the basic soil resource involved. The major disadvantage is that the dollar values established tend to group the soils towards an average value. The land of lower value tends to be overassessed compared with land of higher value. Harter (17) in Polk County used a similar system of assessment but had a location factor that offered opportunity for adjustment of value in relation to the nearness to Des Moines which insured a more equitable assessment.

The Iowa Tax Commission has been conducting assessment sales ratio studies in order to compare the appraised valuation between counties in Iowa to the bona fide sales (46, 47). The assessment sales ratio was established for each sale by dividing the total assessed valuation of land and improvements by the determined purchase price and is expressed in percent. The purpose of the real estate assessment ratio study is to show the relationship of the assessed value to the sales price of real estate sold during a particular year. This type of comparison is an indicator of how equitable assessments are between counties. Figure 4 shows the relationship of assessment ratios from 1962 through 1966 for farm land in Adams and Humboldt

Figure 4. Comparative real estate assessment ratios for Adams and Humboldt Counties, Iowa


Percent Assessed Value to Sales Price
40
30
20
10
0
1962
1963
1964
1965
1966
Year
Adams County
27%
State Average
Humboldt County

Counties and the state average assessment ratio (46, 47). Adams County has a high assessment sales ratio (28 percent in 1966) which indicates that farm land is assessed at a higher value than the state average. Humboldt County has a much lower average assessment sales ratio (18.8 percent in 1966) than the state average, and this indicates that the land in Humboldt County is assessed at a much lower rate than the state average. Earlier in this study it was pointed out that as of January 1, 1968, all land in the state would be assessed at 27 percent of its actual market value. It is assumed that this assessment sales ratio study will be used as a guide by the Tax Commission in order to determine if county assessments are correct. The data in Figure 4 indicates that the state average assessment must be raised. In terms of Adams and Humboldt Counties, Adams County is within the limits or slightly over assessed, and in Humboldt County the assessed value must be raised from 18.8 percent to the 27 percent required by the new tax law.

The variability of assessments within Adams and Humboldt Counties is shown in Table 1. There is a wider range in sales assessment ratios in Adams County which might indicate that there is not enough spread in assessed value between the more productive land and the less productive land.

The frequency distribution in Humboldt County indicates that the land is under-assessed in respect to Adams County. However, the range in distribution of assessment ratios in Humboldt County is much less which would indicate that between

Table 1. Frequency distribution of farm real estate assessment ratios for 1965 and 1966 for Adams and Humboldt Counties[a]

	Sales assessment ratio							Total
	10-14	15-19	20-24	25-29	30-34	35-39	40	sales
Adams	1	6	29	37	30	18	11	132
Humboldt	38	33	18	4	2			95

[a]Source: Iowa State Tax Commission (46, 47).

farm assessments seem more equitable than in Adams County.

In summary, the real estate assessment ratio study indicates that adjustment in the assessments in both Adams and Humboldt Counties need to be undertaken.

AREAS STUDIED

Two largely agricultural counties were chosen for the study. Adams County located in southwest Iowa and Humboldt County in north central Iowa were selected as study areas to investigate techniques using soil survey information for tax assessment. These counties were selected for the following four reasons. First, both counties have modern published soil survey reports. Second, the county tax assessor in Adams and Humboldt Counties used the soil survey data and soil ratings for their current farm land assessment. Third, both Adams and Humboldt Counties are rural counties which largely eliminates the urban effect in terms of land values. Fourth, the counties involve two contrasting areas--Adams is nearly level in some areas and is strongly sloping in others and has a wide variety of soil types. On the other hand, Humboldt County is nearly level with the majority of the soils developed from glacial till.

Brief descriptions of Adams and Humboldt Counties as to location in the state, general soil areas of the counties, and agriculture are given in this section.

Adams County

Adams County is located three counties east and one county north of the southwest corner of Iowa. The location of the county in respect to the state and soil association area is shown in Figure 5a. Adams County is bounded on the north by Cass and Adair Counties, on the east by Union County, on the

Figure 5a. Location of study counties and principal soil association in Iowa

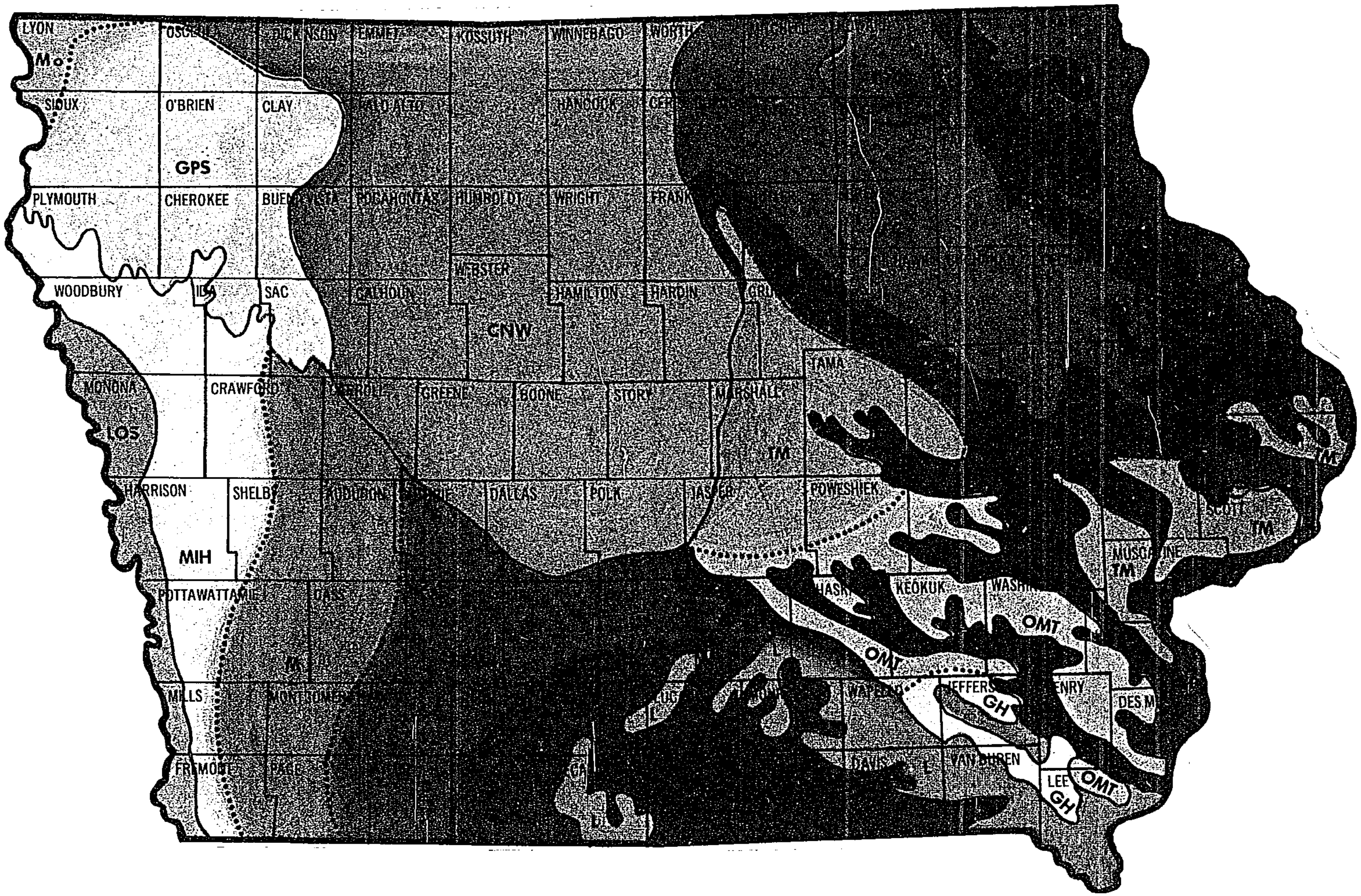

LYON
Mo
DICKINSON
EMMET
KOSSUTH
WINNEBAGO
WORTH
SIOUX
O'BRIEN
CLAY
PALO ALTO
HANCOCK
GPS
PLYMOUTH
CHEROKEE
POCAHONTAS
HUMBOLDT
WRIGHT
WEBSTER
WOODBURY
SAC
CALHOUN
HAMILTON
HARDIN
GNW
TAMA
MONONA
CRAWFORD
CARROLL
GREENE
BOONE
STORY
MARSHALL
LOS
TM
HARRISON
SHELBY
AUDUBON
DALLAS
POLK
JASPER
POWESHIEK
SCOTT
TM
MIH
MUSCATINE
TM
POTTAWATTAMIE
CASS
KEOKUK
OMT
OMT
MILLS
MONTGOMERY
WAPELLO
HENRY
GH
DES M
FREMONT
PAGE
VAN BUREN
LEE
OMT
GH

Figure 5b. Identification of symbols on soil association map

Soils of Mississippi River Bottomland ····· Gradational Boundary ----Tentative Boundary — Abrupt Boundary

Adair-Grundy-Haig	Downs	GH Grundy-Haig
Adair-Seymour-Edina	Dinsdale-Tama	Kenyon-Floyd-Clyde
Clinton-Keswick-Lindley	Fayette	L Lindley-Keswick-Weller
Cresco-Lourdes-Clyde	FDS Fayette-Dubuque-Stonyland	LOS Luton-Onawa-Salix
CNW Clarion-Nicollet-Webster	GPS Galva-Primghar-Sac	M Marshall

MIH Monona-Ida-Hamburg

Mo Moody

OMT Otley-Mahaska-Taintor

Shelby-Sharpsburg-Macksburg

TM Tama-Muscatine

south by Taylor County, and on the west by Montgomery County. Corning is the county seat and largest town in the county.

Soils and climate of Adams County

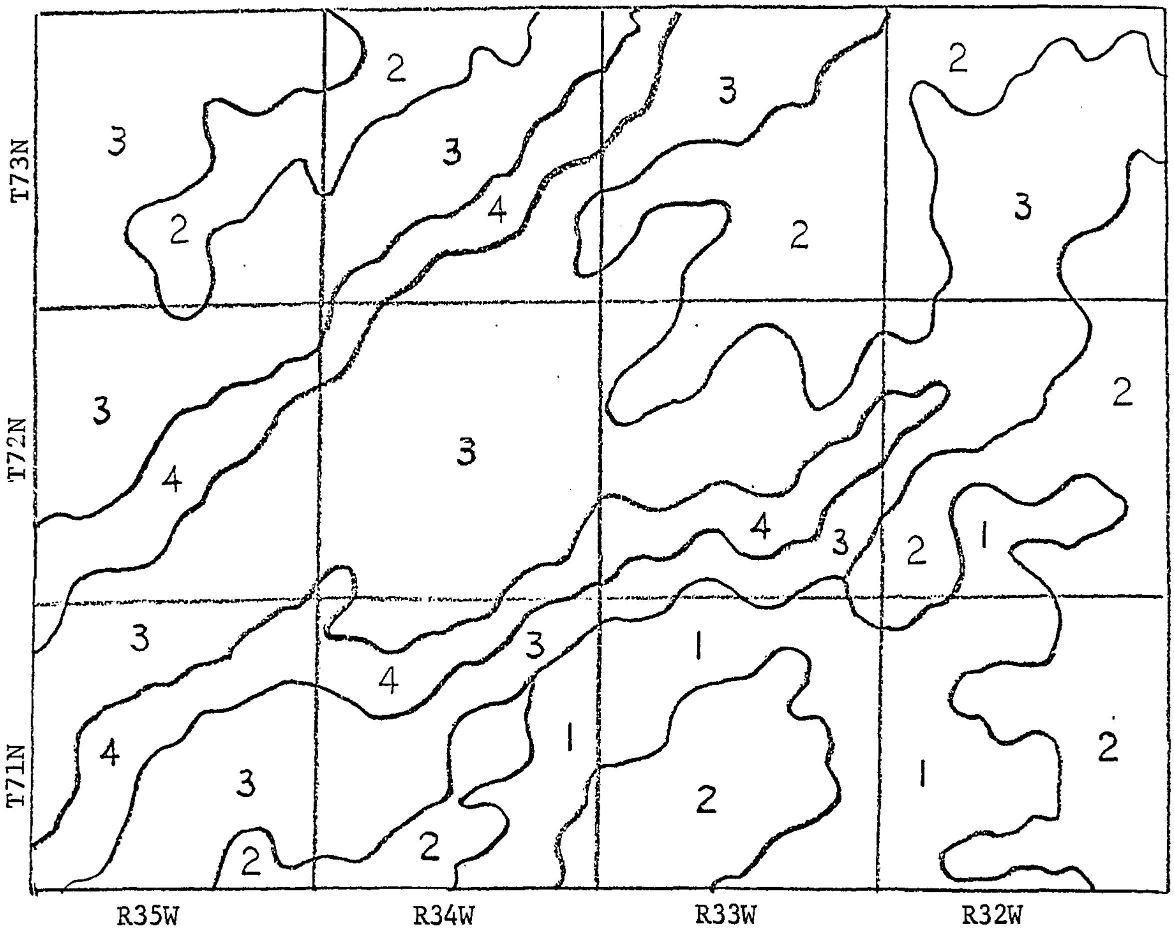
Adams County is in the Shelby-Sharpsburg-Macksburg soil association area, Figure 5a (33). Most of the soils of this area have developed under prairie vegetation and a sub-humid, continental climate (11). The frost-free growing season averages 160 to 165 days with annual average rainfall of about 30 inches. The April through September average precipitation is about 22 inches (18, 42, 43).

The topography is characterized as an upland plain that has been partially dissected by geologic erosion which has resulted in nearly level to gently sloping divides, moderate to steep side slopes, and narrow stream valleys. The soil survey data show that about 40 percent of the landscape is nearly level on 0 to 6 percent slopes. The parent materials in which the soils developed are loess, exhumed paleosols, glacial till, alluvium, and very small areas of bedrock (11).

The soils of Adams County may be generally grouped into four general soil association groupings shown by a general soil map, Figure 6 (11). This association grouping is a subdivision of the larger Shelby-Sharpsburg-Macksburg soil association that includes all of Adams County.

Group 1 on the general soil map is the nearly level to gently sloping Macksburg-Winterset soil association area. The

Figure 6. Soil association areas of Adams County, Iowa



Legend:

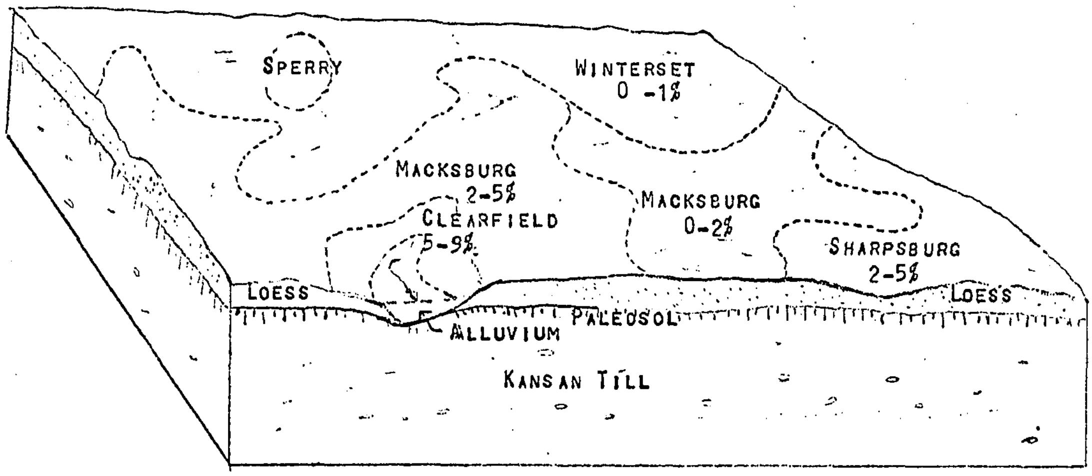
1. Macksburg-Winterset soil area
2. Sharpsburg-Adair soil area
3. Shelby-Sharpsburg soil area
4. Colo-Wabash-Nodaway soil area

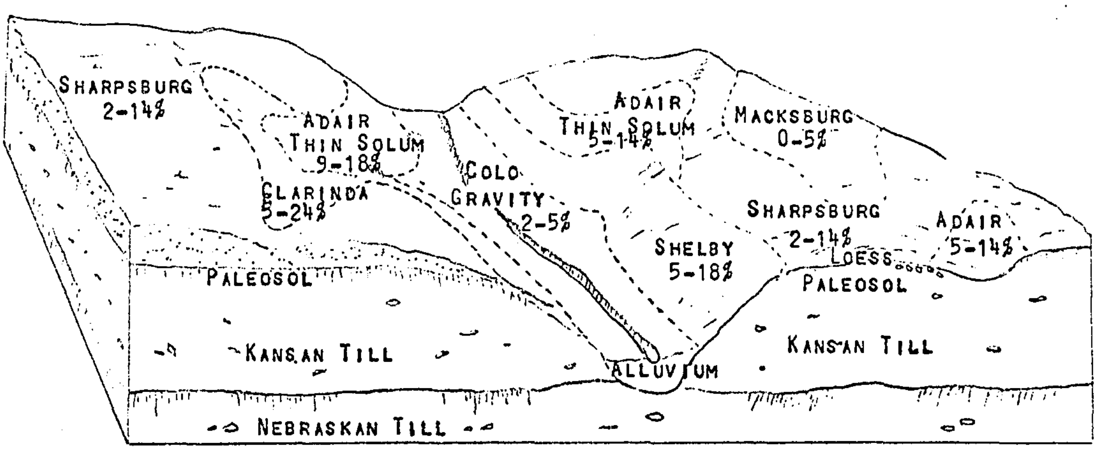
soils of this area have developed primarily from loess on broad nearly level uplands that have gentle side slopes. The relationship between the various soil types and the landscapes are shown in Figure 7 (11). Most of these soils have a thick, dark colored surface layer and a high plant available moisture-holding capacity. Internal drainage ranges from good to poor, and the poorly drained soils can be improved by the use of tile drainage. The soils in this association are well suited for intensive row crop production and the crops respond to additions of nitrogen and phosphate fertilizer. The Macksburg and Winterset soils are the major soils in this area, but there is also a fairly large acreage of Sharpsburg soils. The Sperry and Clearfield soils occupy a small total acreage.

The soils in Group 2 (Sharpsburg-Adair soil association area) on the general soil map occur on nearly level to gently sloping ridgetops, strong to moderately steep side slopes with many narrow drainageways. The soils of this association have developed in loess on the ridgetops and upper slopes and in glacial till on the lower slopes. The relationship between the various soil types and the landscape are shown in Figure 8 (11). Most of the soils in the association are well drained to moderately well drained, but there frequently are seepy soils at the loess-till contact zone. The ridgetops and part of the side slopes are suited to cultivated crops, but some of the till soils and the strongly sloping or severely eroded soils are better suited to pasture. Fertility is moderately high on the

Figure 7. Relationship of soils of Macksburg-Winterset soil association to slope, parent material, and vegetation

Figure 8. Relationship of soils of Sharpsburg-Shelby soil association area to slope, parent material, and vegetation


SPERRY
WINTERSET
0 -1%
MACKSBURG
2-5%
CLEARFIELD
5-9%
MACKSBURG
0-2%
SHARPSBURG
2-5%
LOESS
LOESS
PALEOSOL
ALLUVIUM
KANSAN TILL


SHARPSBURG
2-14%
ADAIR
THIN SOLUM
9-18%
CLARINDA
5-24%
COLO
GRAVITY
2-5%
ADAIR
THIN SOLUM
5-14%
MACKSBURG
0-5%
SHELBY
5-18%
SHARPSBURG
2-14%
ADAIR
5-14%
LOESS
PALEOSOL
PALEOSOL
KANSAN TILL
ALLUVIUM
KANSAN TILL
NEBRASKAN TILL

loess derived soils but is generally low on the till derived soils. Erodibility, slope, and low productivity of some of the till soils are the chief management restraints in this association. The Sharpsburg and Adair soils are the major soils in this association, but there is a fairly large acreage of Clarinda soils with smaller amounts of Shelby and alluvial soils. The Macksburg soils may occur on some of the broader ridgetops in this area.

Group 3 is the Shelby-Sharpsburg soil association area and is characterized by soils occurring on narrow ridgetops, long steep side slopes and narrow valleys. The soils of the association have developed in loess on the upper ridges, in exhumed paleosols on lower ridges and upper slopes, and in till on the steeper side slopes. The relationship between the various soil types and the landscape is shown in Figure 9 (11). The soils in this association are not generally as well suited for row crop production as in the other three areas because of the steep slopes and lower productivity of the soils. Most of the area is used for meadow and pasture, but row crops are grown in rotation on the ridges and less sloping areas. The major soils of the area are Shelby and Sharpsburg with smaller amounts of Adair and alluvial soils. Small amounts of Gara and Ladoga soils are found in this association near the major streams.

Group 4 is the Colo-Wabash-Nodaway soil association area. It is a bottomland association and is located along the broader streams in the county. The soils in this area are nearly level and are formed from alluvium or loess covered alluvium. The drainage of these soils range from very well drained to poorly drained, and the first bottom soils are subject to flooding. Poor drainage in the area may be corrected with tile or surface drains. The majority of the soils in this area have moderate to high yield potential and are well suited for cultivated crops and show good response to nitrogen and phosphate fertilizers. The Colo, Wabash, and Nodaway soils are the major soils of the area and their relationship to the landscape are shown in Figure 10 (11).

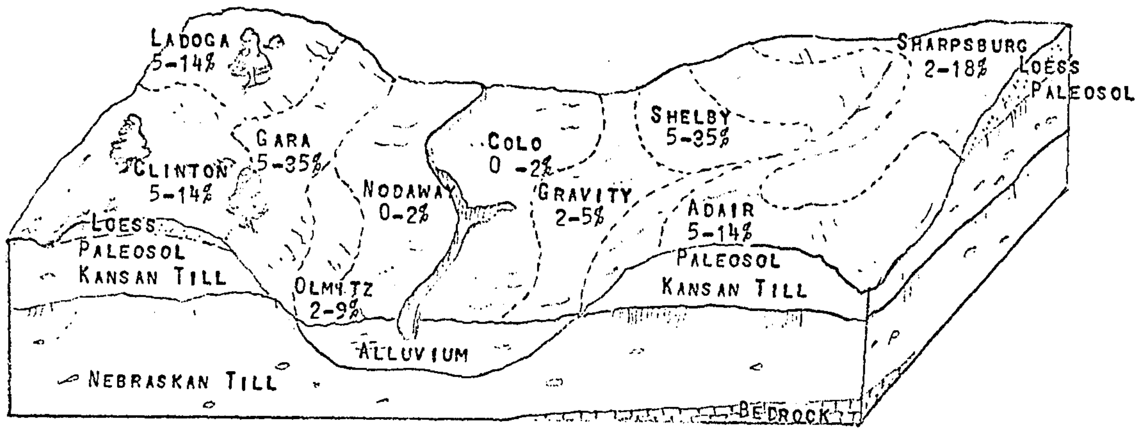
A detailed description of all the soils mapped in Adams County, management suggestions, and soil map may be found in the Adams County soil survey report (11). A listing of the Adams County soils legend with estimated corn yield are presented in the appendix.

Adams County agriculture

Adams County is a rural county with most of the land in farms. It is a general farming area with corn, soybeans, oats, hay, and pasture as the main crops. Corn is the primary grain crop, and most of the corn as well as forage crops are processed through hogs and beef cattle. In 1966 there were 996 farms in Adams County which averaged 268 acres in size for a total farm area of approximately 266,648 acres. The trend in farm size and value is shown in Table 2. Farm numbers have decreased by 267 farms from the 1959 report until the 1966 census report.

Figure 9. Relationship of soils of Shelby-Sharpsburg soil association to slope, parent material, and vegetation

Figure 10. Relationship of soils of Colo-Wabash-Nodaway soil association to slope, parent material, and vegetation


LADOGA
5-14%
SHARPSBURG
2-18%
LOESS
PALEOSOL
SHELBY
5-35%
GARA
5-35%
COLO
0 -2%
CLINTON
5-14%
NODAWAY
0-2%
GRAVITY
2-5%
ADAIR
5-14%
LOESS
PALEOSOL
KANSAN TILL
PALEOSOL
KANSAN TILL
OLMITZ
2-9%
ALLUVIUM
NEBRASKAN TILL
BEDROCK

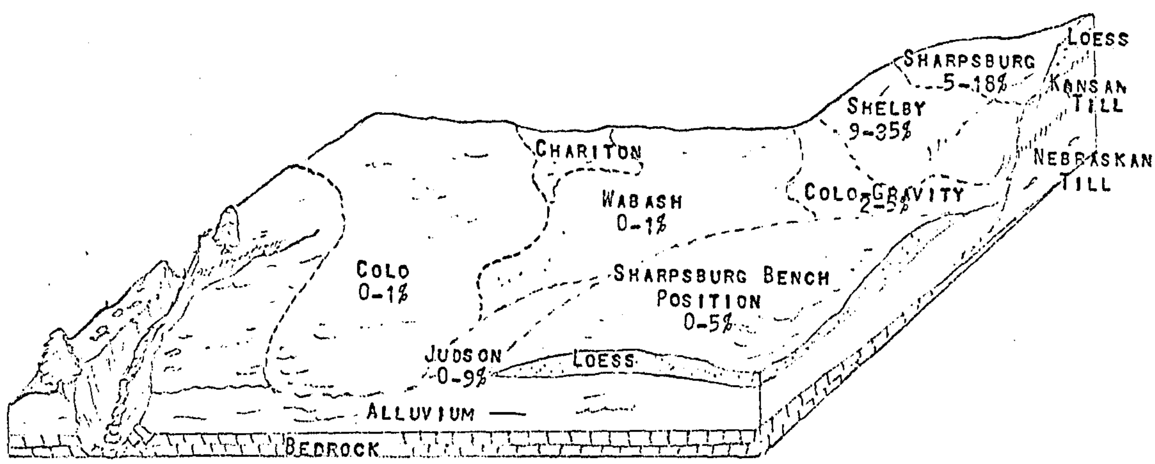

LOESS
SHARPSBURG
5-18%
SHELBY
9-35%
KANSAN
TILL
CHARITON
NEBRASKAN
TILL
WABASH
0-1%
COLO-GRAVITY
2-5%
COLO
0-1%
SHARPSBURG BENCH
POSITION
0-5%
JUDSON
0-9%
LOESS
ALLUVIUM
BEDROCK

Table 2. Farm size and value in Adams County

	Unit of measure	1959[a]	1964[b]	1966[a]
Farm number	number	1,233	1,037	966
Land in farms	acres	260,160	259,424	266,648
Average size farm	acres	211.0	250.2	268.0
Average value of land and buildings per farm	dollars	34,263	40,229	--
Average value per acre	dollars	150.05	161.61	--

[a]Source: Iowa Assessor's Annual Farm Census, Iowa Department of Agriculture. 1966 (23).

[b]Source: U. S. Bureau of Census, Census of Agriculture 1964 (54).

On the other hand, farm size has increased 57 acres during the same period of time. The Federal Census data indicate that per farm value and price per acre has increased from 1959 to 1964. The trend shown in the table indicates that farm size and value are increasing as the farm numbers decline.

The land use pattern of Adams County is shown in Table 3. The trend shown is that cropland acres are decreasing while the acres in pasture are increasing for Adams County. The acres in corn and soybeans are remaining about the same even though overall cropland has decreased. This trend reflects a change in land use patterns with intertilled crops grown more intensively on the more adaptable soils. This can be coupled

Table 3. Land use in Adams County

Use	Total acres or yield by year 1959[a]	1964[a]	1966[b]
Cropland harvested or pastured	156,997	150,716	127,871
Acres corn and soybeans	88,170	75,737	85,548
Yield per acre corn	59.9	64.7	89.2
Cropland not harvested or pastured	10,413	25,303	26,497
Pasture and woodland pasture	73,385	64,385	94,653
Woodland and other land (lots, roads, etc.)	19,365	19,020	17,627
Total land in farms	260,160	259,424	266,648

[a]Source: U. S. Bureau of Census, Census of Agriculture 1964 (54).

[b]Source: Iowa Assessor's Annual Census, 1966 (23).

with increased technology to account for increased average corn yields. In 1966 row crops occupied approximately 32 percent of the total area in farms in Adams County.

The overall productive potential of the farms in Adams County may be reflected in terms of value of all products sold. Table 4 lists the farms of Adams County according to value of products sold and type of farm.

Of the 1037 farms listed in Adams County in 1964, only 157 have sold over $20,000 worth of products, and 291 farms have

Table 4. Number of Adams County farms in terms of value of all products sold in 1964[a]

Type of farm	Value of all products sold	Number
Commercial farms:		
	$40,000 or more	22
	20,000 to 39,999	134
	10,000 to 19,999	328
	5,000 to 9,999	262
	2,500 to 4,999	141
	50 to 2,999[b]	31
		Total 918
Other farms:		
Part time[c]	50 to 2,499	47
Part retirement	50 to 2,499	82
		Total 119

[a]Source: U. S. Bureau of Census, Census of Agriculture, 1964 (54).

[b]Provided farm operator was under 65 years of age and did not work more than 100 days off the farm.

[c]Part time includes farms with a value of sales $50 to $2,499 when operator was under 65 years of age and worked off the farm more than 100 days. Part retirement includes farms with a value of sales $50 to $2,499 and the operator was 65 years of age or over.

sold less than $5,000 worth of products. The remaining half of all the farms have gross sales of products ranging from $5,000 to $20,000. In terms of distribution, this shows a high percentage of farms falling into the lower sales categories.

Humboldt County

Humboldt County is located five counties east and one county south of the northwest corner of Iowa. The location of the county in respect to the state and soil association area is shown in Figure 5a (33). Humboldt County is bounded on the north by Kossuth County, on the east by Wright County, on the south by Webster County, and on the west by Pocahontas County. Dakota City is the county seat. Humboldt, which is just west of and adjoining Dakota City, is the largest town.

Soils of Humboldt County

Humboldt County is in the Clarion-Nicollet-Webster soil association area, Figure 3 (33). Most of the soils of this area have developed under prairie vegetation and a subhumid, continental climate. The frost-free growing season averages about 148 days from May 7 to October 1. Average annual precipitation is about 29.7 inches with approximately 22 inches occurring between April 1 and September 30 (24, 42, 43).

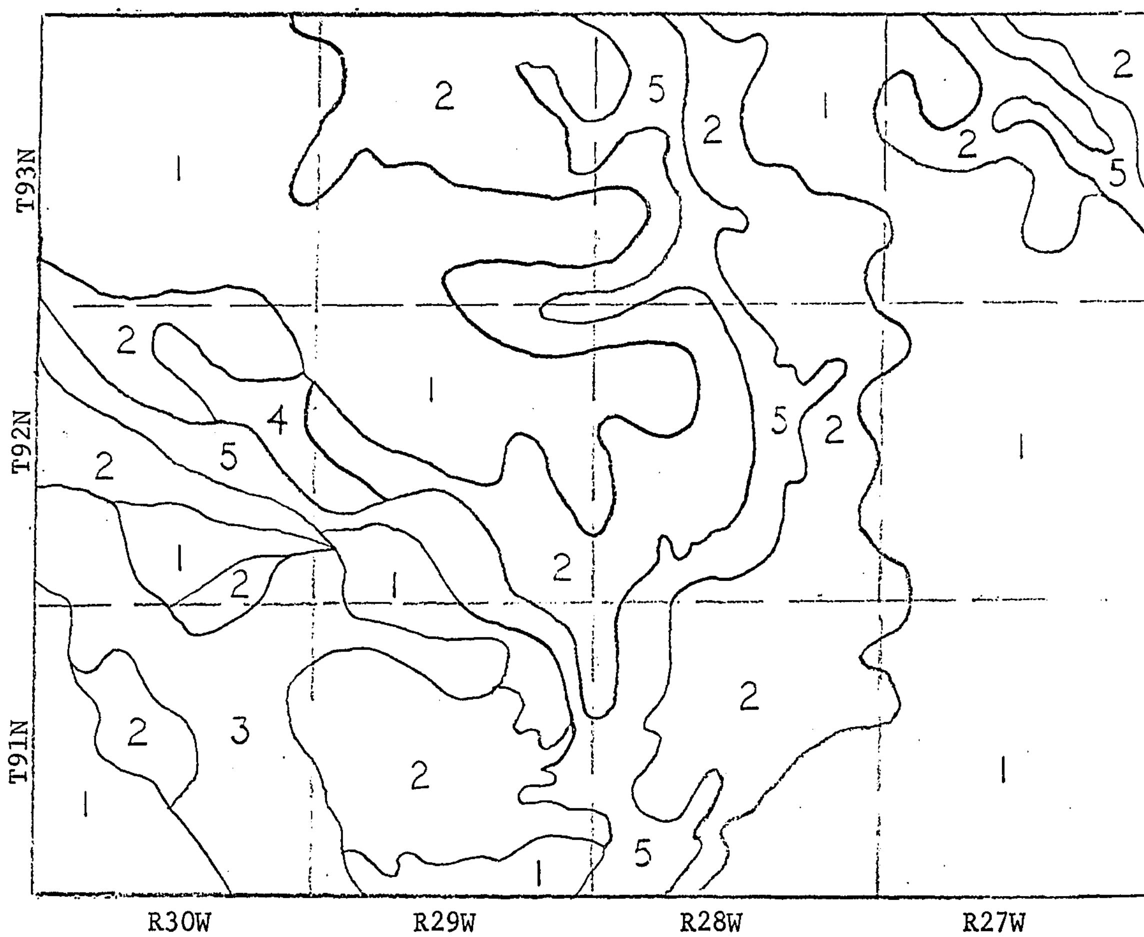
The topography of Humboldt County is characterized as a nearly level glacial till plain with numerous low knobs and ridges and many small depressions that hold water in the rainy season. Approximately 94 percent of the county area has slopes of 0-5 percent according to the soil survey information (38). The more sloping areas for the most part occur along the major stream valleys. The parent material in which the soils developed is glacial till, reworked glacial till, outwash materials, sands, organic materials and alluvium (38).

The soils in Humboldt County may be grouped into five general soil association groupings shown by a general soils map, Figure 11 (38). This association grouping is a subdivision of the larger Clarion-Nicollet-Webster soil association area and reflects the predominant topographies and soil patterns. A brief description of each area follows based on more detailed descriptions given in the soil survey report (38).

Soils area 1 is level to nearly level and is made up primarily of imperfectly drained and poorly drained upland soils. The poorly drained Webster soils and imperfectly drained Nicollet soils are the primary soils of the area with sizeable amounts of pothole soils. The pothole soils are chiefly Glencoe, Okoboji, and Rolfe. There are also several areas of organic soils in the area and a few small areas of well drained Clarion soils. These soils are tile drained for the most part where suitable outlets are available. After drainage the soils are well suited for row crop production and respond to technological inputs such as fertilizer and large machinery.

Soil area 2 is level to undulating with well drained to poorly drained soils. The well drained Clarion soils occupy the slopes with Webster soils in the level areas. There are

Figure 11. Soil association areas in Humboldt County



Legend:

1. Nicollet-Webster soil area
2. Clarion-Webster soil area
3. Clarion-Garmore soil area
4. Waukegan-Kato soil area
5. Waukegan-Huntsville soil area

some well drained Storden, Lester, and Hayden soils included in this area along the major streams. The poorly drained soils are generally tile drained, and the soils of this area are generally well suited for row crop production.

Soil area 3 is level to undulating and is underlain by limestone bedrock at depths of 10 to 20 feet. The area contains some sinkholes and rock outcrops along some of the major drainageways. The soils in this area are better drained than those in areas 1 and 2. Clarion and Garmore are the primary soils of the area, but there are also some poorly drained soils such as Webster. The area is well adapted to row crop production and responds to modern technology such as fertilizer and large machinery.

Soil area 4 is level to undulating and consists of well drained soils developed on sandy or gravelly stream and outwash terraces. The primary soils of the area are Waukegan, Kato, Marshan, and Dickinson. The soils vary in texture from sandy loams to silty clay loam, and the sandy soils tend to be droughty. The productivity of these soils vary but for the most part are adapted to row crop production.

Soil area 5 is level to undulating and consists of soils developed on stream terraces and bottom lands. The Huntsville, Colo and Wabash are the primary soils on the bottoms with Waukegan, Dickinson, Kato, and Marshan soils on the second bottoms and terraces. Some of the bottom soils are subject to flooding, and some of the terrace soils shallow to sands and gravels tend to be droughty. Generally the area is suited to row crop production.

The relationship of the major upland soils of Humboldt County to the landscape position, native vegetation, and natural drainage are shown in Figure 12. A detailed description of all soils mapped in Humboldt County, management suggestions, and soil map may be found in the Humboldt County soil survey report (38). A listing of the soils legend for the field sheets with estimated corn yields is presented in the appendix.

Humboldt County agriculture

Humboldt County is a rural county with more than 95 percent of the area in farms. It is a general farming area with corn, soybeans, oats, and hay and some pasture as the main crops. Corn is the principal crop, and much of it is used on the farm to feed cattle and hogs. In 1966 there were 1054 farms in Humboldt County which averaged 261 acres in size for a total farm area of approximately 275,385 acres. The trend in farm size and value is shown in Table 5. Farm numbers have decreased by 237 farms from the 1959 census report until the 1966 report. On the other hand, farm size has increased 46.4 acres during the same period of time. The Federal Census data indicate that per farm value and price per acre has increased from 1959 to 1964. The trend shown in the table indicates that farm size and value are increasing as the farm numbers decline.

The land use pattern of Humboldt County is shown in Table

Figure 12. Relationships of soils of Clarion-Nicollet-Webster soil association to slope, parent material, and vegetation

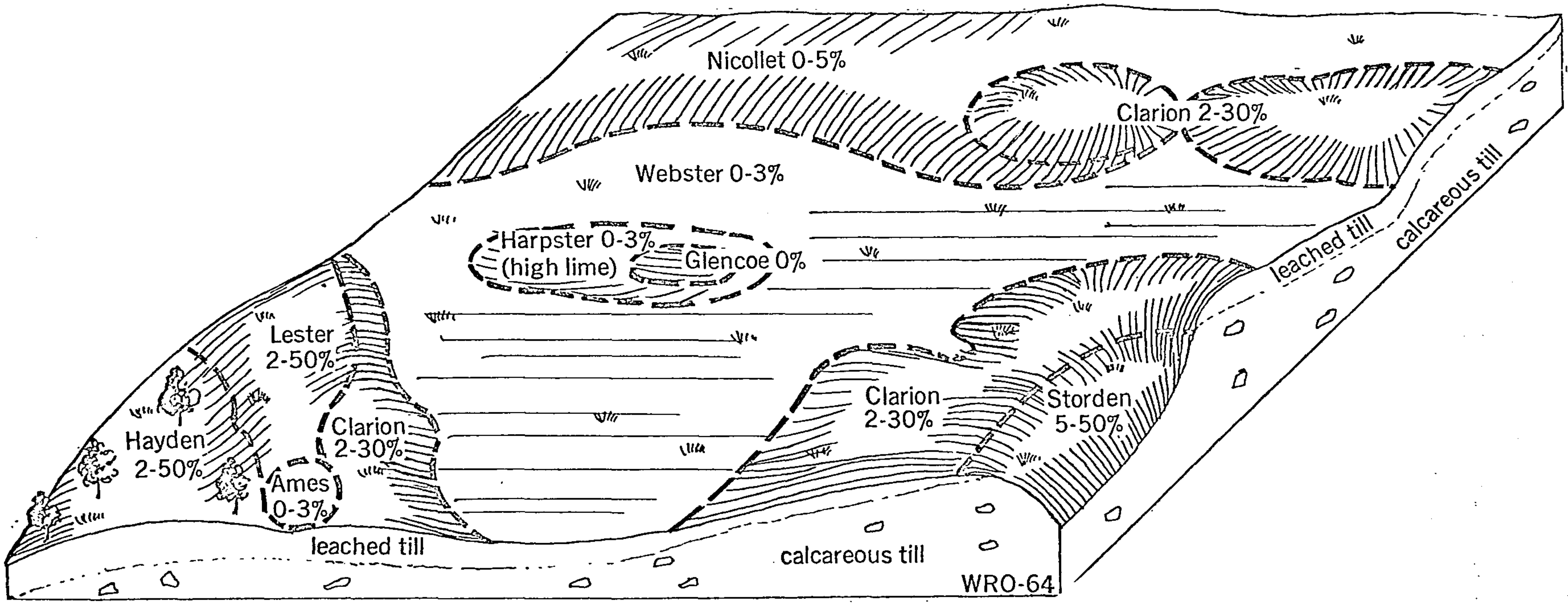

Nicollet 0-5%
Clarion 2-30%
Webster 0-3%
Harpster 0-3%
(high lime)
Glencoe 0%
Lester
2-50%
Hayden
2-50%
Clarion
2-30%
Ames
0-3%
Clarion
2-30%
Storden
5-50%
leached till
calcareous till
leached till
calcareous till
WRO-64

Table 5. Farm size and value in Humboldt County

	Unit of measure	1959[a]	1964[a]	1966[b]
Farm numbers	Numbers	1,291	1,109	1,054
Land in farms	Acres	277,040	274,850	275,385
Average size farm	Acres	214.6	247.8	261.0
Average value of land and buildings per farm	Dollars	80,788	96,337	--
Average value per acre	Dollars	358.46	387.98	--

[a]Source: U. S. Bureau of Census, Census of Agriculture, 1964 (54).

[b]Source: Iowa Assessor's Annual Farm Census, Iowa Department of Agriculture, 1966 (23).

6. The trend shows that crop land acres are decreasing from 1959 to 1966 while the acres in corn and soybeans are increasing. This trend reflects a change in land use pattern with intertilled crops being grown more intensively on these more level productive soils. This can be coupled with increased technology to account for the increased average corn yields. In 1966 intertilled row crops occupied approximately 67 percent of the land in farms in Humboldt County.

The overall productive potential of the farms in Humboldt County may be reflected in terms of value of all farm products sold. Table 7 lists the farms of Humboldt County according to value of products sold and type of farm. Of the 1109 farms

Table 6. Land use in Humboldt County

Use	1959[a]	1964[a]	1966[b]
Acres crop land harvested	232,419	210,419	209,315
Acres corn and soybeans	169,306	172,907	180,602
Yield per acre	69.8	85.7	98.7
Acres crop land not harvested or pastured	2,897	26,676	22,522
Acres pasture and woodland pasture	12,576	19,337	25,401
Acres woodland and other lands	18,256	18,233	18,147
Total acres land in farms	277,040	274,850	275,385

[a]Source: U. S. Bureau of Census, Census of Agriculture, 1964 (54).

[b]Source: Iowa Assessor's Annual Census, 1966 (23).

listed in Humboldt County in 1964, 482 farms reported sales of products that exceeded $20,000. There were only 99 farms in all categories that reported sales of less than $5,000 and of these, 44 farms were listed as operated by part-time or partially-retired farmers. In terms of income distribution, this shows a high percentage (about 48 percent) of the farms had gross sales of more than $20,000. Only about 5 percent of the commercial farms in the county had sales of less than $5,000.

Table 7. Number of Humboldt County farms in terms of value of all products sold in 1964[a]

Type of farm	Value of products sold	Number
Commercial farms:		
	$40,000 or more	142
	20,000 to 39,999	340
	10,000 to 19,999	379
	5,000 to 9,999	149
	2,500 to 4,999	46
	50 to 2,999[b]	9
	Total	1065
Other farms:		
Part-time[c]	50 to 2,999	17
Part retirement	50 to 2,999	27
	Total	44

[a]Source: U. S. Bureau of Census, Census of Agriculture, 1964 (54).

[b]Provided farm operator was under 65 years of age and did not work more than 100 days off the farm.

[c]Part-time includes farms with a value of sales $50 to $2,999 when operator was under 65 years of age and worked more than 100 days off the farm. Part-retired includes farms with a value of sales $50 to $2,999 when operator was 65 years of age or more.

METHODS FOR OBTAINING LAND VALUES FOR ASSESSMENT PURPOSES

Sample Selection and Treatment

The first step in determining the value of land for tax assessment based on market value was to collect the market data on a large scale. Data on all bona fide sales as reflected by the actual price paid were collected from the files of the Iowa State Tax Commission for Adams and Humboldt Counties for the period of January 1, 1962, through December 31, 1966. These sales were verified by the County Tax Assessors of Adams and Humboldt Counties as bona fide sales of real estate transferred by warranty deed or contracts of sales.

The criteria for a bona fide sale used in this study were defined as sales that reflected the actual price paid in the open market by or between a willing buyer and a willing seller. Tax sales, judicial sales, sheriff's sales, bankruptcy sales, sales between certain relatives, sales to governmental agencies, sales by or to charitable and religious organizations, sales with the term "love and affection," and other similar or forced sales were excluded from the study (46, 47).

The "verification" by the respective County Assessors for Adams and Humboldt Counties was to authenticate the sales price and time of actual sale in terms of the conditions of bona fide sales and to "pin-point" the exact location and size in acres of the sales.

There were 223 sales used in Adams County and 189 sales used in Humboldt County; these sales were transacted during the 5-year period. They represent about 12 percent and 9 percent of the land in farms in Adams and Humboldt Counties respectively.

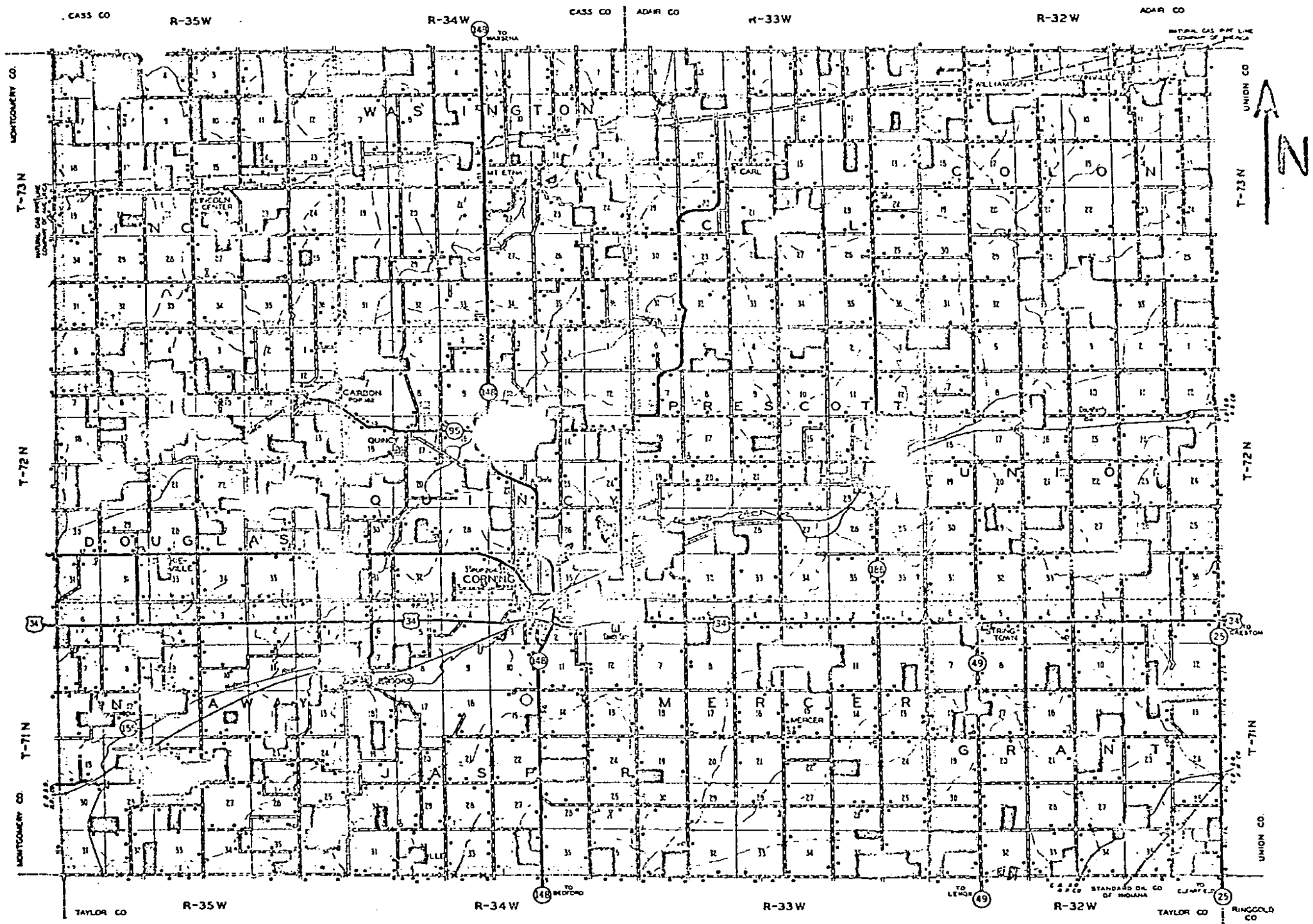
The general location of the sales included in the study are shown in Figure 13 for Adams County and Figure 14 for Humboldt County. The exact location of tracts of land sold are shown in Tables 24 and 25 in the Appendix.

The tracts of land from which bona fide sales data could be obtained are the samples used in this study to test the hypotheses.

After the samples were selected and verified, it was necessary to collect the soils data for each of the sample sites from the soil survey maps. The original field sheets from which the final map is published were used in this study because they contain more detailed information in terms of a particular tract of land than the published maps.

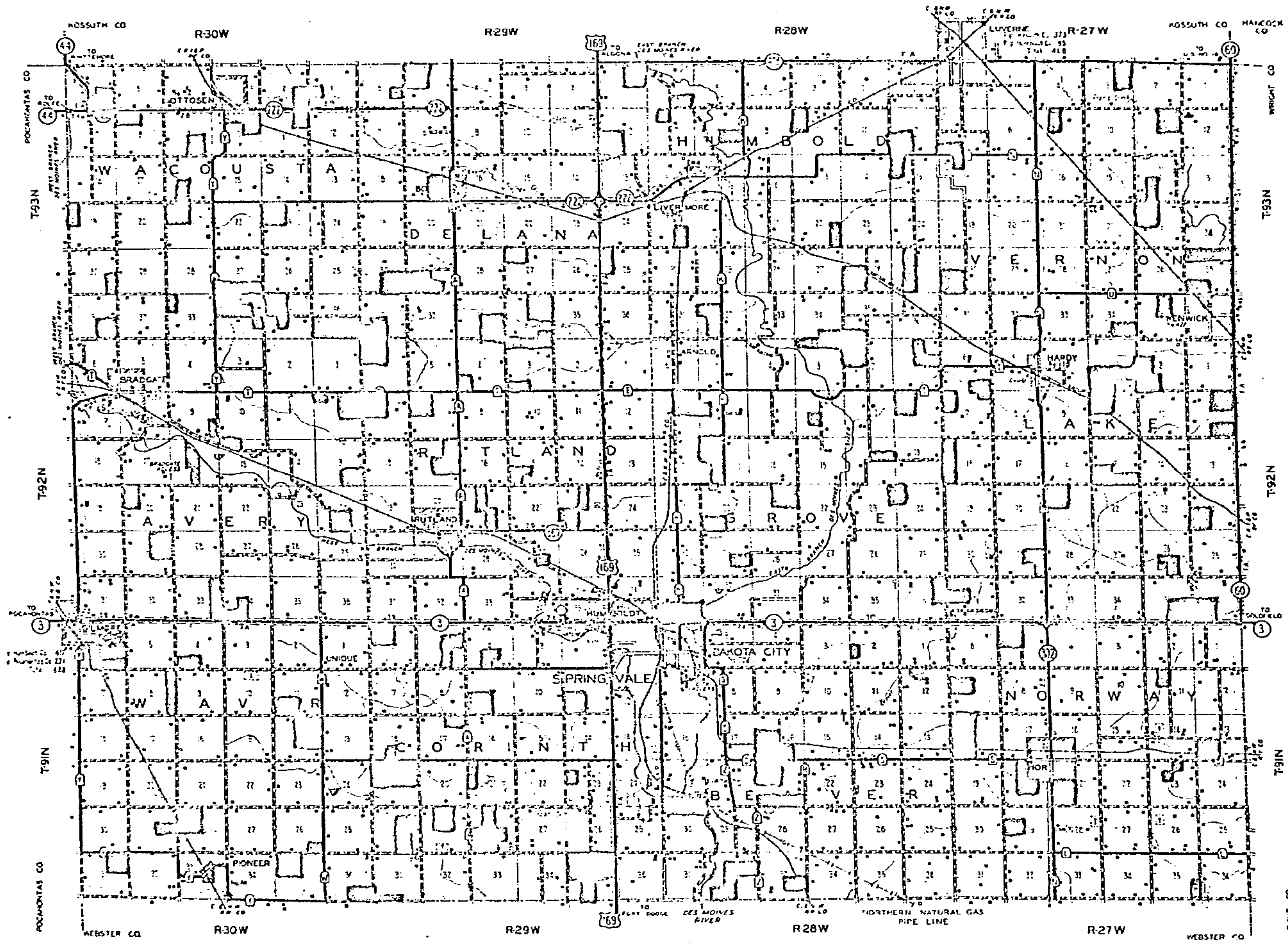
Soil maps drawn on aerial photographs show the distribution, slope, erosion, drainage patterns, location of buildings, and other information needed to make useful decisions as to the value of a tract of land. The soil mapping unit coupled with experience and research data provide a basis for transfer of knowledge from one area to another. For example, a particular soil unit appropriately classified will respond similarly to management inputs from one farm to another within a like climatic area and will have similar productivity for the various

Figure 13. Map of location of land sales in Adams County, Iowa


CASS CO
R-35W
R-34W
CASS CO
ADAIR CO
R-33W
R-32W
ADAIR CO
MONTGOMERY CO
UNION CO
T-73N
T-72N
T-71N
N
CARBON
QUINCY
CORNING
CARL
MERCER
TAYLOR CO
RINGGOLD CO

☐ Area sold

Figure 14. Map of location of land sales in Humboldt County, Iowa


KOSSUTH CO
R-30W
R-29W
R-28W
R-27W
HANCOCK CO
WRIGHT CO
POCAHONTAS CO
WEBSTER CO
T-93N
T-92N
T-91N
OTTOSEN
LUVERNE
W A C O U S T A
D E L A N A
H U M B O L D T
V E R N O N
LIVERMORE
ARNOLD
RENWICK
HARDY
BRADGATE
L A K E
R U T L A N D
A V E R Y
G R O V E
RUTLAND
HUMBOLDT
DAKOTA CITY
SPRING VALE
UNIQUE
W A V E R
C O R N T H
N O R W A Y
B E A V E R
PIONEER
DES MOINES RIVER
NORTHERN NATURAL GAS PIPE LINE

Area sold

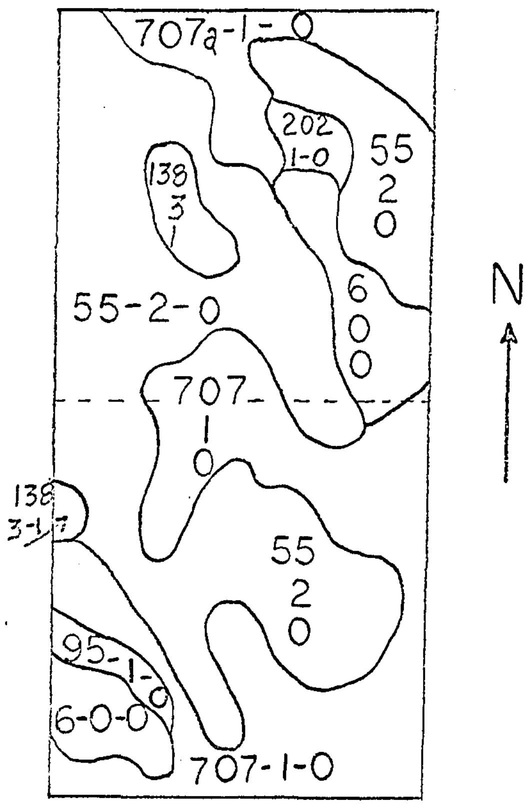
crops.

The second phase of the study, after the sample was selected, was to obtain measurements and record the acreages of all the soil units occurring on the various tracts of land that were exchanged. Areas in ditches, roads, and other non-useable areas were deducted from the measurements of the respective soil types. The measurements were made with a grid counter in Humboldt County and with a polar planimeter in Adams County. Woodland was measured and recorded separately in Adams County. Woodland was ignored in the measurements made in Humboldt County because of the small total acreage and the fact that it is scattered in small tracts.

Figure 15 shows an example of one soil map and the soil data recorded on a tract in Humboldt County. This same general technique was used in both Adams and Humboldt Counties.

The county assessors in Adams and Humboldt Counties are currently using the soil survey data and corn suitability ratings as a basis for tax assessment (35, 40), and a portion of this study is to obtain values for the corn suitability ratings based on sales data. The corn suitability ratings used in the assessments were developed cooperatively by the Agronomy Department and soil survey section of the Soil Conservation Service at Iowa State University. Each soil unit was rated with a score between 5 and 100 with 100 being the most productive soil in the state. Dollar values were estimated for each corn suitability rating by the respective assessor and were

Figure 15. Soil map of W½ SE¼, Sec. 9, T93N, R30W, Humboldt County, Iowa



NW¼ SE¼

Map Unit	Acres
6-0-0	4.4
55-1-0	25.6
138-3-1	1.6
202-1-0	1.2
707-1-0	2.0
7-7a-1-0	5.2
Total	40.0

SW¼ SE¼

Map Unit	Acres
6-0-0	2.4
55-2-0	18.0
95-1-0	1.2
138-3-1	.4
707-1-0	17.0
Total	39.0

reported in terms of 60 percent value which was used for assessment. The corn suitability ratings used by the assessors and soil legends are found in Tables 26 and 27 in the Appendix.

The listing of farm land for tax assessment is made by 40-acre tracts or fractions thereof with the assessed value of buildings being added to tracts on which they occur. The acres of each different soil unit was measured with deductions for ditches and other hazards and recorded in terms of the 40-acre tracts. Once the above information was obtained, values for the individual tracts of land could be approximated. An example of how dollar value of tracts is estimated is shown in Table 8, using a hypothetical example of soils found on a 40 acre tract in Humboldt County. After the approximate value of the soils of the tract were obtained, the assessed value of the buildings, if any, were added. The upward or downward adjustment of value on individual tracts were then made by the assessors to adjust for location, excessive wetness, or any other component of value not contemplated by the rating valuation.

The general outline described was used in both counties on each 40-acre tract or portion thereof for the entire county. The assessor used the field mapping sheets of a scale 8 inches equals one mile for ease of measurement and a more detailed representation of the minor soil units. The minor soil units have in many cases been incorporated into larger units for the final publication of the soil map but are important in assessment work.

Table 8. Sample calculation to show how dollar value of tracts were obtained

Map number	Acres	Minus adjustments	Corn suitability rating	Acre value[a]	Total assessed value
55-1-0	10	0	95	89.10	$ 891.00
107-1-0	20	0	90	83.80	1,676.00
138-7-1	10	0	75	65.30	653.00
	40				$3,220.00

[a]The 60 percent value used for assessment in 1966 in Humboldt County.

Statistical Estimation Procedure

Least-squares regression techniques were used to estimate the parameters of the regression model used in this study. The least-squares regression model is of the following form:

$$Y = A + B_1X_1 \text{ to } \dots + B_iX_i + E_i$$

where Y is the dependent variable (tract value), A is the intercept which is assumed as zero in the problem, X's are the independent variables, and B's are the coefficients of the model and E is the error. The B's are the unknown coefficients of which parameters are to be estimated.

The following assumptions are made to estimate the coefficients by the least-squares (45). They are:

a) The sum of the errors are equal to zero, and errors are random variables with zero expectation and are normally distributed;

b) That the errors have a constant variance of S^2;

c) That X's are a fixed set of numbers and that X's are a nonsingular matrix; and

d) The number of observations exceed the number of parameters to be estimated.

The test of significance used is the F-test and the t-test. The F-test is the ratio of the regression mean square to the residual mean square and is used to test the significance of the overall regression. It is used to test the hypothesis that explanatory variables do not influence dependent variables. The t-test is used to test whether the regression coefficient is significantly different from zero. The t-test is the ratio of the estimated regression coefficient to its standard error.

R^2 values are used to indicate the percent of the variation in the dependent variable that is explained by the explanatory variables. R^2 is the coefficient of determination.

Development of Regression Model and Description of Variable

It has been hypothesized that the value of farm real estate is related directly to the soil resources that occur on the parcel, the location, and the value of buildings on the particular tract being valued. The value of tracts of land is assumed to be a function of the following variable:

$$V = f\ (B,S,L) \tag{4.1}$$

where V is value of land, B is the value of buildings, S is the soil resource and L is the location of the farm in terms of paved roads.

Two general regression models were used to estimate equation 4.1. One was a straight multiple regression with a time series element used on the corn suitability rating, and the other was a curvilinear regression model with a time series variable used on the slope-yield approach.

The general model used can be stated compactly in matrix notation:

$$Y = bX + U \tag{4.2}$$

where Y is a vector of n observations of the dependent variable sale price, b is a vector of unknown coefficients, X is a (nxk) matrix of n observations or k variables and U is a vector of errors which is expected to be zero due to assumptions outlined in previous section on procedures.

The definition of the variables used in both Adams and Humboldt Counties are given in Tables 9 and 10.

Orthogonal polynomials were used in estimating the value coefficients on the soils because the increments between the successive levels of X for each slope group were equal, and this technique provided the best fit for the slope-yield approach. The estimated values for each slope unit were calculated and the values were decoded for each yield level within the slope group.

The time series variable was included in both methods to get an estimation of the B values for the last quarter of 1966.

Table 9. Identification of variables used in regression models in Adams County, Iowa

Designation	Description[a]
X_1	Acres per farm unit (acres)
X_2	Total price of farm unit and is the dependent variable (dollars)
X_3	Total price of farm unit less buildings (dollars)
X_4	Assessed value on buildings (dollars)
X_5	Location: 1 = Yes on highway; 0 = No
X_6	Acres with yield potential of 95+ Bu. of corn on 0-5% slopes (acres)
X_7	" " 90-95 " "
X_8	" " 85-90 " "
X_9	" " 80-85 " "
X_{10}	" " 75-80 " "
X_{11}	" " 70-75 " "
X_{12}	" " 65-70 " "
X_{13}	" " 60-65 " "
X_{14}	" " 55-60 " "
X_{15}	Acres with yield potential of 90-95 Bu. of corn on 5-9% slopes (acres)
X_{16}	" " 85-90 " "
X_{17}	" " 80-85 " "
X_{18}	" " 75-80 " "
X_{19}	" " 70-75 " "
X_{20}	" " 60-65 " "
X_{21}	" " 55-60 " "
X_{22}	" " 50-55 " "
X_{23}	" " <50 " "
X_{24}	Acres with yield potential of 80-85 Bu. of corn on 9-14% slopes (acres)
X_{25}	" " 75-80 " "
X_{26}	" " 70-75 " "
X_{27}	" " 65-70 " "
X_{28}	" " 60-65 " "
X_{29}	" " 55-60 " "
X_{30}	" " 50-55 " "
X_{31}	" " <50 " "
X_{32}	Acres with yield potential of 70-75 Bu. of corn on 14-18% slopes (acres)
X_{33}	" " 65-70 " "
X_{34}	" " 55-60 " "
X_{35}	" " 50-55 " "
X_{36}	" " <50 " "

[a]The unit of measure of the data is given in parentheses.

Table 9. (Continued)

Designation	Description[a]
X_{37}	Acres with yield potential of 50 Bu. of corn on 18+% slopes
X_{38}	Acres on 0-5% slopes in timber (acres)
X_{39}	" 5-9% " "
X_{40}	" 9-14% " "
X_{41}	" 14-18% " "
X_{42}	" 18+% " "
X_{43}	Acres of waste and ditches (acres)
X_{44}	Located in Twp. 73 range 35, 1 = yes; 0 = no
X_{45}	" 73 " 34 "
X_{46}	" 73 " 33 "
X_{47}	" 73 " 32 "
X_{48}	Located in Twp. 72 range 35, 1 = yes; 0 = no
X_{49}	" 72 " 34 "
X_{50}	" 72 " 33 "
X_{51}	" 72 " 32 "
X_{52}	Located in Twp. 71 range 35, 1 = yes; 0 = no
X_{53}	" 71 " 34 "
X_{54}	" 71 " 33 "
X_{55}	" 71 " 32 "
X_{56}	CSR (Corn Suitability Rating)

Orthogonal polynomials for 0-5% slope group:

$$X_{57} = X_6 + X_7 + X_8 + X_9 + X_{10} + X_{11} + X_{12} + X_{13} + X_{14}$$

$$X_{58} = 4X_6 + 3X_7 + 2X_8 - X_9 - X_{11} - 2X_{12} - 3X_{13} - 4X_{14}$$

$$X_{59} = 28X_6 + 7X_7 - 8X_8 - 17X_9 - 20X_{10} - 17X_{11} - 8X_{12} + 7X_{13} + 28X_{14}$$

$$X_{60} = 14X_6 - 7X_7 - 13X_8 - 9X_9 + 9X_{11} + 13X_{12} + 7X_{13} - 14X_{14}$$

Orthogonal polynomials for 5-9% slope group:

$$X_{61} = X_{15} + X_{16} + X_{17} + X_{18} + X_{19} + (\qquad) + X_{20} + X_{21} + X_{22} + X_{23}$$

$$X_{62} = 9X_{15} + 7X_{16} + 5X_{17} + 3X_{18} + 1X_{19} - 3X_{20} - 5X_{21} - 7X_{22} - 9X_{23}$$

$$X_{63} = 6X_{15} + 2X_{16} - 1X_{17} - 3X_{18} - 4X_{19} - 3X_{20} - 1X_{21} + 2X_{22} + 6X_{23}$$

Table 9. (Continued)

Designation	Description[a]
$X_{64} = 42X_{15} - 14X_{16} - 35X_{17} - 31X_{18} - 12X_{19} + 31X_{20} + 35X_{21} + 14X_{22} - 42X_{23}$	
Orthogonal polynomials for 9-14% slope group:	
$X_{65} = X_{24} + X_{25} + X_{26} + X_{27} + X_{28} + X_{29} + X_{30} + X_{31}$	
$X_{66} = 7X_{24} + 5X_{25} + 3X_{26} + X_{27} - X_{28} - 3X_{29} - 5X_{30} - 7X_{31}$	
$X_{67} = 7X_{24} + X_{25} - 3X_{26} - 5X_{27} - 5X_{28} + 3X_{29} + X_{30} + 7X_{31}$	
$X_{68} = 7X_{24} - 5X_{25} - 7X_{26} - 3X_{27} + 3X_{28} + 7X_{29} + 5X_{30} - 7X_{31}$	
Orthogonal polynomials for 14-18% slope group:	
$X_{69} = X_{32} + X_{33} + (\qquad) + X_{34} + X_{35} + X_{36}$	
$X_{70} = 5X_{32} + 3X_{33} - X_{34} - 3X_{35} - 5X_{36}$	
$X_{71} = 5X_{32} - X_{33} - 4X_{34} - X_{35} + 5X_{36}$	
Orthogonal polynomials for woodland:	
$X_{72} = X_{38} + X_{39} + X_{40} + X_{41} + X_{42}$	
$X_{73} = 2X_{38} + X_{39} - X_{41} - 2X_{42}$	
$X_{74} = 3X_{38} - X_{39} - 2X_{40} - X_{41} + 2X_{42}$	
$X_{75} = X_1 - \sum_{i=6}^{43} X_i$	
$X_{76} = X_1X_{56}$	
Time series variables:	
$X_{77} = 0$ if ID = 6604	
$= X_1$ if ID = 6603	
$= 2X_1$ if ID = 6602	
$= 3X_1$ if ID = 6601	
$= 4X_1$ if ID = 6504	

Table 9. (Continued)

Designation	Description[a]
X_{77}	$= 5X_1$ if ID = 6503
	$= 6X_1$ if ID = 6502
	$= 7X_1$ if ID = 6501
	$= 8X_1$ if ID = 6404
	$= 9X_1$ if ID = 6403
	$= 10X_1$ if ID = 6402
	$= 11X_1$ if ID = 6401
	$= 12X_1$ if ID = 6304
	$= 13X_1$ if ID = 6303
	$= 14X_1$ if ID = 6302
	$= 15X_1$ if ID = 6301
	$= 16X_1$ if ID = 6204
	$= 17X_1$ if ID = 6203
	$= 18X_1$ if ID = 6202
	$= 19X_1$ if ID = 6201

Table 10. Identification of variables used in regression models in Humboldt County, Iowa

Designation	Description[a]				
X_1	Size of farm (acres)				
X_2	Total price of farm unit and is the dependent variable (dollars)				
X_3	Total price less value of buildings (dollars)				
X_4	Assessed value buildings (dollars)				
X_5	Location: 1 = Yes on highway; 0 = No				
X_6	Acres with yield	potential of	95+	Bu. of corn on 0-5%	slopes (acres)
X_7	"	"	90-95	"	"
X_8	"	"	85-90	"	"
X_9	"	"	80-85	"	"
X_{10}	"	"	75-80	"	"
X_{11}	"	"	70-75	"	"
X_{12}	"	"	65-70	"	"
X_{13}	"	"	60-65	"	"
X_{14}	"	"	55-60	"	"
X_{15}	"	"	50-55	"	"
X_{16}	"	"	<50	"	"
X_{17}	Acres with yield	potential of	85-90	Bu. of corn on 5-9%	slopes (acres)
X_{18}	"	"	80-85	"	"
X_{19}	"	"	75-80	"	"
X_{20}	"	"	65-70	"	"
X_{21}	"	"	60-65	"	"
X_{22}	"	"	50-55	"	"
X_{23}	"	"	<50	"	"
X_{24}	Acres with yield	potential of	80-85	Bu. of corn on 9-14%	slopes (acres)
X_{25}	"	"	75-80	"	"
X_{26}	"	"	70-75	"	"
X_{27}	"	"	65-70	"	"
X_{28}	"	"	60-65	"	"
X_{29}	"	"	55-60	"	"
X_{30}	"	"	<50	"	"
X_{31}	Acres with yield	potential of	60-65	Bu. of corn on 14-18%	slopes (acres)
X_{32}	"	"	55-60	"	"
X_{33}	"	"	50-55	"	"
X_{34}	"	"	<50	"	"
X_{35}	Acres with yield	potential of	50-55	Bu. of corn on 18+%	slopes (acres)
X_{36}	"	"	<50	"	"

[a]The unit of measure of data is given in parentheses.

Table 10. (Continued)

Designation	Description[a]
X_{37}	Located in Twp. 93 range 30, 1 = yes; 0 = no
X_{38}	" 93 " 29 "
X_{39}	" 93 " 28 "
X_{40}	" 93 " 27 "
X_{41}	Located in Twp. 92 range 30, 1 = yes; 0 = no
X_{42}	" 92 " 29 "
X_{43}	" 92 " 28 "
X_{44}	" 92 " 27 "
X_{45}	Located in Twp. 91 range 30, 1 = yes; 0 = no
X_{46}	" 91 " 29 "
X_{47}	" 91 " 28 "
X_{48}	" 91 " 27 "
X_{49}	CSR (Corn Suitability Rating)

Orthogonal polynomials for 0-5% slope group:

$$X_{50} = X_6 + X_7 + X_8 + X_9 + X_{10} + X_{11} + X_{12} + X_{13} + X_{14} + X_{15} + X_{16}$$

$$X_{51} = 5X_6 + 4X_7 + 3X_8 + 2X_9 + X_{10} - X_{12} - 2X_{13} - 3X_{14} - 4X_{15} - 5X_{16}$$

$$X_{52} = 15X_6 + 6X_7 - X_8 - 6X_9 - 9X_{10} - 10X_{11} - 9X_{12} - 6X_{13} - X_{14} + 6X_{15} + 15X_{16}$$

$$X_{53} = 30X_6 - 6X_7 - 22X_8 - 23X_9 - 14X_{10} + 14X_{12} + 23X_{13} + 22X_{14} + 6X_{15} - 30X_{16}$$

Orthogonal polynomials for 5-9% slope group:

$$X_{54} = X_{17} + X_{18} + X_{19} + (\quad) + X_{20} + X_{21} + (\quad) + X_{22} + X_{23}$$

$$X_{55} = 4X_{17} + 3X_{18} + 2X_{19} - X_{21} - 3X_{22} - 4X_{23}$$

$$X_{56} = 28X_{17} + 7X_{18} - 8X_{19} - 20X_{20} - 17X_{21} + 7X_{22} + 28X_{23}$$

$$X_{57} = 14X_{17} - 7X_{18} - 13X_{19} + 9X_{21} + 7X_{22} - 14X_{23}$$

Orthogonal polynomials for 9-14% slope group:

$$X_{58} = X_{24} + X_{25} + X_{26} + X_{27} + X_{28} + X_{29} + (\quad) + X_{30}$$

$$X_{59} = 7X_{24} + 5X_{25} + 3X_{26} + X_{27} - X_{28} - 3X_{29} - 7X_{30}$$

$$X_{60} = 7X_{24} + X_{25} - 3X_{26} - 5X_{27} - 5X_{28} - 3X_{29} + 7X_{30}$$

Table 10. (Continued)

Designation	Description[a]
	$X_{61} = 7X_{24} - 5X_{25} - 7X_{26} - 3X_{27} + 3X_{28} + 7X_{29} - 7X_{30}$
	Orthogonal polynomials for 14-18% slope group:
	$X_{62} = X_{31} + X_{32} + X_{33} + X_{34}$
	$X_{63} = 3X_{31} + X_{32} - X_{33} - 3X_{34}$
	$X_{64} = X_1 - \sum_{i=6}^{36} X_i$
	$X_{65} = X_1 X_{49}$
	Time series variable:
	$X_{66} = 0$ if ID = 6604
	$= X_1$ if ID = 6603
	$= 2X_1$ if ID = 6602
	$= 3X_1$ if ID = 6601
	$= 4X_1$ if ID = 6504
	$= 5X_1$ if ID = 6503
	$= 6X_1$ if ID = 6502
	$= 7X_1$ if ID = 6501
	$= 8X_1$ if ID = 6404
	$= 9X_1$ if ID = 6403
	$= 10X_1$ if ID = 6402
	$= 11X_1$ if ID = 6401
	$= 12X_1$ if ID = 6304
	$= 13X_1$ if ID = 6303
	$= 14X_1$ if ID = 6302

Table 10. (Continued)

Designation	Description[a]
$X_{66} = 15X_1$ if ID = 6301	
$= 16X_1$ if ID = 6204	
$= 17X_1$ if ID = 6203	
$= 18X_1$ if ID = 6202	
$= 19X_1$ if ID = 6201	

APPLICATION OF METHODS TO SAMPLE AREAS

The empirical results of the study are presented in this chapter and are based on the model proposed in Chapter IV. The models prepared were estimated by the least-square regression and since it is common to explore a range of alternative formulations, several equations are estimated and the most suitable equations were selected to represent the value of land for tax assessment.

This chapter is divided into two parts. The first part consists of the results of the model using corn suitability ratings. The corn suitability ratings of the various soil types and value of buildings are the independent variables in this model. The second part of this chapter contains the results using the yield-slope grouping of the various soils in the respective counties, the location in respect to paved roads, and the value of the buildings.

Results of Investigations, Using Corn Suitability Ratings

Corn suitability ratings were available from the Adams County Assessor for the years 1965 and 1966 on all the bona fide sales. These data were reported in terms of 40-acre tracts or portions thereof but were adjusted to reflect the average corn suitability rating for the entire sale unit. Corn suitability ratings were available from Humboldt County for 1962 through 1966 and were handled in the same way as in Adams County. The assessed value of buildings for each of the sales were obtained from each of the assessors.

These data plus location data, which included if the tract were on a paved road and the township in which the sale was located, were recorded on IBM data cards.

A least-squares regression model (45) of the following form was used:

$$Y = a + B_1X_{1_i} + \ldots . B_kX_{k_i} + E_i \tag{5.1}$$

where Y is the dependent variable, the X's are the independent variables, the B's are the coefficients of the model and E is the error used in the analyses. The error term is assumed to be zero with a normal distribution and a constant variance. The "a" value or intercept is also assumed to be zero. The working model of the regression would then become:

$$Y = B_1X_1 + B_2X_2 \ldots . B_kX_k \tag{5.2}$$

and this was the general model used in the study.

Several calculations were made at the computer center which included the variables of township location, highway location, assessed value of buildings, a time series variable, and corn suitability ratings. A listing of these variables is given in Tables 9 and 10 in the previous section.

The best fitting equation in Adams County to predict the value of farmland was:

$$X_2 = B_4X_4 + B_{76}X_{76} + B_{77}X_{77} \tag{5.3}$$

where X_2 is the dependent variable (value of the land unit),

X_4 is the assessed value of buildings, X_{76} is the corn suitability rating, and X_{77} is the time series variable.

The best fitting equation in Humboldt County to predict the value of farm land was:

$$X_2 = b_4X_4 + b_{65}X_{65} + b_{66}X_{66} \tag{5.4}$$

where X_2 is the dependent variable (value of land unit), X_4 is the assessed value of buildings, X_{65} is the corn suitability rating and X_{66} is the time series variable.

The two above equations were considered the best fitting because they had the highest R-square values and the smallest standard errors. In Table 11, the F-test is the ratio of the regression mean square to the residual mean square and is used to test the significance of the overall regression. The R^2 in this table is the value used to indicate the percent of variation in the dependent variable that is explained by the explanatory variables. The R values indicate that the estimation equations in both counties account for over 95 percent of the value using the three variables. The standard error is rather high in both cases but may be explained by the variable demand conditions of the local land markets. The demand conditions vary when prices are "bid up" in some cases when additions are made for farm enlargements, and in other cases the value would be more nearly the average when a sizeable unit may sell.

The data in Table 12 give the values for the various B values with the standard error of the B value as well as the value of the t-test. All the values were significant at the

Table 11. Statistical aspects of equation 5.3 (Adams County) and 5.4 (Humboldt County)

County	Dependent variable mean	F ratio	Standard error of mean of dependent variable	R^2
Adams	\$23,861.97	833.2**	\$5,803.16	.9597
Humboldt	46,057.71	3,441.8**	7,068.62	.9823

**Highly significant at the 1% level.

Table 12. Estimated "B" values for the variable coefficients of equation 5.3 (Adams County) and 5.4 (Humboldt County)

County	Variable	B value	Standard error of B	t value
Adams	X_4	4.55	\$ 0.88	5.178**
	X_{76}	2.85	0.17	16.637**
	X_{77}	-2.13	1.34	-1.584*
Humboldt	X_4	2.87	0.43	6.735**
	X_{65}	5.32	0.14	39.761**
	X_{66}	-9.16	0.84	-10.939**

*Significant at about 10% level.

**Highly significant at 1% level.

one percent level except for variable X_{77} which was significant at the 10 percent level. The time variable series, which are variables X_{77} and X_{66} for Adams and Humboldt Counties respectively, are designed so that B = 0 for the last quarter of 1966. This was arranged for ease of calculation of the estimated values.

The B values for variables X_4 in both counties are coefficients that when multiplied times the assessed value of building in the respective counties should give the average market value of the buildings on a farm. If the buildings are to be assessed at 27 percent of their actual value as discussed in an earlier section of this study, the multiplier coefficient should be 3.7. This suggests that the buildings in Adams County are under-assessed at the present time with a multiplier of 4.55. The data also show that the reverse is true in Humboldt County, and at the present time the buildings are over-assessed.

The working model that the assessors may use to get an estimate of value as of the last quarter of 1966 would become

$$V = B_1X_1 + B_2X_2 \tag{5.5}$$

where V is the estimated value of a tract of land, B_1 is the multiplier for buildings in the respective counties, X_1 is the assessed value of building if any on the tract, B_2 is the value of each unit of corn suitability for the respective counties, and X_2 is the average corn suitability rating for the tract.

Comparisons of the values of corn suitability rating values are shown in Table 13 for Adams County and in Table 14 for

Table 13. Comparison of corn suitability rating values for Adams County, Iowa

1965-1966 CSR	1965-1966 60% Assessed value	Estimated market value @ 1966 prices: Assessed value (27% Market value)	Estimated market value @ 1966 prices: 100% Value
95	$76.00	$73.11	$270.79
94	75.00	72.34	267.94
93		71.57	265.09
92	74.00	70.80	262.24
91		70.03	259.39
90	72.00	69.26	256.54
89	71.00	68.49	253.69
88	70.00	67.42	250.84
87		66.95	247.98
86		66.19	245.13
85	68.00	65.41	242.28
84	68.00	64.65	239.43
83		63.88	236.58
82	66.00	63.11	233.73
81		62.34	230.88
80	64.00	61.57	228.03
79		60.80	225.18
78	62.00	60.03	222.33
77	62.00	59.26	219.48
76		58.49	216.63
75	60.00	57.72	213.78
74	59.00	56.95	210.93
73		56.18	208.08
72	58.00	55.41	205.23
71	57.00	54.64	202.38
70	56.00	53.87	199.53
69	55.00	53.10	196.68
68		52.33	193.83
67		51.56	190.97
66		50.79	188.13
65	52.00	50.02	185.28
64		49.25	182.43
63		48.48	179.58
62		47.71	176.72
61		46.95	173.87
60	48.00	46.18	171.02
59		45.41	168.17
58		44.64	165.32
57		43.86	162.47

Table 13. (Continued)

1965-1966 CSR	1965-1966 60% Assessed value	Estimated market value @ 1966 prices: Assessed value (27% Market value)	100% Value
56	$45.00	$43.10	$159.62
55	44.00	42.33	156.77
54	43.00	41.56	153.92
53		40.79	151.07
52	42.00	40.02	148.22
51	41.00	39.25	145.37
50	40.00	38.48	142.52
49		37.71	139.67
48	38.00	36.94	136.82
47		36.17	133.97
46	37.00	35.40	131.12
45	36.00	34.63	128.27
44	35.00	33.86	125.42
43	34.00	33.09	122.57
42	33.00	32.32	119.72
41		31.55	116.87
40	32.00	30.78	114.01
39		30.01	111.17
38	31.00	29.24	108.32
37	30.00	28.48	105.46
36	29.00	27.71	102.61
35	28.00	26.94	99.76
34	27.00	26.17	96.91
33		25.40	94.06
32	26.00	24.63	91.21
31	25.00	23.86	88.36
30	24.00	23.09	85.51
29		22.32	82.66
28		21.55	79.81
27	22.00	20.78	76.96
26		20.01	74.11
25	20.00	19.24	71.26
24	19.00	18.47	68.41
23		17.70	65.56
22	18.00	16.93	62.71
21		16.06	59.86
20	16.00	15.39	57.01
19		14.62	54.16
18		13.85	51.31
17		13.08	48.46

Table 13. (Continued)

1965-1966 CSR	1965-1966 60% Assessed value	Estimated market value @ 1966 prices: Assessed value (27% Market value)	100% Value
16		$12.31	$45.61
15	$12.00	11.54	42.76
14		10.77	39.91
13		10.00	37.05
12		9.24	34.20
11	12.00	8.47	31.35
10		7.70	28.50

Table 14. Comparison of corn suitability rating values for Humboldt County, Iowa

CSR	Converted CSR 1.0 = 100	60% Assessed value Prior 1965	1965	1966	1966 Prices 27% value from regression	100% value from regression
1.5	95	$75.00	$81.00	$89.10	$136.57	$508.83
1.6	94	74.00	80.40	88.40	135.13	500.50
1.7	93	73.00	79.20	87.10	133,70	495.18
1.8	92	72.00	78.80	85.80	132.26	489.85
1.9	91	71.00	76.80	84.50	130.82	484.52
2.0	90	69.00	76.20	83.80	129.38	479.20
2.1	89	68.00	74.40	81.80	127.95	473.88
2.2	88	67.00	73.20	80.50	126.51	468.56
2.3	87	66.00	72.00	79.20	125.07	463.23
2.4	86	65.00	70.80	77.90	123.63	457.91
2.5	85	64.00	70.20	77.20	122.19	452.58
2.6	84	63.00	69.00	75.90	120.76	447.26
2.7	83	62.00	67.80	74.60	119.32	441.93
2.8	82	61.00	66.60	73.30	117.88	436.61
2.9	81	60.00	65.40	71.90	116.45	431.28
3.0	80	58.00	64.20	70.60	115.01	425.96
3.1	79	57.00	63.00	69.30	113.57	420.64
3.2	78	56.00	62.40	68.60	112.13	415.31
3.3	77	55.00	61.20	67.30	110.70	409.99
3.4	76	54.00	60.00	66.00	109.26	404.66
3.5	75	53.00	59.40	65.30	107.82	399.34
3.6	74	52.00	58.20	64.00	106.38	394.01
3.7	73	51.00	57.00	62.70	104.94	388.69
3.8	72	50.00	56.40	62.00	103.51	383.36
3.9	71	49.00	55.20	60.70	102.07	378.04
4.0	70	47.00	53.40	58.70	100.63	372.72
4.1	69	46.00	52.20	57.40	99.19	367.39
4.2	68	45.00	51.00	56.10	97.76	362.07
4.3	67	44.00	50.40	55.40	96.32	356.74
4.4	66	43.00	49.20	54.10	94.88	351.42
4.5	65	42.00	48.00	52.80	93.44	346.09
4.6	64	41.00	47.40	52.10	92.00	340.77
4.7	63	40.00	46.20	50.80	90.57	335.44
4.8	62	39.00	45.00	49.50	89.13	330.12
4.9	61	38.00	43.80	48.20	87.69	324.79
5.0	60	36.00	42.00	46.20	86.26	319.47
5.1	59	35.00	41.40	45.50	84.82	314.15
5.2	58	34.00	40.20	44.20	83.38	308.82

Table 14. (Continued)

CSR	Converted CSR 1.0 = 100	60% Assessed value Prior 1965	1965	1966	1966 Prices 27% value from regression	100% value from regression
5.3	57	$33.00	$39.00	$42.90	$81.94	$303.50
5.4	56	32.00	37.80	41.60	80.51	298.17
5.5	55	31.00	36.60	40.30	79.07	292.85
5.6	54	30.00	36.00	39.60	77.63	287.52
5.7	53	29.00	34.80	38.30	76.19	282.20
5.8	52	28.00	33.60	37.00	74.75	276.87
5.9	51	27.00	32.40	35.60	73.32	271.55
6.0	50	26.00	31.20	34.30	71.88	266.22
6.1	49	25.00	30.00	33.00	70.44	260.90
6.2	48	25.00	29.40	32.30	69.00	255.59
6.3	47	24.00	28.80	31.70	67.57	250.25
6.4	46	23.00	28.20	31.00	66.13	244.93
6.5	45	23.00	27.60	30.04	64.69	239.60
6.6	44	22.00	27.00	29.70	63.25	234.28
6.7	43	21.00	26.40	29.00	61.82	228.95
6.8	42	21.00	25.80	28.40	60.38	223.63
6.9	41	20.00	25.20	27.70	58.94	218.30
7.0	40	19.00	23.40	25.70	57.50	212.98
7.1	39	19.00	22.80	25.10	56.06	207.66
7.2	38	18.00	22.20	24.40	54.63	202.33
7.3	37	18.00	21.60	23.80	53.19	197.01
7.4	36	17.00	21.00	23.10	51.75	191.68
7.5	35	17.00	20.40	22.40	50.32	186.36
7.6	34	16.00	19.80	21.80	48.88	181.03
7.7	33	16.00	19.20	21.10	47.44	175.71
7.8	32	15.00	18.60	20.50	46.00	170.38
7.9	31	15.00	18.00	19.80	44.57	165.06
8.0	30	14.00	16.80	18.50	43.13	159.74
8.1	29	14.00	15.60	17.20	41.69	154.41
8.2	28	13.00	14.40	15.80	40.25	149.09
8.3	27	13.00	13.20	14.50	38.82	143.76
8.4	26	12.00	12.00	13.20	37.38	138.44
8.5	25	12.00	12.00	13.20	35.94	133.11
8.6	24	11.00	11.40	12.50	34.50	127.79
8.7	23	11.00	10.80	11.80	33.06	122.46
8.8	22	10.00	10.20	11.20	31.63	117.14
8.9	21	10.00	9.60	10.60	30.19	111.81
9.0	20	9.00	9.00	9.90	28.75	106.49
9.1	19	9.00	9.00	9.90	27.31	101.17

Table 14. (Continued)

CSR	Converted CSR 1.0 = 100	60% Assessed value Prior 1965	1965	1966	1966 Prices 27% value from regression	100% value from regression
9.2	18	$8.00	$8.40	$9.20	$25.87	$95.84
9.3	17	8.00	7.80	8.60	24.44	90.52
9.4	16	7.00	7.20	7.90	23.00	85.19
9.5	15	7.00	6.60	7.30	21.56	79.87
9.6	14	6.00	6.00	6.60	20.13	74.54
9.7	13	6.00	6.00	6.60	18.69	69.22
9.8	12	5.00	5.40	5.90	17.25	63.89
9.9	11	5.00	4.80	5.30	15.81	58.57
10.0	10	4.00	4.20	4.60	14.38	53.25

Humboldt County. These comparisons show the assessed value for each corn suitability rating made by the assessor compared to the calculated values with the use of the regression equation. The 27 percent value of the market value is expected to compare to the 60 percent assessed value because the assessor had calculated 60 percent assessed value to approximate 27 percent of actual market value (46, 47). The data in the two tables indicate that the land in Adams County is slightly over-assessed, and the land in Humboldt County is moderately under-assessed. This is consistent with the sales-assessment ratio study shown earlier in this study and suggests that the respective assessors may have over valued land slightly in Adams County and under valued it in Humboldt County. The other alternative may be that corn suitability ratings need adjustments.

The location variables did not remain in the regression equation because the assessors had made these adjustments when calculating the average adjusted corn suitability rating for individual tracts.

Results of Investigations Using Yield-Slope Groupings

The next step in the study was to examine the sample in terms of potential yields and slope of the various soils occurring on each tract of land exchanged as well as the location variables. The yield and slope combinations should give a reasonable expression of value for various soil types because the measurement would give an expression of production per acre in terms of average annual row crop production. Corn yields were used because corn is the major cash crop grown in both counties, and other yields can be equated in terms of corn yields. The slope measurement will give an indication of how intensively corn can be produced as well as reflect some of the mechanical difficulties of production.

Estimated corn yields were assigned each soil unit, see Tables 26 and 27 in the Appendix, and the acreage of each soil occurring on the sample farms was summarized according to yield and slope. There were five slope categories assigned, 0 to 5 percent, 5 to 9 percent, 9 to 14 percent, 14 to 18 percent, and soils occurring on slopes 18 percent and greater. The soils were further grouped within each slope category in terms of yield. These yield groupings were made in five bushel increments starting with 95 bushels plus, 90 to 95 bushels . . . . . 50 to 55 bushels and less than 50 bushels. Next, the location of the tract was noted in terms of township location and if the tract was located on a paved road. The above data were then recorded on IBM data cards and were analyzed using multiple regression techniques (45) to obtain estimates of value for the various variables.

Tables 15 and 16 show a comparison of the sample farms to the average farm in each of the respective counties. In Adams County, Table 15, the average size of the sample is much smaller than the average size farm in the county. Value per acre is somewhat less for the sample than the county average. The

Table 15. Comparison of average farm size of sample to average for county in Adams County

Unit of comparison		1962 through 1966[a] average of samples	1964 Average of county
Average size of farm		146.1 Acres	250.2 Acres[b]
Average value of farm		$21,810.33	$40,229.00[b]
Average value per acre		$149.28	$161.61[b]
Average percent of farm by slope and yield:			
Percent slope	Estimated corn yield	Acres	Acres[c]
0-5	95+ Bu.	3.3	3.4
	90-95	9.8	16.8
	85-90	0.8	1.0
	80-85	3.5	0.4
	75-80	11.8	15.0
	70-75	0.1	0.2
	65-70	1.6	2.4
	60-65	0.1	0.8
	55-60	0.1	0.2
	50-55	0	0
	<50	3.6	0
5-9	90-95	0.1	0
	85-90	16.1	17.4
	80-85	3.6	2.9
	75-80	0.4	0.3
	70-75	1.5	2.4
	65-70	0	0
	60-65	0.2	0
	55-60	0.2	0.1
	50-55	1.6	2.4
	<50	2.1	2.0
9-14	80-85	0.1	0
	75-80	5.8	3.8

[a]Source: Mean values of sample data.

[b]Source: Farm Census 1964 (54).

[c]Source: Soil Survey data (11).

Table 15. (Continued)

Unit of comparison	1962 through 1966[a] average of samples		1964 Average of county
Percent slope	Estimated corn yield	Acres	Acres[c]
9-14	70-75	0.1	1.2
	65-70	0.1	0
	60-65	4.7	5.6
	55-60	0.1	0.5
	50-55	11.4	12.0
	<50	2.6	1.7
14-18	70-75	0.1	0
	65-70	0.1	0
	60-65	0	0
	55-60	0.6	0.6
	50-55	5.0	3.5
	<50	3.6	2.0
18+	<50	1.2	1.3

Table 16. Comparison of average farm size of sample to average for county in Humboldt County

Unit of comparison		1962-1965[a] average of samples	1964 average of county
Average size of farm		116.8 Acres	247.8 Acres[b]
Average value of farm		$46,057.71	$96,337.06[b]
Average value per acre		$394.33	$387.98[b]
Average percent of farm by slope and yield:			
Percent slope	Estimated corn yield	Acres	Acres
0-5	95+ Bu.	21.5	21.8[c]
	90-95	42.5	42.3
	85-90	8.0	7.2
	80-85	12.3	13.6
	75-80	6.0	4.0
	70-75	0.9	1.9
	65-70	1.4	1.7
	60-65	0.4	0
	55-60	0.2	1.1
	50-55	0.2	0.9
	<50	0.8	0.1
5-9	85-90	2.9	2.0
	80-85	0.3	0.7
	75-80	0.3	0.3
	70-75	0	0
	65-70	0.2	0.2
	60-65	0.1	0
	55-60	0	0
	50-55	0.1	0
	<50	0.1	0.2

[a]Source: Mean values of sample.

[b]Source: Farm census 1964 (54).

[c]Source: Soil Survey Report (38).

Table 16. (Continued)

Unit of comparison	1962-1965[a] average of samples		1964 average of county
Percent slope	Estimated corn yield	Acres	Acres
9-14	80-85	0.1	0
	75-80	0.3	0.5
	70-75	0.1	0.2
	65-70	0.1	0
	60-65	0.1	0.2
	55-60	0	0
	50-55	0.1	0.1
	<50	0.1	0
14-18	60-65	0.1	0.1
	55-60	0.1	0.2
	50-55	0.1	0.1
	<50	0.1	0.1
18+	<50	0.9	0.6

values should compare when the sample value is a mean of all of the sales of the 1962 through 1966 period, and the census data tends to fall in the center of the time period studied. The $12.33 difference in price may be explained by the difference in percentage of the various soil units in each of the slope and yield groups. In the 0 to 5 percent slope group, there is a slightly higher percentage of soils in higher yield levels on the county average than there is on the sample farms.

In Humboldt County, Table 16, the average size of the sample farms are again smaller than the county average. The value per acre is very close to the same between the sample and the county average, and the soil properties are almost mirrored from the sample to the county average.

The multiple regression techniques used in the analysis of the variables differed from the ones used on corn suitability ratings when the soil units were grouped by slope and analyzed by the use of orthogonal polynomials (4b). These treatment of the variables offered a better fit of the data than a straight linear regression when the data were calculated to the third degree on the lower slope groups and to a second degree on the higher slope groups. Listings of the measured variables and generated variables are found in Tables 9 and 10 in the previous section.

Several regression runs were made at the Iowa State Computer Center, and the best fitting model for each county was selected. The model used for estimating value in Adams County is as follows:

$$\begin{aligned} X_2 = {} & B_4X_4 + B_5X_5 + B_{37}X_{37} + B_{43}X_{43} + B_{57}X_{57} + B_{58}X_{58} + \\ & B_{59}X_{59} + B_{60}X_{60} + B_{61}X_{61} + B_{62}X_{62} + B_{63}X_{63} + B_{64}X_{64} + \\ & B_{65}X_{65} + B_{66}X_{66} + B_{67}X_{67} + B_{68}X_{68} + B_{69}X_{69} + B_{70}X_{70} + \\ & B_{71}X_{71} + B_{72}X_{72} + B_{73}X_{73} + B_{74}X_{74} + B_{77}X_{77} \end{aligned} \tag{5.6}$$

where X_2 is the dependent variable expressing value of the sales. The X_4 variable is assessed value of buildings and the X_5 variable is if the sample is located on the paved road. The X_{37}, X_{43} and X_{57} through X_{74} are the soil-slope-yield variables (see Tables 9 and 10 in the previous section), and the X_{77} variable is a time series variable.

The regression model used in Humboldt County is very similar to the one used in Adams County but did not include the location variable because it proved not to be significant in this county. The model used is as follows:

$$X_2 = B_4X_4 + B_{36}X_{36} + B_{50}X_{50} + B_{51}X_{51} + B_{52}X_{52} + B_{53}X_{53} + B_{54}X_{54} + B_{55}X_{55} + B_{56}X_{56} + B_{57}X_{57} + B_{58}X_{58} + B_{59}X_{59} + B_{60}X_{60} + B_{61}X_{61} + B_{62}X_{62} + B_{63}X_{63} + B_{66}X_{66} \quad (5.7)$$

where X_2 is the dependent variable expressing the value of sales. The X_4 variable is assessed value of buildings. The X_{36}, X_{50} through X_{63} variables are the soil-slope-yield variables (see Tables 9 and 10 in previous section), and the X_{66} variable is a time series variable.

The statistical aspects of the equations used in Adams and Humboldt Counties are given in Table 17. According to the F-test, the overall regression equations for both Adams and Humboldt Counties are significant at the 1 percent level. The estimate equations have R square values of .96 in Adams County and .98 in Humboldt County which indicate that the explanatory variables account for a high percentage of the value of a tract of land.

The estimated values of the independent variables for slope and estimated yield were calculated using orthogonal polynomials. The orthogonal polynomials were used by stratifying the soil

Table 17. Statistical aspects of equation 5.6 in Adams County and equation 5.7 used in Humboldt County

County	Dependent variable mean	F ratio	Standard error of mean of dependent variable	R^2
Adams	$23,861.97	212.7**	$5,768.58	.9607
Humboldt	46,057.71	529.1**	7,569.67	.9812

**Significant at the 1% level.

measurements into slope groups and constructing orthogonal polynomial equations for each of the slope groups, see Tables 9 and 10 in previous section. This was possible because the estimated yields were equally spaced within each slope grouping. The advantage over the usual regression method of fitting non-orthogonal polynomials arises from the fact that orthogonal polynomials are so constructed that any term of the polynomial is independent of any other term. This property of independence permits one to compute each regression coefficient independently of the others and also facilitates testing the significance of each coefficient (4b). In addition, the polynomial at the second or third degree fit the data better than a straight linear regression.

The estimated values obtained for Adams County from the regression analysis using estimated yield and slope of the soil units, the location of tract in respect to paved roads, and the assessed value of the buildings are shown in Table 18 and Figure

16. The values for the 0 to 5 percent slope group at each yield level are significant at the 5 percent level or higher. The data show that buyers tend to pay within $20.00 of the same price for land that has a yield potential ranging from 80 to 95 plus bushels. When the yield potential falls below a 70 bushel potential, the price decline is very severe and even has a negative value over yields dropping below the 60 bushel level. There was no land within the sample on 0-5 percent slopes with a yield potential below 55 bushels. The slope of the curve for the 0-5 percent group in Figure 16 shows that a straight linear regression would not have fit nearly as well. The soils that fall in the 0-5 percent slope group make up about 35 percent of the total samples with about 29 percent of the total samples of the 0-5 percent group having a yield potential of 75 bushels or more.

The values for the 5 to 9 percent slope group are significant at 5 percent level or higher using the t-test; however, the data for the lower yields levels is very scant except for the less than 50-bushel level. The values in this group start at $197.87 per acre for the soils with yield potential of 90 to 95 bushels. There is a steady decline in price, as shown in Table 18 and Figure 16, until the 55 to 60 yield level then the values tend to swing upward. This latter situation of higher values for less productive units is in an area of very small acreages and may be overextending the data. This slope group makes up 26 percent of the total acres in the sample.

Table 18. Results of regression analysis using estimated yield, slope, location and assessed value of buildings for Adams County at last quarter 1966 prices

Estimated corn yield level bu/A.	Estimated value dollars per acre by slope groups				
	0-5%	5-9%	9-14%	14-18%	18+%
95+	320.95[a]				
90 to 95	315.80	197.87[a]			
85 to 90	313.26	159.66			
80 to 85	300.19	129.70	116.21[a]		
75 to 80	263.55	108.01	73.26		
70 to 75	190.22	94.58	62.18	51.64[b]	
65 to 70	67.14	--	69.12	112.47	
60 to 65	-118.81	92.51	80.23	--	
55 to 60	-380.71	103.86	81.67	134.17	
50 to 55	--	123.48	59.59	95.04	
50	--	151.36	.14	22.59	22.59[b]

Woodland[b]

Slope group	Dollar value per acre
0-5%	-2.01
5-9	37.46
9-14	29.67
14-18	-25.39
18+	-127.72

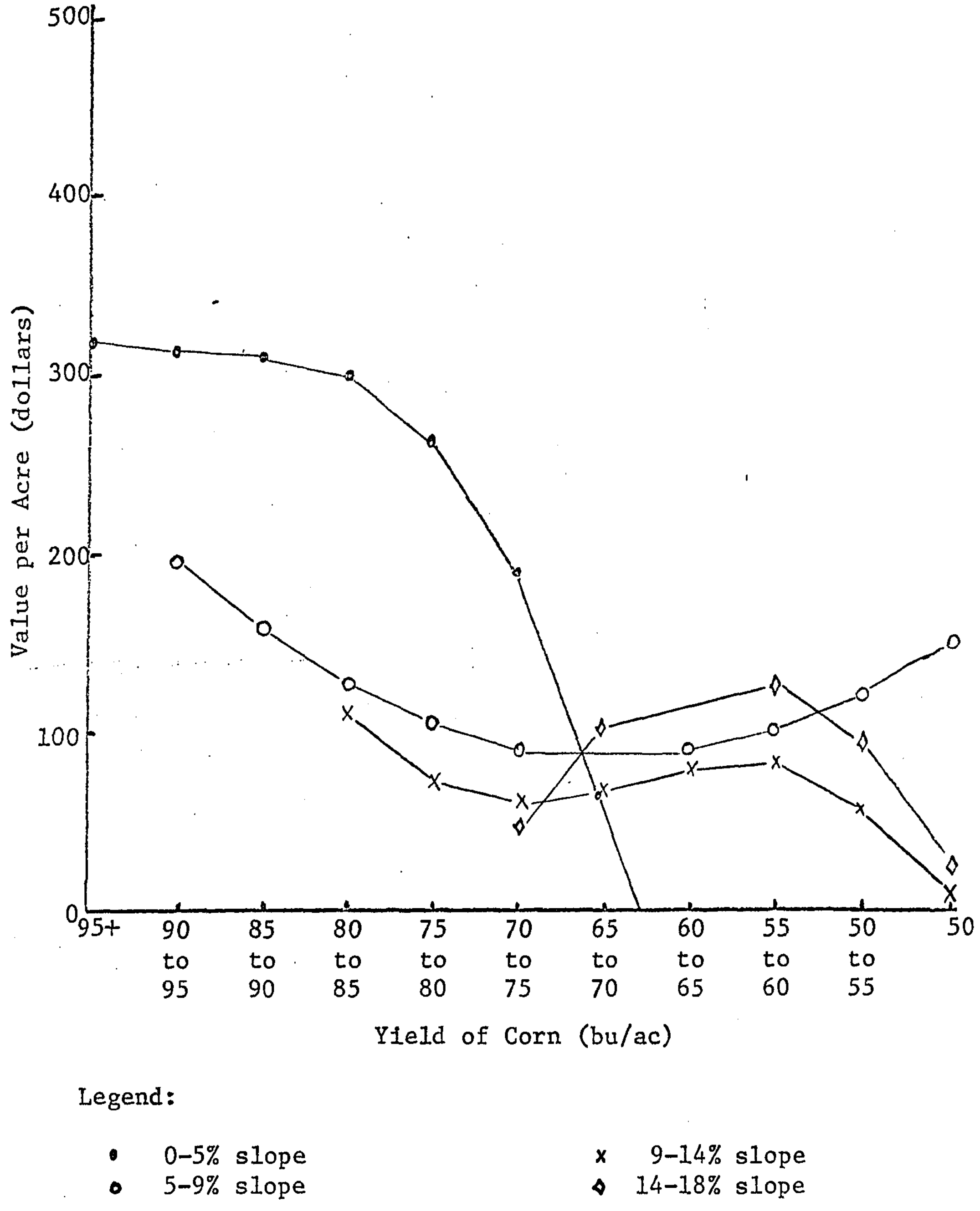
Other contributors of value:

Variable	Effect
Location on paved road	+ $14.32/Acre[a]
Assessed value buildings	+ 2.97 per $1.00 assessed value[a]

[a]Estimated values highly significant.

[b]Estimated values not significant from 0.

Figure 16. Estimated value of soils in Adams County with respect to slope and corn yields


500
400
300
200
100
0
Value per Acre (dollars)
95+
90 to 95
85 to 90
80 to 85
75 to 80
70 to 75
65 to 70
60 to 65
55 to 60
50 to 55
50
Yield of Corn (bu/ac)
Legend:
0-5% slope
5-9% slope
9-14% slope
14-18% slope

Values for the 9 to 14 percent slope group are highly significant using the t-test with the top value in this slope group estimated to be worth $116.21 per acre for soils with a yield potential of 80 to 85 bushels. The data for some of the yield levels is limited because this slope group makes up 25 percent of the total acres in the sample, and about 24 percent of the acres in this group occur at four yield levels within this slope group. The largest portion of soil in this slope group has a yield potential of less than 55 bushels.

The remaining 14 percent of this acreage of the soils in the sample occur on slopes greater than 14 percent are wooded and are considered to be waste land. The data for this group of soils are reported in Table 18, but the estimates are not statistically significant according to the t-test. The estimates for these soils are erratic, and many have negative values. When they occur on farms that have sizeable amounts of the more productive soils, this negative value may be real; however, when wooded tracts or rough pasture tracts are sold, they range in value from $50.00 to $100.00 per acre according to the county assessor[1].

The other variables that contribute to the value of a tract are location in respect to paved roads and the value of the buildings. When the tracts occurred on state highways or

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[1]Roberts, Eldon. County Assessor for Adams County, Corning, Iowa. Information on value of land. Private communication. 1967.

blacktop county roads, the value increased $14.32 per acre. The study shows that buildings have an estimated value of $2.97 for each $1.00 value assessed under the current assessment systems for buildings. The time series variable was constructed so that the prices reported are in terms of the last quarter of 1966. This gives an estimate of value that can be used for 1967 values with a minimum of adjustment.

To obtain a more orderly assessment, Table 19 was constructed using the data from the regression analysis for a portion of the table, but the other values are estimates. The following assumptions were used in making the estimates. First, the values of a lower yield group or next higher slope group would be lower than the preceding value. Second, all soil areas have a positive value. Third, timber will be valued at the same level as the less than 50-bushel yield potential soils for the respective slope groups. This table of values provides estimates that can be used by the assessor to assess farm land for tax purposes. The values are consistent with the principles of taxation, and are average values for the most part with estimates for the least significant values.

Estimated values obtained for Humboldt County from the regression analysis using estimated yields and slope of the soil units as well as the assessed value of the buildings are shown in Table 20 and Figure 17. The soils in the 0 to 5 percent slope group make up over 94 percent of all the soils in the sample and estimated values for these soils are significant

Table 19. Estimated values for yield and slope groups adjusted for orderly assessment in Adams County

Estimated corn yield level bu/A.	Estimated value dollars per acre by slope groups				
	0-5%	5-9%	9-14%	14-18%	18+%
95+	321.00				
90 to 95	316.00	198.00			
85 to 90	313.00	160.00			
80 to 85	300.00	130.00	116.00		
75 to 80	264.00	108.00	73.00		
70 to 75	190.00	95.00	62.00	55.00[a]	
65 to 70	100.00	85.00	60.00	55.00	
60 to 65	90.00	75.00	55.00	50.00	
55 to 60	80.00	65.00	55.00	50.00	
50 to 55	70.00	60.00	50.00	45.00	
<50	60.00	60.00	50.00	40.00	30.00
Timber	60.00	60.00	50.00	40.00	30.00

Other contributors of value:

Variable	Effect
Location on paved road	+ $14.32 per acre
Assessed value buildings	+ 2.97 per $1.00 assessed value

[a]Values below this line are estimated without the use of regression techniques. Other contributors of value were calculated.

Table 20. Results of regression analysis using yield, slope and assessed value of buildings for Humboldt County

Estimated corn yield bu/Acre	Estimated dollar value per acre by slope groups: 0-5%[a]	5-9%[b]	9-14%[b]	14-18%[b]	18+%[b]
95+	480.79				
90 to 95	429.56				
85 to 90	412.52	402.72			
80 to 85	414.90	598.22	1626.57		
75 to 80	422.01	851.22	237.65		
70 to 75	419.10	--	-534.71		
65 to 70	391.45	429.42	-690.50		
60 to 65	423.35	-795.20	-229.72	84.83	
55 to 60	203.06	--	--	68.78	
50 to 55	12.86	-6646.53	847.64	52.70	-47.92
<50	-260.98	-11823.00	4852.01	36.64	-47.82

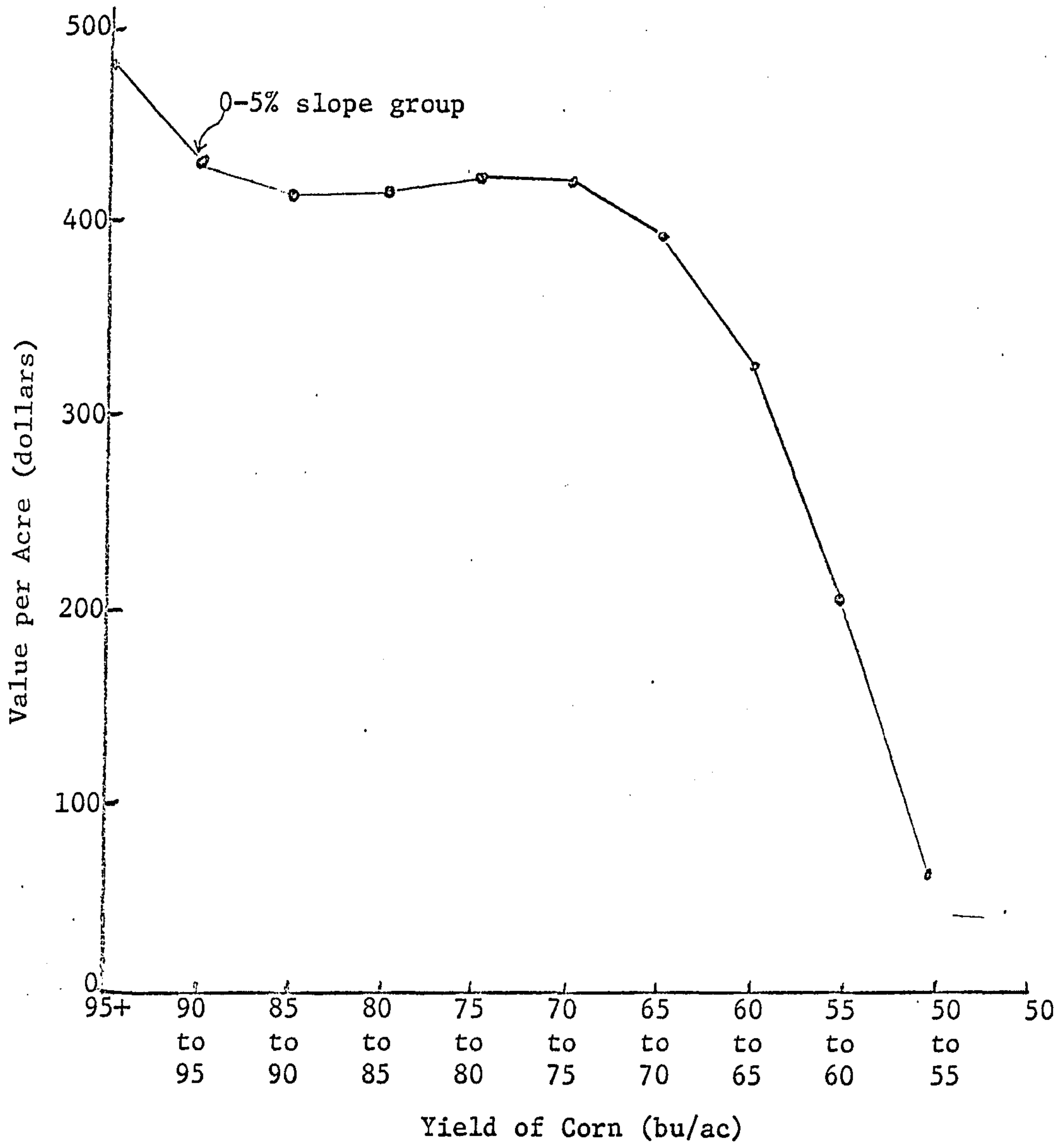
Other contributors of value

Variables		Effect
Building value	+	2.81 per $1.00 assessed value[a]

[a]Data significant at 5 percent level using t-test.

[b]Data significant at 20 percent level using t-test.

Figure 17. Estimated value of soils in Humboldt County on 0 to 5 percent slope with respect to corn yields


500
400
300
200
100
0
Value per Acre (dollars)
0-5% slope group
95+
90 to 95
85 to 90
80 to 85
75 to 80
70 to 75
65 to 70
60 to 65
55 to 60
50 to 55
50
Yield of Corn (bu/ac)

at the 5 percent level using the t-test. The values of this slope group range from a high of $480.79 per acre to a negative value for those soils with yield potentials less than 50 bushels per acre. The buyers do not pay significantly different prices for soils with a yield potential of 70 to 95 bushels, but after yield potentials drop below this level, there is a sharp decline in value as noted in Figure 17. Buyers recognize the value of soils with yield potentials greater than 95 bushels in this slope group and are willing to pay $50.00 more per acre for these soils than for soils that have potential yield levels of 90 to 95 bushels.

The values for the remaining slope groups are significant only at the 20 percent level using the t-test. The reason for this lower value of significance is assumed to be the lack of acres in the sample in this slope range because these soils make up 5 percent of the total sample. The 80 to 85 potential bushel level of the 5 to 9 percent slope make up 58 percent of this remaining 5 percent which leaves only fractional acreages in the other yield and slope slots. The results, even with their low reliability, are shown in Table 18 and ploted on Figure 17.

The other variable listed in Table 18 is the factor for determining the estimated market value of buildings. The value for buildings is obtained by multiplying $2.81 times each $1.00 assessed value of buildings under the current assessment system for buildings. The time series variable used in the Humboldt

County regression model is the same as the one used in Adams County. This variable was constructed so that the values are estimated in terms of the last quarter of 1966.

For a more orderly assessment, Table 21 was constructed using the value estimates from the regression for the 0-5 percent slope and yield group at the higher yield levels and estimating subjectively the values for the other slope and yield groups. The same assumption was used for the values in Humboldt County as were used previously for the construction of a similar table for Adams County. The values below the heavy line in Table 21 were estimated without the use of regression techniques and are value estimates.

Table 21. Estimated values of yield and slope groups adjusted for orderly assessment in Humboldt County

Estimated corn yield level bu/A.	Estimated value dollars per acre by slope groups 0-5%	5-9%	9-14%	14-18%	18+%
95+	481.00				
90 to 95	430.00				
85 to 90	413.00				
80 to 85	410.00	402.72			
75 to 80	410.00	400.00	300.00		
70 to 75	400.00	375.00	275.00		
65 to 70	391.00	350.00	250.00		
60 to 65	325.00	200.00	100.00	85.00	
55 to 60	203.00	100.00	75.00	70.00	
50 to 55	100.00	75.00	65.00	60.00	
<50	75.00	65.00	60.00	50.00	50.00

Other contributor of value:

Variable — Effect

Building value = $2.81 per $1.00 assessed value

[a]Values below this line are estimated without use of regression techniques excepting those values for the buildings.

STRENGTHS AND WEAKNESS OF METHODS FOR TAX ASSESSMENT PURPOSES

This chapter consists of a discussion of the application of the methods developed in the previous chapter to a particular tract of land and the prerequisites required for the system to be used. Secondly, there is a discussion of the strengths and weaknesses of the system.

Application of the Data to a Tract of Land for Valuation for Tax Assessment

County assessors in Iowa are faced with the problem of revaluation of real property every four years for tax purposes. The Iowa General Assembly has set forth specific criteria to be used in arriving at the value of land which primarily follows the market value approach (25). The purpose of the revaluation is to insure that tax assessments are current in respect to the land market and that the assessments are equalized between farms within a county and between counties. To insure equalization and reflection of market at the time of revaluation, a systematic assessment procedure must be used to arrive at value.

Before a county assessor can use either of the systematic procedures illustrated in this section, he must have the following basic data available. First, there must be a modern up-to-date soil map of the county available for his use. Second, he must have estimated corn yields for each mapping unit or a corn suitability rating for each mapping unit. Third, he must have an accurate listing of the bona fide sales of the last 4 to 5 years that would include sale value, legal description, and assessed value of improvements. These are the basic data from which variables representing the components of value are obtained.

Two approaches for obtaining value of specific soil units in Adams and Humboldt Counties have been considered in this study. Values of soil units were estimated using corn suitability ratings, and then values were estimated using yield and slope data. From this data and other variables that contribute to the value of the land an estimate of the value of a tract can be made.

The first basic step using either of the two approaches is to measure the acreages of soil on each 40-acre tract or portion thereof and adjust the acreage by deducting ditches, rock outcrops, etc., to obtain net useable acreages. This basic set of measurements is made and recorded on a permanent record because they are consistent over time. Acreages of timber land should also be reflected in each of these soil unit measurements and recorded. The assessed value and location of the buildings should be listed on this record as well as any other factors that would be reflected in the value of a tract.

There are two approaches presented in this study that can be followed using the soil survey data. One is the corn suitability rating approach and the other is the yield-slope data approach. An example of calculations will be presented for

Adams County, but the approach would be very similar in Humboldt County.

Corn suitability approach

The formula used to estimate values of farm land in Adams County by the corn suitability rating approach may be expressed as follows:

$$\text{Estimated value} = \$4.55 \times \text{assessed value of buildings} + (\text{value of soil unit} \times \text{acres of soil unit}) \qquad (6.1)$$

The $4.55 is the expansion factor calculated for buildings. Value of soil unit is the value estimated for the various mapping units using the corn suitability ratings, and acres of soil unit are the measured acres of each soil mapping unit. The corn suitability rating for a soil mapping unit is obtained from Table 26 in the Appendix and the estimated value for the corn suitability rating in Table 13 in the previous section of the study.

The sample calculations for this technique are shown in Table 22. The estimated value for a fractional 40-acre tract was estimated to be $11,431.28. This tract sold in 1966 for $12,000.00. In this example, the corn suitability method was a good estimator of the actual sale price. The assessor could then follow this general procedure for each of the tracts of land in the county and complete the first approximation of value. The next step would be to review the first approximation

Table 22. Estimated value for NW¼ NE¼ Sec. 26, T72N, R32W, Adams County, Iowa, using corn suitability ratings

Soil unit	Gross acres	Adjustments	Net acres[a]	Corn suitability rating[b] (CSR)	Market value per A[c]	Net acres x market value
11-3-0	9	3	6	69	196.68	1180.08
93-11-1	4	0	4	40	114.01	456.04
93-11-2	8	0	8	35	99.76	798.08
370-3-1	2	0	2	88	250.84	501.68
370-7-2	12	0	12	80	228.03	2736.36
593-11-1	4	0	4	35	99.76	399.04
Total	39		36			$5971.28

Assessed value of buildings $1200.00

Estimated value = $4.55 ($1200) + $5971.28 = $11,431.28

Actual sales value in 1966 was $12,000.00

[a]Source: Data obtained from soils map.

[b]Source: Data obtained from Table 26 in Appendix.

[c]Source: Data obtained from Table 13, values of CSR in Adams County, at 1966 prices.

of value to insure that no component of value may have been overlooked in arriving at this value of the various tracts.

To obtain the assessed value for tax assessment, the assessor would use 27 percent of the estimated market value and this would then become the appraisal value for tax assessment purposes.

<u>Soil yield and slope approach</u>

This approach is very similar to the corn suitability rating approach, except that estimated values for the various mapping units are obtained by regression procedures using slope and estimated yields of soil units rather than the corn suitability rating. One additional feature, location of the tract in respect to paved roads was added for Adams County to determine the value of a tract of land. The general formula for arriving at estimated value of a tract by this approach may be expressed as follows:

Estimated value = (\$2.97 x assessed value of buildings) + (14.32 x acres in tract if farm is on paved road) + (value of soil unit x acres of soil unit)

The \$2.97 is the expansion factor estimated for buildings; \$14.32 is the estimated increased value per acre of land when located on paved highway. Value of soil unit is the value estimated for a soil mapping unit depending upon which yield and slope group the soil unit occurs. Acres are the acres in each mapping unit. The estimated value of the mapping unit is determined by obtaining the estimated yield for a soil from Table 26 in the Appendix and obtaining the estimated value from Table 19 of the previous section.

The sample calculation using the soil yield and slope approach is shown in Table 23. This is the same 40-acre tract used in the previous example given in Table 22. The actual sales value of this tract of land in 1966 was $12,000.00. The estimated value using these techniques is $10,656.00, or an under-estimation of $1,344.00. This system under-valuates this particular tract more than the previous method using corn suitability ratings.

Comparative Advantage of Using Soil Survey and Economic Data for Tax Assessment

The primary advantages of using soil survey data for tax assessment over previous systems is that the major components of value have been isolated, and values estimated are the average value for these components in relation to the actual market value. Once the value of the soil mapping unit, location are estimated, each taxpayer is treated equally in respect to the land resources that he owns in the taxing district. The soil survey data provides the inventory of soil resources, and these resources can be measured systematically, quantitatively, and recorded for each tract of land. The value of a particular tract of land may then be calculated as shown earlier in this

Table 23. Estimated value for NW¼ NE¼ Sec. 26, T72N, R32W, Adams County, Iowa, using soil slope and yield approach

Soil unit	Gross acres	Adjustments	Net acres[a]	Estimated yields corn[b] Bu/A.	Estimated market value[c] per A.	Net acres x market value
11-3-0	9	3	6	75	$264.00	$1584.00
93-11-1	4	0	4	52	70.00	280.00
93-11-2	8	0	8	52	70.00	560.00
370-3-1	2	0	2	90	316.00	632.00
370-7-2	12	0	12	85	313.00	3756.00
593-11-1	4	0	4	50	70.00	280.00
Total	39		36			$7092.00

(Value x acres) = $7092.00

Assessed value of buildings = $1200.00

Not located on paved road

Estimated value = ($2.97) ($1200.00) + ($14.32) (0) + $7092.00

= $10,656

Actual 1966 sales value = $12,000.00

[a]Source: data from soil map measurements.

[b]Source: data from Table 26 in the Appendix.

[c]Source: data from Table 19 in the previous section.

section. The advantages may be stated as follows: 1) The system offers a systematic approach to land valuation, 2) The system offers equal treatment to taxpayers with similar resources in a taxing district, 3) The system offers equality between tax districts because the market value of land for the district is used as a basis for the value of soil resources in the districts, and 4) The method of assessment is primarily objective in nature in arriving at the values for the components of value, whereas, previous methods in current use by assessors is more of a subjective nature and depend primarily on visual inspection and comparisons to other tracts.

There is a difference in emphasis on values in comparing the two approaches to tax assessment presented in this study. The corn suitability rating system is a straight linear regression in which the soil unit values are calculated in terms of corn suitability ratings with a forced fit. This approach does not fit the market data as closely as the soil yield and slope system; however, it is assumed that farmers recognize variability in the production potential of soils and respond in terms of price. The data in Figures 16 and 17 show that buyers in Humboldt County are willing to pay approximately the same price for all soil types that yield between 70 to 90 bushels of corn on slopes of 0 to 5 percent. In Adams County the price for soils with yield potentials of 80 bushels of corn or greater in the 0 to 5 percent slope group did not vary significantly, and in this county the price is lower than in Humboldt County for soils with the same slope and yield capacity. Values are discounted more for soils on steeper slopes with lower yield potential using the soil yield and slope system than with the corn suitability rating system. These differences in value might indicate that buyers are basing income potentials on short run yield expectations rather than yield over a longer period of time. Another reason may be that buyers may underestimate values of sloping land for uses other than row crops. This is a brief explanation of why the value of the soils differ using the two systems.

The expansion factors for the assessed value of buildings differ in the two systems because of the regression equations. It was assumed that the adjusted corn suitability rating used by the assessors reflected the upward or downward adjustments of a soil to include variations not included in the corn suitability ratings which in fact it may not have done. This might account for the larger expansion factor for buildings in Adams County which is $4.55 using the corn suitability rating formula. When the corn suitability ratings method in Humboldt County and the soil yield-slope method in both Adams and Humboldt Counties are used, the expansion factor for assessed value of building is essentially the same, $2.87 for the corn suitability rating and $2.97 for the soil yield-slope method in Humboldt County and $2.81 for the soil yield-slope method in Adams County.

The location factor in respect to paved roads was not significant in Humboldt County but should be taken into account in

Adams County. The reason for this difference is assumed to be that the road system in Humboldt County is superior in quality to that of Adams County; therefore, this factor does not affect the value of land in Humboldt County but buyers in Adams are willing to pay more for land adjacent to a paved road.

Both approaches tested in this study offer an opportunity for a systematic approach for tax assessment and provide a high degree of equality in terms of assessment within a county. The systems also offer an opportunity for equalization between counties because the market value approach is used, and it is 27 percent of the market value that determines the assessed value.

The major limitations in using soil survey data for assessment purposes are that modern up-to-date soil surveys are not available for all counties in Iowa and the need for educational programs in soils for assessors that use the soil surveys. When the soils information is available both from a soil inventory standpoint and interpretations of the soils data in terms of yield or corn suitability ratings, refinements of the procedures can be made and more sophisticated systems of assessment can be developed.

Limitations of the Study

The major limitation of the study was the lack of sales data for the more sloping less productive land. The difficulty, for example, lies in the fact that 95 percent of the soils in Humboldt County occupy slopes less than 5 percent; this leaves a small portion of the sample studied in the rougher lower productive land. Estimates of value for soils in these categories are very subjective and were made only for an orderly assessment even though they only affect the total value slightly. The problem of obtaining values for the minor mapping units in both Humboldt and Adams Counties could be overcome by collecting more data from several counties by soil association and combining the data to obtain estimated values for the minor units.

The study is a first approximation in terms of an approach and was limited in the total components of value that were considered. Here, only soil, buildings, and location in terms of paved highways were considered, whereas, other less definable values are characteristics that attribute to the value of land. Future studies may well define these characteristics as well as refine the components of value considered in this study.

Implications for Future Study

County assessors in Iowa are charged with the responsibility of revaluating all farm property in their respective counties every four years. The assessed value of a property should reflect on the average 27 percent of the market value of that property when sold as a bona fide sale. Because only a small percentage of the total farms in a county are exchanged in a 4-year period, the assessor is faced with the problem of translating the value of the properties that were sold to those that have not changed ownership for several generations. Future study in this area may be directed towards refinement of the techniques used to estimate the value of the soil units as well as define and measure other components of value associated with land.

Future consideration should be given to the development of a system that would be computerized and placed on cards with a program that would take into consideration past sales, the previous assessment period, and update all the 40-acre tracts in a county automatically.

With the method proposed in this study, tax assessment valuations may be made. Data could be expanded to provide current net worth statements in terms of the value of a farm unit that could be used by land appraisers for loan companies and for many other uses when a comparative value of farm land may be needed.

Further study of the data in terms of county soil association areas might reduce the error fraction in the current study. This would allow a more homogeneous group of soil types, but it would reduce the sample size considerably if conducted on a single county basis.

Another approach to the problem in terms of future study may be a net income approach. With this approach income could be capitalized, and estimates of value could be made. The real problem of this approach for the assessor is to separate management from the inherent productivity of soil so that management value will not be reflected in land value.

SUMMARY AND CONCLUSIONS

Summary

The county tax assessor in Iowa is faced with the problem of placing value on 6900 or more tracts of land at least once every four years. The legal framework in which the assessor must operate provides that all land must be assessed for tax purposes at 27 percent of its market value by 40-acre tracts or proportions thereof and that the property will be assessed proportionately to all other property. Valuation of real property must be completed every four years by the assessor and is complicated by limited assessment tools and financial resources available to the assessor.

The objectives of this study were to explore alternatives in using soil survey information as a basis for the appraisal of tracts of land for tax assessments and to develop a method that may be used in appraising land based on soil survey information and other data. Major emphasis of the study was to test the hypothesis that mean values of soil units can be identified in terms of current market value when the soil inventory obtained from a soil map is used in estimating the value of the land component. It was also hypothesized that buildings, location, and current use made up other major components of value. To test these hypotheses, records of all bona fide farm sales of Adams and Humboldt Counties were obtained for the periods January 1, 1962 through December 31, 1966. Measurements of the acreages of each of the soil units occurring in the sample areas were collected. Other variables such as assessed value of buildings and proximity of the farm to a paved road were recorded.

Two approaches were used in obtaining values for the different soil mapping units. One approach compared corn suitability ratings (CSR) and assessed values of buildings with estimated values obtained through multiple regression techniques. Each soil unit was assigned a corn suitability rating. The corn suitability rating, assessed value of buildings, and location were regressed against the sale values of the farm. Estimated values of each unit of corn suitability and of each dollar assessed value were obtained and used in the prediction equation used to determine the value of a tract of land. The study included all the bona fide sales in Humboldt County during the time period January 1, 1962 through December 31, 1966, but in Adams County the corn suitability data was available from the assessor only for the years 1965 and 1966.

In the second approach, the farm sales were analyzed by curvilinear regression techniques with a time variable to obtain estimated value of land units in terms of the acreages of the soil mapping units with respect to corn yield potential and slope grouping of the various soil units. The slope groups were 0 to 5 percent, 5 to 9 percent, 9 to 14 percent, 14 to 18 percent and slopes greater than 18 percent. The estimated corn yield grouping were made in 5-bushel increments from greater than 95 bushels to less than 50 bushels. Other factors such as the value of buildings and location in terms of hard surfaced roads were also considered in this valuation approach. From the data estimated values of each soil mapping unit, buildings, and locations were determined so that they could be used in the estimation of the value for farm land. This second approach was considered more objective because the variables are measured more precisely in terms of slope, leaving only the yields to be estimated based on previous studies and publications.

It was shown that soils, buildings, and in some cases location account for more than 95 percent of the variability of value of farm lands as measured by either the soil yield-slope method or by the corn suitability rating method.

Using the soil yield and slope approach, it was found that buyers were willing to pay more for the level soils (0 to 5 percent slopes) and that yield potentials did not influence significantly the price of the soil until yields fell below the 70-bushel level in Humboldt County and below the 80-bushel level in Adams County. This may indicate that farm buyers are appraising the value of land at yield expectations that are commensurate with technology levels of the 1950's rather than using yield expectations that reflect the adoption of modern technology. With the adaptation, however, of new production techniques designed to increase yields per acre, the variations of the physical and chemical properties of the different soils become more apparent. As these differences are recognized, the value of the more productive soils will probably be reflected by price offered by future buyers.

It was shown that soils with the same slope and yield potential or the same corn suitability rating differed in price from Adams County to Humboldt County. It was found that soils with the same production potential were more costly in Humboldt County than in Adams County. The higher land values in Humboldt County may be a result of better opportunities to combine larger acreages of more level soils with high production potentials than in Adams County.

In the final stage of the study, examples were shown as to how the value of a tract of land could be estimated using the corn suitability rating system and the soil yield-slope system. Each of the examples were based on measured acreages of soil units occurring in a given tract of land, estimated value of the soil units, appraised value of the buildings, and a location factor for Adams County. Application of the concept of using the soil data for systematic tax assessment for a county was illustrated and the required data for the process were presented.

Conclusions

In conclusion, the soil units identified through soil survey are indicative of land value and can be used in conjunction with other value components such as buildings and location to estimate the valuation of farm land for tax assessment purposes. These estimates of value can be made using current market value of land at a given point of time in the immediate past. There will be a lag in value between assessment periods when the value may fluctuate up or down during the 4 year interim period.

On the basis of this study, it was concluded that soil productivity differences are the principal differences in land values within a county area, and the soil survey data can be and should be used in a systematic approach for tax assessment in counties where the data is available.

It was concluded based on this study, that the techniques assigning estimated values to the soil data are consistent with the basic principles of taxation. Each taxpayer in respect to a tax unit is treated equally in respect to other taxpayers because value is placed on each soil unit and is taxed in accordance to the value and acreage of the soil. The system reflects the ability to pay in terms of the taxpayer's soil resources and is simple to understand and administer. The system is not overly expensive to put into effect when compared with commercial appraisals costs; the assessor with some assistance can make the appraisals and further reduce the evaluation costs. The system is stable because soils are stable over time, and this method offers an opportunity for adjustments as prices fluctuate.

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APPENDIX

Table 24. Location and legal description of farm sales in Adams County

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6601	1001	395.0	6	73	34	SW¼, SE¼, S¼ of NE¼, S¼ of NW¼
	1002	196.0	27	73	32	E½ SW¼, SW¼ SW¼, W½ SE¼
	1003	312.0	34	72	32	N½
	1004	39.0	26	72	32	NW¼ NE¼
	1005	116.0	6	73	32	S½ SW¼, SW¼ SE¼
	1006	158.0	33	72	35	NE¼ SW¼, E½ W½ NW¼, E½ NW¼, E 2 rods W½, W½ NW¼
	1007	81.0	18	71	33	S½ SW¼
	1008	240.0	4	71	35	SW¼ SW¼
			5	71	35	S½ SE¼, SE¼ SW¼
			8	71	35	NE¼ NE¼
			9	71	35	NW¼ NW¼
	1009	150.0	5	73	34	NW¼ (fractional)
	1010	120.0	29	72	34	N½ SE¼, SW¼ NE¼
	1011	158.0	27	72	34	NW¼
	1012	118.0	33	73	35	SE¼ NE¼, N½ SE¼
	1013	113.0	3	72	35	SW¼ SW¼
			10	72	35	W½ NW¼
	1014	117.0	27	72	35	W½ NW¼, SE¼ NW¼
	1015	76.7	23	71	34	W½ SW¼
	1016	177.0	31	72	34	N½ NW¼, SW¼ NW¼, NW¼, SW¼
	1017	231.0	26	72	32	S½ SW¼
			35	72	32	NW¼
	1018	178.0	6	72	34	W½ NE¼, E½ NW¼, SW¼ NW¼
	1019	157.0	26	73	32	NE¼

Table 24. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6601	1020	158.0	35	73	35	W½ NW¼, E½ NW¼
	1021	113.0	2	73	35	E½ SE¼, SE¼ NE¼
	1022	117.0	20	72	35	W½ NE¼, NE¼ NW¼
	1023	448.0	30	72	33	S½ NW¼, E½ SW¼, SE¼
			31	72	33	E½ NW¼, NW¼ NE¼, Part SW¼ NE¼
	1024	75.0	28	71	35	E½ SW¼
	1025	84.0	12	72	35	Part SE¼ NW¼
			13	72	35	W½ SW¼
	1026	384.0	23	72	35	SE¼ NE¼, E½ SE¼
			24	72	35	S½ NW¼, SW¼ SE¼, SW¼
	1027	79.0	22	71	35	NE¼ SW¼, SE¼ NW¼
	1028	79.0	16	73	35	W½ NW¼
	1029	29.0	11	71	35	Part NE¼ SW¼, Part SE¼ SW¼, Part SW¼ SE¼
	1030	77.0	9	73	32	N½ NW¼
	1031	115.0	17	73	34	E½ SW¼, SE¼ NW¼
	1032	89.0	31	71	32	W fractional ½ of SW¼
	1033	78.0	16	73	35	E½ SW¼ (ex.)
	1034	79.0	20	73	35	N½ SE¼
6602	1035	111.5	6	71	35	W½ SW¼
			7	71	35	W½ NW¼
	1036	238.0	36	73	32	SE¼, E½ SW¼
	1037	121.0	25	71	32	S 60 Ac. SE¼
			36	71	32	NW¼ NE¼, N 24 Ac. NW¼ NE¼
	1038	80.0	36	73	35	E½ NE¼, N 3 Ac. NE SE

Table 24. (Continued)

Year and quarter	Farm number	Size acres	Location			Legal description
			Sec.	Twp.	Range	
6602	1039	577.0	28	72	33	W½ SW¼
			29	72	33	SE½, part S½ NE¼
	1040	181.0	2	73	35	W½ E½, fractional NE¼ NE¼
	1041	39.0	17	71	34	SW¼ SW¼
	1042	77.0	22	71	34	S½ SW¼
	1043	58.5	20	71	35	Part NW¼ SE¼, N½ of 22 Ac. in NE¼ SW¼, part SW¼ NE¼
	1044	103.0	33	73	34	SW¼ SW¼, NE¼ SW½, E 25 Ac. NW¼ SW¼
	1045	79.0	35	71	33	N½ NE¼
	1046	80.0	18	71	34	SW¼ SE¼
			19	71	34	NW¼ NE¼
	1047	91.0	18	72	33	N½ SW¼
6603	1048	150.5	10	73	35	W½ W½
	1049	48.0	8	73	35	SW¼ NE¼, W 10 Ac. NW¼ NE¼
	1050	76.5	16	73	35	N½ NE¼
	1051	128.0	31	73	35	NW¼
	1052	79.0	31	73	34	E½ NW½
	1053	79.0	14	73	33	W½ NE¼
	1054	314.0	28	73	32	SW¼
			33	73	32	NW¼
	1055	193.0	22	72	35	S½ SE¼
			23	72	35	W½ NW¼, NW¼ SW¼
6604	1056	194.0	11	71	32	W½ SE¼
			14	71	32	W½ NE¼, NE¼ NE¼
	1057	158.0	34	73	32	SE¼

Table 24. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6604	1058	79.0	9	71	32	W½ SE¼
	1059	160.5	10	73	32	E½ NE¼
			11	73	32	W½ NW¼
	1060	302.5	6	72	34	SW fractional ¼, NW¼ SE¼ part SW¼ SE¼
			7	72	34	N½ NW¼
	1061	417.0	13	72	33	SW¼ SW¼, part S½ SE¼, part W 30 AC. of NE¼ SW¼, part W 26 AC. SE¼ SW¼
			23	72	33	Part NE¼ NE¼
			24	72	33	N½
			Lots			Lots 223, 235 past lots 236-238 Prescott
	1062	118.0	17	73	34	N½ SE¼, SW¼ NE¼
	1063	156.0	36	72	33	N½ NW¼, W½ NE¼
	1064	77.0	8	73	33	N½ NE¼
	1065	77.0	14	72	34	SW¼ NW¼
			15	72	34	SE¼ NE¼
	1066	320.0	8	71	34	SE¼ SE¼
			16	71	34	NW¼
			17	71	34	E½ NE¼, NE¼ SE¼
6501	1067	57.5	15	73	34	W½ SE¼ NE¼, SW¼ NE¼
	1068	75.0	6	71	32	E½ SE¼ (ex. 1.73 Ac.)
	1069	176.0	5	72	35	W½ NE¼
			32	73	35	E½ SW¼
	1070	156.0	34	73	32	NE¼
	1071	156.0	28	72	32	NW¼
	1072	158.0	13	73	32	SE¼
	1073	76.0	8	71	34	W½ NW¼

Table 24. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6501	1074	195.0	29	73	35	NW$\frac{1}{4}$ SW$\frac{1}{4}$, S$\frac{1}{2}$ SW$\frac{1}{4}$
			32	73	35	E$\frac{1}{2}$ NW$\frac{1}{4}$
	1075	313.0	10	72	34	S$\frac{1}{2}$ SE$\frac{1}{4}$, SE$\frac{1}{4}$ SW$\frac{1}{4}$
			11	72	34	N$\frac{1}{2}$ SW$\frac{1}{4}$, SW$\frac{1}{4}$ SW$\frac{1}{4}$
			14	72	34	NW$\frac{1}{4}$ NW$\frac{1}{4}$
			15	72	34	NE$\frac{1}{4}$ NE$\frac{1}{4}$
	1076	158.0	9	71	33	NE$\frac{1}{4}$
	1077	230.0	1	71	35	NE$\frac{1}{4}$ NE$\frac{1}{4}$
			31	72	34	SW$\frac{1}{4}$ SW$\frac{1}{4}$
			36	72	35	S$\frac{1}{2}$ SE$\frac{1}{4}$, NE$\frac{1}{4}$ SE$\frac{1}{4}$, SE$\frac{1}{4}$ NE$\frac{1}{4}$
	1078	49.0	18	72	34	Part SW$\frac{1}{4}$ SE$\frac{1}{4}$
			19	72	34	NW$\frac{1}{4}$ NE$\frac{1}{4}$
	1079	196.0	5	72	33	SE$\frac{1}{4}$ SE$\frac{1}{4}$, W$\frac{1}{2}$ SE$\frac{1}{4}$, SW$\frac{1}{4}$ NE$\frac{1}{4}$, SE$\frac{1}{4}$ SW$\frac{1}{4}$
	1080	239.4	23	72	35	W$\frac{1}{2}$ SE$\frac{1}{4}$, S 40 feet SW$\frac{1}{4}$
			26	72	35	N$\frac{1}{2}$ NW$\frac{1}{4}$, SE$\frac{1}{4}$ NW$\frac{1}{4}$, SW$\frac{1}{4}$ NE$\frac{1}{4}$
	1081	33.0	14	72	35	N 20 1/3 rods of S 61 rods of SW$\frac{1}{4}$ NE$\frac{1}{4}$, N 20 1/3 rods of S 61 rods of SE$\frac{1}{4}$ NW$\frac{1}{4}$, N 26 2/3 rods of SW$\frac{1}{4}$ NW$\frac{1}{4}$
	1082	77.0	18	73	32	W$\frac{1}{2}$ NW$\frac{1}{4}$
	1083	195.0	33	71	32	SE$\frac{1}{4}$, SE$\frac{1}{4}$ SW$\frac{1}{4}$
	1084	156.0	24	72	33	SE$\frac{1}{4}$
	1085	98.0	36	72	35	SW$\frac{1}{4}$ NE$\frac{1}{4}$, NW$\frac{1}{4}$ SE$\frac{1}{4}$, W 22 Ac. NW$\frac{1}{4}$ NE$\frac{1}{4}$
	1086	77.0	8	72	33	E$\frac{1}{2}$ SE$\frac{1}{4}$
	1087	158.0	30	73	34	W$\frac{1}{2}$ SE$\frac{1}{4}$, E$\frac{1}{2}$ SW$\frac{1}{4}$
	1088	158.0	9	72	33	NW$\frac{1}{4}$, W 4 rods NE$\frac{1}{4}$

Table 24. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6502	1089	169.0	9	72	32	E½ SW¼
			16	72	32	NW¼ N of CB & Q R.R.
	1090	156.0	7	73	32	SE¼
	1091	155.0	25	72	35	W½ NE¼, E½ SW¼ (ex.)
	1092	138.0	28	73	34	S½ SW¼, NE¼ SW¼, part NW¼ SW¼
	1093	313.0	22	73	33	E½ NW¼, E½ SW¼ SE¼
	1094	79.0	12	73	33	NW¼ SE¼, SW½ NE¼
	1095	130.0	5	72	35	Fractional NW¼
	1096	156.0	24	71	33	NE¼
	1097	120.0	18	73	34	W½ NW¼, NE¼ SW¼
	1098	199.0	22	73	35	S½ SE¼, NW¼ SE¼, NE¼ SW¼
			27	73	35	NW¼ NE¼
	1099	98.0	16	73	34	W½ NE¼, N½ NW¼ SE¼
	1100	97.0	21	71	35	SE½ SE¼, S½ NE¼ SE¼
			28	71	35	NE¼ NE¼
	1101	49.5	26	72	34	SE¼ SW¼, E 10 Ac. of S 3/4 of SW¼ SW¼
			35	72	34	Part NE¼ NW¼
	1102	312.0	15	72	34	S½
6503	1103	151.0	34	71	34	E½ NE¼, N½ SE¼ (ex. 4.25 Ac.)
	1104	156.0	35	71	33	SE¼
	1105	78.0	29	72	32	E½ NW¼
	1106	374.6	7	73	33	SE¼ NW¼ S of river, SW¼ SE¼ and road
			12	73	34	E½ SE¼, SW¼ S of river

Table 24. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6503	1106 (cont.)		18	73	33	N½ NW¼ and road
	1107	112.0	10	73	34	W½ NW¼ (ex. 1 Ac.), SE¼ NW¼, part SW¼ NE¼
	1108	76.0	6	71	34	W½ NW¼ (ex. 6.1 Ac.)
6401	1109	167.0	26	71	32	SW¼
			34	71	32	Part NE¼ NE¼
	1110	194.0	36	71	33	SW¼, SW¼ SE¼
	1111	157.0	15	71	32	SE¼
	1112	153.6	34	73	34	NW¼
	1113	196.0	13	72	32	W½ SW¼, NE¼ SW¼
			23	72	32	E½ NE¼
	1114	116.0	13	71	32	NW¼ NE¼, N½ NW¼
	1115	78.0	17	73	34	S½ SE¼
	1116	78.0	23	71	35	NE¼ NW¼, NW¼ NE¼
	1117	103.0	13	72	33	NW¼ SW¼, Part W 3/4 E½ SW
			14	72	33	NE¼ SE¼
	1118	354.0	21	73	33	S½ SE¼, SE¼ SW¼
			22	73	33	W½ SW¼
			28	73	33	NE¼
	1119	40.0	25	73	35	SE¼ NW¼
	1120	37.5	23	72	35	NE¼ NE¼
	1121	256.0	1	71	35	S 10 Ac. SW¼ SE¼
			7	71	34	Fractional W½ NW¼
			12	71	35	NE¼
	1122	79.0	25	72	32	W½ NE¼
	1123	77.0	26	73	35	N½ NW¼

Table 24. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6401	1124	79.0	23	71	33	N½ SW¼
	1125	78.0	35	73	35	E½ NW
6402	1126	324.0	31	71	32	N½
	1127	146.0	1	73	32	W 6 Ac. SW¼ SW¼
			2	73	32	S½ SE¼ (ex.), SE¼ SE¼ SW¼
			11	73	32	N½ N½ NE¼, NE¼ NE¼ NW¼
	1128	339.0	12	72	35	Part E½ NW¼
			36	73	35	N½ SW¼, S½ NW¼, S 8 Ac. NW¼ NW¼, SW¼ NE¼, N 39 Ac. NW + SE¼, N 36 Ac. of S 37 Ac. NE¼
	1129	154.0	13	72	34	W½ SE¼, E½ SW¼
	1130	131.0	19	71	34	NW¼ SW¼, W½ NW¼
	1131	77.0	22	73	33	W½ SW¼
	1132	77.0	12	71	33	E½ SE¼
	1133	75.0	26	72	34	N½ NW¼
	1134	35.5	3	72	34	SW¼ SW¼
	1135	40.0	15	71	35	NW¼ SE¼
6403	1136	414.0	13	72	33	½ of N½, part E 20 rods of SW¼ part SE¼
	1137	115.0	17	71	32	SW¼ NW¼
			18	71	32	E½ NE¼
	1138	260.0	3	72	33	NW fractional ¼, S½ NE fractional ¼, NW¼ SW¼
	1139	663.0	4	72	35	S½ SW¼
			9	72	35	W½ SE¼ NW¼, W½ NE¼
			16	72	35	NW¼, N½ SW¼, SW¼ SW¼
	1140	77.0	12	71	35	SE¼ SW¼

Table 24. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6403	1140 (cont.)		13	71	35	NE¼ NW¼
	1141	79.0	31	73	35	W½ NE¼
	1142	43.0	7	71	32	SW¼ SW¼
	1143	22.0	18	73	35	Part SW¼ SW¼
	1144	79.0	30	73	35	E½ SW¼
	1145	144.0	13	73	34	E½ SE¼, N½ S½ SW¼ SE¼, 18 Ac. N½ SW¼ SE¼
			24	73	34	NE¼ NE¼
6404	1146	158.0	36	71	34	SW¼
	1147	236.0	36	71	32	E½ SW¼, E½ NW¼, SW¼ SW¼, SW¼ NE¼
	1148	119.0	32	71	35	E½ SE¼, SE¼ NE¼
	1149	39.0	20	72	35	SE¼ NE¼
	1150	77.0	15	71	34	E½ SE¼
	1151	39.0	2	72	35	SW¼ SW¼
	1152	119.0	16	72	33	N½ SE¼, NE¼ SW¼
6301	1153	275.7	10	72	34	W½ SW¼
			15	72	34	W½ NE¼, NW¼ ex. E½ NW¼ NW¼ and ex. 1.5 Ac. in NE NW
	1154	107.0	1	73	33	Fractional N½ NE¼, SW¼ NE¼
	1155	235.0	22	71	32	NW¼, N½ SW¼
	1156	79.0	9	71	33	W½ SE¼
	1157	221.6	1	71	34	NW¼ E½ fractional NE¼
			2	71	34	Part NE¼

Table 24. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6301	1158	95.8	35	72	34	Lots 2, 4, 5, 19, 20 Loomis Sub. D. of SE¼
			36	72	34	SW¼
	1159	158.0	8	73	32	NE¼
	1160	39.0	19	72	34	NE¼ NW¼
	1161	613.0	5	73	35	All
			8	73	35	Part NW¼
	1162	401.0	15	72	35	NW¼, S½ NE¼, NW¼ NE¼ ex. part of NW¼ SE¼ (4 Ac.)
			16	72	35	N½ NE¼, SE¼ NE¼
	1163	123.0	19	71	33	S½ SW¼
			24	71	34	SE¼ SE¼
	1164	219.8	25	71	35	W½ SW¼ SE¼
			36	71	35	W½ NE¼, NE¼ NE¼, E½ NW, N 20 feet N NW¼ NW¼
	1165	72.0	3	73	34	E½ SW¼, ex. E 22½ rods of S 50 rods
	1166	79.0	10	73	34	SE¼ SE¼
			11	73	34	SW¼ SW¼
	1167	80.0	29	71	35	W½ SW¼ SW¼
			30	71	35	SE¼ SE¼, E½ SW¼
	1168	78.0	22	72	33	W½ NE¼
	1169	147.0	6	73	35	W½ W½ NE fractional ¼, NW fractional ¼
	1170	118.0	11	72	34	S½ SE¼
			14	72	34	NE¼ NE¼
	1171	158.0	19	72	34	SE¼ NE¼ (ex. 1 Ac.) NE¼ SE¼
			20	72	34	NW¼ SW¼, SW¼ NW¼
	1172	33.0	13	72	35	E½ NE¼ NE¼, NW 13 Ac. of NW¼ NE¼

Table 24. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6301	1173	82.3	35	72	34	Part N½ NE¼, Lot 2 Franks Sub. D. of S½ NE¼, part Lot 11, 10 Loomis Sub D. of SE¼
	1174	153.0	3	73	32	S½ SW¼
			4	73	32	S½ SE¼
	1175	79.0	26	73	35	S½ SW¼
	1176	25.0	1	72	33	E½ NE fractional ¼
	1177	77.0	23	71	35	W½ SW¼
	1178	79.0	11	73	35	E½ NE¼
	1179	37.0	15	73	33	NW¼ SW¼ (ex. 1 Ac.)
	1180	119.0	5	72	34	SW¼ SW¼
			6	72	34	SE¼ SE¼, SW¼ SE¼
	1181	71.7	16	72	34	E½ NE¼
	1182	76.0	22	71	35	W½ SW¼
	1183	255.0	12	73	34	SW¼
			13	73	34	NW¼ NW¼, W 22 Ac. of SW¼ NW¼, NW¼ NW¼ SW¼
			14	73	34	SE¼ NE¼
	1184	194.0	5	72	33	SE¼ SW¼, S½ SE¼, NW¼ SE¼, SW¼ NE¼
	1185	38.0	29	72	32	SE¼ SE¼
	1186	78.0	13	72	35	SE¼ NE¼, NE¼ SE¼
6302	1187	115.0	17	71	34	SE¼ SW¼
			20	71	34	N½ NW¼
	1188	76.5	16	73	33	N½ NE¼
	1189	115.0	35	71	35	E½ SE¼, SW¼ SE¼ (ex. 104 square rods)

Table 24. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6302	1190	72.6	1	71	34	S½ NE¼
	1191	33.0	14	72	35	N 20 1/3 rods of S 40 2/3 rods of SW¼ NE¼, N 20 1/3 rods of S 40 2/3 rods of SE¼ NW¼ N 26 2/3 rods of S 53 1/3 rods of SW¼ NW¼, part NE¼
	1192	40.0	18	71	35	E½ W½ NE¼
	1193	79.0	14	73	35	E½ NW¼
	1194	45.0	13	72	35	S 15 Ac. of NW¼ NE¼ W½ NE¼ NE¼, NE 12 Ac. of NW¼ NE¼
	1195	238.0	23	71	34	E½ SW¼, SE¼
	1196	219.8	25 36	71 71	35 35	W½ SW¼ SE¼ W½ NE¼, NE¼ NE¼, E½ NW¼, N 20 feet of NW¼ NW¼
	1197	238.0	10	71	33	NW¼, W½ NE¼
	1198	235.0	10	71	33	SE¼, E½ NE¼
6304	1199	166.0	21	72	34	NE¼ and part NE¼ NW¼
	1200	78.0	11	71	33	W½ NW¼
	1201	36.0	2	73	33	Fractional NW¼ NW¼
	1202	78.0	25	73	34	S½ NE¼
6201	1203	75.5	8	72	35	SW¼ NW¼
	1204	79.0	29	71	32	W½ SE¼
	1205	79.0	28	72	32	W½ NE¼
	1206	159.0	1 6	72 72	33 32	Part E½ NE¼ (15.6 Ac.) Fractional NW¼
	1207	77.0	14	72	33	W½ NE¼

Table 24. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6201	1208	117.0	23	73	35	$S\frac{1}{2}$ $SE\frac{1}{4}$, $NE\frac{1}{4}$ $SE\frac{1}{4}$
	1209	156.0	31	71	33	$SE\frac{1}{4}$
	1210	79.0	18	71	32	$W\frac{1}{2}$ $SE\frac{1}{4}$
	1211	273.0	20	71	35	E 32 Ac. (ex. N 8 Ac.) of $SE\frac{1}{4}$
			21	71	35	$SW\frac{1}{4}$ $SE\frac{1}{4}$, $S\frac{1}{2}$ $NW\frac{1}{4}$ $SE\frac{1}{4}$ $S\frac{1}{2}$ $SW\frac{1}{2}$
			28	71	35	$NW\frac{1}{4}$ $NE\frac{1}{4}$, $N\frac{1}{2}$ $NW\frac{1}{4}$
	1212	135.0	17	71	35	$NW\frac{1}{4}$ $SW\frac{1}{4}$
			18	71	35	$SE\frac{1}{4}$ $NE\frac{1}{4}$, $NE\frac{1}{4}$ $SE\frac{1}{4}$, $S\frac{1}{2}$ $NE\frac{1}{4}$ $NE\frac{1}{4}$ part $SE\frac{1}{4}$ $SE\frac{1}{4}$
	1213	157.0	9	71	33	$NE\frac{1}{4}$
	1214	135.0	19	72	34	NW fractional $\frac{1}{4}$
	1215	155.0	13	72	34	$W\frac{1}{2}$ $SE\frac{1}{4}$, $E\frac{1}{2}$ $SW\frac{1}{4}$
	1216	233.0	33	73	32	$E\frac{1}{2}$ $NE\frac{1}{2}$
			34	73	32	$NW\frac{1}{4}$
	1217	80.0	17	72	35	$N\frac{1}{2}$ $NW\frac{1}{4}$
	1218	655.0	17	72	35	$SW\frac{1}{4}$
			18	72	35	$SE\frac{1}{4}$
			19	72	35	$NE\frac{1}{4}$
			20	72	35	$W\frac{1}{2}$ $NW\frac{1}{4}$, $SE\frac{1}{4}$ $NW\frac{1}{4}$, $N\frac{1}{2}$ $SW\frac{1}{4}$
6202	1219	159.0	14	71	35	$W\frac{1}{2}$ $SE\frac{1}{4}$, $S\frac{1}{2}$ $NE\frac{1}{4}$
6203	1220	156.0	5	71	33	$SW\frac{1}{4}$
	1221	96.0	23	73	34	$N\frac{1}{2}$ $E\frac{1}{4}$ (ex.) Part $SE\frac{1}{4}$ $NE\frac{1}{4}$
			24	73	34	Part $NW\frac{1}{4}$ $NW\frac{1}{4}$ $SW\frac{1}{4}$, N 3 Ac. $SW\frac{1}{4}$ $NW\frac{1}{4}$ $SW\frac{1}{4}$
	1222	148.0	1	73	32	NE fractional $\frac{1}{4}$
6204	1223	79.0	30	71	34	$W\frac{1}{2}$ $SE\frac{1}{4}$

Table 25. Location and legal description of farm sales in Humboldt County.

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6601	2001	70.1	3	92	29	S½ SW¼
	2002	198.0	3	92	27	SW¼, NW¼ SE¼
	2003	145.3	11	93	27	NE fractional ¼
	2004	319.1	19 30	91 91	28 28	Govt. Lots 9 & 10 Govt. Lots 2, 3, 4, & 5; NW¼ NE¼, SW¼ SE¼, SE¼ SW¼, and SW¼ NW¼
	2005	194.5	29	92	27	S½ NE¼ NW¼ SE¼
	2006	155.5	32	93	28	E½ SW¼, S½ NW¼
	2007	319.1	19 30	91 91	28 28	Same as farm No. 2004
	2008	122.3	5	91	27	S½ NW fractional ¼ S½ N½ NW fractional ¼
	2009	156.8	30	93	27	SW¼
	2010	124.4	21	91	28	S½ SE¼, SE¼ SW¼, S 10 Ac. of NE¼ SW¼
	2011	77.0	21	92	29	E½ SE¼
	2012	161.6	23 24	92 92	28 28	E½ NE¼ and 2 Ac. NW¼ NE¼ W½ NW¼
	2013	156.2	11	91	30	SW¼
	2014	158.1	33	93	29	SE¼
	2015	77.0	14	92	28	S½ NE¼
	2016	180.0	3 34	92 93	28 28	Part N½ S½ S½ SE¼
	2017	77.0	36	91	29	S½ SE¼
	2018	79.0	25	93	27	N½ NW¼

Table 25. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6601	2019	79.0	29	92	28	N½ SE¼
	2020	154.8	8	91	30	E½ E½
	2021	88.0	2	92	28	W½ NW¼ (ex. 3 rods)
	2022	70.8	26	91	30	SW¼ NW¼, 31.76 Ac. NW¼ NW¼
	2023	156.0	12	93	28	SW¼
6602	2024	79.0	30	91	29	W½ SE¼
	2025	77.0	30	93	30	NE¼ SE¼, SE¼ SE¼
	2026	145.8	1	93	30	NW¼ SW¼
			2	93	30	E½ SE¼
			11	93	30	NE¼ NE¼
	2027	79.0	30	91	29	W½ SE¼
	2028	146.1	9	92	30	E½ SE¼
			15	92	30	Part of NW¼ NW¼
	2029	178.3	1	93	29	NE¼
	2030	163.8	19	91	29	NW
	2031	79.0	9	93	30	W½ SE¼
6603	2032	105.2	19	93	28	Part W½ SE¼, SW¼ NE¼ lying W of C & NW R.R. r. of w.
	2033	157.2	12	92	28	NW¼
	2034	151.0	29	91	29	E½ NW¼, W½ NE¼
	2035	180.7	11	91	27	NE¼ NW¼
			36	92	27	SW¼
	2036	52.4	21	91	28	SE SW, 10 Ac. NE NW
	2037	52.5	1	92	28	Fractional NE¼ of NW¼
	2038	76.4	4	92	29	W½ SW¼ (ex. S 10 Ac.)

Table 25. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6603	2039	76.4	21	91	28	S½ SE¼
	2040	48.8	33	91	28	N½ SE¼ (E of R.R. r. of w.)
	2041	39.0	7	93	28	NE¼ NW¼
6604	2042	152.4	21	91	27	SW¼
	2043	164.7	6	92	29	NW Fractional
	2044	164.7	6	92	29	NW Fractional
	2045	103.0	14	93	27	E½ SW¼, S 22 Ac. E½ NW¼
6501	2046	77.0	15	92	27	S½ SE¼
	2047	78.6	18	91	29	E½ SW¼
	2048	111.8	3 10	92 92	28 28	Part of Lots 4 and 5 SE¼ NW¼ and 40 Ac. in Lot 3
	2049	112.6	26	92	27	W½ SE¼ and NE¼ SW¼
	2050	157.0	36	93	30	SE¼
	2051	74.8	30	91	29	S½ NE¼
	2052	95.9	27	92	29	Govt. Lots 1 & 2. All that part of NW¼ SE¼ and SW¼ NE¼ lying S. of C & NW R.R.
	2053	153.0	23	93	30	NW¼
	2054	155.6	19	91	29	NE¼
	2055	319.4	19	91	29	N½
	2056	149.3	10	92	27	NW¼
	2057	153.3	26	93	28	SW fractional ¼ (ex. 3 Ac.)
	2058	158.0	35	91	30	NW¼

Table 25. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6501	2059	169.9	5	93	29	NW¼ NW¼, NE¼ NW¼
			6	93	29	NE¼ of NE¼
	2060	79.0	29	92	28	N½ SE¼
	2061	48.8	10	92	28	NE¼ SW¼ and W 10 Ac. of SE¼ SW¼
	2062	79.0	29	91	27	S½ NW¼
	2063	74.3	25	93	29	W½ NW¼
	2064	6.0	33	93	28	6 Ac. in NE corner of Govt. Lot 1
	2065	86.4	5	93	29	Part of NE fractional ¼ of NW¼
6502	2066	230.7	2	92	27	SW¼ NW¼ and SW¼
			3	92	27	NE¼ SE¼
	2067	130.0	2	92	28	NE fractional ¼ of NW fractional ¼
			35	93	28	S½ SW¼
	2068	38.2	23	91	29	SW¼ NE¼
	2069	75.9	12	92	27	S½ SE¼
	2070	74.3	21	91	29	W½ NW¼
	2071	146.7	32	91	28	S½ NE¼, SE¼ NW¼ and Govt. Lot 2
	2072	41.0	25	93	27	NW¼ NE¼ and N 1 Ac. of SE¼ NE¼
6503	2073	156.2	21	91	28	NW¼
	2074	292.5	31	92	28	S½ SW¼, N½ SW¼, SW¼ SW¼, NW¼ SE¼, Govt. Lots 2 & 3
	2075	151.5	16	91	28	S½ S½ S½ NW¼, Part of N½ SW¼, Part of SE¼
			17	91	28	Part of NE¼ SE¼

Table 25. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6503	2076	143.7	34	93	27	NE¼ SE¼, NW¼ SE¼ ex 3.6 Ac. SE¼ SE¼, SW¼ SE¼ ex. tract in SW corner
	2077	155.6	31	91	30	NE¼
	2078	195.0	29	93	29	SW¼, SW¼ SE¼
	2079	114.4	31	93	29	S fractional ½ of SW¼, E 37.2 Ac. NE¼ SW¼
	2080	112.5	6 7	92 92	27 27	S½ SE¼ NE¼ NE¼
	2081	85.7	7	91	27	S½ NW fractional
6401	2082	79.0	23	92	29	W½ NE¼
	2083	155.0	15	92	27	SW¼
	2084	78.6	5	91	29	S½ NE¼
	2085	153.4	12	92	27	NE¼
	2086	73.4	10	93	28	W½ NW¼, Part of N½ SW¼
	2087	157.6	35	91	30	NW¼
	2088	75.6	7	92	29	S½ NW fractional ¼
	2089	38.0	18	93	27	NE¼ SW¼
	2090	72.2	7	92	29	N fractional ½ of NW¼
	2091	76.6	17	91	29	N½ NE¼
	2092	77.2	22	93	28	E½ SE¼
	2093	79.0	15	92	29	NE¼ SW¼ and NW¼ SW¼
	2094	39.0	15	92	29	NW¼ SW¼
	2095	40.0	15	92	29	NE¼ SW¼

Table 25. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6401	2096	107.1	3	93	28	N fractional ½ of NW fractional ¼
6402	2097	77.0	27	93	29	N½ NW¼
	2098	158.0	24	92	27	SW¼
	2099	155.1	24	92	30	W½ SE¼ and E½ SW¼
	2100	156.0	21	93	30	NW¼
	2101	72.5	12	93	29	S½ SW¼ (ex. 4 Ac. for cemetery)
	2102	180.9	3 34	92 93	28 28	Part of N½ S½ of S½ of SE¼
	2103	157.6	7 8	92 92	28 28	Part N½ NE¼ and S½ NE¼ SW¼ NW¼
	2104	275.0	27	91	29	SW¼ NE¼ and E½ NW¼ and SW¼
	2105	38.8	11	91	29	SE¼ SW¼
	2106	39.9	31	91	29	S½ S½ SW fractional ¼
	2107	66.5	6	91	30	E½ SW¼ (ex. 8.5 Ac. of N end)
	2108	39.0	35	91	29	SE¼ SW¼
	2109	77.0	6	91	30	S½ SE¼
	2110	78.8	17	92	29	N½ SE¼
	2111	149.4	25	92	30	Govt. Lots 1, 2, 3
	2112	40.0	2	91	28	NW¼ SW¼
6403	2113	232.0	27 35	93 93	30 30	SE¼ SE¼ NW¼ and NE¼ SW¼
	2114	77.0	9	93	27	E½ NW¼

Table 25. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6403	2115	76.6	17	92	29	E½ NE¼
	2116	77.0	6	93	28	S½ SE¼
	2117	74.6	36	92	30	S½ SE¼
6404	2118	156.0	34	93	29	NE¼
	2119	190.7	31 32	91 92	28 28	Lot 1 S½ SW¼ and NE¼ SW¼ and Lot 3
	2120	264.1	27 34	93 93	30 30	S½ SW¼ NW¼, SW¼ NE¼
	2121	40.0	27	93	30	SW¼ SE¼
6301	2122	71.0	28	92	27	N½ NW¼
	2123	78.9	35	93	27	W½ NE¼
	2124	77.0	20	92	30	W½ NW¼
	2125	150.9	21	92	28	NE¼
	2126	77.0	4	91	30	S½ SW¼
	2127	116.0	34	92	30	S½ SW¼ and NW¼ SW¼
	2128	87.8	18	92	27	W fractional ½, NW fractional ¼
	2129	170.0	14	91	30	S½ NE¼ N½ SE¼
	2130	154.5	13	92	30	SE¼
	2131	76.8	32	93	27	S½ SE¼
	2132	159.0	25	93	28	E½ W½, W 40 feet of N 500 feet of NW¼ NE¼
	2133	79.0	21	92	29	E½ NW¼
	2134	235.0	17	92	28	NW¼, E½ SW¼

Table 25. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6301	2135	79.0	5	91	29	W½ SE¼
	2136	156.0	31	93	30	SE¼
	2137	79.0	21	92	29	E½ NW¼
	2138	77.0	14	91	30	N½ NE¼
	2139	38.0	15	92	29	SW¼ SW¼
	2140	47.8	34	93	30	N 47.8 Ac. of E 100 Ac. of SE¼
	2141	78.8	32	93	27	N½ SE¼
	2142	156.0	12	93	28	SW¼
	2143	127.7	6	93	30	E½ SE¼, E 45 Ac. of Govt. Lot 3, W 17.42 Ac. of Govt Lot 3
	2144	76.3	16	93	30	E½ SW¼
6302	2145	192.8	35	91	29	NW¼ and NE¼ SW¼
	2146	155.2	8	92	29	NW¼
	2147	154.2	36	92	30	SW¼
	2148	34.7	33	92	30	Part of W½ NW¼
	2149	112.7	23	93	27	N½ NW¼ and N½ S½ NW¼
	2150	152.7	30	93	29	SE¼
	2151	158.0	29	92	30	NE¼
	2152	153.8	20	91	27	E½ NW¼, NE¼ SW¼ and NW¼ SE¼
	2153	132.9	17	93	29	W½ SE¼, E 30 Ac. NE¼ SW¼, E 30 Ac. SE¼ SW¼
	2154	25.3	12	92	30	N 53 rods of W½ NW¼

Table 25. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6302	2155	79.0	9	93	30	W½ of SE¼
	2156	39.0	2	92	28	SE¼ NW¼
	2157	204.9	31 36	92 92	28 28	W½ NW¼, SE¼ NW¼ E½ NE¼
	2158	150.8	18	91	27	E fractional ½ of W½
	2159	100.0	3	93	27	E fractional ½ of NE¼
	2160	77.0	35	91	27	E½ of SE¼
	2161	76.2	9	91	29	W½ of SW¼
	2162	76.0	9	91	29	E½ of SW¼
6303	2163	152.1	35	91	29	NE¼
	2164	153.8	35	92	27	SE¼
	2165	77.0	30	93	30	NE¼ SE¼, SE¼ SE¼
	2166	59.5	4	91	29	NW¼ SE¼, E½ SW¼ SE¼
	2167	220.7	13 23	91 91	27 27	SW¼ NW¼ NE¼, SE¼ NW¼
	2168	76.3	20	92	28	S½ SW¼
6304	2169	75.7	7	93	27	S½ of SW¼
	2170	319.0	19	91	29	N fractional ½
	2171	307.6	33	92	30	E½ ex. 1 Ac. in NE corner
	2172	36.6	19	93	30	W½ of W½ of NW¼
6201	2173	39.0	2	92	28	SE¼ NW¼
	2174	119.0	23	92	29	E½ SW¼, NW¼ SW¼
	2175	76.8	8	93	30	N½ NW¼

Table 25. (Continued)

Year and quarter	Farm number	Size acres	Location Sec.	Twp.	Range	Legal description
6201	2176	170.1	10	93	30	NE¼ NW¼, NW¼ NE¼ and E½ NE¼
			11	93	30	Part of W½
	2177	76.6	12	92	30	N½ NE¼
	2178	76.8	21	92	27	N½ NW¼
	2179	73.7	26	93	27	S½ SW¼
	2180	116.8	11	91	29	N½ SW¼, SW¼ SW¼
	2181	40.0	12	92	30	SW¼ NE¼
6202	2182	78.8	21	92	27	S½ NW¼
	2183	79.0	5	91	29	W½ SE¼
6203	2184	40.0	1	92	28	SW¼ NE¼
	2185	77.8	1	92	28	SE¼ NE¼, SE¼ NW¼
	2186	69.3	8	93	28	NE¼ SE¼ and Lot 4
6204	2187	147.0	6	91	29	W fractional ½ of NW¼, N 7 Ac. of W½ SW¼, W 47.96 Ac. of E½ NW¼
	2188	79.0	13	92	28	W½ NW¼
	2189	184.5	28	91	30	NW¼
			29	91	30	N½ N½ SE¼

Table 26. Adams County soils legend, corn yields and CSR ratings

Soil type	Soil mapping unit	Est. corn yield average Bu/A [a]	CSR [b]
Wiota silt loam	7-1-0	95-98	95
	7-3-1	90-95	89
Judson silt loam	8-1-0	95-98	85
	8-3-1	90-95	
	8-7-1	90	
Colo-Gravity	11-3-0	75	69
	11c-3-0	60	50
Shelby loam	24-7-1	75	65
	24-7-2	70	60
	24-11-1	60	45
	24-11-2	60	40
	24-11-3	50	35
	24-11-4	<50	20
	24-15-1	55	35
	24-15-2	50	30
	24-15-3	<50	20
	24-15-4	<50	10
	24-22-1	<50	25
	24-22-2	<50	20
	24-30-1	<50	10
	24-30-2	<50	10
Hagener loamy fine sand	41-7-2	50	35
	41-11-2	<50	25
Bremer silt loam	43-1-0	80-85	75
Lindley loam	65-15-2	50	25
	65-15-3	<50	20
	65-22-2	<50	20
Clearfield silty clay loam	69-7-1	70	80
	69-7-2	70	75
Ladoga silt loam	76-3-1	85	80
	76-3-2	85	78
	76-7-1	83	75
	76-7-2	83	70

[a]Estimates based on data in SR 42 and NC Regional Publication.

[b]Assigned by Agronomy Staff ISU cooperating with the SCS.

Table 26. (Continued)

Soil type	Soil mapping unit	Est. corn yield average[a] Bu/A	CSR[b]
Ladoga silt loam	76-7-3	75	60
	76-11-1	75	60
	T76-1-0	88	82
	T76-3-1	85	80
	T76-7-1	83	75
	T76-7-2	83	70
Clinton silt loam	80-7-1	75	55
	80-7-2	75	50
	80-11-1	65	50
	80-11-2	65	40
Nevin silt loam	88-1-0	87	85
Shelby-Adair complex	93-7-1	60	50
	93-7-2	55	45
	93-11-1	52	40
	93-11-2	52	35
	93-11-3	50	25
	93-15-1	50	35
	93-15-2	<50	30
	93-15-3	<50	22
Gravity silty clay loam	103-3-0	75	75
Chariton silt loam	105-1-0	60	50
Sperry silt loam	122-1-0	60	55
	T122-1-0	60	55
Colo silty clay loam	133-1-0	90	75
	133c-1-0	65	56
	133-1-+	90	80
Wabash silty clay	172-1-0	55	48
Gara loam	179-7-1	70	55
	179-7-2	70	50
	179-11-1	60	40
	179-11-2	60	36
	179-15-1	55	30
	179-15-2	50	27
	179-15-3	<50	24
	179-22-1	<50	24
	179-22-2	<50	40

Table 26. (Continued)

Soil type	Soil mapping unit	Est. corn yield average[a] Bu/A	CSR[b]
Adair clay loam	192-7-1	50	35
	192-7-2	<50	30
	192-11-1	<50	25
	192-11-2	<50	20
	192-11-3	<50	15
Kennebec silt loam	212-1-0	90	80
Nodaway silt loam	220-1-0	90	80
	220c-1-0	80	60
Clarinda silty clay loam	222-7-1	<50	30
	222-7-2	<50	20
	222-7-3	<50	15
	222-11-1	<50	20
	222-11-2	<50	15
	222-11-3	<50	10
Wabash silty clay loam	248-1-0	65	55
	248c-1-0	60	40
Chariton silt loam	269-1-0	71	50
Olmitz loam	273-3-1	90	80
	273-7-1	76	75
	273-7-2	76	75
Alluvial land	315-1-0	60	48
	315c-1-0	55	30
Macksburg silty clay loam	368-1-0	95	95
	368-3-1	95	94
	T368-1-0	95	95
	T368-3-1	95	94
Winterset silty clay loam	369-1-0	91	90
Sharpsburg silty clay loam	370-1-0	95	92
	370-3-1	90	88
	370-3-2	90	84
	370-7-1	85	80
	370-7-2	85	77
	370-11-1	79	70
	370-11-2	75	65
	370-15-1	71	60
	370-15-2	65	55
	T370-1-0	95	92

Table 26. (Continued)

Soil type	Soil mapping unit	Est. corn yield average[a] Bu/A	CSR[b]
Sharpsburg silty clay loam	T370-3-1	90	88
	T370-7-1	85	80
	T370-7-2	85	77
Arbor loam	434-7-1	76	75
	434-11-1	70	70
Gosport soils	435-7-2	<50	15
	435-11-2	<50	12
	435-11-3	<50	12
	435-15-2	<50	10
	435-15-3	<50	10
	435-22-2	<50	5
	435-22-3	<50	5
	435-30-2	<50	5
Adair clay loam (thin solum)	593-7-1	55	40
	593-7-2	53	35
	593-7-3	50	30
	593-11-1	50	35
	593-11-2	50	30
	593-11-3	<50	25
	593-15-2	<50	20

Table 27. Humboldt County soils legend, corn yields and CSR ratings

Soil name	Soil unit	Corn yield[a] Bu/A	CSR[b]
Glencoe silty clay loam	6-0-0	75	5-10
Glencoe calcareous variant	6a-0-0	70	5-10
Glencoe-like silty clay loam variant	6b-0-0	65	5-10
	6w-0-0	50	5-10
Muck	21-0-0	65	4-10
Muck calcareous variant	21-0-0	60	4-10
Terril loam	27-1-0	90	2.0
	27-2-+	90	2.5
	27-3-+	85	3.0
	27-3-1	85	3.0
	27-7-+	75	4.0
Lakeville gravelly loam	34-3-1	50	7.0
	34-3-2	50	7.5
	34-7-2	50	8.5
	34-11-3	<50	9.5
	34-12-3	<50	9.5
	34-17-3	<50	10.0
Thurman loamy sand	41-3-1	50	8.0
	41-7-2	45	9.0
	41-11-2	40	10.0
Nicollet loam	55-2-0	95	1.5
Storden loam	62-3-1	75	5.0
	62-3-2	75	5.5
	62-7-2	65	6.5
	62-11-2	60	7.5
	62-11-3	55	8.0
	62-17-2	50	8.5
	62-17-3	45	9.0
	62-25-2	45	9.0
	62-35-3	45	10.0
Lakeville sandy loam	73-3-1	45	6.5
	73-3-2	45	7.0
	73-7-2	32	8.5

[a]Estimates based on data in SR 42 and NC Regional Publication.

[b]Assigned by Agronomy Staff ISU cooperating with the SCS.

Table 27. (Continued)

Soil name	Soil unit	Corn yield[a] Bu/A	CSR
Lakeville sandy loam	73-11-2	32	9.0
	73-17-2	30	9.5
Okoboji silt loam	90-0-0	80	4.1
Okoboji calcareous variant	90a-0-0	75	4.5-10
	90a-1-0	75	4.5-10
Okoboji silt loam variant	90b-0-0	77	4.5-10
Okoboji silt loam calcareous variant	90ba-0-0	70	5-10
Harpster loam	95-1-0	80	4.0-10.0
Harpster terrace variant	95b-1-0	80	4.5-10.0
Harpster D of sand and gravel	95d-1-0	75	4.5-10.0
Huntsville silt loam	98-1-0	95	4-10
Huntsville channelled	98c-1-0	80	7-10
Huntsville very channeled	98cc-1-0	60	8-10
Webster silty clay loam	107-1-0	91	2.0
Webster calcareous variant	107a-1-0	86	2.5
Waukegan loam	108-1-1	80	4.0
	108-3-1	80	4.5
	108-3-2	80	5.0
	108-7-2	77	6.0
	108-11-2	60	7.0
	108-17-2	50	9.0
Lamont fine sandy loam	110-3-1	50	8.0
	110-7-2	45	9.0
	110-11-2	40	9-10
	110-17-2	35	10
Lamont loam	113-3-1	55	8.0
	113-7-2	50	9.0
	113-11-2	45	9-10
Colo silty clay loam	133-1-0	90	3-8
Colo channeled	133c-1-0	65	8-10
Colo very channeled	133cc-1-0	50	8-10
	133a-1-0	85	8-10
	133w-0-0	50	8-10
Zook silty clay	134-0-0	65	6-9
	134c-0-0	50	7-10

Table 27. (Continued)

Soil name	Soil unit	Corn yield[a] Bu/A	CSR[b]
Colo loam	135-0-0	90	4.5-8
	135-1-0	90	4.5-8
	135c-1-0	65	6-10
Ankeny sandy loam	136-1-0	65	5.5
	136-3-+	65	6.0
	136-7-+	60	7.5
Clarion loam	138-3-1	90	2.0
	138-3-2	90	2.5
	138-7-1	85	3.5
	138-7-2	85	4.0
	138-11-2	75	6.0
	138-11-3	70	6.0
	138-17-2	60	7.0
	138-17-3	55	7.0
	138-25-2	50	8.0
	138-35-3	50	9.0
Ames loam	167-0-0	72	6.0
Hayden loam	168-1-1	85	3.5
	168-3-1	84	4.0
	168-7-1	80	5.0
	168-7-2	80	5.0
	168-11-2	70	7.0
	168-11-3	65	7.0
	168-17-2	55	8.0
	168-25-3	50	9.0
	168-35-3	50	10.0
Dickinson sandy loam	175-1-0	60	6.0
	175-3-1	50	6.5
	175-3-2	50	7.0
	175-7-2	50	7.5
	175-11-2	50	9.0
	175-17-3	<50	10.0
	175-25-3	<50	10.0
Colo-Terril complex silt loam	201-1-0	85	4.0
	201-1-+	85	4.0
	201-3-+	80	5.0
	201-7-+	75	6.5

Table 27. (Continued)

Soil name	Soil unit	Corn yield[a] Bu/A	CSR[b]
Kato loam	202-1-0	85	3.0
Kato loam 36" sand	202-2-0	85	3.0
	202-3-1	80	3.5
Kato silt loam	203-1-0	90	2.0
Kato sand + 36"	203-2-0	90	2.0
	203-2-1	90	2.0
	203-3-1	85	2.5
	203-3-2	85	3.0
	203a-1-0	85	2.5
Unnamed	210 same as 175		
Muck unit	221-0-0	65	4.5-10
Lester loam	236-1-0	90	3.0
	236-3-1	85	3.5
	236-3-2	85	3.5
	236-7-1	80	4.5
	236-7-2	80	5.0
	236-11-2	75	6.0
	236-11-3	65	6.5
	236-17-2	55	7.0
	236-17-3	50	7.5
	236-25-3	<50	8.5
	236-35-4	<50	10.0
Farrar fine sandy loam	253-3-1	70	4.5
	253-3-2	70	4.5
	253-7-1	65	5.5
	253-7-2	60	6.0
	253-11-2	55	7.5
	253-11-3	50	8.0
	253-17-2	<50	9.0
	253-25-2	<50	10.0
Marshan silty clay loam	258-0-0	85	3.5
Marshan 36" to gravels	258-1-0	85	3.5
	258a-1-0	75	4.0
Marshan silty clay loam	259-0-0	90	2.0
Marshan + 36" to gravels	259-1-0	90	2.0
	259a-1-0	85	2.5

Table 27. (Continued)

Soil name	Soil unit	Corn yield[a] Bu/A	CSR[b]
Rolfe silt loam	274-0-0	75	5-10
Crocker loamy fine sand	297-3-1	55	8.0
	297-7-2	50	9.0
	297-11-2	<50	9-10
	297-17-2	<50	10.0
Waukegan loam	308-1-0	90	2.0
Waukegan loam deep phase	308-3-1	85	2.5
	308-3-2	85	3.0
	308-7-1	75	4.0
	308-7-2	75	4.5
	308-11-2	65	6.5
Alluvial soils undifferentiated	315-1-0	55	7-10
	315c-1-0	50	8-10
	315cc-1-0	<50	8-10
Peat	321-0-0	55	5.5-10
Flagley sandy loam	323-1-1	60	6.5
	323-3-1	55	7.0
	323-7-2	50	8.5
	323-11-2	<50	10.0
LeSuer loam	325-2-0	90	2.5
	325-3-1	85	3.0
Clarion loam (thin solum)	332-3-1	85	4.0
	332-3-2	85	4.5
	332-7-2	80	5.5
	332-11-2	70	6.5
	332-17-3	55	7.5
Colo-Webster intergrade	334-1-+	85	3.0
	334-3-+	80	4.0
Harpster loam	335-1-0	75	5.0
Harpster sand and gravel substratum			
Orio fine sandy loam	336-0-0	60	6.0
Cullo silty clay loam	337-0-0	80	4.0
	337-1-0	80	4.0

Table 27. (Continued)

Soil name	Soil unit	Corn yield[a] Bu/A	CSR[b]
Garmore silt loam	338-2-0	90	2.0
Garmore silt loam	339-1-0	95	1.5
	339a-1-0	90	2.0
	339b-1-0	90	2.0
	339-3-1	90	2.0
	339-3-2	90	2.5
	339-7-2	85	4.0
	339-11-2	75	6.0
	339-17-2	65	7.0
	340-1-0	50	9.0
	340-3-1	50	9.5
	340-7-2	50	10.0
Garmore silty clay loam	342-1-0	85	2.5
Okoboji silt loam imperfectly drained variant	343-0-0	85	3.0
Copes loam limestone 18-30 inches	344-1-0	65	4.0
Plattville loam limestone 35-60 inches	345-1-0	85	3.0
	345-3-1	80	4.0
Plattville silt loam	346-1-0	70	4.5
Plattville limestone 18-30 inches	346-3-1	65	5.0
Plattville silt loam	347-1-0	85	4.0
Plattville limestone 35-60 inches	347-3-1	80	5.0
Peat 48" deep	421-0-0	60	5-10
Peat 48" over sand and gravel	521-0-0	65	4.5-10
Muck more than 6-10" thick	621-0-0	65	4-10
Muck calcareous	621a-0-0	60	4.5-10
Webster silty clay loam	707-1-0	91	2.0
	707a-1-0	86	2.5
Muck 48" thick	721-0-0	65	5-10
Mucky peat 10" over till	821-0-0	70	4-10

Table 27. (Continued)

Soil name	Soil unit	Corn yield[a] Bu/A	CSR[b]
Mucky peat 10-25" peaty muck	921-0-0	65	4.5-10
Mucky peat 25-40" thick	922-0-0	60	5-10