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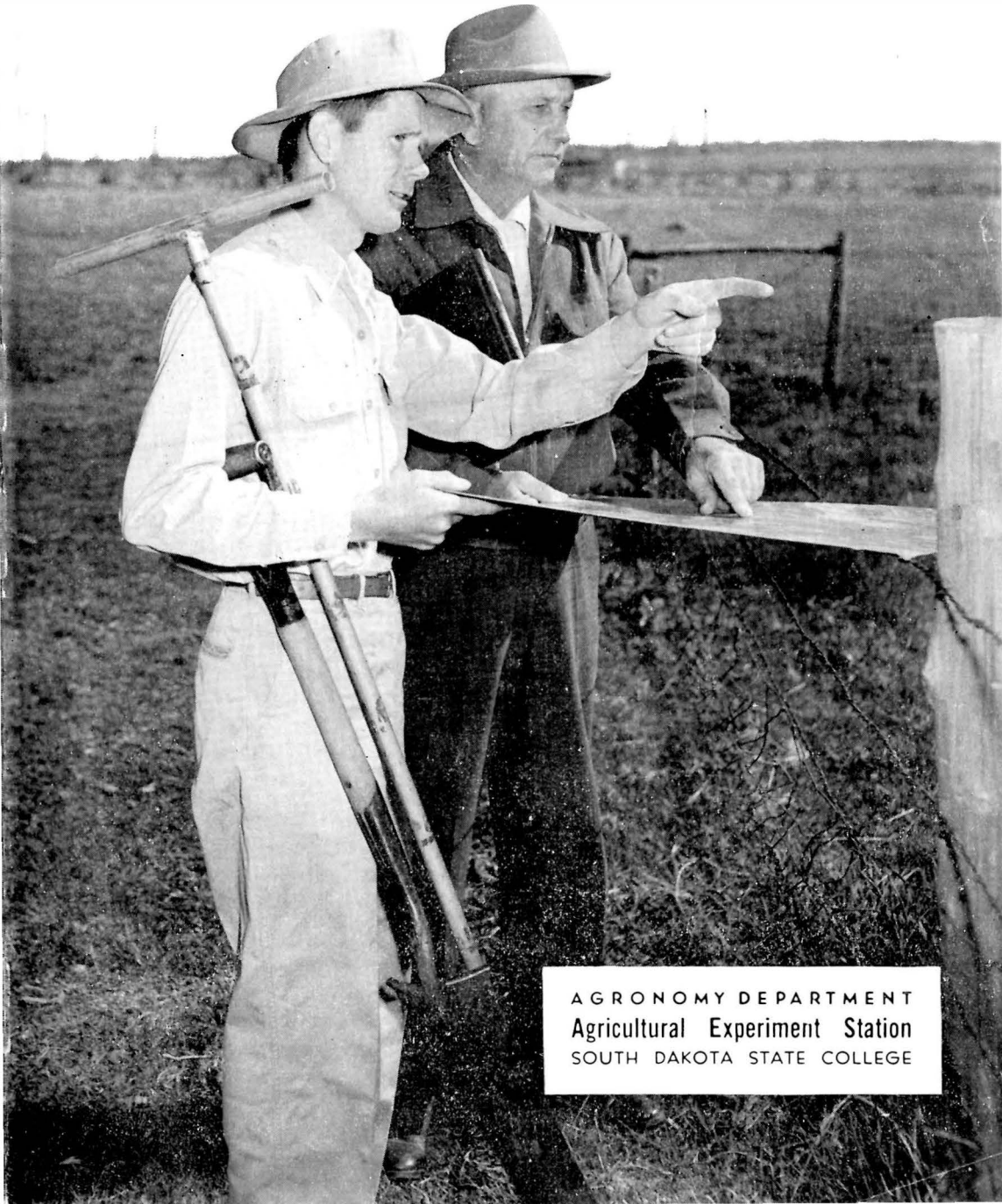

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Soil Survey and Land Valuation For Tax Purposes

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THE RESPONSIBILITY of assessing farm real estate for taxation purposes falls to the tax assessor. Even though most assessors have a sincere desire to achieve an equitable relationship between individual farms, justifiable criticism has been directed against the present taxation procedure for many years. Too often determination of the assessed value of rural property has been based upon average values for an area and upon the management of land rather than on such basic factors as types of soils, location and accessibility.

Some farmers have decided against making improvements to the farmstead, such as a needed paint job or repair of buildings because well-kept buildings invite further taxes. However, it is difficult for a good farmer not to keep his fields in good condition and appearance. Good management often can make poor land appear better than good land under poor management. It is in cases of this sort that the assessor may tax the better management.

Soil Survey as a Tool in Land Evaluation

The search for a more equitable method of assessing farm properties has led to increased interest in use of soil surveys as a base for tax assessment. While soil surveys do not provide the entire answer, they can be used as an effective tool in uniform land evaluation. Like any other tool, the effectiveness of soil surveys will be dependent in a large measure on how they are used. A soil survey can be very useful in determining productivity or ability of different soil types to produce crops. It must be supplemented with other information such as distance to market, prices, roads, as well as kind, number and use of buildings which are also important in determining the value of a particular farm unit.

Soils may be divided into different classes reflecting productivity. Classifying soils in this manner may be compared to the grading of livestock or agricultural products. Not all soils are adapted to all crops nor will they yield the same in terms of pounds, bushels or tons per acre. In order to classify land into these various grades, personnel trained for this type of work collect all available information about an area by making a soil survey.

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The Soil Survey. A soil survey consists of a soil map and report. The map shows the extent and distribution of soil types and other soil mapping units. It also shows the lay of the land or topography, natural drainage of the area, degree of wind and water erosion that has occurred (as measured by the depth of top soil remaining), stoniness, depressions and lakes, location of farmsteads and other buildings, kinds of roads, railroads, and present land use. The accompanying report describes the natural and cultural features (such as roads, schools and churches) of the area surveyed; it describes the important characteristics of soils; predicts the adaptability of soils to various crops, grasses, and trees; predicts their behavior and productivity under different management practices, and the yields which may be expected under defined management systems.

By determining the productive capacity of each soil type or separation on the map, a soil survey furnishes the best available basis for reliable estimates of future production and for comparisons of different tracts of land. While producivity is the principal information furnished by soil surveys for tax assessment purposes, other useful information may also be provided. Kinds of roads, location of schools and churches, size of individual areas of soil types and other mapping units and their distribution pattern, all may be important for use in land appraisal.

Rural land assessment for tax purposes based on productivity should result in a more equitable and uniform method of land evaluation both within and between counties. The basic information furnished by a soil survey is a major help in determining farm costs and gross income for each type of soil mapped. The difference between farm costs and gross income would be the net income for that particular soil type. This net income figure can very readily be used in obtaining an economic rating for each soil type.

Economic Rating. Determining what the economic rating should be for any individual tract of land, such as 40 acres, is relatively simple when the acreage of all the soil types occurring in that tract with their economic ratings are known. It consists of taking that portion of production which each of the soils within the tract contributes and adding them together to get the total. Relationships between values for cropland and pasture land or woodlands could be worked out in the same manner. Some adjustments would have to be made for such factors as roads, schools, markets and types of communities before valuation of tracts would closely approximate their actual sales value.

An Example of Soil Survey Applied to Land Evaluation

Soil surveys have been used successfully as a base for tax assessment in various ways in several states. One method of utilizing soils information for land evaluation which can be used in South Dakota is summarized in this circular.[2] The example given is hypothetical and is used primarily to

[2]A detailed account of this method is given in a paper by Dr. A. R. Aandahl, *et al.*, to be published in the August 1954 issue of the *Journal of Farm Economics.*

show one procedure which could be applied to any county in the state. This particular example pertains to the Kranzburg soil in Brookings County.

The first step in this procedure is to obtain the relative economic classification of each soil separation for both cropland and pasture land. In order to obtain economic ratings for crops an estimation of physical production must be made. This should be based on the most likely soil management for each mapping unit used for crops, and on the expected long-time average yields of each crop included in the soil management systems. Estimates as to average yields could be based on information such as Experiment Station records and results, long-term farm records, opinions of soil survey personnel and other agricultural workers familiar with the area, as well as the experiences of farmers.

Although there are many other different soil types in Brookings County, Table 1 shows the physical production data for 100 acres of Kranzburg loam which is one of the dominant soil types.

Relative Economic Rating for Cropland. Table 1 shows that, on the average, 100 acres of Kranzburg loam (on 3 to 5 percent slopes) in Brookings County will have approximately 40 acres in corn, 45 acres in oats and 15 acres in hay. Yields that can be expected from these acreages are: 1400 bushels of corn, 1800 bushels of oats, and 30 tons of hay.

To convert this production into net income, the gross income from these crops must be calculated, based on a prediction of future prices. Total crop expenses subtracted from gross income will give net income.

Table 1. Physical Production Data for 100 Acres of Kranzburg Loam (on 3 to 5 Percent Slopes)*

Crop	Acres	Yield Per Acre	Total Production
Corn	40	35 Bu.	1400 Bu.
Oats	45	40 Bu.	1800 Bu.
Hay	15	2 T.	30 T.

*Yield records from the Experiment Station farm at Brookings provided the major source of informaiton relating to crop yields used in this example.

Table 2 gives the predicted prices used in this example for estimating gross income.

Table 2. Predicted Prices for Estimated Gross Income

Crops	Price
Corn (1 Bu.)	$ 1.10
Oats (1 Bu.)	0.60
Alfalfa-brome hay (1 T.)	$16.00

Table 3 shows what the gross income would be per 100 acres of Kranzburg loam (on 3 to 5 percent slope) based on predicted prices.

Table 3. Production and Gross Income for 100 Acres*

Crop	Total Production	Price per Unit	Total Income
Corn	1400 Bu.	$ 1.10	$1,540.00
Oats	1800 Bu.	0.60	1,080.00
Alfalfa-brome	30 T.	$16.00	480.00
Gross income per 100 acres			$3,100.00

*The projected long-term base prices which were adjusted slightly to meet current conditions in this section were taken from Agricultural Economics Pamphlet, No. 51, "Base Prices for Long-Term Farm Budgets in South Dakota," Agricultural Economics Dpartment, South Dakota Agricultural Experiment Station, February 1954.

Table 4 gives total expenses for growing and harvesting crops on 100

Table 4. Expenses for Growing and Harvesting 100 Acres*

Growing and harvesting corn, 40 acres @ $13.40 per acre	$ 536.00
Growing and harvesting oats, 45 acres @ $10.55 per acre	474.75
Handling and storing corn and oats, 3,200 bushels @ $0.10 per bushel	320.00
Growing and harvesting alfalfa-brome hay, 15 acres @ $6.00 per acre	90.00
Baling, hauling and storing hay, 30 tons @ $5.50 per ton	165.00
Fertilizer used on the 100 acres	75.00
Total crop expense	$1660.75

Growing and Harvesting 1 Acre of Corn		Growing and Harvesting 1 Acre of Oats		Seeding and Harvesting 1 Acre of Alfalfa-Brome Hay	
Seed	$ 1.20	Seed	$ 2.25	Seed	$1.40
1 plowing	2.50	2 diskings	1.80	2 mowings	2.20
1 double disking	0.90	2 harrowings	1.00	3 rakings (1 turning)	2.40
2 harrowings	1.00	1 planting (with end-gate seeder)	0.50	Total cost per acre	$6.00
1 planting	1.20	1 windrowing and combining	5.00		
3 cultivations	3.00				
1 corn picking	3.60				
Total cost per acre	$13.40	Total cost per acre	$10.55		

*Data for costs per acre of growing and harvesting farm crops were secured from Agricultural Economics Pamphlet ditions in South Dakota" Agricultural Economics Department, South Dakota Agricultural Experiment Station, Revised August 1953.

acres of Kranzburg loam (3 to 5 percent slope).

By subtracting the total crop expense of $1,660.75 from the gross income of $3,100.00 a net income of $1,439.25 is obtained for 100 acres of Kranzburg loam (on 3 to 5 percent slope).

To obtain a relative economic rating for the Kranzburg soil, its net income for 100 acres should be divided by the highest net income for 100 acres of the most productive soil in the county and then multiplied by 100 to convert it into a percentage rating. Let us assume that the net income from 100 acres of the most productive soil in Brookings County is $2,040. For Kranzburg loam in Brookings County the economic rating would be $1,439.25 divided by $2,040 multiplied by 100 equals 70 percent. This means that 100 acres of Kranzburg loam will only produce as much income under equal management levels as 70 acres of the most productive land in the county.

With the exception of cost for handling the crops, other costs of growing crops are generally not related to the productivity of soils. Sometimes other costs such as plowing and working clay pan soils may actually be higher on less productive land.

Figure 1 illustrates how crop costs per acre rise slightly with soil productivity and shows the general relationship of gross income, cropping expenses and net income from crops on different soil types.

Relative Economic Rating for Pasture. The relative economic rating of Kranzburg loam used for pasture could be determined in a similar manner, except that its value should be based upon the number of acres required per animal unit during a normal grazing season rather than on yield per acre. When land is used for

crops, cost *per acre* is relatively easy to determine, whereas when land is used for pasture the costs are *per herd*. The value of pasture land is almost directly proportional to its carrying capacity, and the costs are related largely to the herd and not to the acre of land. The costs of a herd consist of investment in livestock, labor and management required, water, shelter and supplementary feed. These costs are relatively constant for any given size herd.

This means that the lower the porductivity of a soil the greater the number of acres over which these costs will be distributed. As an example, a herd pastured on land one-half as productive as some other land would require twice as many acres, with the same costs of the herd being distributed over twice the acreage. The cost per acre would then be one-half. The important aspect of pasturing costs is that they are highly and directly proportional to the productivity of the different soils.

Figure 2 illustrates this general principle and shows the relationship of cost per acre of maintaining a herd on highly productive soil (see point "A"), and on only one-half as porductive land (see point "B").

Relationship Between Crop and Pasture Rating. When the net income from a soil is the same whether the land is used for permanent pasture or crops, a "balance point" is reached. This point is the key to the relationship between crop and pasture ratings. Farmers on soils of this productivity can realize as much income from pasture as from crops, and frequently half of this type of land in an

Fig. 1. Relationship of gross income, cropping expenses, and net income from crops on soils with different productivity levels

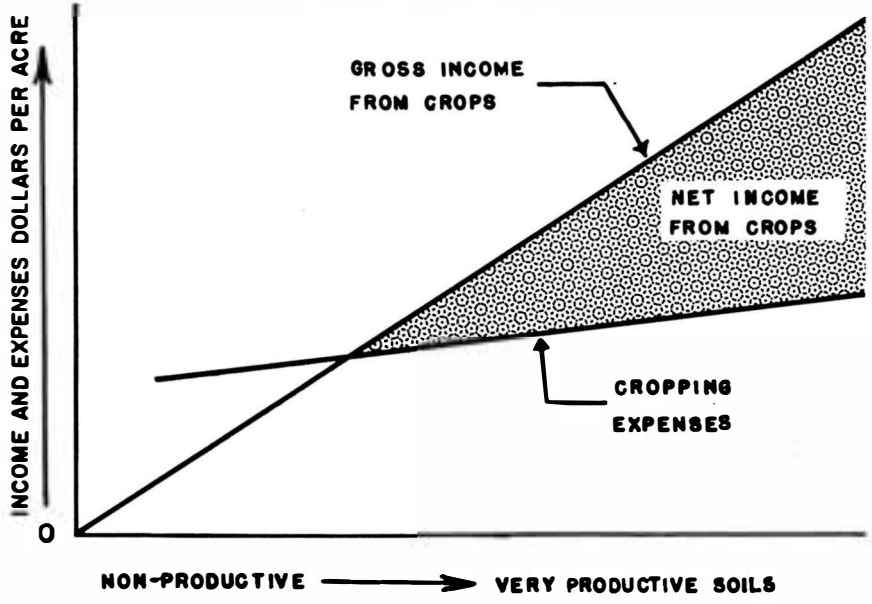


Fig. 2. Relationship of gross income, expenses and net income from pastures on soils with different productivity levels

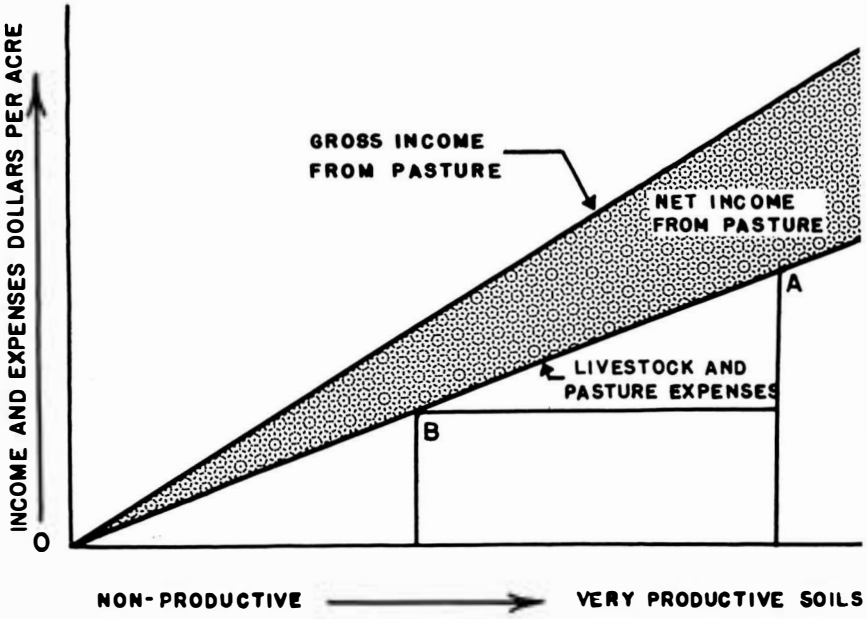
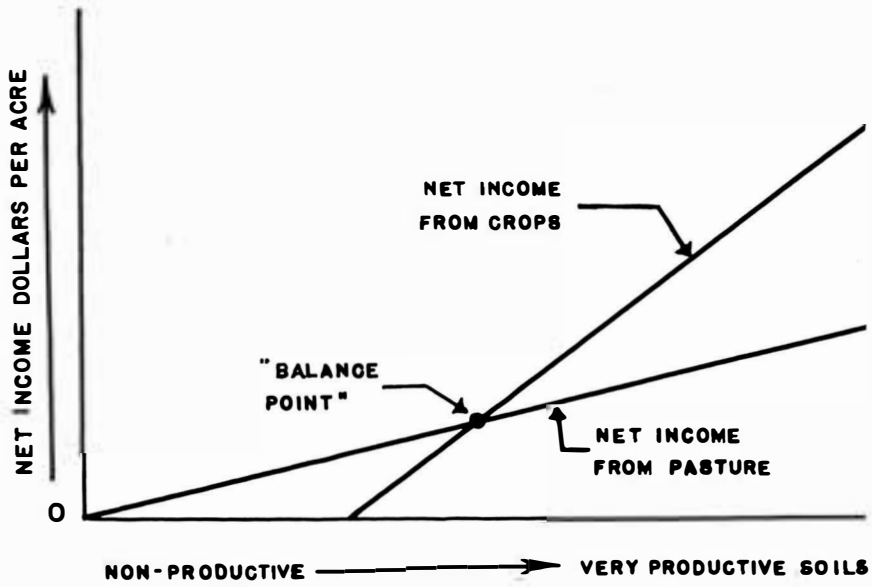


Fig. 3. Relationship of net income from crops and from permanent pasture on soils with different productivity levels



area is used for permanent pasture while the other half is being cropped. More productive soils are generally cropped, while more frequently less productive soils will be used for pasture. Figure 3 illustrates this general relationship of net income from crops and from permanent pasture on soils with different productivity levels. It also shows the "balance point", to the right of which it is more profitable to crop the land, while to the left the soil is more suitable for pasture.

Once this "balance point" has been determined for a county it is a relatively simple matter to obtain the pasture rating for each soil separation. A ratio between the crop relative economic rating and cow-acre-days[3] of pasture can be determined for the soils at this point by dividing the crop rating by cow-acre-days. The average ratio obtained can then be multiplied by the number of cow-acre-days of all the other soil separations in a particular area. This average ratio can be obtained by dividing the relative economic crop rating of several soils which occur at or near the "balance point" by their respective number of cow-acre-days The average of these resulting figures is the average ratio. A hypothetical example of this is presented in Table 5.

Relative economic ratings can also be worked out for forests when they are important enough to warrant it.

Classification of each area within a tract into its highest and most feasible use requires a careful examination of the entire farm as a unit; nevertheless the application of this classification into use for assessment may involve adjustment for factors such as "current use." Classification can be done by assessment officials. Then the acreage of each combination of soil mapping units and land use which require different ratings can be measured (see Figure 4). The products of each combination can then be multiplied by its economic rating and the resulting figure divided by the number of acres in the tract to get an average relative economic rating for the tract Figure 4 is a sample soil survey of a 40-acre tract of land showing the soil mapping units and land use. An example of how this survey may be used and the calculations necessary may be found in Table 6. Sum of Products 2022 divided by acres (40) equals 50.5 which is the average economic rating for this tract.

These average ratings for tracts can then be converted to unadjusted assessed values. The major task in this conversion is the selection of a *constant* to be used to connect each rating to the unadjusted assessed values.

[3]Cow-acre-days is the number of days one acre of pasture will support one animal unit during a normal grazing season.

Table 5. Determination of Ratio Between Crop Relative Economic Rating and Cow-Acre-Days of Pasture

Soil Type	Pasture Cow-Acre-Days	Relative Economic Ratings Crop	Relative Economic Ratings Pasture
Trent silt loam (0-2% slope)	110	100	60
Kranzburg loam (3-5% slope)	66	70	36
Sioux loam (0-2% slope)	38	20	21
Pierce gravelly loam (15-30% slope)	20	—	11

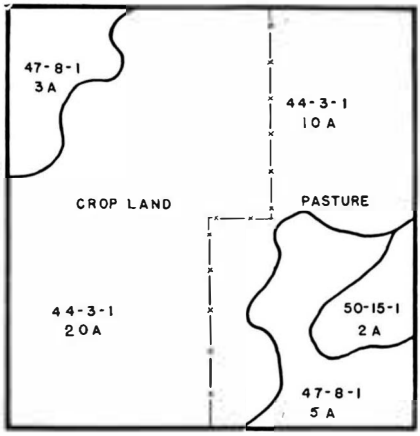


Fig. 4. Sample soil survey of a 40-acre tract of land showing soil mapping units and land use.

This constant is derived by comparing valid sales by representatives of the local land market with the relative economic ratings of the land that was sold. After the constant has been selected it is a simple matter to multiply the average rating of each tract by the constant to convert it into market value.

While productivity should be the major factor in this procedure of land evaluation for tax purposes, other factors affecting land value must also be considered.

Some such factors are: farm buildings, roads, schools, churches, markets, people in the community, and past soil management.

Program Needed For Rural Land Valuation

In order to procure the best available information necessary to relate soils and economic data to land values, a sustained soil survey program is needed. Although some of the counties in South Dakota have basic soil surveys containing the necessary information, others do not. Many of the counties have broader types of surveys which can supply some of the information needed, but this must be supplemented by additional data before accurate land assessments can be made. A soil survey program which is to furnish the basic data for tax assessment purposes in every county in the state will require several years. To some extent, the program will need to be extended indefinitely, because even after all counties have been surveyed, changing conditions such as new crops, new techniques in management and other economic and social changes will necessitate some revision of earlier work.

Experience has demonstrated that full participation by the assessors, commissioners, as well as by the people of the county is necessary to gain acceptance of a valuation program based on a soil survey. Local people can contribute information not available from other sources which would improve the accuracy of the evalua-

Table 6. Determining the Average Relative Economic Rating for a Particular Tract

Soil Map Symbol	Land Use	Acres	Economic Rating	Product
44-3 -1	Crop	20	70.0	1400
44-3 -1	Pasture	10	36.0	360
47-8 -1	Crop	3	30.0	90
47-8 -1	Pasture	5	32.0	150
50-15-1	Pasture	2	11.0	22
1	Total	40		2022

tion. They also can best determine the application and adjustment of procedures. Experience has shown that cooperation by all county personnel in a project of this nature can make the job less expensive and more successful than if it were done under contract by an outside firm.

Costly changes and adjustments are sometimes necessary if a program of land evaluation is based on insufficient and inaccurate data. Counties should be cautioned against making final appraisals until a detailed study has been made and all the necessary data have been accumulated. The need to proceed sowly cannot be *overemphasized* in areas where this type of an approach has not been used heretofore. New problems are bound to occur and they must be solved before an equitable and just system of rural land assessment such as the one suggested here can be initiated.

Recent South Dakota Soil Survey Reports Are Available on:

Soils of Jerauld County.....1951
Soils of Day County.....1952
Soils of Clay County.....1953

Soil Survey Report in Preparation

Soils Survey of Spink County.....1954