EFFECTS OF VARIATIONS IN INPUTS AND PRICE RELATIONSHIPS ON THE VALUE OF CROPLAND, GEARY COUNTY, KANSAS

by

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INTRODUCTION

Scope and Purpose

The property tax in Kansas is an important source of revenue for public expenditure. In 1953, $180,021,448 was levied on Kansas property for all purposes. Ninety-six per cent was levied for local use (county, city, schools and other local government uses). Twenty-five per cent was levied on farm real estate and improvements outside of the city limits.[1] One may reasonably assume that the property tax will continue to be a major source of revenue, particularly at the local level. The important matter with the property tax is the proper distribution of the property tax load to property owners. The value of the property is the basis for the equitable taxation of property owners. The evaluation of property for taxation is called assessment.

The primary problems with which we are concerned are the inequities of assessment. The Kansas Citizens Commission on Assessment Equalization outlined the following problems pertinent to real estate assessment: (1) Great inequalities in assessment among individual parcels of farm real estate, (2) discrimination in relative assessments between large and small properties, (3) different ratios of assessed valuations to sales values among taxing units, and (4) different ratios among rural, urban, personal and real property within and among taxing units.[2]

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[1]Commission of Revenue and Taxation, State of Kansas, Unpublished material on collection and distribution of taxes, 1954.

[2]Report of the Kansas Citizens Commission on Assessment Equalization, submitted to the Governor and the 1955 Legislature, January 1955, p. 21.

There is a tendency for Kansas farm land to be valued, with little variation, around a common mean. Highly productive land tends to be under valued and the less productive land over valued.

Assessed value-sale value ratio studies find that there are great differences in the ratios among political subdivisions in Kansas. The ratios for counties varied from 15 to 59 per cent for rural property among counties in 1954.[1] This inequity affects the apportionment of state collected-locally shared funds. For example, the sales tax residue and aid for elementary schools are apportioned partly on the basis of assessed valuation.[2]

Kansas law states that all property shall be taxed in accordance to the uniform and equal clause of the Kansas Constitution. This does not support the variation in the assessment ratio between personal and real property, and between rural and urban properties. The uniform and equal clause would imply that the item of property should be taxed on its true money value, not to be influenced by the kind of property.

Kansas land by law is to be assessed at true value in money. The common accepted measure of the true value of land by assessors is its market value. Unlike other salable properties land has a slow turnover and existing land sales are scarce. For instance, Geary County, Kansas, in 1954 had nine sales listed for rural property.[3] Market values on some kinds of farm land are unavailable, particularly on the highly productive

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[1]Commission of Revenue and Taxation, Report of Assessment Ratio Study, State of Kansas, 1954, p. 6.

[2]Research Department, Kansas Legislative Council, State-Collected Locally-Shared Revenues in Kansas, 1937-1950, Pub. No. 170, November 1950, pp. 11-14.

[3]Report of Assessment Ratio Study, 1954, loc. cit.

soils. Sales must be screened to determine if the transaction represented a willing seller and a willing buyer. Property for sale adjoining property already owned by the buyer might be sold high. On the other hand a forced sale by the seller might result in a low sale value. Improvements on the land will influence the sales price. The assessor must isolate sales of farm land which are of the same kind as the land he is to value, eliminate the effects of the above variations, and apply this value to the land in question. This is a subjective process.

In recent years there has been a movement toward the classification and special treatment of different kinds of property for the purpose of adjusting taxes more in accordance with ability to pay.[1] This would support the theory of classifying land in relation to its ability to produce a return to the land owner as an investment.

Theoretically, the sum of the expected annual net incomes or economic productivity will equal land value. Economic productivity implies that a delineated soil or tract of land can be rated according to its ability to return a net income over a period of years. In determining an economic productivity rating, the procedure should be as objective as possible. It should involve the determination of the expected physical output and the expected physical input so that by applying the appropriate prices the economic productivity can be determined.

The accurateness in determining the economic productivity depends on three major groups of variables. These are: (1) soil, land use and management differences, (2) accessibility relationships and (3) cost and

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[1]Roland R. Renne, Land Economics, Montana State College, p. 565.

price relationships for the calculation of the expected economic productivity. In delimiting the area of study for this thesis it was thought desirable to investigate the significance of the cost and price inter-and intra-relationships as they affect land value.

Objectives of the Study

It is conceivable that the relative economic productivity of different tracts of land would be changed because of the variable production costs incurred. It is granted that the variation in the physical product from the different tracts of land may have the greatest effect on the relative economic productivity. However, in using the capitalization process in determining land value, a small change in net income will cause a considerable change in the capitalized value.[1] Two delineated soils may have the same physical productivity but one extra tillage (cost) operation such as a harrow operation may be required for one soil. Assuming that this extra harrow operation would decrease the net income of Soil A by $1, this difference, capitalized by a rate of 5 per cent, will cause the value of Soil A to drop $20. The number of operations and the time required for crop operations are assumed to vary due to the nature of the soil. One objective of this study was to investigate the variations in production costs common to major cropland soil types as delineated by the detail soil survey and to test the significance of this variation upon land values.[2]

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[1]The commonly accepted formula for capitalizing the series of expected annual incomes into land value is $V = a/r$ where "V" is the value of the land, "a" the annual income and "r" the going rate of interest.

[2]Soil Survey Manual, USDA, Misc. Pub. No. 274, Washington, D. C., 1937, p. 88. The term "soil type" is a classification of the texture of the surface soil only. "Soil series" classifies the soil as a whole according to the sub-soil and surface soil but not as to texture.

Secondly, this study is to investigate the major crop price relationships, along with varying uses to different soils, and their ultimate effect upon land values. It can be conceived where the increase in the price of one crop in comparison to others would influence the value of one soil more than others due to the disproportionate use of this crop on different soils. For instance if it is found that Soil A produces twice as much wheat per acre as Soil B on the average, then a raise in the price of wheat with other prices held constant will cause the capitalized value of Soil A to be affected twice as much when the economic productivity of Soil A is weighted for the crops grown on it.

Finally, this study is to investigate the significance of the price and cost relationships and their effects on the economic productivity and ultimate effects on land values. In the selection of standards for the budgetary process of calculating the net income, the price level and the cost level selected are expected to have an effect on the relative economic productivities. A hypothetical example is shown in Table 1. Two levels of output prices were used while the level of input prices was held constant. The expected physical productivity remained the same. A common practice in modern appraisal procedures is to use the comparison method in gearing current sale values to the relative ratings derived from the economic productivity. This entails selecting the average land and by an objective process determine the sales or true value for that land type. Land area 3 is the average land in Table 1, with its value being set at $150. When there is a larger spread between costs and prices, there is a tendency for the relative values to be pulled toward a common mean as illustrated for price level II.

Table 1. Land value tendencies due to change in output price level (hypothetical).

Land area	Price level I (Base-Input = 100, Output = 100)					Price level II (Input = 100, Output = 150)				
	Input	Output	Econ. prod.	Rel. rating	Value	Input	Output	Econ. prod.	Rel. rating	Value
	$	$	$	%	$	$	$	$	%	$
1	10.00	19.00	9.00	129	194	10.00	28.50	18.50	116	174
2	10.50	18.50	8.00	114	171	10.50	27.75	17.25	108	162
3	11.00	18.00	7.00	100	150	11.00	27.00	16.00	100	150
4	11.50	17.50	6.00	86	129	11.50	26.25	14.75	92	138
5	12.00	17.00	5.00	71	107	12.00	25.50	13.50	84	126

General Assumptions

In determining the return or payment to the factor of production, land, it is assumed that market prices reflect the marginal value productivities of labor and capital and that the landowner is a residual claimant. By extracting a return for management from the residual claimant comparable to its marginal productivity, the relationship among the remainder in the various residual claimants for different land tracts will give an objective means of determining the sale values or marginal productivity of various land tracts using the sales comparison method.

In the theory that land is valued according to its ability to produce a net income or economic rent, it is assumed that the expected average economic rent, will provide the basic figure for determining the final land value.

Hypotheses

1. Physical characteristics of soils such as its origin, texture, and slope affect speed and number of farm operations and other inputs and thereby production costs and land values.

2. Because of differences in crop use, price relationships of inputs and outputs affect the relative returns from the soils and their values.

3. Variations in input and output price levels will influence relative land values.

General Procedure

Literature relevant to this study was reviewed to determine what others have found concerning this problem and to serve as a guide for this study. Primary data for this study were obtained for five cropland soils in the three west-border townships in Geary County, Kansas, for 1953 and 1954 crops.

Secondary information in the form of formulas and studies made by the Department of Agricultural Engineering on cost of operating and cost of owning farming machinery were utilized. Primary data obtained from five implement dealers in Geary County for the crop year, 1953-54, were used to supplement the Agricultural Engineering data.

Secondary information concerning output prices for the area studied were obtained from Reports of the Kansas State Board of Agriculture. Input prices were obtained from the annual Crops and Market publication and Agricultural Statistics, using the state of Kansas figures.

Method of Analysis

The statistical procedure of this study consisted primarily of the use of weighted and unweighted arithmetic averages of the field data obtained in this study. Frequency and modal analyses were used in determining the most frequent and typical operations performed on the soils studied. Analyses of variance were used to test the significance of the averages of the primary data.

Indices and price relative methods were employed to show the output price relationships and the ratio between price and cost level.

REVIEW OF LITERATURE

Future economic productivity is the basis for determining the true value of a tract of land. In determining value by the summation of all the expected annual economic productivities or by the capitalization process, the following basic questions need answers: First, what is the best method of determining the expected physical productivity or outputs of the various land types? Second, what is the best method of determining the expected production costs or inputs for the various land types? Third, what is the best method of using these items with prices to obtain the expected net income or economic productivity? These questions are primary. To obtain their answers, other questions need to be answered.

It is the purpose of this review to present summarily recent work concerning economic productivity classification of land for assessment purposes and their implications. Information concerning the last two questions above is most significant to this study and its hypotheses.

Physical Productivities

There are four principal groups of factors affecting physical productivities: (1) management, (2) climate, (3) soil, and (4) technological improvements according to Lindsey.[1] Accurate methods for determining the effects of management practices are needed. The expected physical productivity for a land tract should reflect typical management. The physical yields used should reflect those that the majority of the operators will receive and not the poorest or best yields. In determining land values for loan purposes, the managerial ability of the individual operator is important. If the individual can perform superior management he should be able to amortize his debt earlier and because of this he would be able to pay more for the land. However, to tax the outstanding operator for his management and energetic efforts or to grant favors to the inefficient operator who lacks initiative and foresight would be unfair.[2] Land values for taxation purposes should reflect its inherent ability to return an income without the influence of extremes in management. Returns from land are impossible without the application of some forms of labor, management and capital. Land taxed on its maximum profit capabilities represents the best management possibilities. Typical management represents the land use practices that commonly occur on the soil and that return which most of the operators are obtaining.

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[1]Quentin W. Lindsey, A Procedure for the Equitable Assessment of Nebraska Farm Land, Agricultural Experiment Station, University of Nebraska, Lincoln, Bulletin 400, December 1950, p. 10.

[2]Ibid., p. 11.

If a certain kind of soil, in the majority of the cases, has fertilizer used in its crop production, the cost of the fertilizer should be considered as an expense for that soil. The minority who did not fertilize that particular soil would tend to be encouraged to utilize their land in a better manner due to the tax load. On the other hand if a particular soil type was not fertilized as a rule and the physical productivity was based on their average, the few managers who did fertilize would not be penalized for their extra intensification.

Pine found in a land productivity study in Geary County, Kansas, in 1946 that according to his rating system of good, fair and poor management, wheat yields varied 5.7 bushel between good and fair management and 5.5 bushel between fair and poor management.[1] He utilized primary practice and yield data, using the detailed soil survey for the county to delineate the soils. The various practices were subjectively rated by the author and Experiment Station personnel according to accepted agronomic standards. By averaging the yields for these management groups the differences found show apparent accurateness.

If physical productivities are to be determined objectively through the averaging of yield information from the farmers, a method of collecting and analyzing management data is essential for the proper adjustment of the yields for management. Even if physical productivities are to be estimated, to logically arrive at the correct figure, knowledge of the nature and effect of the various management practices are essential.

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[1]W. H. Pine, Methods of Classifying Kansas Land According to Economic Productivity, Unpublished Ph.D. thesis, University of Minnesota, 1948, p. 167.

Climatic conditions are uncontrollable. In determining physical productivities for different land types within a tax unit, it is conceivable that variations in yields may result due to rainfall and temperature change. An historical average of yields taken over a period long enough to level off the cyclical changes is apparently the best method of determining the influence of weather.[1]

Homogeneous soil areas could, even with historical averages, have different physical productivities due to the increased average rainfall from one corner of the tax unit to the other. Kansas average rainfall figures decrease approximately one inch for each 20-25 miles, starting from the southeastern corner where the average precipitation is 40 inches to the western edge of Kansas where the average precipitation is less than 20 inches.[2] This necessitates that physical productivities be determined for relatively small tax units to eliminate this effect of climatic change.

The nature of the soil is definitely a variable in determining physical productivity. Three features of the soil need to be considered: (1) slope, (2) erosion, and (3) type of soil.

Normally the extent of erosion and the degree of slope are related. The steeper slope has accelerated erosion and receives less benefit from the rainfall due to rapid runoff. Soils with steep slopes and advanced erosion would have a tendency to have higher production costs as a result of loss of efficiency because of the slope and heaviness of the soil.

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[1]Quentin W. Lindsey, loc. cit.

[2]Kansas State Finance Council, Report to the 1955 Legislature, Water in Kansas, p. 14.

Smith found in his study that the effective drawbar pull of a tractor is lessened 1 per cent for each per cent of grade.[1]

The degree of erosion tends to have both a direct and inverse effect on yields. The eroded soil lacks organic matter and capacity to grow heavy crops. During dry weather, the more eroded soil may have a greater moisture holding capacity due to the higher clay content of the remaining soil. The first condition tends to reduce yields while the second would tend to increase yields during drought seasons. Due to the various degrees of erosion and different slopes on one specific soil type, it is conceivable that a wide range of physical productivities could occur. Due to the loss in efficiency of the machinery operations from slope characteristics it is conceivable that the production costs or inputs would vary.

Soil type classifies the soil according to texture. It is a further refinement of the soil series classification which considers the morphology of the soil. Smith in a plowing study found that the pounds of draft per square inch of plow furrow will vary from three to ten pounds between sandy and heavy clay soils.[2] This variation would tend to affect the speed of tillage operation. Besides the physical characteristics of slope and erosion, the origin and makeup of the soil tends to be a variable in crop producing ability. Likewise due to the texture of the soil, such as the amount of clay and the heaviness of the soil, production costs would tend to vary because of the speed and number of tillage operations necessary.

Basically, there are two types of soil maps showing soils information. The detailed soil survey is the result of considerable time and effort.

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[1]H. P. Smith, Farm Machinery and Equipment, 1948, p. 115.

[2]H. P. Smith, op. cit., p. 111.

The soils are examined carefully farm by farm and are mapped quite accurately on aerial photographs. Lindsey states that the soil scientist in his analysis of a soil "would include differences in the parent soil material, the position of the soil with respect to elevation and subsoil moisture, drainage conditions, alkaline conditions and depth, texture and general composition of the soil."[1] Simonson states: "Major emphasis is given to soil profile, including its various horizons, because the profile is a reflection of the factors of soil formation. These factors are important to the growth of plants and are significant to engineering uses of soils."[2] Recent detailed surveys include the slope and erosion symbols. Older surveys did not. The mapping units are soil types. Each unit represents a homogeneous combination of soil factors represented by a soil symbol. If this symbol designates another area of soils, it contains the same soil factors. The maps are made in cooperation with the U. S. Soil Conservation Service and the U. S. Soil Survey Division of the United States Department of Agriculture.

The second map showing soils information is the Reconnaissance Survey and the land capability classification. The primary purpose of the land capability classification is for land use. Stevens states: "A land capability unit is the smallest unit of land capability classification. Each of these units consists of the land within specified limits of soil, slope and degree of erosion and other physical land characteristics that affect

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[1]Quentin W. Lindsey, op. cit., p. 13.

[2]Roy W. Simonson, The Function of Soil Surveys in a Land Classification Program for Tax Assessment, Proceedings, Land Classification Conference, Great Falls, Montana, June 1950, p. 16.

the plants to be grown and the responses of vegetation to management. Each one has nearly uniform use possibilities and conservation needs."[1] When detailed soil surveys are available the land capability units are determined from them. In the absence of the detailed survey, a reconnaissance survey is used which is prepared rather hastily. This type survey dismisses much detail and has generalized boundaries for the land capability units. The units are delineated according to recommended use and conservation. It is possible that two or more soil types as delineated by the detailed soil survey could be represented in one land capability unit, having varying physical productivities and production costs.

Technological improvements have a definite influence on the productivity of different soils. Improved tillage methods or better soil amendments would tend to increase the physical productivity and also change the production costs. These improvements do not occur overnight but it is important to the extent that the physical productivity cannot be determined once, then forgot about.[2] There must be periodic revision and continuous study concerning their influence.

It is not within the scope of this thesis to investigate alternate means of determining physical productivities. However, the methods of determining physical productivities are important also in the accurate determination of production costs as well. The detailed soil survey which delineates the slope, erosion and type of soil conceivably is the best basis for determining physical productivities and production costs.

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[1]D. M. Stevens, Land Classification in Relation to Colorado's Tax Equalization Program, Proceedings, Land Classification Conference, Great Falls, Montana, June 1950, p. 48.

[2]Quentin W. Lindsey, op. cit., p. 11.

Production Costs

Like physical productivities, production costs can vary for land types. The primary reasons for the variation are the nature of the soil and its management. A difference in the kind and speed of field operations may occur because of the soil. As mentioned in discussing physical productivities, management enters the cost consideration. The better operator probably would prepare the seedbed with additional machine operations and would tend to use more or better soil amendments. Production practices followed by the typical operator must be used in determining the cost of production. Costs that are charged against the output of a soil should be those which the majority of the operators incur and not what a few operators incur. The same reasoning is applied here as in determining the typical physical productivity. The extreme practices should not be considered even though the extreme may be the most profitable practices.

The physical features of the soil such as slope and erosion will affect the speed and efficiency of the machines. Barger in a test found that contour farming or farming on the level increased the acres covered by the field implement by 12.8 per cent over up and down hill farming and that contour farming used 4 per cent less fuel.[1]

Lindsey in a procedure for determining production costs in Harlan County, Nebraska, used the opinions of a group of farmers living in the county. The estimates were modified by factual data found in Nebraska publications. Production costs for each land class were determined for

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[1]E. L. Barger, Contour Operation Tests, Agricultural Engineering Journal, April 1938, p. 158.

each of the major crops grown. Costs determined varied $2.79 per acre between the high and low productivity class for wheat in the sample county.[1] Production costs vary because of transportation costs and harvesting costs. These costs vary in proportion to their physical productivities. Lindsey in his study in Harlan County, Nebraska, determined that for corn the hauling and harvesting costs would vary $3.15 from high to low physical productivity classes.[2] This variation for hauling and harvesting costs on corn varied more than the total costs varied for wheat production in this study.

Fenton and Fairbanks outline a procedure for determining farm machinery cost per acre. Use was made of the initial cost of the machine and the speed of operation. Depreciation, interest on investment, taxes, insurance and housing are determined by taking a percentage of the initial cost. Percentage figures for this annual cost of ownership have been determined for most farm implements, representing comprehensive study of depreciation, insurance and tax rates.[3] By adding the incurred variable costs and determining the average use per year, the per acre cost can be determined. With primary data to determine the average or typical operations performed on each soil type, the machinery costs could easily be determined. This would provide an objective means of determining variations in production costs due to variation in kind and speed of operations on the various soils.

Custom rates for particular operations have some merit for use in determining production costs. The supply and demand for custom operations

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[1]Quentin W. Lindsey, op. cit., p. 49.

[2]Quentin W. Lindsey, op. cit., p. 46.

[3]F. C. Fenton and G. E. Fairbanks, The Cost of Using Farm Machinery, Engineering Experiment Station, Kansas State College, Manhattan, Bulletin 74, September 1954, p. 34.

in most areas limit the accuracy of the rates found. Custom rates include a charge for management and labor. It is conceivable that custom rates would reflect little variation for the nature of the soil and efficiency of operation. However Smith found that the custom rates for plowing in 1936 in some of the middle western states varied from $1.10 to $1.77 and was caused by the heaviness of the soil.[1] Rates for tillage operation should vary with the texture and slope of the soil while rates for harvesting and hauling operations should vary with the physical productivity.

Economic Productivity

The method of determining the net income and the price and cost level relationships are essential parts in the determination of the expected economic productivity of land.

The enterprise budget and the farm budget are the two primary means of arriving at a net income or economic productivity figure for a tract of land. The single enterprise budget has the advantage of simplicity since it pertains to the input-output relation of a single crop or pasture land unit. Pine states: "A difficult problem in using single enterprises in budgeting is the allocation of joint costs."[2]

The farm budget includes the crop, pasture and livestock enterprises or the total aspect of the farm unit. Joint costs are not a problem but the budgetary process becomes complicated in determining the amount and kind of livestock and their degree of utilization of the produce from the cropland. There is an advantage in using a budgetary procedure that is as

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[1] H. P. Smith, op. cit., p. 132.

[2] W. E. Pine, loc. cit., p. 193.

simple and practical as possible. If the procedure is involved, its acceptance will be limited.

There would seem to be some appreciable difference in the net income of the land by using the two methods since the crops in the farm budget were utilized through livestock. Pine found that the net income from the farm budget was almost identical to the weighted average of the net income from a crop enterprise budget and a pasture enterprise budget. The same acreages, standards, kinds and amounts of inputs were used for the comparisons.[1] With simplicity foremost in selecting a budgetary procedure, the single enterprise budget seems desirable. Joint costs can be estimated without a serious loss of accuracy. The primary problem is determining the most typical inputs for each soil type and determining their costs so that the costs most commonly incurred for each soil may be subtracted from the respective gross productivities for the net return.

The landlord share method of computing costs and arriving at a net income is an alternate method to the budget procedure for the entire farm. Normal expenses incurred by the landlord would be subtracted from his share and would represent the net income.[2] Payments for capital improvements are usually included in the contract shares to the landlord. This presents some difficulty in separating these from the actual return to the land. The share to the landlord may be determined somewhat by tradition and may be quite uniform regardless of the level of productivity or the nature of the costs to the tenant.

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[1]W. H. Pine, loc. cit., p. 209.

[2]Philip H. Henderson, How to Get Land Valuation Work Started, Proceedings, Land Valuation Conference, Fort Collins, Colorado, June 1952, p. 42.

Price and Cost Levels

Determining the proper price-cost relationships is as important as finding exactly what the inputs and outputs are. Expected future prices and costs should be considered. The standards should reflect an average of what the landowner would expect to receive and pay for the items to be sold or bought on his land in the future with primary emphasis on the immediate future. The determination of these standards is difficult because of changes in consumer habits and technological changes in methods of production.[1]

Pine states: "If absolute expected net income is desired, the exact level of the prices is highly important. If only the relative net income is desired, the level of prices is not so important as a set of prices in which there is a proper relationship among the prices."[2] If the straight capitalized income value is used for the various land type values, the absolute value is desirable. If the net income sales comparison method is used where the common sale value is determined for one of the land types and this value is prorated to the other land types according to their relative net incomes, the relationship between prices received and prices paid is primary.[3] The net income-sales comparison method does not need the capitalization process to obtain the relative rating. The same relationship is present among the net income as with the capitalized values.

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[1]W. H. Pine, loc. cit., p. 76.

[2]W. H. Pine, loc. cit., p. 72.

[3]See explanation of the sales comparison method under the Objectives of the Study section.

The set of prices used should represent the expected levels with first emphasis on the immediate future.

Murray states:

> The right to receive $10 today is worth more than the right to receive $10 a year from today, and much more than the right to receive $10 ten years from now. The appraiser is far more concerned with the probable prices received for farm products in the next 20 years than with the prices in effect from 40 to 60 years from now.[1]

Two methods can be used to arrive at future relationships. First, current price and cost figures might be used either by adjusting the preceding years' figures for expected changes or by utilizing the last few years' figures in a weighted average. Second, an historical price series representing expected conditions can be used. Murray found in a study of land values in Story County, Iowa, that the 10 year weighted moving average of prices for corn correlated close to the annual sale price of farm real estate from 1900 to 1945.[2] In weighting the moving average the most recent year was given the weight of ten, the next nine, and so on with the last and most distant having the weight of one.[3]

For averages of historical series, consideration must be given to obtaining periods representing the expected conditions within the economy. Consideration must be given to the expected employment conditions and levels of economic activity.

Pine states:

> It usually is necessary to compute average prices for a period of years in the past which is considered to represent best the future conditions and to make reasonable adjustments where such averages appear out of line. The period selected should be a recent period.

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[1] William G. Murray, Farm Appraisal, Iowa State College, 1947, p. 133.

[2] Ibid., p. 136.

[3] Ibid., p. 137.

> . . . The period should be of sufficient length to include a complete cycle of the prices for each commodity.[1]

There is a tendency for prices received by farmers to rise faster than prices paid and also for prices received to drop faster in comparison to prices paid. These conditions create either favorable or unfavorable conditions in the determination of the net income received. Parity ratios are measures of the relation of the index of prices received divided by the index of prices paid by farmers. This ratio of prices and costs is a direct measure of the contraction and expansion of the net incomes.

The base period for the index of the prices that farmers pay is the average of the 1910-1914 prices. The base period for the index of the prices received is the average of the period, August 1909 to July 1914. Each of these base periods equal 100.

Using these base periods Fuhriman indexed prices for individual commodities to different historical levels to obtain the weighted relationships of each for the specified historical period.[2] This study investigated several historical periods to determine their influences on the returns to irrigation water. This procedure has some merit with its index procedure. Most USDA publications carry individual commodity indices, these indices gearing current prices to historical period would achieve the relationship at that time. Actual prices are not available for a number of commodities, particularly input items.

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[1] W. H. Pine, op. cit., p. 73.

[2] W. V. Fuhriman, G. T. Blanch, and C. E. Stewart, Economic Analysis of Agricultural Potentials of Weber Basin Reclamation Project, Utah, Special Report 7, Utah Agr. Exp. Station, Logan, December 1942, p. 27.

Fuhriman in the Weber Basin Reclamation Project study in Utah projected two long term future sets of prices, one for high employment and prosperous conditions and the other with intermediate employment. For the high employment the indices of prices paid and received were 215, representing a parity ratio of 100. For the intermediate employment, the index for the prices received was 150 and the index for prices paid was 175, with the parity ratio being 86.[1]

In the above study five historical periods were compared to determine the resulting parity ratios. The 1939-44 average of prices, representing an intermediate period between favorable and unfavorable conditions, the average parity ratio was 98, three points above the 1910-1951 average of parity ratios of 95. The relatively favorable times between the world wars during 1924-29 derived a parity of 91. The years, 1935-39, which were relatively unfavorable to agriculture, had a ratio of 86. The period, 1947-49, which represents the most favorable conditions witnessed in agriculture, had a parity of 108.[2]

The historical prices to use require careful study by the appraiser so that the relationships of prices to costs will represent most nearly the expected conditions.

Recommended Appraisal Procedures and Implications

The Department of Revenue in Kentucky recommends an appraisal procedure which utilizes the eight Land Capability Classifications. These eight

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[1]W. V. Fuhriman, et al, op. cit., p. 26.
[2]Fuhriman, et al, op. cit., p. 29.

classifications are a result of a broader grouping of the Land Capability units mentioned in the Physical Productivities section of this review. Physical productivities are established for the eight land classes through a local land value advisory committee from the tax unit.[1] The advisory committee first determines the relative physical productivities of the eight classes. The land class representing average physical productivity in the tax unit is determined. Input-output information is collected for this average land class to include crop yields, price information, operating ratios and going farm mortgage rates.

With the above information the five major steps involved in determining the base value for the average land class are:

(1) Multiply the acres harvested of each major crop in the tax unit by its average yield and the average price. This will give the gross dollar yield for cultivated acres in the county.

(2) Multiply the gross dollar yield by the net percentage return to the landowners to obtain the return to all the landowners in the tax unit.

(3) Capitalize this total return to the land by the going farm mortgage rate of interest.

(4) Divide this capitalized value by the cultivated acres in the county.

(5) This average acre value is assigned to the average class designated above and is prorated to the other classes in proportion to their relative physical productivities determined by the advisory committee.[2]

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[1]Department of Revenue, Kentucky Real Property Appraisal Manual, Commonwealth of Kentucky, January 1952, p. 37.

[2]Department of Revenue, Ibid., p. 39.

Special adjustments are made for location and type of road. After the adjustments are made to the per acre value, the number of acres in each tract representing the various land classes are summed, then multiplied by their adjusted per acre value to obtain the assessed value.

The net per cent return to the landowner is determined by isolating a representative sample of individual farms in the tax unit, determining their gross farm income, then dividing by the going rental share. The result minus any expenses incurred by the landlord represents the return for the land. This divided by the gross farm income gives the net per cent return to the land owner. This is comparable to the landlord share method of computing costs mentioned earlier in this review. The net percentage return to the land used for illustration purposes in the Kentucky Appraisal Manual was 15 per cent.[1] In a similar procedure, Colorado set a figure of 10 per cent as net return to the landlord.[2] In using the net per cent return method, the implication is that all soils have a common proportionate cost.

The base value, determined for the average land in the Kentucky procedure is weighted by the acreage of each major crop as that acreage is to the total cropland for the county. With this base value being prorated up and down to the other land classes according to their relative physical productivities, it implies that all eight land classes would use the same proportion of row, hay or small grain crops. It is conceivable and a hypothesis of this study that different land classes or types will

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[1]Department of Revenue, loc. cit.

[2]D. M. Stevens, op. cit., p. 50.

utilize varying percentages of row, grain and hay crops and as a result of this variation the land values would be influenced. The eight land capability classes are set up primarily for the purpose of land use and treatment with the first farm classification being those recommended for cultivation and the remaining for pasture use.

The Nebraska Agricultural Experiment Station outlined a procedure for the appraisal of Nebraska farm land in 1950. This procedure makes use of the detailed soil survey. Through an advisory committee of well informed farmers an average yield was estimated for the major crops on each delineated soil type in the assessment unit. An average was made of prices received by farmers in the tax unit, using an historical period of 1927 to 1946.[1] These prices multiplied by the average yields weighted for the per cent of each major crop grown, derives the dollar gross return for each soil type. Cost of production figures were determined by estimates and opinions of the advisory committee for each land type. The farm budget method of analysis was used to determine the net income or economic productivity. The net return is then capitalized by the average farm mortgage rate plus the average percentage tax rate. Returning to the soils map, the per acre value for each 40 acres is determined, according to the amount of each soil type represented. The tract value was then ready for any special adjustment for accessibility or location.[2]

The Nebraska procedure utilizes the advisory committee in making estimates of the physical productivities and the production costs common

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[1]Quentin W. Lindsey, op. cit., p. 43.

[2]Quentin W. Lindsey, op. cit., p. 75.

to the various soil types. Although the opinions of well informed farmers should not be underestimated, these estimates might not represent the true picture. Actual observation through a survey or by farming the land will aid in estimating the physical productivity.

NATURE OF PRIMARY DATA

Previous Work in Geary County, Kansas

This study was started by the Kansas Agricultural Experiment Station in cooperation with the Kansas Commission of Revenue and Taxation. One of the purposes of the overall study is to investigate a procedure for an objective measure of land values for taxation purposes.

Previous work that had been done by the Kansas Agricultural Experiment Station included a soil productivity study of Geary County, Kansas, in 1946.[1] Primary yield and practice data had been collected for various soil types as delineated by the detailed soil survey which had been completed for the county in 1945. Only two of the west border townships, Smoky Hill and Lyons, were used. The western tier of townships in Geary County represents the major portion of the crop land area in the county. The area to the east is predominantly pasture land and lies south of the Kansas River in the Flint Hills area.

In 1946 information was obtained for 285 fields of small grain for that crop year. The emmerators were instructed to obtain information for each field of small grain they saw driving down the township roads. No

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[1] W. H. Pine, op. cit., p. 142.

emphasis was made in selecting fields with particular soils. Analysis of the type of soil represented was made after the survey was completed.

The enumerator outlined the fields surveyed on a 4 inch to the mile scale aerial photo. The areas of these fields were then transferred to the detailed soil map and the acreages of each soil represented planimetered for acreage. The chief limitation of the survey data was the number of soil types represented in each field. A method was needed to segregate the yields for each of the soils and their relative yields determined.

An attempt was made in the 1946 study to subjectively rate the soils in Geary County. The primary purpose of the field data was to check the accuracy of the subjective ratings. In the analysis, the yields for the various soils were proportioned by the subjective rating. This method is limited in that the estimated ratings may not be accurate.

For statistical analysis it was found that there were too few yields for many of the minor soils. It was concluded that a stratified sample on the basis of major soil types would be desirable. The conclusions and recommendations of the 1946 study were most valuable in determining the procedure in the current study.

The data used for Geary County in 1946 were for one year. For the purpose of obtaining average or expected physical productivities, one year's data are inadequate. Several years' records are needed to average the effects of climatic conditions and other natural and unnatural conditions affecting yields. The current study has been set up with a goal of obtaining yield and practice data for the major soils in the three west border townships of Geary County for a period of 8 to 10 years. These are Smoky Hill, Lyons, and Madison townships.

Selection of the Soil Areas

With the long term objective in mind, it was decided to obtain information concerning the major soils represented in these three townships. Five major soil types were dominant.[1] It was decided to stratify the sample for these five soils and attempt to obtain a minimum of 40 field records for each soil. It was thought that by acquiring information for 40 fields over a period of years that the necessary statistical analysis could be made.

The five soils represented in the survey were Smolan silty clay loam, Hastings silt loam, Marshall silt loam, Waukesha silt loam, and Junction City-Thurman sandy loam. The Smolan silty clay loam is an upland tight claypan soil. This soil lies south of the Smoky Hill River in Lyons township. This soil is believed to be loessial in origin. It is highly eroded. It is represented on the soils map by the symbol 35. The Hastings silt loam is an upland moderately heavy loessial soil. This soil is predominant in Smoky Hill township west of Junction City between the two rivers, the Republican and the Smoky Hill. Its soils map symbol is 15. The Marshall silt loam is an upland silty to friable clayey soil. It is a loessial soil found mostly along the south and east bluffs of the Republican River in Madison and Smoky Hill townships. It is represented on the soils map by the symbol 1. The Waukesha silt loam is a terrace silty to friable clayey soil. This alluvial flood plain soil is predominant along Lyons Creek in Lyons township. Its soils map symbol is 85.

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[1]The detailed soil survey was examined to determine the major cropland soils in Geary County by O. W. Bidwell, Agronomist, W. H. Pine, Agricultural Economist, Henry Tucker, Statistician, and the writer, of the Kansas Agricultural Experiment Station.

The Junction City and Thurman sandy loam soils are upland moderately sandy soils. These loessial soils lie north of the Smoky Hill River and south of the Hastings area in Smoky Hill township. The Thurman sandy loam is represented by the symbol 62 and the Junction City sandy loam by the symbol 63 on the soils map.

Collection and Analysis of Survey Data

The survey was conducted during July and August in 1954 right after the small grain harvest by two enumerators, Charles Reed, Kansas Commission of Revenue and Taxation, and the writer. Information was collected for the two crop years of 1953 and 1954. Fields were selected on the basis of soils represented and not on the basis of the current crop. Fields with one soil were preferable. A field with two soils was acceptable. In the case of two soils, the operator was asked the difference in yield between the two soils. Form 1 shows the form used to obtain the practice and yield information from the farmer. A field with three soils would not be accepted unless the third soil was less than 25 per cent of the total field acreage and was of the same soil series but was differentiated only because of the per cent slope or degree of erosion. The crop history was obtained for five years. If the rotation differed for any part of the field considered, the field was discarded. For instance if the field had continuous wheat for the five years except in 1952 part of the field was in oats, the record was discarded or in some cases where the enumerator thought the information given would be accurate, the field was subdivided. The same principle was applied to the various management practices such as fertilizing, treatment of seed and kinds of tillage operations to obtain homogeneous data.

Form 1

Survey Schedule Used to Obtain Information for Geary County Study, 1954

KANSAS AGRICULTURAL EXPERIMENT STATION
Practice and Yield Record

Reference No. ____________ Photo No. ________ Date ________

Farm operator ____________________ Address ____________________

Legal description	Total field/acreage		soil type /acreage		soil type /acreage
Field history:	1954	1953	1952	1951	1950
Crop.......................:					
Yield per acre (total).......:	( )		Field operations for 1954 crop		
Yield diff. between soils....:			Operation:	Tool size:	Acres/10 hr day: MOH
Soil type, highest yield.....:					
Variety planted..............:					
Fertilizer (kind)............:					
Fertilizer (amt. per acre)...:					
Crop damage (kind)...........:					
Crop damage (amt. per acre)..:					
Seed treatment (yes, no).....:					
Contour (yes, no)............:					
Date of first tillage........:			Terraced (year)		
Lime, year ______, amount per acre			Tractor (size)		

(*) Final yield card left with farmer.

To obtain the yields for the fall harvested crops in 1954 it was necessary to leave post cards for the farmer to fill in and send to the Experiment Station. Form 2 shows a sample postcard. Sixty-four cards were left with the farmers. Twenty-five cards came back without further correspondence. After two letters to these farmers all but 15 of the cards were returned. These remaining fields, representing 11 farmers, were either personally contacted or telephoned from Junction City concerning their yield.

Form 2

Form for Postcard Left with Farmers to Report Yields of Fall Harvested Crops, Geary County Survey, 1954

______________ Reference No.	________ Year	I have just finished harvesting the crop from this outlined field. Following is information to the best of my knowledge:
		Crop...........: ______________
		(Alf.) Tons per acre per cutting
		1st _____, 2nd_____, 3rd _____, 4th _____, 5th _____.
		Yield Per Acre (ave): ____________
		Difference in yield per acre between Areas A & B: _______
		Area with highest yield: _________
(outline of field)		Signed ______________________ operator

Two hundred forty-one fields were surveyed, representing successful interviews with 107 farmers. In the analysis of those fields having two soils represented, the yield for each soil was computed by an algebraic equation.[1] The actual difference between the soils was asked for in physical amounts to avoid the farmer rounding the figure in percentage terms. This computation was done by the emmerators. The data were then coded and put on IBM cards. With the expectation of this type data being collected over a considerable period of time and from different sample counties over the state, it was thought that the analysis of the data would be facilitated.

In the final analysis for 1953 and 1954, there were 68 computed yields for the Marshall soil, 109 for the Hastings soil, 71 for the Smolan soil, 80 for the Junction City-Thurman soils and 48 for the Waukesha soil. The total number of computed yields for the Waukesha soil was not much larger than the number of Waukesha fields surveyed. The Waukesha being a bottom soil and level had few second soils represented in the surveyed fields.

Each field was carefully plotted on aerial photos superimposed with the detailed soil information. The total acreage of the field was given by the farmer. Each field was measured by a grid square acreage computer to check the acreage figure given by the farmer and to determine the acreage of the soil types represented. In the case of a major disagreement in the computed acreage and the farmer's figure the field was either discarded or the farmer recontacted.

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[1]Given the following information, a simple algebraic equation can be used to prorate the yields to the soils represented in each field.

Total Acreage—12	Total Yield	288 bu. (8X + 4Y)
Soil A Acreage—8	Difference in yield	4 bu. (X − Y)
Soil B Acreage—4	Yield of A = X	Yield of B = Y

$$\begin{array}{rl} 8X + 4Y &= 288 \\ \underline{4X - 4Y} &= \underline{16} \\ 12X &= 304 \end{array} \qquad X = 25.3 \text{ bu.} \quad Y = 21.3 \text{ bu.}$$

The aerial photo mosaics were obtained from the Soil Conservation Service State Office at Salina. The aerial photos were cut up into farm units and pasted in manila folders. Each folder has the farmer's name, address, reference number and the legal description of his land unit or units. Plastic overlay ascetate was taped over each map to avoid marking the map itself.

In interviewing the farmer no mention was made of the ultimate purpose of this study, that being land valuation for taxation purposes. It was thought that if the taxation connotation was given, a possible bias may have occurred. The purpose of the study as represented to the farmer was that the data were needed for a study of the factors influencing the productivities of the different soils.

Primary data were obtained from five implement dealers in Junction City, Kansas. Initial cost figures were obtained for 24 specified machinery items for the years 1952 and 1953. These figures included sales tax and transportation costs. An attempt was made to obtain the actual cost to the farmer. Not all the dealers carried the full line of the 24 specified implements. At least three dealers listed initial costs for each item that was pertinent to the Geary County study. The average initial costs for each machine were used in the calculation of per acre machinery costs. The enumerators interviewed the implement dealers personally.

DETERMINATION OF OUTPUT VALUES

Determination of Physical Productivities

For the purpose of this thesis the physical productivities used for the five soils will, of necessity, be estimated. Yield data received for

1953 and 1954 were sufficient to determine reliable averages for wheat and alfalfa. Oats having a smaller percentage of total land use did not have a sufficient number of fields for each soil in the sample to determine an average. Corn yields were severely reduced in both 1953 and 1954 due to climatic conditions.

Determining the actual physical productivity for each soil is not of prime importance to this study since the problem concerns the effects of the price-cost inter and intra relationships. However to add realism to the study, it was thought desirable to utilize as much of the Geary County data available.

Table 2. Physical productivities of major crops for specified soils, Geary County, Kansas, 1953-54.*

Soil	Wheat bu.	Corn bu.	Oats bu.	Alfalfa tons
Marshall silt loam	22.5	22	18	2.01
Hastings silt loam	23.9	18	19	1.07
Smolan silty clay	20.2	16	17	0.80
Junction City and Thurman sandy loam	24.3	20	22	1.53
Waukesha silt loam	27.7	28	25	3.24

* The 5 per cent least significant difference was 3.4 bushels for wheat and 1.00 tons for alfalfa. Corn and oats yields were determined by the writer from mean yields listed in the 1953 Report of the State Board of Agriculture for Geary County.

Table 2 represents the physical productivities for the four major crops for the five delineated soils in Geary County for the years 1953 and 1954. For the average wheat yields it was found that the Waukesha soil was significantly higher than all soils for both years except for the Hastings silt loam and the Junction City-Thurman sandy loam. The Waukesha silt loam and Marshall silt loam alfalfa yields were significantly different from the other soils. The Smolan silty clay alfalfa yield was significantly lower than the other soils. No other differences were noted at the 95 per cent level. The least significant difference for wheat yields was 3.4 bushels and for alfalfa 1.00 ton.

The average wheat damage for the two years, determined by the survey was most severe on the Smolan soil. The average total damage for all Smolan wheat fields was 4.4 bushels, Hastings and Marshall wheat fields 2.6 bushels, Junction City and Thurman wheat fields 2.2 bushels and the Waukesha wheat fields 1.6 bushels. Since the soils were in different locations in the three townships surveyed, climatic conditions could vary from area to area. Normally over a period of years, the effects of climate should average out over a small area. Elmer Betz, Work Unit Conservationist of the Geary County Soil Conservation Service, pointed out that the Smolan soil area received little moisture during the fall of 1952 when the 1953 wheat crop was planted. This delayed the fall growth and affected the yield. In analyzing the data it was found that the hail damage was most severe in 1953 in the Smolan area. The Smolan wheat yield average in 1953 was 15.6 bushel and averaged 25.5 bushel in 1954. Mean yields used for wheat were not adjusted for damage.

Alfalfa yields used are from the actual data. The Waukesha soil yielded significantly higher than all soils for both years except for the Marshall soil. The nature of the Marshall soil and the slope may explain some of its variation and give a reason for it not being significantly different from the Waukesha even though its average yield is approximately one ton less. The climatic conditions affected the average alfalfa yield for both years. An average of two hay cuttings was all that was obtained each year.

In determining the yield for corn and oats, the average yields for the county in 1953, as recorded by the State Board of Agriculture, were used.[1] The corn yield average of 20.9 bushel is proportioned to each soil with the relationships found among the soils for the alfalfa yields as a guide. It was thought that the same seasonal moisture requirements would be influential on the yield. The relationship among soils found for the wheat yields were used to estimate the oat yields for each soil. A simple average of these estimated yields is equal to the county average. With wheat and oats having the same seasonal conditions that prevail it was thought that the relationship of wheat yields would be a measure of the variation in the oat yields.

This set of physical productivities cannot be considered as typical for these five soil types. It will require several more years of data to eliminate the effects of climatic conditions and to obtain sufficient information so that reliable averages can be obtained. The expected physical productivities could reasonably be higher. The adjusted yields for corn and oats were purposely left low to be in line with the low wheat and alfalfa yields obtained because of the drought conditions. For the analysis in this study it is more important that the yields have the proper intra relationship rather than the exact level of productivity. For the final appraisal this would not be true. The level of productivity should affect the relationship of the net incomes to a greater degree than the

[1]Kansas State Board of Agriculture, Topeka, Crop Reporting Service, 1953 Farm Facts, pp. 13 and 15.

intra relationship of the individual levels of productivity for each crop or land use. Ideally the final appraisal would want to consider the expected physical productivities. This would include the expected level of yields for the major land uses and would include the proper relationship among yields.

Determination of Output Prices

The crux of the budgetary procedure in determining the net income is the price-cost level used. As demonstrated in the hypothetical example in the introduction of this thesis, the spread between prices and costs has a great effect not only upon the size of the net income but the interrelationships of all the net incomes. The wider the gap between the price level and the cost level, the greater the tendency for net incomes and capitalized values to move toward a common mean.[1]

There is a tendency for changes in cost levels to lag behind changes in prices received levels in agriculture. Agriculture witnessed this during the prosperous conditions from 1942 to 1948 during World War II and the years immediately following when economic activity was high and there were high levels of employment. This wide ratio contributed to larger net incomes and caused a corresponding amount of formerly marginal land to become utilized. The average ratio was 110.[2] With the larger net incomes there would be a tendency for the capitalized values to group together. Perhaps the appraiser has an optimistic view on the future relationships

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[1]See the hypothetical example listed under the Objectives of the Study section.

[2]United States Department of Agriculture, Agricultural Statistics, 1955, p. 602.

of prices to costs when he tends to group land values around a common mean. The problem is: Will conditions continue to be as favorable to agriculture? For the period 1949 to 1953, conditions were not. The parity average was 100, meaning that the prices and costs are on the same comparative levels with the 1910-14 bases. The 1935 to 1939 period had a parity of 86 representing an unfavorable period for agriculture.[1] In this period of a price-cost squeeze marginal land would be taken out of production and land values would have a wider range.

For the purposes of this thesis two historical series were used, one representing the 1949-53 period and the other representing 1935-39 period. A parity of 100 as represented by the 1949-53 is considered relatively favorable to farmers.[2] This would represent a period of relatively high employment, prospects for a stable peace and relatively high economic activity. The 1935-39 period with a parity of 87 represents an unfavorable period to farmers. There was considerable unemployment and economic activity was limited with public expenditures contributing most of the activity present.[3]

Prices received by Geary County farmers for their major crops were obtained from annual reports of the State Board of Agriculture. Per unit prices were received by dividing total value by total production for crops concerned.

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[1]Ibid., p. 602.

[2]United States Department of Agriculture, Agricultural Statistics, 1953, and Statistical Abstract for the United States, 1954.

[3]Board of Governors, Federal Reserve System, Historical Supplement, Federal Reserve Charts on Bank Credit, Money Rates and Business, September 1954, pp. 68, 109, 111.

Table 3 represents an average of prices received for the periods specified. Besides the two historical sets of prices, a weighted average price for 1944-1953 is used. This 10 year average gives the weight of 10 to the 1953 price, 9 to the 1952 price and so on until 1944 when it receives the weight of one. The weighted average is suggested by Murray of Iowa State College. Murray's idea of the weighted average is that the more recent prices received are given more weight in determining the future price level.[1] It was thought desirable to test this procedure and determine its implications. These prices for Geary County are those determined by the Crop Reporting Service from crop reporters in Geary County.

Table 3. Historical prices for specified crops, Geary County, Kansas, 1954.*

Year	Wheat bu.	Corn bu.	Oats bu.	Alfalfa tons
	$	$	$	$
1953	2.04	1.44	.75	30.00
Average 1949-53	2.02	1.45	.81	25.18
Average 1935-39	0.84	0.71	.33	9.58
Weighted Average 1944-53**	2.01	1.48	.83	23.20

* Source: Calculated from Reports of the State Board of Agriculture.
** Average is determined by giving the 1953 prices the weight of 10, the 1952 prices the weight of 9, etc. with the 1944 prices receiving the weight of 1.

Alfalfa hay and oats are primarily locally consumed crops which would respond readily to the supply and demand conditions within the county and surrounding area. These variations are noticeable in the prices for alfalfa

[1] William G. Murray, op. cit., p. 133.

hay in particular. Since these are actual conditions prevailing that would influence net incomes the data are not adjusted for variations for supply and demand. These variations would not occur for wheat and corn which have a widespread demand unless production over a large area changed.

The State Board of Agriculture data did not have a complete price series for alfalfa. A period from 1938 to 1942 did not have alfalfa hay prices listed separately. It was combined with all hay produced and sold. In this case the relationship of prices received for No. 1 alfalfa hay at Kansas City were used from Agricultural Statistics to gear the 1937 Geary County price to the five year period without prices.

Between the 1935-39 historical period and the 1949-53 period, the price of wheat rose 240 per cent, the price of corn rose 204 per cent, the price of alfalfa rose 262 per cent, and the price of oats rose 245 per cent. This demonstrates the intra relationships that can develop among crop prices from period to period.

Besides the price-cost level relationships, there would appear to be an effect in the net income because of a disproportionate increase in one of the crop prices, particularly if a certain farm or tract of land uses a larger proportion of that crop in its rotation.

Determination of Gross Returns

Using the physical productivities determined from the Geary County data, the gross returns or output can be determined for each crop use of the soil. Production costs subtracted from the gross returns determine the net income for each crop. After the net income per acre for each crop is determined, the composite net income will need to be determined according to the per cent each crop is used in the rotation for each soil. Table 4 shows the gross returns for each crop for each soil.

The prices determined by the weighted moving average tend to smooth out fluctuations that are present in the price series. There is a marked decrease in the alfalfa hay price for the 1944-53 weighted moving average over the 1949-53 simple average. Although the most weight is given to the more recent years, the previous years influence the average. Alfalfa hay had two years of very high prices in 1951 and 1952 due to limitation in supply. These two years influenced the 1949-53 price average considerably. When there is little variation in price between years and the range of variation for the period is small there will be little difference between the 10 year weighted moving average price and a simple average of the last few years. This is true for the wheat, oats and corn figures for Geary County.

DETERMINATION OF INPUT VALUES

Calculation of Machinery Costs

There is need for an objective means whereby machinery costs can be measured for each soil type. The procedure must have the necessary accuracy to properly apportion the costs to the different soils. One of the hypotheses of this study is that the variation and speed of machine operations will differ for each soil and thereby affect the production costs and ultimately the net income and land value.

Custom rates that might be found in the study area are limited in that there are few custom operators, particularly in Geary County, a general farming area made up of self contained farm units. It is conceivable

Table 4. Gross returns from major crops on specified soils for three historical price periods, Geary County, Kansas, 1954.*

Soil	Wheat			Corn			Oats			Alfalfa		
	Ave. 49-53	Ave. 35-39	W.A. 44-53	Ave. 49-53	Ave. 35-39	W.A. 44-53	Ave. 49-53	Ave. 35-39	W.A. 44-53	Ave. 49-53	Ave. 35-39	W.A.** 44-53
Marshall silt loam	45.45	19.57	45.22	31.90	15.62	32.56	14.58	5.94	14.94	50.61	19.25	46.63
Hastings silt loam	48.27	20.79	48.03	26.10	12.78	26.64	15.39	6.27	15.77	26.94	10.25	24.82
Smolan silty clay	40.80	17.57	40.60	23.20	11.36	23.68	13.77	5.61	14.11	20.14	7.66	18.56
Junction City-Thurman sandy loam	49.08	21.14	48.84	29.00	14.20	29.60	17.82	7.26	18.26	38.52	14.65	35.49
Waukesha silt loam	55.95	24.09	55.67	40.60	19.88	41.44	20.25	8.25	20.75	61.58	31.03	75.16

* Source: Returns based on average physical productivities determined for 1953-54 in Geary County survey. Prices calculated from data in reports of the Kansas State Board of Agriculture.

** Weighted average determined by giving the prices for 1953 the weight of 10, the 1952 prices the weight of 9, etc., with the 1944 prices receiving the weight of 1.

that rates would not be available for all machine operators. Custom rates would not reflect accurately variation for speed of operation. Due to the supply and demand fluctuations on custom rates and the lack of custom operations to gear their prices to the nature of the soil, custom rates will be dismissed as a measure of costs in this study. They will prove valuable as a check on any other methods used to determine machinery costs.

For the purpose of this study it is necessary to turn to a procedure whereby the machinery cost per acre or bushel can be built up. Fenton and Fairbanks, agricultural engineers of the Kansas Engineering Experiment Station have published material on the cost of operating farm machinery. In their study a procedure is outlined where, through the use of a percentage of initial cost of the machine and the acres covered per 10 hour day, the per acre cost can be determined.[1]

Form 3 shows a form for calculating machinery costs, adapted from materials published by Fenton and Fairbanks. The initial cost of the machine multiplied by the cost percentage represents an allowance for depreciation, interest on investment, taxes, insurance, housing, repairs and lubrication. These percentage figures represent extensive study by the authors as to the relative proportions of the included items. Depreciation is figured by the straight line method. The interest rate was 5 per cent to determine the return on capital invested. Although the publication has suggested values for all the items of cost for all the major machinery items, data adapted for Geary County will be used for labor, fuel, oil and the initial cost.

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[1]Fenton and Fairbanks, op. cit., p. 35.

Form 3. Form for calculating farm machinery costs.*

Item of cost	How to find			Cost per 10 hr. day
Cost of ownership, lubrication, repair	Initial cost of machine	x	Cost percentage	
	______	x	______ %	$ ______
Labor	Cost per hour	x	Hours per day	
	______	x	10	______
Fuel	Cost per gallon	x	Gallons per day	
	______	x	______	______
Oil	Cost per gallon	x	Gallons per day	
	______	x	______	______
Preparation for operation	Sum of other costs	x	Estimated percentage	
	______	x	20 %	______
			Total Daily Cost	$ ______

Cost per acre = $\frac{\text{cost per day}}{\text{acres covered per day}}$ = $ ______

Cost per bushel = $\frac{\text{cost per day}}{\text{bushels handled per day}}$ = $ ______

* Source: Adapted by the writer from material in Bulletin 74, Cost of Using Farm Machinery, Kansas State Engineering Experiment Station, Sept. 1954, and Bulletin 391, Cost of Using Farm Machinery on Nebraska farms, Nebraska Agr. Expt. Sta., Lincoln, 1947.

The cost percentage figure is adapted directly from the Engineering Bulletin. This percentage figure is weighted by the average number of days the machine is used per year. Table 5 shows the method of adapting the individual percentage figures for cost of ownership, lubrication,

Table 5. Initial cost percentages for annual and per day ownership, lubrication and repair costs.*

Machine	Annual percentage costs			Days used per year	Per day combined cost percentage
	Ownership	Repair	Lubrication		
Tractor, 2 plow	14.0	3.5	0.7	86	0.22
Tractor, 3 plow	14.0	3.5	0.7	76	0.24
Plow, 3-14	10.6	7.0	0.5	15	1.21
Disk, Tandem 8'	10.6	3.0	0.5	14	1.00
Harrow, Peg 18'	9.5	1.0	0.1	11	0.96
Grain drill, (fert) 16-8	10.0	1.5	0.7	11	1.05
Combine, 12' SP	14.0	3.0	0.4	11	1.58
Mower, 7'	10.0	3.5	0.7	10	1.42
Rake, S-D 7'	10.6	2.0	0.5	9**	1.46
Baler, Pickup	14.0	3.0	0.8	9**	1.98
Cultivator, 2 row	10.6	3.5	0.3	14	1.03
Corn picker, 1 row	14.0	3.0	1.0	8**	2.25
Lister, 2 row	10.6	5.0	0.5	13	1.24
Trailer, 4 wheel	11.4	1.5	0.2	41**	0.62

* Adapted from Tables IV, XI, XII, XIV, and XVI of the Cost of Using Farm Machinery, Engineering Experiment Station Bulletin 74, September 1954.

** Items estimated by the writer. Average use for baler and rake operations based on the typical 3 hay crop operations with the estimate of 3 days use for each hay crop. The one row corn picker will harvest on the average 8-10 acres per day. The average farmer owning a corn picker probably would have an average of 60-80 acres of corn. The estimate for the 4 wheel trailer is the summation of the average days the fertilizer grain drill, combine, baler and corn picker are used per year. It was thought that the trailer would be used along with these implements, thus a minimum use of 41 days on the average.

repairs and average use per year found in the Engineering Bulletin, for use in this study.[1]

Initial cost data were obtained from five implement dealers in Geary County. Since Junction City, the county seat, is the principal city in the county and serves the rural trade territory, implement dealers in this city were surveyed. Major machinery item costs were obtained for 1952 and 1953. The costs included sales tax and transportation costs. Table 6 shows the average initial costs for specified machinery items for 1952 and 1953 and through the use of the farm machinery index for the United States in Agricultural Statistics, the average cost is geared to a 1949-1953 level. By the same procedure a 1935-39 level was calculated and a weighted average for years 1944-1953 figured. Various historical series were determined for later analysis in calculating net income at different price levels.

Labor, gasoline and oil prices were determined for the same historical periods. Secondary data from Crops and Markets and Agricultural Statistics are used to determine the current and historical averages for these inputs. Crops and Markets contains a new series started in 1949 called the hourly composite farm wage rate. This is a composite of all types of farm labor, with or without board. Agricultural Statistics reports a wage rate index for the U. S. which is used to gear the current Kansas figures to the historical level.

Crops and Markets reports Kansas gasoline and oil prices in a series started in 1948. Agricultural Statistics has a U. S. index for equipment

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[1]Fenton and Fairbanks, op. cit., p. 13.

Table 6. Current and historical prices for specified farm machinery items in Geary County, Kansas.*

Machine	1953	1952	1949-53	1935-39	Weighted average 1944-1953
Tractor, 2 plow	$2,128	$2,092	$2,014	$1,041	$1,892
Tractor, 3 plow	2,665	2,460	2,364	1,222	2,196
Plow, 3-14	357	362	347	180	327
Disk, tandem 8'	283	281	270	139	254
Harrow, peg 18'	115	107	103	53	96
Grain drill (fert) 16-8	646	645	619	320	582
Combine 12' SP	4,970	4,950	4,757	2,459	4,467
Mower, 7'	304	303	291	150	273
Rake, S-D 7'	352	341	327	169	308
Baler, pickup	2,220	2,156	2,072	1,071	1,946
Cultivator, 2 row	270	263	252	131	237
Corn picker, 1 row	1,042	1,047	1,006	520	945
Lister, Corn, 2 row	310	310	298	154	280
Trailer, 4 wheel	152	152	146	75	137

* Source: Geary County survey for 1952-53 figures. Historical series adapted by prorating 1952 prices by the U. S. Farm Machinery Index in Agricultural Statistics.

and supplies of which gasoline and oil were component items. This index ends in 1948 to be divided into a Motor Supply and Farm Supply index. Since the Kansas data in Crops and Markets extend back to 1948, there was no need of using the Motor Supply index which started with 1949. The U. S. index for equipment and supplies was used to gear the 1948 figure to the historical periods listed in Table 7.

An additional item of expense is the preparation for the field operation. A certain amount of time is spent in preliminary work getting the implements in order for the operation and in moving to and from fields. A certain amount of time is lost during maintenance and lubrication halts in the field. To allow for this item a deduction equal to 20 per cent of other costs is used. This percentage is applied to all other costs incurred to include the cost of ownership, lubrication, repair, fuel, oil and labor. This percentage figure was derived from a study on machinery costs made in Nebraska in 1947 which used 20 per cent for a deduction for preliminary work.[1] It is assumed that this figure would be appropriate for the extra expenses involved by Geary County farmers.

Table 7. Current and historical prices for specified inputs, Geary County, Kansas, 1954.*

Item	1953	1952	1949-53	1935-39	Weighted average 1944-53
Hourly composite farm wage rate	0.821	0.845	0.760	0.187	0.721
Gasoline/gal.	0.247	0.247	0.243	0.136	0.232
Oil/gal.	1.250	1.240	1.240	0.650	1.170

* Source: 1952-53 data are Kansas figures from Crops and Markets. Historical average prices were found by using the U. S. wage rate index and the U. S. equipment and supply index in Agricultural Statistics to gear 1952 Kansas data to historical level.

With the foregoing information it is possible to calculate the daily machinery cost for each of the machinery items. Additional items of information necessary are the average fuel and oil consumption of the 3 plow tractor, self propelled combine, and the pickup baler. Average fuel used per day for a 3 plow tractor is 17.9 gallons and for the 2 plow tractor 15.6 gallons. This figure was derived from fuel and oil consumption tests conducted by the Kansas Engineering Experiment Station. The average oil used per day was 0.63 gallon for the 3 plow tractor and 0.60 gallon for the

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[1]Frank Miller, Quentin Lindsey, Arthur C. George, Cost of Operating Farm Machinery on Nebraska Farms, Nebraska Agricultural Experiment Station, Bulletin 391, 1947, p. 31.

2 plow tractor.[1] No data were available on the fuel and oil consumption for self propelled combines. An estimated figure of 30 gallons of gasoline and one gallon of oil per 10 hour day will be used. Similarly, the baler motor is estimated to use 15 gallons of gasoline and 0.5 gallon of oil per day. Table 8 shows the cost for operating the specified farm machines for one 10 hour period. Prices are used from the 1949-53 historical average which are given in Tables 6 and 7. The daily cost now needs to be divided by either the acres covered by each machine or the bushels handled for each to determine the per acre or per bushel cost. The variable of acres covered per 10 hour day is the crux of this procedure. Table 9 shows the variation in acres covered for each machine for the five soil types surveyed in Geary County. Those tillage implements whose influence on cost variation due to the nature of the soil are listed in this table. Therefore the average acreage covered per day divided into the total daily cost will give the per acre cost and would show the variation.

Table 8. Operation costs per 10 hours for specified farm machines, Geary County, Kansas.*

Machine	Daily cost (including tractor costs)	Machine	Daily cost (including tractor costs)
	$		$
Plow, 3-14	22.59	Rake, S-D 7'	21.33
Disk, tandem 8'	21.09	Baler, pickup	59.41
Harrow, peg 18'	17.55	Cultivator, 2 row	19.15
Grain drill (fert) 16-8	23.06	Corn picker, 1 row	41.02
Combine, 12' SP	82.76	Lister, corn, 2 row	20.25
Mower, 7'	20.69	Trailer, 4 wheel	17.47**

* Based on the 1949-53 input price level.
** Includes labor for one man.

[1] Fenton and Fairbanks, op. cit., p. 25.

Table 9. Acres covered per 10 hour day for specified implements on major soil types, Geary County, Kansas, 1954.

Operation	Marshall silt loam	Hastings silt loam	Smolan silty clay	Junction City-Thurman sandy loam	Waukesha silt loam
Plow, 3-14*	10.9	12.7	12.3	13.3	14.5
Disk, tandem 8'*	19.6	26.6	29.6	23.6	28.9
Harrow, peg 18'*	43.2	64.2	64.4	56.6	50.5
Drill (fert) 16-8	26.0	32.3	34.2	29.1	32.7
Lister, 2 row**	16.0	20.0	19.0	21.0	23.0
Cultivator, 2 row**	18.0	22.0	21.0	23.0	25.0

* The least significant difference at the 95 per cent level for plowing was 2.9 acres, tandem disking 6.7 acres, and harrowing 13.0 acres.
** Estimated by the writer. Enough records were obtained to give some indication of the speed of the lister and cultivator operation. These figures were prorated to each soil in the same proportion plowing speeds varied.

Harvesting and hauling costs are dependent to a great extent on the physical productivity. To determine the per bushel or per unit cost the total average number of units handled per day are necessary. Table 10 shows the average produce handled per 10 hour day for harvesting and hay implements. In the survey the acres covered per day and the average yield per acre was obtained. These multiplied together result in the number of units per day as shown in the table.

It is now possible to calculate the total per acre cost for each machinery item for each soil. By preparing a master table for all tillage and harvesting operations, it then becomes a process of selecting those operations performed for the crop in consideration for each soil. Table 11

Table 10. Grain, hay handled per 10 hour day for specified harvesting implements, for major soils types, Geary County, Kansas, 1954.*

Operation	Marshall silt loam	Hastings silt loam	Smolan silty clay	Junction City-Thurman sandy loam	Waukesha silt loam
Combine--SP--12' (wheat, bu.)	697	877	715	874	831
Combine--SP--12' (oats, bu.)	558	697	568	792	750
Corn picker, 1 row (corn, bu.)	250	210	200	230	280
Baler, pickup (alfalfa, tons)	80	60	50	70	90
Rake, SD 7' (alfalfa, tons)	100	80	70	90	110
Mower, 7' (alfalfa, tons)	90	70	60	80	100
Wagon, 4 wheel (wheat, bu.)	697	877	715	874	831
Wagon, 4 wheel (corn, bu.)	250	210	200	230	280
Wagon, 4 wheel (oats, bu.)	558	697	568	792	750
Wagon, 4 wheel (alfalfa, tons)	80	60	50	70	90

* Source: Survey data in Geary County was sufficient to give a variation of wheat handled. Wheat handled for the Waukesha soil was significantly different from the other soils. No other differences were noted. Oats, corn, and alfalfa data were limited in the size of sample. Virtually no corn and two sub-normal crops of alfalfa were produced in 1954, so that representative averages were not obtained. In this case the table was built up to represent expected conditions. Particular reference was made to the physical productivities listed in Table 2.

presents a master list of machinery costs per acre for the major soils studied in Geary County.

Costs calculated for illustrative purposes in the Nebraska study were examined. The costs calculated for the various implements for Nebraska have the same relative relationships as the Geary County costs except for some of the harvesting operations which were based on heavier

Table 11. Per acre costs for specified farm machinery operations for major soil types in Geary County, Kansas, 1949-53 price level.

Machine	Marshall silt loam	Hastings silt loam	Smolan silty clay	Junction City-Thurman sandy loam	Waukesha silt loam
	$	$	$	$	$
Plow, 3-14	2.48	2.15	2.21	2.05	1.87
Disk, tandem 8'	1.28	0.98	0.85	1.04	0.86
Harrow, peg 18'	0.47	0.34	0.37	0.37	0.42
Drill (fert) 16-8	1.04	0.85	0.80	0.95	0.85
Lister, 2 row	1.51	1.21	1.27	1.15	0.95
Cultivator, 2 row	1.28	1.04	1.09	1.00	0.91
Combine, SP 12' (wheat)	3.09	2.69	2.78	2.76	3.28
Combine, SP 12' (oats)	3.19	2.69	2.78	2.73	3.69
Corn picker, 1 row	4.32	4.21	3.83	4.27	4.89
Baler, pickup	1.77	1.26	1.12	1.56	2.55
Rake, S-D 7'	0.50	0.34	0.28	0.43	0.73
Mower, 7'	1.00	1.14	0.99	0.98	0.75
Wagon, 4 wheel (wheat)	0.66	0.54	0.58	0.59	0.69
Wagon, 4 wheel (oats)	0.65	0.58	0.62	0.58	0.68
Wagon, 4 wheel (corn)	1.80	1.79	1.57	1.81	2.09
Wagon, 4 wheel (alf.)	0.50	0.37	0.34	0.45	0.73

yields than were present in Geary County at the time of this study. Heavier yields will tend to slow down the harvesting operations and thereby increase the per acre costs. By adding the average per acre costs of the machinery items in the Geary County study and selecting the same machinery costs from the Nebraska bulletin and summarizing them, it was found that the Geary County costs were 13 per cent higher. The Geary County figures represent a 1949-53 price period while the Nebraska study was published in 1947. By using the wage rate, farm machinery and equipment and supply indices in Agricultural Statistics and weighting each for their proportionate influence on machinery costs, the expected increase from 1947 in machinery costs was determined. The wage rate and farm machinery indices were given the weight of two each and the equipment and supply index a weight of one. Labor and fuel are the major items of expense. These composite indices for 1947 and 1949-53 were compared and it was found that the 1949-53 period was 17 per cent higher than the 1947 period. It is felt that the harvesting costs were low for Geary County due to the low physical productivities that tended to lower these specified costs.

The Marshall silt loam has the highest machinery costs for tillage operations. The Marshall soil in Geary County is not considered to be a heavy textured soil and does not have a well defined subsoil. Texture is not considered to be the major cause of the smaller acreage covered per day as compared to the other soils. Marshall has a predominant slope and the fields are highly irregular in size and shape. Since the Marshall lies along the bluffs above the bottom land of the rivers, the fields are small. The size of fields and slopes are considered to cause the major influences in the smaller acreage covered per day.

The plowing cost for the Smolan soil was $2.21 per acre rating next in cost to the $2.48 per acre for the Marshall. Smolan is a heavy soil with a high clay content. The fields are less irregular in shape and size. Apparently this was an influence on the acres covered per day. The other tillage operations costs for the Smolan soil were low compared to the other soils. Possibly these operations were performed at a faster rate because of better traction and less draft due to the lack of penetration of the implement in the clay soil. In the case of a sandy or loamy soil the harrow and disk operations would tend to penetrate deeper and caused increased draft. These soils would have lost efficiency through slippage of the power implement in the less firm soil.

The harvesting implement costs varied directly with the physical productivities of the various soils. The acres covered per day by the harvesting implements and the amount of produce handled per day will have a negative relationship to the increased physical productivity; however the acres covered per day will decrease at a more rapid rate than the amount of produce handled per day. If each varied at the same rate the same harvesting cost would be charged to each soil. The low productivity soil would have a high per unit cost and a small number of units handled per acre while the highly productive soil would have a small unit cost and a large number of units handled per acre. The crux of the harvesting cost variation is the ability of the implements to cover more acres because of reduced physical productivity. As shown in Table 10 the variations in units handled per day is less than the variation in physical productivities shown in Table 2 for the different soils.

A final table is necessary showing the frequency and kind of operation used to produce the crops that are to be used in the budgetary procedure. In the Geary County data by using modal analysis and selecting the most typical operation performed, Table 12 was prepared. Modal analysis was used to determine the size of the machine. Although the population was small, there appeared to be no difference as to the size of equipment among soils. In most cases the items appearing in Table 12 were predominant on all soils. In some cases bi-modal and tri-modal groups appeared. Since the items listed were either the most typical or one of the principal modal groups, the same kind and size of implement is budgeted for all soils. The cost for seedbed preparation and planting alfalfa must be prorated over the average length of stand. The average length of stand for alfalfa was not

Table 12. Frequency of machinery operations performed for specified crops on major soil types, Geary County, Kansas, 1954.*

Machine	Marshall silt loam				Hastings silt loam				Smolan silty clay				Junction City-Thurman sandy loam				Waukesha silt loam			
	Wheat	Corn	Oats	Alf.	Wheat	Corn	Oats	Alf.	Wheat	Corn	Oats	Alf.	Wheat	Corn	Oats	Alf.	Wheat	Corn	Oats	Alf.
Plow, 3-14	1	-	1	¼	1	-	1	¼	1	-	1	¼	1	-	1	¼	1	-	1	1/5
Disk, tandem 8'	1	1	1	½	1	1	1	½	1	1	1	½	1	1	1	½	1	1	1	1/3
Harrow, peg 18'	2	-	2	½	2	-	2	½	1	-	2	½	1	-	2	½	2	-	2	1/3
Drill (fert) 16-8'	1	-	1	¼	1	-	1	¼	1	-	1	¼	1	-	1	¼	1	-	1	1/3
Lister, 2 row	-	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-
Cultivator, 2 row	-	3	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	3	-	-
Combine, SP 12'	1	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-
Corn picker, 1 row	-	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-
Baler, pickup	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	4
Mower, 7'	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	4
Rake, S-D, 7'	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	3	-	-	-	4
Wagon, 4 wheel	1	1	1	3	1	1	1	3	1	1	1	3	1	1	1	3	1	1	1	4

* Source: Survey data in Geary County. Due to climatic conditions and the small sample, figures for corn, oats and alfalfa were estimated by the writer. Seedbed preparation and planting operations are averages per year.

surveyed but it is assumed to last four to five years. The upland alfalfa will last four years, while the bottomland possibly will last five years or more. To allow for the spreading of the seeding cost, only a fraction of the cost is assumed in one year.

Determining Total Production Costs

To determine total production costs which are common to the major soils the following items must be considered: (1) machinery and labor costs, (2) seed and fertilizer costs, (3) taxes, and (4) a return for management. After these costs have been deducted the residual is then the return to land or the economic productivity.

The procedure used in determining machinery costs in this thesis includes a charge for labor. The wage for the machinery operator is included in the per day cost of the machinery item. In the case of extra labor during harvesting operations, a charge is included for labor for the hauling operation in the per day cost of the farm trailer.

Seed and fertilizer costs may be applied directly to each soil. Seeding rates are assumed to be the same for each soil. Table 13 shows the seeding rates per acre and the price of seed for the three historical price periods.

In the analysis of the rate and kind of fertilizer application, it was found that a mixed fertilizer containing nitrogen and phosphorus was the most commonly used. It was found that varying percentages of fields fertilized existed for the different soils for wheat. Due to the size of the sample, reliable percentages could not be determined for each soil for each crop. Table 14 shows the average per cent fertilizer use for the

Table 13. Seeding rates and seed prices for major crops, Geary County, 1954.*

	Seeding rate	Historical averages		
		Ave. 1949-53	Ave. 1935-39	Wt. ave. 1944-53
Wheat seed, bu.	1 bu.	$ 2.43	$ 1.48	$ 2.39
Hybrid seed corn, bu.	10 lbs.	10.07	6.15	9.95
Oats, seed, bu.	2 bu.	1.65	1.00	1.62
Alfalfa, seed, 100 lbs.	14 lbs.	61.57	37.56	60.81

* Source: Seeding rates were determined according to standards used by the Department of Agricultural Economics for budget purposes. Kansas seed prices were obtained from Crops and Markets. The seed price index in Agricultural Statistics was used to gear Kansas figures to historical levels.

Table 14. Per cent of soil areas fertilized for each major crop, Geary County, Kansas, 1953-54.*

	Wheat	Corn	Oats	Alfalfa
	%	%	%	%
Marshall silt loam	53	44	24	16
Hastings silt loam	66	48	30	18
Smolan silt loam	62	43	22	15
Junction City-Thurman sandy loam	80	60	40	25
Waukesha silt loam	35	15	10	5

* Wheat percentages determined from Geary County data. Corn, oats, and alfalfa percentages estimated from the per cent of fertilizer application of all soils combined for these crops. These percentages were prorated to each individual soil in the same proportion that wheat was fertilized. Wheat fertilized was significantly lower for Waukesha and significantly higher for Junction City-Thurman sandy loam.

major crops for each soil. Corn, oats and alfalfa percentages were built up with reference made to the wheat percentages and the percentage determined for these crops irregardless of soils. The per cent of the total fields using fertilizer for all soils was 44 per cent for corn, 24 per cent for oats, and 15 per cent for alfalfa. The modal rate of application when applied for all crops and soils was at the rate of 33 pounds available nitrogen and 45 pounds of available phosphorus. This is the modal group and not the average. The average would be considerably lower. For the purpose of this thesis the cost of applying the modal rate will be used and this cost will be prorated to each soil according to the per cent of its total fields using fertilizer. This will apportion the cost of fertilizing among the soils in relation to actual use.

Prices for fertilizer are determined from Agricultural Statistics. Prices for nitrogen and phosphorus were calculated from the price per ton for 33 per cent ammonium nitrate and the 45 per cent superphosphate figures. The 1949-53 average price for nitrogen per pound available is $0.124 and for phosphorus per pound available is $0.082. The modal application of fertilizer when applied cost $4.09 for the nitrogen and $3.69 for the phosphorus or a total of $7.78. This price geared to the 1935-39 level would be $5.16 and for the weighted average from 1944 to 1953 $7.59.

Determining a charge for management is an important and difficult task. The problem arises as to the desirability of using (1) a per cent of gross return or (2) a constant rate for all soils. The first would give the operator of the soil with a higher productivity a larger return for management. The operator on the low productivity soil would receive a smaller return for management. It might be argued that the operator on the low productivity soil might use better management techniques to successfully farm the poor soils. Some might contend that management on the higher productive soils involves more risk. A constant rate for all soils is possibly more equitable in view of the above arguments. For this budget a constant rate of $2.75 per acre is used for 1949-53 price level. This rate was determined by taking the average composite gross return for all soils by 8 per cent. This percentage figure was estimated by the writer.[1] A $1.10 management charge was made for the 1935-39 historical period and $2.55 for the 1944-53 weighted average historical period. These charges represent 8 per cent of the average composite gross returns for the respective periods.

The labor charge was separated from the composite machinery costs for the Hastings soil. The Hastings soil is considered a representative soil as far as labor requirements are concerned. This charge approximated $2.75 which included an estimate of labor requirements for preliminary preparation and for moving to and from the field. The labor charge plus the charge for management is 16 per cent of the composite gross return figure for all soils.

In checking the Farm Management Association Summary and Analysis Reports for 1949-53, it was found that an average of the four years obtained a 10 per cent return for labor and management.[2] The average return for labor and management of all farms in farming area 6a for the four years was divided by the average gross income for all the farms to obtain the percentage. Farming area 6a is a general livestock and crop

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[1]Virtually little information is available concerning management rates. T. O. F. Herzer reported in the April 1942 issue of the Journal of the American Society of Farm Managers and Rural Appraisers, p. 11, that fees charged for management in Illinois ranged from $.50 to $4 depending upon farm intensification. He stated that one manager charged 10 per cent of the returns to the owner.

[2]Extension Service, Summary and Analysis Report of Farm Management Association Farms, Kansas State College, 1950, 1951, 1952, 1953.

area of which the three townships in Geary County border. Actually Geary County is in farming area 5, a livestock and pasture area but these three townships are more typical of area 6a due to crop producing capabilities of the soils studied. The major portion of Geary County is pasture land. A factor in the Farm Management data is that the Association farms probably represent the better farms and managers. The practice and yield data obtained in Geary County are assumed to be a cross section of all farmers. The Farm Management figure may be somewhat high compared to the average for all farms in area 6a.

It was considered that the 16 per cent average return for all soils in this study would not be far out of line. The return for labor and management in this study is for cropland only while the Farm Management returns for labor and management includes both pasture and cropland. It is conceivable that there would be less labor and management requirements for pasture land; therefore this may justify the 6 per cent increase over the Farm Management reports for this budgetary work in Geary County.

Tax levies to be charged against Geary County farm land were determined from mill levy sheets available in the office of the county clerk. The average total mill levy for 1952, 1953 and 1954 on Geary County land was 30.6 mills.[1]

Average total farm land assessed values for Geary County for the 1952-54 period was $6,799,869. The mill levy applied to this equals $208,076. This assessment was spread between 79,741 acres of cropland and 156,044 acres of

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[1]Office of the County Clerk, Riley County, Manhattan, Kansas, Mill levy sheets for Geary County, Kansas, 1952-54.

pasture land.[1] Pine found in his study in 1946 that the average value of the cropland in Geary County was $70.40 and pasture land $29.[2] Applying these values to the crop and pasture acres, respectively, their sums divided into the average total assessment results in a tax per dollar of land value of $.0206 or $1.45 per acre of average cropland. This tax was applied to the Hastings soil for the 1949-53 price period. The tax charge was prorated to the other soils in the relation that their net incomes compared with the net income of the Hastings soil. This same procedure was applied for the 1935-39 and 1944-53 price periods.

Table 15 shows the itemized costs for each soil for each crop for the three price levels. Machinery and labor costs were geared to the 1935-39 and 1944-53 period by means of a composite index determined from Agricultural Statistics for Wage Rates, Equipment and Supplies and Farm Machinery. The Wage Rate and Farm Machinery index were each given the weight of two and the Equipment and Supply index the weight of one. In examining the machinery data it appeared that this was the approximate ratio of importance of the items contributing to the machinery cost. It was found that the 1935-39 level was 38 per cent of the 1949-54 level and the 1944-53 level was 94 per cent of the 1949-54 level. These percentages were used to apportion the 1949-54 costs to the respective historical periods.

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[1]Commission of Revenue and Taxation, State of Kansas, Sixth Biennial Report, 1949-50, pp. 142 and 256.

Assessment Ratio Studies, State Commission of Revenue and Taxation, State of Kansas, 1952-54.

The Assessment Ratio Studies were used to obtain the average assessed value of farm land and improvements. The Sixth Biennial Report was used to determine the estimated value of the improvements. This report contains the latest figures available. For the years 1949-50, improvements were 10 per cent of the total farm land and improvement assessed value.

[2]Pine, op. cit., p. 238.

Table 15. Production costs per acre itemized for major crops for specified soils using three historical price levels, Geary County, 1953-54.

Soil	Cost item	Wheat Ave 49-53	Wheat Ave 35-39	Wheat W.ave 44-53	Corn Ave 49-53	Corn Ave 35-39	Corn W.ave 44-53	Oats Ave 49-53	Oats Ave 35-39	Oats W.ave 44-53	Alfalfa Ave 49-53	Alfalfa Ave 35-39	Alfalfa W.ave 44-53
							(dollars)						
Marshall silt loam	Mach. & labor	9.50	3.60	8.92	12.74	4.83	11.97	8.55	3.24	8.04	12.06	4.57	11.32
	Seed & fert.	6.55	4.25	6.41	5.53	3.59	5.41	5.63	3.65	5.51	3.55	2.30	3.47
	Management	2.75	1.10	2.55	2.75	1.10	2.55	2.75	1.10	2.55	2.75	1.10	2.55
	Taxes	1.49	0.57	1.50	1.49	0.57	1.50	1.49	0.57	1.50	1.49	0.57	1.50
	Total	20.29	9.52	19.38	22.51	10.09	21.43	18.42	8.56	17.60	19.85	8.54	18.84
Hastings silt loam	Mach. & labor	7.71	2.92	7.25	11.32	4.29	10.64	7.92	3.00	7.44	10.70	4.03	10.05
	Seed & fert.	7.56	4.91	7.40	5.22	3.39	5.11	5.16	3.35	5.05	3.39	2.20	3.32
	Management	2.75	1.10	2.55	2.75	1.10	2.55	2.75	1.10	2.55	2.75	1.10	2.55
	Taxes	1.45	0.55	1.46	1.45	0.55	1.46	1.45	0.55	1.46	1.45	0.55	1.46
	Total	19.47	9.48	18.66	20.74	9.33	19.76	17.28	8.00	16.50	18.29	7.88	17.38
Smolan silty clay	Mach. & labor	7.54	2.86	7.09	11.00	4.15	10.33	7.90	3.00	7.42	9.52	3.61	8.95
	Seed & fert.	7.25	4.71	7.10	5.14	3.34	5.03	5.01	3.25	4.90	3.32	2.15	3.25
	Management	2.75	1.10	2.55	2.75	1.10	2.55	2.75	1.10	2.55	2.75	1.10	2.55
	Taxes	1.02	0.34	1.04	1.02	0.34	1.04	1.02	0.34	1.04	1.02	0.34	1.04
	Total	18.56	9.01	17.78	19.91	8.92	18.95	16.68	7.69	15.91	16.61	7.20	15.79
Junction City & Thurman sandy loam	Mach. & labor	7.76	2.94	7.29	11.28	4.28	10.60	8.10	3.07	7.61	11.48	4.40	10.78
	Seed & fert.	8.65	5.62	8.47	6.46	4.19	6.35	6.49	4.21	6.36	4.09	2.65	4.00
	Management	2.75	1.10	2.55	2.75	1.10	2.55	2.75	1.10	2.55	2.75	1.10	2.55
	Taxes	1.42	0.45	1.43	1.42	0.45	1.43	1.42	0.45	1.43	1.42	0.45	1.43
	Total	20.58	10.11	19.74	21.91	10.02	20.93	18.76	8.83	17.95	19.74	8.60	18.76
Waukesha silt loam	Mach. & labor	8.41	3.19	7.89	11.64	4.41	10.93	8.80	3.31	8.26	19.18	7.28	18.03
	Seed & fert.	5.15	3.34	5.04	2.96	1.92	2.90	4.15	2.69	4.06	2.16	1.40	2.11
	Management	2.75	1.10	2.55	2.75	1.10	2.55	2.75	1.10	2.55	2.75	1.10	2.55
	Taxes	2.07	0.86	2.08	2.07	0.86	2.08	2.07	0.86	2.08	2.07	0.86	2.08
	Total	18.38	8.49	17.56	19.42	8.29	18.46	17.77	7.96	16.95	26.16	10.64	24.77

A similar procedure was used to gear the fertilizer and seed costs to the historical levels. By utilizing the fertilizer cost index in Agricultural Statistics it was found that the 1935-39 level was 67 per cent of the 1949-53 level and the 1944-53 level was 98 per cent of the same level. The seed cost index was 61 per cent of the 1945-49 level for 1935-39 and 99 per cent of the 1945-49 level for the 1944-53 historical period.

DETERMINING ECONOMIC PRODUCTIVITY

Determining Land Use

After determining the physical productivity for the major crops for the soils concerned, it is necessary to determine to what extent each crop is grown on the specified soils. It is necessary to prorate the net income obtainable from the various crop uses according to their extent of use. The extent of use was determined for each soil in the survey. A five year crop history was obtained for each field. By listing these by soil and adding the acreages of each crop for the five year period, percentages were determined for each crop use. Averages for the major cropland soils in Geary County for 1950-54 are listed in Table 16.

The upland soils grow more wheat than the bottom land soils as demonstrated by the 59 per cent figure for the Waukesha, a second bottom soil. This decrease in wheat for the Waukesha is offset by an increase in corn acreage. The other percentages have little variation and conceivably would have little influence on the final net income. A 15 per cent increase in the corn acreage should have an influence on the composite net income.

In the appraisal procedure the land use should represent the expected use that will be made of the land. Governmental programs for acreage allotments would have a definite bearing on land use. Two of the five years that were used to determine the land use had wheat acreage allotments. The effects from wheat acreage restrictions should be present. Geary County is not a commercial corn county, therefore corn acreage is not allotted. A change in demand for alfalfa hay and oats locally is not foreseen. An alfalfa dehydrator is located in Junction City but it has been in operation for a number of years and probably would not influence a change in demand for alfalfa appreciably.

Table 16. Per cent land use by major crops, Geary County, 1950-54.*

	Wheat %	Alfalfa %	Corn %	Oats %
Marshall silt loam	81	13	3	3
Hastings silt loam	82	7	6	5
Smolan silty clay	76	17	2	5
Junction City-Thurman sandy loam	73	17	6	4
Waukesha silt loam	59	16	20	5

* Source: Geary County data. Wheat use for Waukesha silt loam is significantly lower than for other soils. Alfalfa use for Hastings silt loam is significantly lower than other soils. Corn use for the Waukesha soil is significantly higher than the other soils. No other differences were noted.

Determining Net Income

In determining economic productivity it is necessary to subtract the total production costs as determined in Table 15 from the gross returns determined in Table 4. This results in a net return to land for each crop use. For the net income that is common to a particular soil it is necessary to weight the net incomes of each soil by the per cent each crop is grown on the soil in question. The per cent land use of each of the major crops on each of the soil types was shown in Table 16. By using these percentages and weighting each crop's net income, the composite net incomes in Table 17 were determined.

Table 17. Composite net incomes and relative ratings for specified soils for three price periods, Geary County, 1954.*

Soil	1949-53		1935-39		1944-53	
	Net income	Relative rating	Net income	Relative rating	Net income	Relative rating
Marshall silt loam	24.48	100.3	9.58	100.6	24.74	99.2
Hastings silt loam	24.39	100.0	9.52	100.0	24.92	100.0
Smolan silty clay	17.36	71.2	6.49	68.2	17.76	71.3
Junction City-Thurman sandy loam	24.32	99.7	9.23	96.9	24.56	98.5
Waukesha silt loam	35.33	144.7	14.76	154.9	35.29	141.4

* Source: Geary County data.

The relative ratings demonstrate the relationships of the net incomes for the three price periods in Table 17. Hastings, arbitrarily, is chosen the average soil and is given the rating of 100 for all price periods. The range of ratings for the 1949-53 period was 71.2 to 144.7 compared to a 68.2 to 154.9 range for the price period 1935-39.

The 1944-53 weighted average relative ratings varied little from those in the 1949-53 budget as shown in Table 17. Most weight was given to prices received and paid during the last five years. The weighted average has a tendency of reducing the extreme fluctuations of certain prices which vary for local supply and demand conditions. The Waukesha rating was high for the 1949-53 price period due to the relatively higher prices which were received for alfalfa in 1952 and 1953. The weighted average reduced these extremes.

All net incomes were not affected in the same manner due to the interrelations of the price changes from period to period. Some prices changed more than others. Relative changes on the individual prices received and paid for items pertinent to the Geary County crop budget are listed in Table 18. The price relatives were determined by dividing the average prices for the particular commodity for 1949-53 into the average price received for the historical period for the same commodity. Between the 1935-39 period and the 1949-53 period alfalfa had the largest increase in price for prices received by Geary County farmers. As explained earlier in the determination of output prices section, alfalfa hay prices respond more readily to limited supply conditions of the local areas. Corn had the smallest increase which was 11 per cent less than the alfalfa increase. Of the prices paid, the machinery and labor cost had the largest increase while fertilizer had the smallest increase.

Table 18. Relative prices for specified commodities for three historical price periods, Geary County, 1954.

Item	Average 1949-53	Average 1935-39	Weighted average 1944-53
Prices received			
Wheat	100	42	100
Corn	100	49	103
Oats	100	40	102
Alfalfa	100	38	92
Weighted average	100	42	99
Prices paid			
Machinery & labor	100	38	94
Seed	100	61	99
Fertilizer	100	67	98
Management	100	40	93
Taxes	100	38	100
Weighted average	100	46	96
Ratio—Prices received/paid	100	91.3	103.1

The price relatives were weighted in proportion that the commodity they represent determines the net incomes for this study into an average for prices received and prices paid. The simple ratio between these for the 1935-39 period was 91.3 and for the 1944-53 weighted average period 103.1. The average parity ratio as determined in Agricultural Statistics is 87 for the 1935-39 period and 100 for the 1949-53 period. The Agricultural Statistics parity ratio is not comparable to this weighted ratio because of the method of weighting and the number of items considered in the ratio; however this may suggest that cropland derives its income under more favorable conditions than are represented by the parity ratio.

The assessment ratio cards, used by the State Commission of Revenue and Taxation to determine the ratio of assessed values to sales value, were examined to determine the average sales value for land tracts that were predominantly one of the soil types in this study. For the period 1949-53 six farms were isolated that were sold which were predominantly Hastings silt loam and six farms for Smolan silty clay. The sales price for each farm was weighted by the acreage. The weighted average value for the Hastings farms was $88.95 and the weighted average for the Smolan soil was $64.74. The Hastings sales represented 480 acres and the Smolan sales 1,190 acres. With the small number of sales, complete reliance cannot be put on the averages. The averages were significant at the 90 per cent level.

Using the sale value of Hastings soil as equal to 100 the sale values of the other soils were determined by applying the relative net incomes to the sale value of Hastings. These values are shown in Table 19. Relative ratings for other methods of calculating net income are shown to compare

Table 19. Relative net income ratings and land values for specified methods of determining net income for delineated soils, Geary County, Kansas, 1954.*

Soil	Net return weighted for crop use								Net return from: crops given equal weight 1949-53		15% of gross return weighted for crop use 1949-53	
	1949-53		1935-39		Adj. 1935-39		1944-53					
	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value	Rating	Value
	%	$	%	$	%	$	%	$	%	$	%	$
Marshall silt loam	100.3	89	100.6	89	104.0	93	99.2	88	150.3	133	102.2	91
Hastings silt loam	100.0	89	100.0	89	100.0	89	100.0	89	100.0	89	100.0	89
Smolan silty clay	71.2	63	68.2	61	65.0	58	71.3	63	63.7	57	81.2	72
Junction City-Thurman sandy loam	99.7	89	96.9	86	100.7	90	98.5	88	130.7	116	102.5	91
Waukesha silt loam	144.7	128	154.9	138	155.5	138	141.4	125	285.5	254	126.0	112

* The rating is determined by the relation between the net incomes with Hastings soil equal to 100. The value is determined by the sales-comparison method with Hastings soil having an $89 value determined from assessment ratio cards.

their effects in prorating the sales value to the other soils. The value determined from sales data for the Smolan soil in 1949-53 period is $63 compared to the determined value for the Smolan soil of $64.74 from the sales ratio cards.

Alternate Methods of Determining Net Income

Besides the three basic budgets for the three price periods carried through in this study, the net incomes for the 1935-39 period were adjusted for the effects of the intra price relationships. The relative ratings and values determined from sale data are shown in Table 19. Of the four crops the price for wheat was used as a standard to adjust the other crop prices to the same relationships as were present in the 1949-53 period. The wheat price for the 1935-39 period is 42 per cent of the 1949-53 period; therefore the prices paid are geared to the 42 per cent level. The adjusted prices were determined by finding the per cent the prices of corn, oats and alfalfa were of the wheat price and then applying these percentages to the 1935-39 period to obtain the adjusted prices. By the same procedure the costs were adjusted by using the machinery and labor cost as a standard. These particular costs for the 1935-39 period were 38 per cent of the 1949-53 period. For this reason they were adjusted to 48 per cent so that the costs would be geared to a price cost ratio of 87. This is the parity ratio for the 1935-39 period.

Comparing the adjusted and unadjusted periods for 1935-39, apparently the decrease in income for the unadjusted period due to the relatively lower alfalfa price were counterbalanced by the increase in income compared to the other soils due to its using less of the relatively higher fertilizer prices. For both periods the value for Waukesha was $138. The unadjusted 1935-39 value for the Junction City and Thurman soil was $4 less due to the reduced income from the larger use of the relatively higher fertilizer prices. The Smolan soil value increased $3 for the unadjusted period due to the small influence (poor yields) from the relatively low alfalfa prices and the small influence from the relatively low machinery costs of this period since the Smolan has less machinery and labor requirements per acre. With gross returns being influenced little and costs decreased the net return was larger for the unadjusted period. The Marshall soil has a higher rating for the adjusted period due to the increased income from the higher adjusted alfalfa prices. Costs would tend to be higher for the adjusted period due to the higher adjusted machinery costs but are not sufficient to counterbalance the increase from the alfalfa price.

The values determined by sales data for the 1949-53 period and for the adjusted 1935-39 period represent the real effect of the difference between the price-cost levels for the two periods. The prices and costs for the adjusted 1935-39 period have the same intra relationships as those for the 1949-53 period. Comparing the two periods in Table 19, the tendency is shown for the relative ratings to be spread over a wider range for the period which is less favorable to farmers representing a parity ratio of 87. The value determined for the Waukesha increased $10 and decreased $5 for the Smolan soil. Comparing the 1949-53 period with the unadjusted 1935-39 period the same variation for the Waukesha is noted but the other soils were affected due to their larger or smaller use or sale of relatively higher or lower priced commodities for the unadjusted period. These relationships were explained in the preceding paragraph.

The net incomes from the four crops on each soil were given equal weight to determine their effect and their relative ratings. As is shown in Table 19, there is considerable variation in the relative ratings over those determined from their proportionate use of each crop. The Smolan and Hastings soils have a lower relative rating because of the low physical productivity on alfalfa. With alfalfa given more weight in the composite net income and it being less profitable the relative ratings decreased. In contrast the other soils have a higher rating due to higher yields and returns from alfalfa which has an equal weight with the other soils.

Some procedures assume a constant percentage of gross returns as a return to land. The Kentucky procedure as mentioned in the Review of Literature uses a 15 per cent figure for determining the return to land. Although this procedure does not use the budget approach for each land type, it implies that the same proportionate cost is deducted from each soil. Table 19 shows the relationship among the soils if 15 per cent of the gross return is allowed as the return to land. The same relationship is present among the gross returns or any per cent of gross returns. This gives an opportunity to compare the relationships of gross returns and the relationships of the net income for the same price period. The increased costs budgeted for the 1949-53 period for the Marshall and Junction City-Thurman soils brought their values down on the same level with Hastings soil. In the constant cost budget both the Marshall and Junction City-Thurman had a sales value of $91 compared to $89 for the Hastings. The value determined for Waukesha was higher for the budgeted cost method due to the smaller cost in comparison to the gross returns. By the same token the Smolan soil had a higher rating because the budgeted cost was a higher per cent of its gross income causing a smaller net income, hence a lower rating and compared value for the Smolan soil in the itemized cost budget.

SUMMARY AND CONCLUSIONS

An attempt has been made to budget the returns to five different soil types in Geary County, Kansas, as defined by the detailed soil survey. The physical productivities used were those obtained from primary yield and practice data obtained for crop years 1953 and 1954. Corn and oats yields were estimated without the use of primary data because of poor climatic conditions for the two years and the limitations of the size of the sample.

Machinery costs were determined by a method devised by the Agricultural Engineering Experiment Station to obtain daily machinery costs. Primary data were used to prorate the daily cost to each soil according to the speed of the operation and the kind of operation. Labor costs were figured in the machinery costs. Management was figured at an average rate of 8 per cent of gross returns. A constant management cost was attributed to each soil. Real estate taxes were determined by applying the average mill levy to the average total assessed value of Geary County farm land. This figure was weighted by the acres and relative values of the crop and pasture land to determine the average crop acre tax.

Three price periods were used and carried through the entire budget process to determine the inter and intra relationships of the prices and their effects on the relative net incomes. The three periods were: (1) 1949-53 period, a recent period with price-cost relationships considered favorable to agriculture, (2) 1935-39 period, a period relatively unfavorable to agriculture with prices and costs having a narrow ratio, and (3) a weighted average period, 1944-53, price-cost conditions considered favorable to agriculture with most weight given to the most recent years.

By budgeting the net income for each one of the major crop uses and prorating these net incomes to each soil according to the amount each crop was used in the rotation, a composite net income was obtained for each soil. These net incomes were then compared to determine their relationships. Other methods of determining the net income and price adjustments were used to determine the possible variations from inter and intra price level relationships.

It would be erroneous to make definite conclusions concerning the rating of the Geary County soils since the physical productivities were determined primarily from only two years' data. These two years had relatively unfavorable climatic conditions for crop production except for wheat and other small grains. For this reason it cannot be stated that the physical productivities would be at the level used or have the exact relationship for expected conditions. However, an evaluation can be made as to the procedure of obtaining the rating and their implications.

According to the method used in determining machinery costs, there tends to be a variation in costs of tillage operations among the soils. The primary variable on per acre costs for tillage implements is the number of acres covered in a 10 hour day. The average for the acres covered per day was determined from primary data. The means for the high and low figures varied significantly from most of the other soils. Apparently the variable of acres covered per 10 hour day is influenced more by the size and shape of the field rather than the texture of the soil and its relationship to draft. The Marshall silt loam which is not considered a heavy soil has the highest tillage costs per acre. The Marshall does have a steep slope and has small irregular, cut-up fields in Geary County. The Smolan silty clay, although a heavy clayey soil, has average costs because of a tendency toward larger fields and more gentle slopes. Traction would possibly be increased for the secondary tillage operations due to the heaviness of the soil. The Waukesha silt loam has the lowest tillage costs due to the level fields and their large regular size. The Waukesha is not considered a heavy soil; therefore increased draft would not be a factor in increasing its costs. The Junction City and Thurman sandy loam soils which conceivably would have less draft had slightly below average tillage costs. These soils have a more steep slope and smaller fields than the Waukesha soil. The traction would tend to be less for the secondary tillage operations and would tend to have increased draft because of the tendency for the implement to penetrate in the sandy textured soil.

Soil texture has a definite influence on tillage costs. The size, slope and shape of the field apparently have a significant influence on costs also.

The harvesting costs are primarily a function of the yield from the soil. The variation in harvesting costs depends on the ability of the harvesting implement to cover more acres per day when yields are reduced. If the same number of acres were covered per day for two soils with differing productivities, the harvesting cost would be the same, except for an extra depreciation charge for the machine handling the heavier yield. Acres covered per day for the combine for the Waukesha soil varied significantly from the other soils. Figures for other harvesting implements were estimated. Hauling costs are a definite function of the yield.

Harvesting and hauling costs appear to have a greater influence in the variation of production costs than do the tillage costs. In other words the soils with the higher physical productivities will have the higher production costs. This will particularly be true if there is a wide range in physical productivities. If there is a narrow range in the physical productivities, then the variation in the speed of the tillage operation will have a relatively greater influence in machinery costs.

Market values appear to reflect some consideration of production costs. By assigning costs that are a fixed per cent of gross returns, the value determined for the low productive soil is high and the value for the highly productive soil is low. As determined for the Smolan soil the constant cost compared value is $72 compared to a value of $65 if the calculated costs are used. The production costs for the Smolan soil were 51 per cent of their gross returns while the costs for the Waukesha were 35 per cent of the gross returns. This implies that a constant cost procedure would not reflect variations in net income due to differences in production costs.

According to Table 20, there appears to be approximately 12 per cent maximum variation in Geary County land values due to different production costs incurred. This variation would be between the soils with the high and low production costs. If the average soil was valued at $150 and average or constant costs were considered for each there would be an approximate error of $18 between the two soils. An error of $7 is detected in Table 19 between the Smolan silty clay (low production costs) and

Table 20. Effects of production costs on net income using three historical price periods, Geary County, Kansas, 1954.

Soil	Dollar difference in production costs*			Per cent change in net income**		
	1949-53	1935-39	1944-53	1949-53	1935-39	1944-53
Smolan silty clay	- 1.44	- .53	- 1.35	+ 8.2	+ 8.1	+ 7.5
Hastings silt loam	+ .25	+ .12	+ .20	- 1.0	- 1.2	+ 0.8
Waukesha silt loam	+ .20	- .40	+ .14	- 0.5	+ 2.7	- 0.2
Marshall silt loam	+ .64	+ .22	+ .59	- 2.6	- 2.3	- 2.4
Junction City-Thurman sandy loam	+ .84	+ .63	+ .85	- 3.4	- 6.8	- 3.4
Percentage range				11.6	14.9	10.9

* Increase or decrease from average production costs.
** Dollar difference expressed as a per cent of the net income for the respective soil and price period.

Junction City-Thurman sandy loam (high production costs) when comparing their differences for the 1949-53 price period using the calculated production costs and the same period with the gross return relationships (implying constant costs).

The above summary of the effects of production costs prompts the writer to make the following conclusion concerning the first hypothesis of this study, i.e., that production costs affect land values. Variations in production costs do affect land values and must be considered in determining land values for taxation purposes. It is not to be implied from this conclusion that the detail used in this study to determine production costs will be needed for each soil area to be considered. However, with modification of the procedure and with sound judgment on the grouping of similar soils, a practical procedure is possible. However, further study is needed to substantiate the findings of this study and to test other factors in production cost variations.

It appears that the disproportionate use of the major crops on the various soils has a bearing on the market value of that soil. The value determined from sales data for the Smolan silty clay is $63 per acre for the 1949-53 price period. The market value as determined for farms which were predominantly Smolan silty clay by sales from assessment-sales ratio cards was $65. The sales were determined from the same period, 1949-53. The average sale value of Smolan soil was significantly different from the average sale value for the Hastings soil at the 90 per cent level.

Comparing the adjusted and unadjusted prices for the 1935-39 period, it appears that the relatively high and relatively low prices and costs tend to counterbalance each other in the determination of the net incomes. When this tendency is present there is little influence in the relative ratings. Comparing the intra price relationships of 1935-39 with those of 1949-53 the alfalfa prices were relatively low and corn prices relatively high. For costs it was found that the machinery and labor costs were relatively low and that seed and fertilizer costs were relatively high. The net incomes for the unadjusted price period would vary because of variations in the use of these items and the variations in intra price relationships.

The unadjusted net income for the Waukesha soil resulted in the same value as the adjusted net income. With its larger yields of alfalfa the gross income would be lowered for the relatively lower alfalfa prices; however it would be raised with the increase in the relatively higher corn price. On the cost side the lower machinery and labor costs would be balanced by the higher fertilizer costs. For the Waukesha these effects were counterbalancing. For the Marshall soil the unadjusted value was $4 lower because of the lower net income from alfalfa and still lower net income from the higher fertilizer costs. For this soil the factors that counterbalance the effects (high corn prices and low machinery and labor costs) were not used to the degree that the net income came back to the same level. All soils were affected, however the largest variation was $4. The Smolan soils compared value was $3 higher for the unadjusted period than the adjusted. It is felt that this is within the probable error. However, if the prices or costs that are disproportionate in a direction that would not counterbalance the net income, their effects would cause the net income to move in only one direction. The intra price relationships would have an increased bearing on the values.

The percentage range of 8.7 per cent in Table 21 implies an error of approximately $13 if the average soil is valued at $150 from variation in intra price relationships. There is a $7 difference noted in Table 19 between the Smolan silty clay and the Junction City-Thurman sandy loam for the adjusted and unadjusted 1935-39 period. The average soil (Hastings) is valued at $89 in Table 19.

Concerning the second hypothesis of this study, i.e., (that intra price relationships affect land values) the following conclusion is made. The price relationships within a given set of prices do influence land values and must be considered when selecting price standards for budgetary purposes. The implication of this conclusion is that a historical set of prices selected to represent future conditions must be adjusted to represent intra price relationships expected. For example, it was found that the wage rate and machinery cost were relatively low and fertilizer costs relatively high compared to the other prices for the 1935-39 period. It is necessary to determine the expected relationships and adjust accordingly.

Table 21. Effects of intra price relationships on net income using 1935-39 adjusted and unadjusted prices, Geary County, Kansas, 1954.

Soil	Net income 1935-39 (adjusted)	Net income 1935-39 (unadjusted)	Per cent change due to unadjusted prices*
Marshall silt loam	$ 9.83	$ 9.58	- 2.5
Hastings silt loam	9.46	9.52	+ 0.6
Smolan silty clay	6.14	6.49	+ 5.7
Junction City-Thurman sandy loam	9.52	9.23	- 3.0
Waukesha silt loam	14.71	14.76	+ 0.3
Percentage range			8.7

* The differences between the adjusted and unadjusted net incomes for each soil was divided by the adjusted net income to determine the per cent change in land values.

It appears that the price and cost levels have an influence in the determination of market values. The determined market prices for the Hastings and Smolan soil from the assessment-sales ratio cards compare favorably with values determined from relationships of the net incomes from the 1949-53 period. The market values were determined from sales made during the 1949-53 period. Using the 1949-53 prices the compared value was $63 while the determined market value was $65. The value determined by sales data for Smolan was $61 for the unadjusted 1935-39 period and $58 for the adjusted 1935-39 period. By varying the ratio of prices received to prices paid from 100 to 87 the value determined by sales data decreases which suggests that the 1949-53 price cost level relationships had some influence in the eyes of the buyers. The period preceding the 1949-53 period represented a parity ratio of well above 100. Assuming a time lag for the effects of increased net incomes to reflect in land values, the determined market value may be higher than the budgeted value for the 1949-53 period. Absolute changes in net income are shown in Table 22. The percentage change was not the same for each soil.

Table 22. Effects of inter price relationships on net incomes for the 1935-39 adjusted and the 1949-53 price periods.

Soil	Net income base	Dollar difference in net income*		Per cent change in net income**	
	1944-53	1949-53	1935-39	1949-53	1935-39
Marshall silt loam	24.74	- .26	- 15.39	1.0	62.2
Hastings silt loam	24.92	- .53	- 15.93	2.1	63.9
Smolan silty clay	17.76	- .40	- 11.91	2.2	67.0
Junction City-Thurman sandy loam	24.56	- .24	- 15.50	0.9	63.1
Waukesha silt loam	35.29	+ .04	- 21.31	0.1	60.3

* Change in net income from 1944-53 price period.
** Change in net income determined by differences in relative ratings.

There is a 2.4 per cent wider range in land values using the 1949-53 price period representing a 100 per cent price cost parity ratio compared to the 1944-53 average used as a base which has a 103 parity ratio. This is considered to be an insignificant change in land values and would likely fall within the probable error. The 1935-39 adjusted price period, representing an 87 per cent parity ratio, resulted in a 20.4 per cent wider range in land values as compared to the 1944-53 price period. These percentage ranges are shown in Table 19. Assuming an average land value at $150 the 20.4 per cent would increase the range in values approximately $31. This is considered to be a significant variation. In Table 19 there was an $18 variation between the 1935-39 and 1944-53 periods for the Waukesha silt loam and the Smolan silty clay.

Concerning the third hypothesis of this study (i.e., that price-cost interrelationships will affect land values) the following conclusion is made. Price and cost interrelationships do affect land values and must be considered when prices and costs are selected for budgetary purposes. In selecting standards for land value determination it is essential that the price and cost level relationships reflect the expected conditions.

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EFFECTS OF VARIATIONS IN INPUTS AND PRICE RELATIONSHIPS
ON THE VALUE OF CROPLAND, GEARY COUNTY, KANSAS

by

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The property tax is an important source of revenue for government expenditure. The important matter with the property tax is the proper distribution of the tax to the owners. The evaluation of property for taxation is called assessment. Inequalities exist between different kinds and sizes of property.

The value of land as an investment is a sum of the expected net incomes. The accurateness in determining the expected net income or economic productivity depends on three groups of variables: (1) soil, land use, and management differences, (2) location relationships, and (3) cost and price relationships. This thesis limits its study to cost and price inter and intra relationships and their effects on land value.

This study has three hypotheses: (1) Physical characteristics such as texture and slope of soils affect speed and number of farm operations and other inputs and thereby production costs and land values, (2) Price intra relationships of inputs and outputs affect the relative returns from the soils and their values, (3) Variation of input and output price levels influence relative land values.

Net returns were budgeted for five different soil types in Geary County, Kansas, as defined by the detailed soil survey. The physical productivities were those obtained from primary yield and practice data for crop years 1953 and 1954. Corn and oats yields were estimated because of the limitation of the size of sample and climatic conditions.

Formulas and studies made by the Kansas Agricultural Engineering Department were used along with primary data to determine costs of owning and operating farm machinery. Information concerning output prices for the area studied were obtained from Reports of the Kansas State Board of Agriculture.

Input prices were obtained from the annual Crops and Markets and Agricultural Statistics publications of the USDA using figures for Kansas.

The statistical procedure of this study consisted primarily of the use of weighted and unweighted arithmetic averages of the input-output data obtained in this study. Frequency and modal analyses were used in determining the operations performed on the soils studied. Analyses of variance were used to test the significance of the averages of the primary data. Indices and price relative methods were employed to show the intra price relationships and the ratio between price and cost levels.

Three price periods were used in the budget process: (1) 1949-53, a recent period with price-cost relationships with a parity ratio of 100, (2) 1935-39, a period with prices and costs having a parity ratio of 87, (3) a weighted average period, 1944-53, with the most weight given to the most recent years. A parity ratio was 103.

Labor costs were figured in the machinery costs. Management was figured at a rate of 8 per cent of average gross returns. A constant management cost was attributed to each soil. Real estate taxes were determined by applying the average mill levy to the average total assessed value of Geary County farm land. This figure weighted by the acres and relative values of the crop and pasture land gave the crop acre tax. The crop acre tax was apportioned to each soil in proportion to their net incomes. Fertilizer charges were determined from the primary data. Seeding rates and costs were constant for all soils.

A composite net income was obtained for each soil by budgeting the net income for each one of the major crop uses and prorating these net incomes to each soil according to the amount each crop was used in the rotation.

Price adjustments and other methods of determining net income were used to determine the possible variation in net income from inter and intra price relationships.

According to the method used in determining machinery tillage costs, there tends to be a variation in costs due to the texture of the soil, but the variables of slope, shape and size of field apparently tend to be the major influence in production cost variation. There were significant differences among most of the average acres covered per day by the major tillage implements among soils.

Harvesting costs are primarily a function of the yield from the soil although not strictly proportionate. The variation in harvesting costs depends on the ability of the implement to cover more acres per day when yields are reduced. Hauling costs are a function of the yield.

Harvesting and hauling costs appear to have a greater influence in the variation in production cost than tillage costs. The overall tendency will be that production costs will tend to be a function of yields. With a narrow range of yields this may not be true since influences of size, shape and draft of land tracts may cause greater variations in costs. Machinery costs for the Marshall soil were high due to the size, shape and slope of the fields having a greater influence on costs than the harvesting operations.

According to this study there was approximately 12 per cent variation in values of land tracts due to variations in production costs. This variation would mean that soils with an average value of $150 would have an $18 error if constant proportional costs were used. This could be considered a significant difference. It leads to the conclusion that variations in production costs should cause differences in land values and should be considered in determining land values for taxation purposes.

Relationships among individual prices tend to affect land values. Alfalfa prices were relatively low and corn prices high in 1935-39 as compared with 1949-53. For costs, machinery and labor costs were low and fertilizer costs relatively high. These relationships have counterbalancing effects on net income; however, depending on their proportionate use on various soils, net incomes may vary. Land values between two soils varied as much as 8.7 per cent in this study because of different relative prices. This variation would mean that soils with an average value of $150 would have an approximate $13 error if unadjusted 1935-39 prices were used, and the relationships within the 1949-53 prices were correct.

Price relationships within a given set of prices do influence land values and should be considered when selecting price standards for budgetary purposes. It would be necessary to adjust historical price series for expected intra price relationships.

The price period reflecting a parity ratio of 87 reduces the net incomes to the extent that the spread in values is greater than for a period with prices having a higher ratio. Compared to the 1944-53 period representing a parity ratio of 103, the adjusted 1935-39 net income ratings had a 20.4 per cent greater range in value. This variation would mean that soils with an average value of $150 would have an approximate error of $31 if the 1935-39 prices were used with the ratio of 87 when a ratio of 103 was expected. This can be considered a significant variation. The absolute net income decreased on the average 63 per cent between the period with a 103 ratio and the 87 ratio. Price and cost level interrelationships do affect land values and must be considered when prices and costs are selected for budgetary purposes. Selecting standards for land value determinations necessitates consideration of the expected levels of prices and costs.