How Valuable Are the Soils of Central Illinois

A Ten-Year Study of Selected Soils, Systems of Farming, and Relative Earnings

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UNIVERSITY OF ILLINOIS
AGRICULTURAL EXPERIMENT STATION
Bulletin 550

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ACKNOWLEDGMENT

To Russell T. Odell, Professor of Soil Physics, is due special acknowledgment for assistance in this study. Dr. Odell is author of Bulletin 522 of this Station, referred to on the opposite page. For information concerning soil types and associations the authors are indebted to the long-time research of the division of Soil Physics.

Urbana, Illinois January, 1952

Publications in the Bulletin series report the results of investigations made or sponsored by the Experiment Station

HOW VALUABLE ARE THE SOILS OF CENTRAL ILLINOIS?

By W. N. THOMPSON and P. E. JOHNSTON[1]

HOW MUCH MORE are some types of soil worth than others? How does soil type influence systems of farming? How does the quality of the soil influence the amount of capital it takes for operation? And how much can earnings be expected to increase with better soil management? These are questions that farmers, land appraisers, bankers, and investors are asking. Answers, at least in part, can be found here for the soils of central and north-central Illinois.

Variations in crop yields under good, poor, and fair soil management for selected central and north-central Illinois soil types were reported in Bulletin 522 of this Station, entitled *How Productive Are the Soils of Central Illinois.* The present bulletin, reporting earnings on these soils, is a companion study based on 203 of the same farms. These 203 farms were selected because records of their financial operations were available for the ten years 1935-1944, and their soils belonged in one of the twelve more prevalent soil associations in this area. (A soil association is made up of two or more closely related soils that have developed from similar parent material but that differ in profile characteristics because of difference in topography or drainage, or both.)

Readers are urged to bear in mind that it is the *relative,* not the absolute, earnings of these soils that constitute the important findings in this study. These relative earnings would be expected to be about the same today as they were during the period of the study, even though absolute earnings were lower at that time and the period was characterized by unusual economic shifts.

It will probably be helpful to consider this bulletin and Bulletin 522 together.

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OBJECTIVES

This analysis was designed to show three things:

1. Influence of soil types and location on systems of farming.

2. Relative long-time earning capacity of farms located on some of the more prevalent soil associations in central and north-central Illinois and variations in the amounts of capital and labor used on them.

3. Extent to which earnings on various soil types are influenced by soil management.

SOILS AND LOCATION OF FARMS

The entire farm as an operating unit is the basis for analysis in this study.[1] The soil types found on these farms are listed in Table 1, together with indications of their productivity, the slopes on which they occur, and their location with reference to the main soil regions of central Illinois. These soil regions are indicated on the map (Fig. 1) on page 350.

All the soils involved in this study, except Clinton silt loam, developed under prairie vegetation and are dark colored. Clinton silt loam, with a productivity rating[2] of 5, is a light-colored soil which developed under forest vegetation. On the dark prairie soils the productivity ratings range from 1 to 4-6; Sable silty clay, Ipava silty clay, and Drummer silty clay loam have a rating of 1 and Harrison silt loam has a rating of 4-6.

The index for the soils when untreated (Table 1) is the average of the estimated percentages of the limestone, phosphorous, and potassium requirements of crops that are satisfied by the amounts of these elements naturally in the soil. It is not an adequate measure of the inherent productivity of a soil, as

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[1] The tract was the unit of analysis in Bulletin 522, already referred to. The word "tract" was used to indicate a piece of land where the soil types and soil-management practices were uniform. A tract, therefore, was sometimes a whole farm, sometimes one or more fields on a farm.

[2] The productivity rating is based on the ability of the soil to produce the major crops grown in the area without soil treatment but with the soil cleared and drained. Ratings used here range from 1 to 10, the most productive soils in the state being rated as 1 and the least productive as 10. But after this manuscript was prepared, the 1 to 10 rating system was revised. The new system rates soils on the basis of 1 to 100, with 100 corresponding to the previous rating of 1.

Table 1. — Productivity, Slope, and Location of Selected Soil Types in Central Illinois

Soil type No.	Soil type name	Productivity rating[a]	Untreated soil index[b]	Slope	Soil regions (see Fig. 1)
				percent	
36	Tama silt loam.	3	70	3.5–7.0	1a, 1b, 1c
41	Muscatine silt loam. . . .	2	83	0.5–3.5	1a, 1b, 1c
68	Sable silty clay.	1	98	0–0.5	1a, 1b, 1c
41X[c]	Muscatine X.	2–3	80	0.5–3.5	7
68X[c]	Sable X.	1–2	97	0–0.5	7
247	Tovey silt loam.	3–4	60	3.5–7.0	1a, 1c
246	Bolivia silt loam.	2–3	70	1.5–3.5	1a, 1c
43	Ipava silt loam.	2	75	0.5–1.5	1a, 1c
65	Ipava silty clay.	1	93	0–0.5	1a, 1c
145	Saybrook silt loam.	2–3	67	1.5–3.5	8a, 8b
59	Lisbon silt loam.	1–2	80	0.5–1.5	8a, 8b
154	Flanagan silt loam.	2	80	0.5–3.5	6
152	Drummer silty clay loam	1	95	0–0.5	5, 6, 8a, 8b
148	Proctor silt loam.	3–4	67	1.5–3.5	5
149	Brenton silt loam.	2	80	0.5–1.5	5
146	Elliott silt loam.	4	69	1.0–3.5	9
232	Ashkum clay loam to silty clay loam.	2–3	91	0–1.0	9
91	Swygert silt loam to silty clay loam.	4–5	71	1.0–3.5	4
235	Bryce clay loam to clay. .	3–4	91	0–1.0	4
127	Harrison silt loam.	4–6	58	1.5–3.5	2a, 2b
46	Herrick silt loam.	4–5	65	0.5–1.5	2a, 2b
50	Herrick clay loam.	3	79	0–0.5	2a, 2b
18	Clinton silt loam.	5	57	1.5–3.5	1a, 1b, 1c

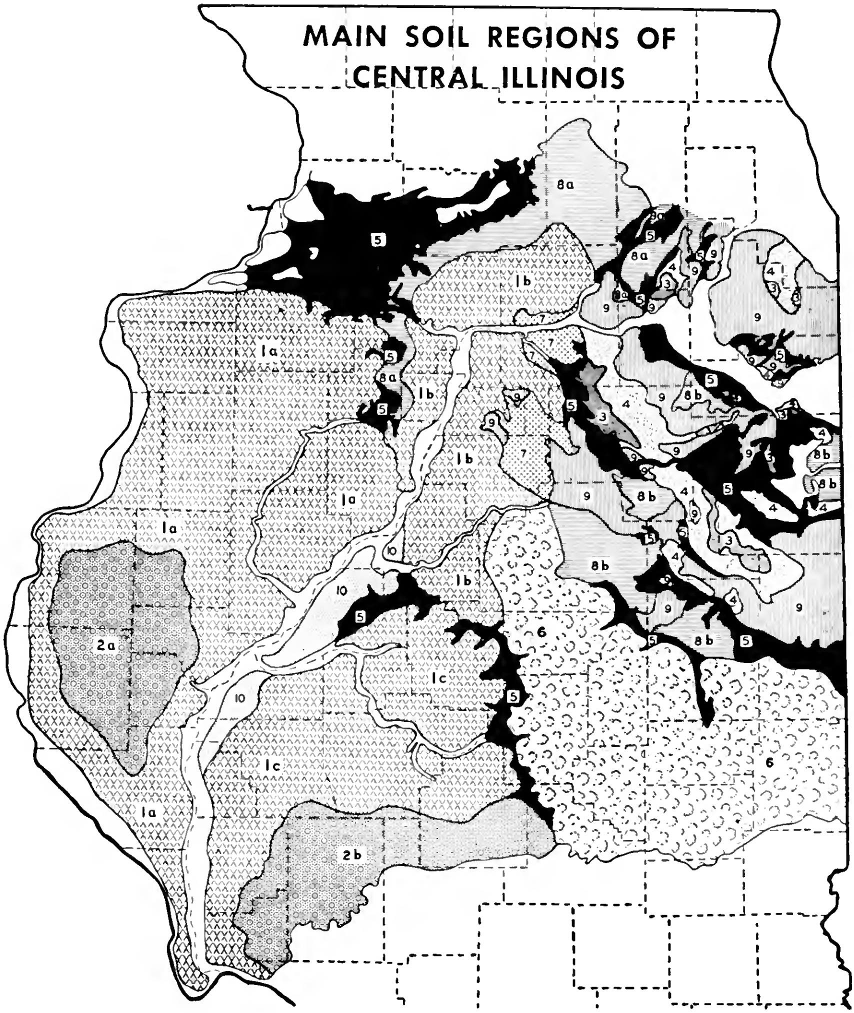
[a] The productivity rating is based on the ability of the soil type to produce the major crops grown in the area without soil treatment but with the soil cleared and drained. The scale used is 1 to 10, the most productive soils in the state being rated as 1 and the least productive as 10.

[b] The untreated-soil index is the average of the estimated percentages of limestone, phosphate, and potash requirements of crops that are satisfied by the amounts of these elements naturally in the soil.

[c] Muscatine X and Sable X are unofficial designations for brown silt loam and black clay loam respectively which have developed from 40 to 65 inches of loess over calcareous (limey), slowly permeable, silty clay loam till. No official type numbers or names have been assigned to them.

it does not take into account its physical properties or, except for the three elements named, its chemical characteristics.

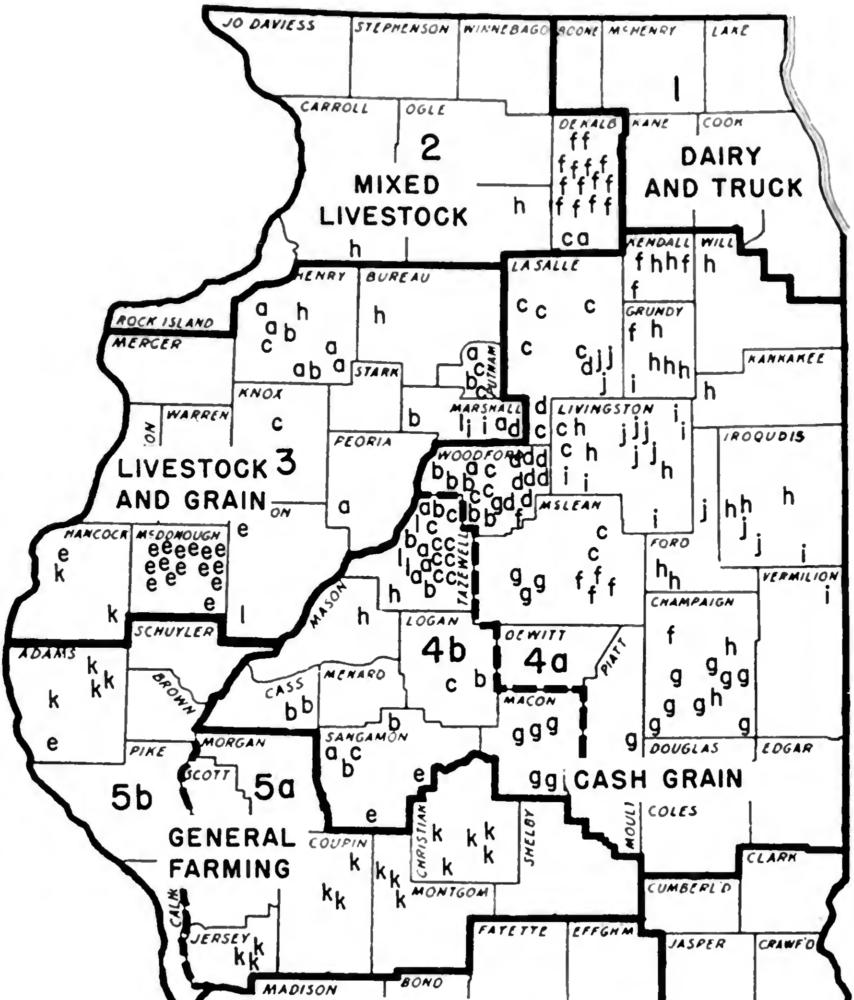
For example, Swygert silt loam and Tama silt loam have about the same index for untreated soil: 71 and 70 respectively. Tama, however, has a *productivity rating* of 3, while Swygert's



PARENT MATERIALS IN DIFFERENT REGIONS

- 1a, b, c — Loess 70-300 inches thick, calcareous at 40-70 inches
- 2a, b — Loess 50-80 inches thick, generally noncalcareous
- 3 — Calcareous, nearly impermeable clay till
- 4 — Calcareous, very slowly permeable silty clay till
- 5 — Glacial outwash and lake-bed sediments
- 6 — Loess 40-75 inches thick over calcareous permeable loam till
- 7 — Loess, 40-65 inches, over calcareous, slowly permeable silty clay loam till
- 8a, b — Calcareous permeable loam till
- 9 — Calcareous, slowly permeable silty clay loam till
- 10 — Predominantly sandy glacial outwash and terrace deposits

Region 1 on the above map is divided into three subareas because it is so large and information for some soil types is not complete in every area. In Regions 2 and 8 the subareas are widely separated geographically; in fact, the climate in 8a and 8b is different enough to affect crop yields. *(Map is reproduced from Bulletin 522 of this Station.)* (Fig. 1)



LOCATION OF FARMS

a — Tama silt loam and Muscatine silt loam

b — Tama silt loam, Muscatine silt loam, and Sable silty clay

c — Muscatine silt loam and Sable silty clay

d — Muscatine X-Sable X (uncorrelated brown silt loam and black clay loam associated, no official names assigned)

e — Tavey silt loam, Bolivia silt loam, Ipava silt loam, and Ipava silty clay

f — Saybrook silt loam, Lisbon silt loam, and Drummer clay loam

g — Flanagan silt loam and Drummer silty clay loam

h — Proctor silt loam, Brenton silt loam, and Drummer clay loam

i — Elliott silt loam and Ashkum clay loam to silty clay loam

j — Swygert silt loam to silty clay loam and Bryce clay loam to clay

k — Harrison silt loam, Herrick silt loam, and Herrick clay loam

l — Clinton silt loam

On this map each farm is shown by a letter indicating the soil association on which it is located. Note (Fig. 1) that in about three-fourths of the area the soils developed from moderately thick loess; in the rest of the area, from thin loess on glacial till or from glacial till with no loess. (Fig. 2) rating is only 4 to 5. Though their needs for limestone, phosphorous, and potassium are similar, Swygert is less productive because it has a heavier subsoil that is less favorable for crop growth.

Most farms contain two or more soil types which have developed from similar parent material but which may differ in slope, organic-matter content, workability, and other characteristics. The various soil types have therefore been grouped into "associations" on the basis of their characteristics and their occurrence on farms.[1] The associations selected for this study, their locations, and letter designations are shown in Fig. 2 (page 351). Some of these selected associations, such as Swygert-Bryce (j), have a limited geographical distribution, while others, such as Proctor-Brenton-Drummer (h), are more widely dispersed.

In about three-quarters of the area, most of the soils developed from moderately thick to thick loess (Fig. 1). (Loess is silty material that was deposited by wind.) These soils include Clinton and the following associations: Tama-Muscatine, Tama-Muscatine-Sable, Muscatine-Sable, MuscatineX-SableX, Tovey-Bolivia-Ipava, Flanagan-Drummer, and Harrison-Herrick.[2]

The Tama-Muscatine, Tama-Muscatine-Sable, Muscatine-Sable, MuscatineX-SableX, and Tovey-Bolivia-Ipava associations occur in west-central Illinois on land that is generally nearly level to moderately sloping and in the northwest part of the state where the land is somewhat more rolling (Fig. 2). The surface of these soils is medium in texture, and the subsoils are moderately permeable to water. They underdrain well. Though erosion is less active and less harmful on these soils than on some others, its control should not be neglected. These silt loam and silty clay loam soils are highly to very highly productive and include some of the best soils in the state.

In this study the Flanagan-Drummer farms occur on nearly level to gently sloping land in east-central Illinois (Fig. 2). They developed over calcareous loam till. (*Till* is an unstratified glacial deposit; *calcareous* means the material contains enough

[1] Only those farms containing a high proportion of the soil types that belong to a given association were included in this study.

[2] For simplicity, the Harrison-Herrick-Herrick association will be referred to as Harrison-Herrick in the text and illustrations.

free lime to bubble when it is treated with hydrochloric acid.) The texture of these soils on the surface is medium and their subsoils are moderately permeable to water. The major soil-management problems on this association are to get satisfactory drainage and to keep the soils in good physical condition. These soils are among the most productive in the state.

The Harrison-Herrick association occurs on nearly level and gently sloping land in south-central and southwestern Illinois (Fig. 2). The subsoil is fine in texture and only moderately slowly permeable to water. Though tile drainage is slow, it is generally satisfactory if the tile laterals are spaced moderately close together. The productivity of this association is only medium.

Clinton soil occurs on moderately sloping land where erosion may be a problem. The Clinton farms included in this study are located in the north-central part of the state near the Illinois river (Fig. 2). Though the subsoil is only moderately to moderately slowly permeable to water, it does not need artificial drainage. It is suited to the production of small grains and forage crops. The productivity of the tillable land is low to medium.

The soils in the northeast quarter of the area developed either from thin loess on glacial till or from glacial till with no loess (Fig. 1). The associations are Saybrook-Lisbon-Drummer, Elliott-Ashkum, Swygert-Bryce, and Proctor-Brenton-Drummer (Fig. 2).

The Saybrook-Lisbon-Drummer association occurs on nearly level to gently sloping land. It developed from thin loess on glacial till of loam texture. The surface of these soils is medium in texture and their subsoils are moderately permeable. Tile function well on them. They are among the best soils in the state.

The Elliott-Ashkum, Swygert-Bryce, and Proctor-Brenton-Drummer associations occur on nearly level to gently sloping land. The Elliott-Ashkum association developed from thin loess on calcareous silty clay loam till; the Swygert-Bryce soils also developed from thin loess but on silty clay to clay drift; while the Proctor-Brenton-Drummer soils developed from wind- and water-laid silty sediments.

The Elliott-Ashkum association has a subsoil that is fine in texture and only moderately permeable to water. On these soils erosion is a problem even on gentle slopes, because the water runoff is so great. Water moves to tile rather slowly, and if drainage is to be satisfactory, the tile laterals must be placed moderately close together. The productivity of this association is medium to high.

The Swygert-Bryce association has a clay subsoil that is only slowly permeable to water and plant roots. Since tile do not function satisfactorily on these soils, the chief means of drainage must be surface drainage. On sloping land erosion is a problem. When the thin silty covering that blankets the underlying slowly permeable till is lost, the productivity of these soils is permanently reduced. Where the soils of this association are not eroded, however, they are moderately productive.

On the Proctor-Brenton-Drummer association the subsoils are normally permeable to water. Tile drainage is satisfactory on these soils if outlets are available. The major problems are drainage and the maintenance of good physical condition. These soils are highly to very highly productive.

Illinois has been divided into nine major type-of-farming areas. Farms in four of these areas are included in this study (Fig. 2). In that part of the study area that lies west of the Illinois river (Areas 2 and 3), livestock production is on an intensive basis. Except for a transition belt lying east of the Illinois river in Area 4 (where more livestock are produced than in the rest of the area but less than in Areas 2 and 3), Area 4 is one of the most specialized grain-producing regions in the United States. Area 5 is a general farming region.

Because of the differences within them, the farming-type areas included in this study furnish an excellent setting for an analysis of the influences of soil types and their associated natural, economic, and biological factors on the amount of labor and capital farmers must combine with land to operate successfully. The action and interaction of these factors has, of course, produced the various systems of farming found in these areas.

INFLUENCE OF SOIL TYPES AND LOCATION ON SYSTEMS OF FARMING

One of the aims of this study was to find out how much soil types and climate and markets as they are associated with soil types have influenced systems of farming. That they have influenced the way men farm has long been recognized, but the degree of their influence has been a matter of debate.

Before presenting the results of this part of the study, however, it seems necessary to discuss in general terms the geography of the area, since such knowledge must underlie an understanding of the discussion to follow.

The east-central part of the state is largely composed of level land, the west-central part of both level and somewhat rolling soils. In east-central Illinois the percentage of soils having productivity ratings of 1 and 2 is higher than it is in west-central Illinois. These high-grade, relatively level soils make east-central Illinois a cash-grain area and put it in a favorable position to produce feed grains — corn, oats, and soybeans — to be used outside the area or converted into mixed feeds and manufactured products.

Farmers in those parts of the country who have the advantage of location for producing bulky or perishable food products, such as dairy and poultry products, and who also have little soil adapted to raising the feed grains they need, buy the grains produced in east-central Illinois and similar areas.

The rolling land of west-central Illinois must be used to produce hay and pasture. The pasture and roughage this area produces and the favorable location of the area with reference to livestock freight rates put it in a favorable spot to produce livestock.

Findings in General

1. The slope of the land greatly influenced the organization of the farms studied, because it helped determine the kinds of cover needed for erosion control and the proportion of the land that could be cultivated. Slope is one of the characteristics that distinguishes soil types, and it varies greatly among them.

In an effort to adapt the organization of their farms to differences in the slope and productivity of their soils, these farmers made various adjustments in the use of their land and in their livestock programs, as the feed fed per acre on Tama, Muscatine, and Sable soils shows.

2. These soils vary in their capacity to maintain high yields under cropping systems that keep high percentages of the tillable land in corn and soybeans.

3. The location of these soils in the state with respect to markets, as well as their characteristics as soils, was important in determining the type of farming that prevailed in any given part of the area included in this study. Location, crop yields, total production of the different grain and roughage crops, and the slope of the land all influenced the kinds and amounts of livestock to be found in any part of the area.

Slope and Farm Organization

The sharp contrasts between the proportions of tillable land that were kept in corn and soybeans and in roughage crops on level and on rolling soils show pointedly the degree to which slope influenced farm organization.

On farms in the prairie soils associations (all associations in this study except Clinton soil), the proportion of tillable land ranged from 77 percent on the rolling Tama-Muscatine farms to 95 percent on the level Flanagan-Drummer farms (Table 2).

As would be expected, those associations that had a high proportion of nearly level soil types, such as Sable, Drummer, and Bryce, also had high percentages of tillable land; while those that had a higher percentage of such rolling soils as Tama contained a lower percentage of tillable land.

On three soil associations — Muscatine-Sable, Flanagan-Drummer, and Elliott-Ashkum — over 50 percent of the tillable land was in corn and soybeans, the two most profitable crops (Table 2). Practically all these farms were in the cash-grain area of east-central Illinois[1] (Fig. 2).

[1] Because they do not have the ability to manage livestock efficiently, or because they are unwilling to handle it, or for still other reasons, many farmers in the area where these farms are located (chiefly Farming-Type Area 4) do not turn soil-building crops into the cash equivalents of what they can get from grain crops. On these farms the yields may be maintained at a high level by use of legumes, including catch crops, and by applications of commercial fertilizers.

Table 2. — Size of Farm, Land Use, Crop Yields, and Soil-Management Index for Selected Soil Associations, Central Illinois, 1935-1944

Soil associations	Number of farms	Acres per farm	Land tillable	Tillable land in hay and pasture[a]	Tillable land in corn and soybeans	Corn yield per acre	Soil-management index[b]
			perct.	*perct.*	*perct.*	*bu.*	
Tama silt loam and Muscatine silt loam	15	273	77	31	43	64	84
Tama silt loam, Muscatine silt loam, and Sable silty clay	17	278	91	27	43	66	82
Muscatine silt loam and Sable silty clay	28	298	94	23	53	67	85
Muscatine X and Sable X[c]	11	294	95	22	47	65	87
Tovey silt loam, Bolivia silt loam, Ipava silt loam, and Ipava silty clay	20	234	92	29	45	60	79
Saybrook silt loam, Lisbon silt loam, and Drummer silty clay loam	24	272	93	26	45	67	85
Flanagan silt loam and Drummer silty clay loam	18	284	95	20	57	61	73
Proctor silt loam, Brenton silt loam, and Drummer silty clay loam	24	259	90	23	49	62	81
Elliott silt loam and Ashkum clay loam to silty clay loam	10	230	90	21	51	59	82
Swygert silt loam to silty clay loam and Bryce clay loam to clay	11	303	94	27	44	55	85
Harrison silt loam, Herrick silt loam, and Herrick clay loam	20	250	89	29	46	52	70
Clinton silt loam	5	285	65	38	34	53	74

[a] Percent of tillable land as determined by farm operators.
[b] The soil-management index is a measure of the kind of cropping system used and soil treatment applied in relation to the needs of the various soils. The index is composed of yearly averages.
[c] Uncorrelated brown silt loam and black clay loam associated. No official names assigned.

Those associations that had a high proportion of tillable land in corn and soybeans had a low proportion in hay and pasture. Of farms on the prairie soil associations, the Flanagan-Drummer had the highest proportion of tillable land in corn and soybeans (57 percent) and the lowest in hay and pasture (20 percent) (Table 2).

Among prairie soils, the two associations containing Tama (Tama-Muscatine and Tama-Muscatine-Sable) had the lowest proportion of tillable land in corn and soybeans (43 percent) and high percentages of hay and pasture (31 and 27 percent respectively). These associations occur in west- and northwest-central Illinois. The Swygert-Bryce farms, in the northeast quarter of the area studied, also had a low proportion of tillable land in corn and soybeans. On the light-colored timber soil, Clinton, only 34 percent of the tillable land was in corn and soybeans.

On farms where Clinton soil predominated, only 65 percent of the land was tillable, the least of any association. Of each 100 acres in these farms about 25 tillable acres were kept in hay and pasture and 22 in corn and soybeans. Of the other 53 acres, 18 were in small grain and 35 in nontillable pasture, woods, lots, and wasteland. The Clinton farms were all near the Illinois river. On Flanagan-Drummer farms, 54 of each 100 acres were in corn and soybeans.

Further example of the way these farmers adapted the organization of their farms to differences in slope and soil productivity is found on the Tama, Muscatine, and Sable associations. On these farms the proportion of land kept in hay and pasture increased as the proportion of Tama increased and decreased as the proportion of Sable increased, as the following table shows:

Soil type	*Productivity rating*	*Slope*	*Soil association*	*Tillable land in hay and pasture perct.*
Sable	1	0 –0.5	Muscatine-Sable	23
Muscatine	2	0.5–3.5	Tama-Muscatine-Sable	27
Tama	3	3.5–7.0	Tama-Muscatine	31

Soils, Soil Management, Corn Yields, and Grain Production

Since not all farms received the same soil management, soil-management practices had to be studied before the effect of soil types on crop yields could be evaluated. For making this study, a soil-management index was used. This soil-management index is a measure of the kind of cropping system used and of the soil treatment applied, as these relate to the needs of various soils.

Better soils received better treatment. The tendency for the better soils to be treated better than the poorer soils was definite, though on the basis of need the opposite might be expected to be true. For example, on the MuscatineX-SableX soils, some of the best in the state, the soil-management index was 87, while on the Harrison-Herrick soils, which are of medium productivity, it was only 70 (Table 2).

There were, however, exceptions to this general tendency. The Flanagan-Drummer soils, which are good, were relatively poorly managed; but these rather level soils yield well with relatively poor soil management. That the Elliott-Ashkum and Swygert-Bryce soils, which are not as good as the Flanagan-Drummer, were rather well managed may be explained by the fact that the subsoil of these associations is only moderately to slowly permeable to water and maintaining the surface soil on them is a critical problem. These characteristics encourage farmers to take good care of these soils.

Some of the differences in management come about because many farmers think they should manage some soils better than others. Furthermore, it is usually much more costly and difficult to apply good management to a naturally poor soil than to a naturally productive one.

Corn yields as related to soils and soil management. In the corn-yield data[1] two tendencies were apparent (Table 2).

[1] In Bulletin 522 of this Station, hybrid corn yields on various soil associations for 1937-1944 were reported. Largely because of two relatively low years, 1935 and 1936, yields in the period covered by this study averaged about 10 bushels an acre under those reported in Bulletin 522. Otherwise, yields reported here and in Bulletin 522 are comparable on those soil associations where the soil management was comparable.

One was for yields to be highest on the better soils. For example, on the highly productive Saybrook-Lisbon-Drummer and MuscatineX-SableX soils, the yields were high, as was the soil-management index; while on the Harrison-Herrick association, both the yields and the soil-management index were the lowest of those for any group.

The second tendency was for corn yields to be relatively high on less-than-the-best soils when not too much of the land was kept in soil-depleting, cultivated crops. The contrast between the yields on Tama-Muscatine farms, 64 bushels an acre, and Flanagan-Drummer farms, 61 bushels an acre, well illustrates this tendency. (Both the yields and the soil-management index for Flanagan-Drummer soils were low, however, compared with those reported in Bulletin 522.)

Grain production. The proportion of tillable land in the farm as a whole and the proportion of tillable land that can be planted to various crops, as well as crop yields, determine the acre-contributions various crops make to the total production of a farm. Comparison of the Muscatine-Sable farms with the Clinton silt loam farms illustrates this point.

On the Muscatine-Sable farms, where 94 percent of the land was tillable, 49 out of each 100 acres were in corn and soybeans and the corn yield was 67 bushels an acre. On the Clinton silt loam farms, where only 65 percent of the land was tillable, 22 out of each 100 acres were in corn and soybeans and the corn yield was 53 bushels an acre.

Nearly three times as many bushels of corn and soybeans were grown per 100 acres on the Muscatine-Sable farms as on the Clinton farms. The oat production was more than 50 percent greater on the Muscatine-Sable farms.

Soil Types and Livestock Organization

In the area covered by this study there were more livestock on the associations containing combinations of Tama, Muscatine, and Sable, and on the Tovey-Bolivia-Ipava, and Saybrook-Lisbon-Drummer farms than on farms on the other associations. These associations, located in central, northwest, and northwest-central Illinois, are composed of gently sloping to somewhat rolling soils on which rather high percentages of hay and pasture must be grown. But they are also soils that yielded from 60 to 67 bushels of corn an acre under cropping systems that kept from 43 to 45 percent of the tillable land in corn and soybeans (Table 2). Thus their soil characteristics suit them to livestock farming.

The location of the Tovey-Bolivia-Ipava, Tama-Muscatine, and Tama-Muscatine-Sable farms southwest of Chicago enables livestock shippers to make use of relatively favorable freight rates. All these livestock farms are also comparatively near local markets.

The kinds and numbers of livestock on the farms in this study were measured in two different ways: (1) by the value of the feed fed per acre to all livestock except horses; and (2) by the number of cows milked and litters of pigs farrowed.

Feed fed per acre. On farms on three associations — Tama-Muscatine-Sable, Tovey-Bolivia-Ipava, and Saybrook-Lisbon-Drummer — more than $20's worth of feed per acre was fed to productive livestock (Table 3). These were the farms on which there were most hogs.

Of the farms composed of combinations of Tama, Muscatine, and Sable soils, most feed per acre was fed on those that contained all three types, Tama, Muscatine, and Sable. Most hogs were raised on these farms, and the proportion of land kept in hay and pasture was intermediate (Tables 2 and 3). On the Tama-Muscatine farms, where 31 percent of the tillable land was in hay and pasture, there were more beef cattle than on either the Tama-Muscatine-Sable or the Muscatine-Sable farms. The number of cash-grain farms and the percentage of land kept in corn and soybeans were higher on the Muscatine-Sable farms than on either the Tama-Muscatine or Tama-Muscatine-Sable farms.

Less feed per acre ($8's worth) was fed on the Flanagan-Drummer farms in east-central Illinois than on the farms on any other association. Also on the Proctor-Brenton-Drummer and Swygert-Bryce farms in this same area few livestock were kept.

Table 3. — Cows Milked, Litters of Pigs Farrowed, and Value of Feed Fed per Acre on Farms on Selected Soil Associations, Central Illinois, Yearly Average for 1935-1944

Soil associations	Number of cows milked	Number of litters of pigs farrowed	Litters per 100 tillable acres	Value of feed fed per acre to productive livestock
Tama silt loam and Muscatine silt loam	6	20	9.7	$20
Tama silt loam, Muscatine silt loam, and Sable silty clay	4	26	10.2	22
Muscatine silt loam and Sable silty clay	6	19	7.0	16
Muscatine X and Sable X[a]	4	16	5.6	16
Tovey silt loam, Bolivia silt loam, Ipava silt loam, and Ipava silty clay	6	31	14.6	21
Saybrook silt loam, Lisbon silt loam, and Drummer silty clay loam	6	21	8.2	22
Flanagan silt loam and Drummer silty clay loam	5	10	3.6	8
Proctor silt loam, Brenton silt loam, and Drummer silty clay loam	6	11	4.5	12
Elliott silt loam and Ashkum clay loam to silty clay loam	6	16	7.9	15
Swygert silt loam to silty clay loam and Bryce clay loam to clay	5	11	3.7	10
Harrison silt loam, Herrick silt loam, and Herrick clay loam	6	18	8.3	17
Clinton silt loam	11	19	10.3	13

[a] Uncorrelated brown silt loam and black clay loam associated. No official names assigned.

Most hogs raised in McDonough county. More litters of pigs were farrowed on the Tovey-Bolivia-Ipava farms concentrated in McDonough county in the west part of the area under study than on farms on any other association. The next largest number were farrowed on the Tama-Muscatine-Sable farms located in the western half of the area. And as would be expected from the amount of feed fed per acre, there were fewest on the Flanagan-Drummer farms. The range was from 10 to 31 (Table 3). Thus more hogs were raised on Grade 1 and Grade 2 soils[1] in the north and west parts of the area under study than on soils of similar grade in the southeast quarter.

Cows milked per farm. On most of these farms a few cows were kept to produce milk for home use. There was an occasional small commercial herd. On the prairie-soil associations the num-

[1] Soils with a productivity rating of 1 or 2.

ber of cows per farm ranged from 4 to 6 (Table 3). On Clinton soils the average number of cows was 11. Two of the five Clinton farms had herds of 20 cows.

RELATIVE EARNINGS AND EXPENSES

Findings in General

1. As the slope of the land increased, the acre-investment in operating capital became higher in relation to investment in improved land.

2. Gross earnings per acre were highest on level land where a large part of the farm was in corn and soybeans and large amounts of grain were fed.

3. The cost of operating power and machinery per crop acre was lowest on big, level grain farms, partly because the overhead costs were distributed over large acreages.

4. The cost of labor per crop acre was highest on the livestock farms that had to produce a great deal of forage to control erosion. The reasons were that the livestock itself, of course, took labor, and then labor costs had to be spread over small acreages since only comparatively small parts of these farms were planted to cultivated crops.

5. Heavy expenses for improvements went with livestock farms.

6. The cost of feed and livestock was highest on the rolling soils that had to be kept in legumes and grasses a good part of the time.

7. Net earnings per acre were about twice as much on the best as on the poorest soils.

8. The index of earnings from real estate ranged from 100 on Muscatine-Sable soils to 55 on farms where Clinton silt loam predominated.

9. The thickness of the loess, the slope of the land, and the texture of the till were very important in accounting for differences in the earnings from various soils.

Investment Structure as Related to Soils

We are concerned here with capital investment. The figure denoting this investment is made up of: (1) an estimate of the long-time market value of the land[1]; (2) the inventory value of buildings and land improvements; and (3) operating capital. Operating capital consists of the beginning-of-the-year value of livestock, feed, and machinery.

The acre-value of land and improvements is influenced by the quality of the land and the capital invested in tile, buildings, fences, limestone, and rock phosphate. The investment in buildings varies with the amounts and kinds of livestock kept; and since the livestock farms in this study were located on rolling-to-rough land, the tendency was for high investments in buildings to go with low investments per acre in land.

As the slope of the land increased, the investment in operating capital rose in relation to the investment in land and buildings, as the farms on the Harrison-Herrick and Clinton soils demonstrated. Though the operating investment on these farms was the lowest, it was high in proportion to the investment in land and buildings (Table 4).

On the Saybrook-Lisbon-Drummer soils, largely livestock farms, the capital invested per acre in land and buildings was $168; the operating capital, $56 an acre. But on Flanagan-Drummer soils, grain farms, the acre-investment in land and buildings was $155 and the operating capital only $37 an acre.

Soils and Gross Earnings

As might be expected, gross earnings were highest on those farms that: (1) had a high percentage of tillable land; (2) had a high percentage of that tillable land in corn and soybeans; (3) had high crop yields; and (4) fed large amounts of feed to livestock. Gross earnings for the farms in the different associations are shown in Table 5; the other details just mentioned are given in Tables 2 and 3.

On the Saybrook farms, where gross earnings were highest, 93 percent of the land was tillable and 45 percent of that was in

[1] The estimates used here for the long-time value of land were those placed on these farms during the depression.

Table 4. — Variations in Use of Capital on Farms on Selected Soil Associations, Central Illinois, Yearly Average for 1935-1944

Soil associations	Investments per acre			Percent operating capital was of investment in land and improvements
	Land and improvements[a]	Operating capital[b]	Total	
Tama silt loam and Muscatine silt loam	$140	$45	$185	32
Tama silt loam, Muscatine silt loam, and Sable silty clay	157	48	205	31
Muscatine silt loam and Sable silty clay	166	46	212	28
Muscatine X and Sable X[c]	171	49	220	29
Tovey silt loam, Bolivia silt loam, Ipava silt loam, and Ipava silty clay	134	44	178	33
Saybrook silt loam, Lisbon silt loam, and Drummer silty clay loam	168	56	224	33
Flanagan silt loam and Drummer silty clay loam	155	37	192	24
Proctor silt loam, Brenton silt loam, and Drummer silty clay loam	155	44	199	28
Elliott silt loam and Ashkum clay loam to silty clay loam	158	44	202	28
Swygert silt loam to silty clay loam and Bryce clay loam to clay	149	45	194	30
Harrison silt loam, Herrick silt loam, and Herrick clay loam	95	36	131	38
Clinton silt loam	107	34	141	32

[a] Values placed on land, buildings, and land improvements during and following a period of very low farm earnings.
[b] Beginning-of-year inventory of livestock, feed and grain, and machinery.
[c] Uncorrelated brown silt loam and black clay loam associated. No official names assigned.

corn and soybeans. The average corn yield was 67 bushels an acre, an average equaled only by the Muscatine-Sable farms. On these Saybrook farms $22's worth of feed was fed per acre, the largest amount fed on farms of any association except Tama-Muscatine-Sable. Though these farms perhaps best illustrate the combination of factors required for high gross returns, farms on four other soil associations, Tama-Muscatine-Sable, Muscatine-Sable, MuscatineX-SableX, and Tovey-Bolivia-Ipava, also had gross returns of over $40 an acre.

In contrast with the Saybrook farms were those on Clinton. On these farms only 65 percent of the land was tillable, and only 34 percent of that was in corn and soybeans. The average corn yield was 53 bushels an acre and only $13's worth of feed an acre was fed to livestock. The gross returns were only $28.67 an acre.

Table 5. — Gross Earnings, Operating Expenses, and Net Earnings of Farms on Selected Soil Associations in Central Illinois, Yearly Average for 1935-1944

Soil associations	Gross earnings per acre	Expenses per *crop* acre		Expenses per acre		Net earnings per acre[e]
		For power and machinery[a]	For labor[b]	For improvements[c]	Total operating[d]	
Tama silt loam and Muscatine silt loam	$36.39	$7.20	$10.13	$1.84	$16.98	$19.41
Tama silt loam, Muscatine silt loam, and Sable silty clay	42.63	6.18	8.47	1.84	18.99	23.64
Muscatine silt loam and Sable silty clay	42.05	5.82	7.68	1.68	16.17	25.88
Muscatine X and Sable X[f]	40.77	4.91	6.73	1.66	16.05	24.72
Tovey silt loam, Bolivia silt loam, Ipava silt loam, and Ipava silty clay	40.13	5.60	8.95	1.55	17.35	22.78
Saybrook silt loam, Lisbon silt loam, and Drummer silty clay loam	42.88	6.08	8.46	2.15	17.81	25.07
Flanagan silt loam and Drummer silty clay loam	33.57	4.89	6.56	1.33	12.88	20.69
Proctor silt loam, Brenton silt loam, and Drummer silty clay loam	35.00	5.58	7.79	1.63	14.36	20.64
Elliott silt loam and Ashkum clay loam to silty clay loam	38.68	5.10	7.20	1.59	16.12	22.56
Swygert silt loam to silty clay loam and Bryce clay loam to clay	30.14	4.82	6.36	1.75	13.18	16.96
Harrison silt loam, Herrick silt loam, and Herrick clay loam	32.89	5.90	9.70	1.43	16.40	16.49
Clinton silt loam	28.67	8.20	11.40	1.66	15.69	12.98

[a] Includes cash operating expenses and depreciation.
[b] Includes value of operator's labor and unpaid family labor at wage rate of hired men.
[c] Includes cash operating expenses and depreciation.
[d] Includes cash operating expenses, depreciation, and value of operator's labor and unpaid family labor at wage rate of hired men.
[e] Total earnings per acre less total operating expenses.
[f] Uncorrelated brown silt loam and black clay loam associated. No official names assigned.

Soils and Operating Expenses

Power and machinery expenses and labor costs were lowest on large grain farms. The average cost per crop acre for power and machinery ranged from $4.82 on the Swygert farms up to $8.20 on the Clinton farms (Table 5). Thus it was lowest on the large grain farms and increased with the numbers of livestock kept.

On these Clinton farms the relatively small number of crop acres over which the cost of operating machinery and equipment could be spread largely explains this high figure. The equipment required on the two Clinton farms that had dairy herds of 20 cows each also partly explains the high cost.

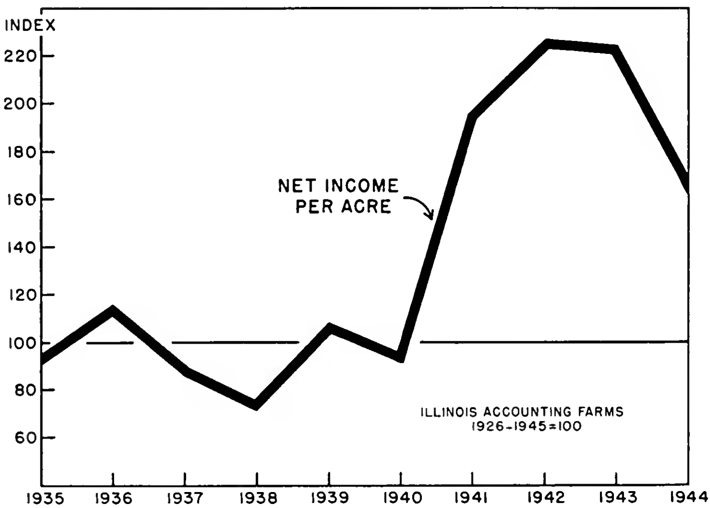
Like the cost of power and machinery, the cost of labor per crop acre was lowest on the large grain farms and increased with the amount of livestock kept. It ranged from $6.36 on Swygert farms up to $11.40 on Clinton (Table 5). (The operator's labor and unpaid family labor were included at a rate equivalent to the wages of a hired man.)

Annual expenses for improvements and total operating expenses were heaviest on livestock farms. In general, the heaviest annual expenses for improvements (buildings, fences, and soil improvements) were on the farms where large amounts of feed were fed per acre, particularly on farms where beef cattle were fed. Expenses for improvements ranged from $2.15 an acre on Saybrook farms down to $1.33 an acre on Flanagan (Table 5). The annual amount (depreciation plus cash operating expenses) charged to improvements was closely related to the capital invested.

Total operating expenses per acre were heaviest on the rolling soils that had to be kept in legumes and grasses a relatively large part of the time. These expenses increased with the value of the purchased feed that was fed. They were heaviest on Tama-Muscatine-Sable farms and lowest on Flanagan. The range was from $18.99 down to $12.88 an acre (Table 5).

Net Earnings

Ten and 20-year periods compared. Most farms in Illinois, not merely those in this study, had higher earnings for the 10 years 1935-1944 than for any previous ten-year period. Farmers keeping records in cooperation with the University of Illinois[1] had an average net income during these 10 years of $13.40 an acre a year, or $3.64 more than during the 20 years 1926-1945, when the average was $9.76, only 72.4 percent as much. In two of these years, 1936 and 1939, the net income, though below the 10-year average, was above the 20-year average, amounting to $11.06 an acre in 1936 and $10.33 in 1939. As a result of economic conditions during World War II, incomes for 1941-1944 were unusually high (Fig. 3).



The ten years 1935-1944 saw great changes in the average yearly net income of the account-keeping farmers whose records are the basis for this study. (Fig. 3)

Account-keeping farmers in Farming-Type Areas 3, 4, and 5 averaged even higher net incomes during both these 10- and 20-year periods than did all the cooperating account-keeping farmers in the state. They netted $16.25 an acre a year for the

[1] Sometimes called Illinois account-keeping farms.

10-year period and $12.10, or 72.7 percent as much, for the 20-year period.

These increases in net farm earnings for 1935-1944 are reflected in the earnings of the farms in this study, where all farms except Clinton netted more than $16.25 an acre (Table 5).

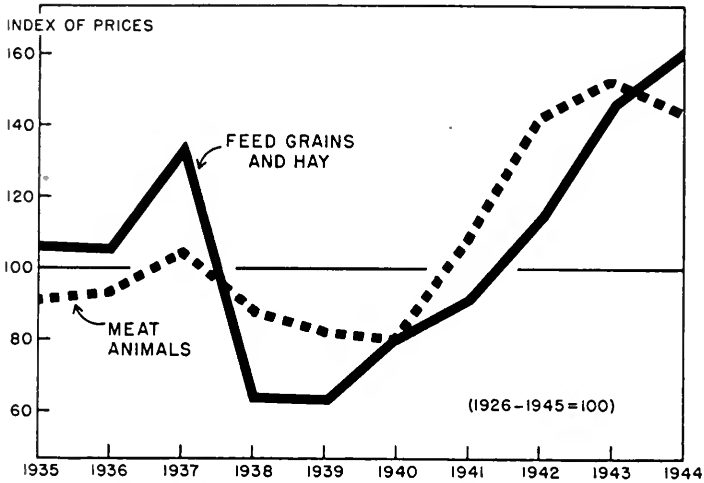
Best soils netted about twice as much as poorest. Net earnings per acre ranged from $25.88 on Muscatine-Sable farms down to $12.98 on Clinton (Table 5). Among prairie soils the Harrison-Herrick farms had the lowest net earnings, $16.49 an acre. All the associations containing a soil with a productivity rating of 1 had net earnings of more than $20 an acre. In this group the Proctor farms had the lowest earnings, $20.64 an acre. The Elliott farms were the only ones that did not include a soil with a productivity rating of 1 and had net earnings of more than $20 an acre.

Saybrook farms netted more than Flanagan. These two associations, which include Drummer silty clay loam as one of their soil types, furnish an interesting contrast in earnings. The Flanagan farms had an untreated-soil index[1] of 86, and 95 percent of the land was tillable. The Saybrook farms had an untreated-soil index of 78, and 93 percent of the land was tillable.

The Flanagan farms had less land in hay and pasture and more in corn and soybeans than the Saybrook farms. But on the Saybrook farms the corn yield was 6 bushels an acre higher. There were twice as many litters of pigs and almost three times as much feed fed per acre on these farms as on the Flanagan farms. Gross expenditures were higher on the Saybrook farms, but gross earnings were also higher, with the result that the net earnings per acre, the important figure, were $4.38 an acre higher (Table 5). On a 280-acre farm, which was about the average size of the farms in these two associations, this difference would amount to about $1,200 a year.

The above contrast illustrates how some livestock farmers

[1] The untreated-soil index is the average of the estimated percentages of limestone, phosphorous, and potassium requirements of crops that are satisfied by the amounts of these elements naturally in the soil. The figures given above are for the associations, not the individual soil types.



During 1935-1944 the yearly price index for feed grain and hay fluctuated widely, as did also that for meat animals; but the average indexes for these two items for the entire period differed only a little. For meat animals the average was 108, for feed grains and hay 106. (Fig. 4)

whose soils are inherently less productive than those of cash-grain farmers can still come out ahead in crop yields per acre and net earnings. Their good soil management and *efficient* livestock programs account for their success.

Further evidence that these farmers' success was attributable to their good soil and livestock management, not to more favorable prices, was to be found in the relationship of the feed-grain index to the meat-animal index. During the ten years a fair balance existed between the prices of the two, as Fig. 4 shows. Those associations[1] containing farms on which a large number of litters of pigs were farrowed and on which relatively large amounts of feed were fed did have a slight advantage over the associations made up primarily of grain farms, but the advantage was very slight, the price index of meat animals being 108 for the ten years, that of feed grains 106.

The contrast in earnings between the Saybrook and Flanagan

[1] Among the various soil associations, the major differences in livestock organization were in the proportion of feed fed to hogs and beef cattle. On most of these farms, dairy, sheep, and poultry enterprises furnished only a minor amount of income.

farms, discussed above, suggests that any increase in earnings arising out of an operator's superior management (that is, in earnings above the direct costs necessary to obtain those earnings) should, it would seem only fair, go to the operator, not to the landlord in the form of higher rent and higher capitalized value.

Soils and Returns From Real Estate

Net earnings per acre, just discussed, show the combined returns from land, capital, and management. They include not only a return from the use of the land, but if the productivity of the land has not been maintained, they also include an amount that really represents a loss of land value rather than true earnings from its use.

The returns from real estate (land, buildings, and land improvements) were calculated by deducting from the net earnings per acre an amount that represents the use of the operating capital (livestock, feed, and machinery).[1] It is important to keep in mind that returns from real estate include also the return for the operator's management, and on a rented farm the landlord's management, as well as an amount covering some loss of land value where the soil has deteriorated.

The returns from real estate ranged from $23.58 an acre on Muscatine-Sable farms down to $11.25 on Clinton farms (Table 6). Of the prairie soils, the farms on the Harrison-Herrick and Swygert-Bryce associations had the lowest returns, $14.70 and $14.69 an acre.

Earnings as affected by three soil characteristics. Using the farms on Muscatine-Sable soils as a basis for comparison, an unadjusted index of earnings from real estate was calculated and is shown in Table 6. Clearly indicated are the effects of one or more of these three soil characteristics: (1) thickness of loess (silty, windblown material); (2) slope of land; and (3) texture of till (an unstratified glacial deposit) (Table 6 and Figs. 5 and 6). Slope differences are easy to see. A careful investigation of subsurface conditions is necessary, however, to determine the thickness of loess and the texture of the till underlying a soil. Anyone

[1] A charge of 5 percent of the average beginning-of-the-year investment in operating capital per acre was deducted from the net earnings per acre.

Table 6. — Earnings From Real Estate, on Acre Basis, From Farms on Selected Soil Associations, Central Illinois, Yearly Average for 1935-1944

Soil associations	Unadjusted earnings		Soil-management index	Earnings adjusted			Acre-value of land and buildings with adjusted earnings capitalized at 5 percent
				To uniform soil management		To uniform soil management and 1926-45 level of earnings[d]	
	Actual	Index[a]		Actual[b]	Index[c]		
Tama silt loam and Muscatine silt loam	$17.14	73	84	$17.35	74	$12.61	$252
Tama silt loam, Muscatine silt loam, and Sable silty clay	21.26	90	82	22.05	94	16.03	321
Muscatine silt loam and Sable silty clay	23.58	100	85	23.58	100	17.14	343
Muscatine X and Sable X[e]	22.28	94	87	21.77	92	15.83	317
Tovey silt loam, Bolivia silt loam, Ipava silt loam, and Ipava silty clay	20.57	87	79	22.13	94	16.09	322
Saybrook silt loam, Lisbon silt loam, and Drummer silty clay loam	22.28	94	85	22.28	94	16.20	324
Flanagan silt loam and Drummer silty clay loam	18.83	80	73	21.92	93	15.94	319
Proctor silt loam, Brenton silt loam, and Drummer silty clay loam	18.42	78	81	19.32	82	14.05	281
Elliott silt loam and Ashkum clay loam to silty clay loam	20.38	86	82	21.13	90	15.36	307
Swygert silt loam to silty clay loam and Bryce clay loam to clay	14.69	62	85	14.69	62	10.68	214
Harrison silt loam, Herrick silt loam, and Herrick clay loam	14.70	62	70	17.85	76	12.98	260
Clinton silt loam	11.25	48	74	12.93	55	9.40	188

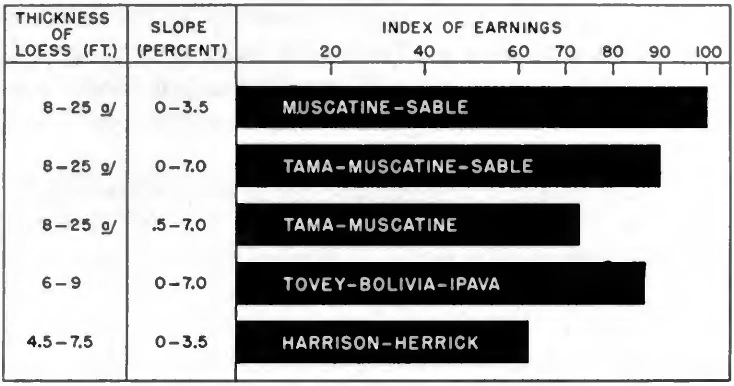
[a] Earnings expressed as percentage of earnings on Muscatine-Sable soils.

[b] Earnings adjusted by getting ratio of soil-management index of Muscatine-Sable soil to the soil-management index of each association and multiplying earnings per acre of each association by this ratio. For example, the ratio of the soil-management index of Muscatine-Sable soil to that of Tama-Muscatine-Sable soil was 1.037 (85 ÷ 82 = 1.037). Unadjusted earnings of Tama-Muscatine-Sable were $21.26. The adjusted earnings were $21.26 × 1.037 = $22.05.

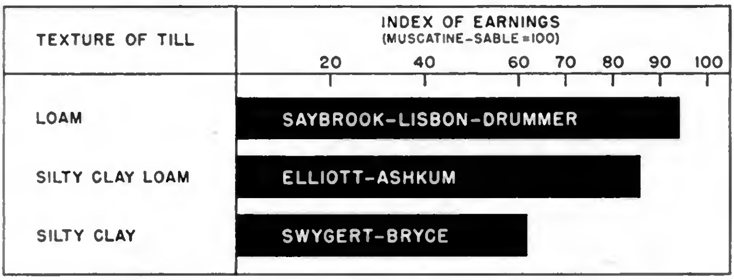
[c] Expressed as percentage of the adjusted earnings on Muscatine-Sable soils.

[d] Earnings on Illinois accounting farms in Farming-Type Areas 3, 4, and 5 in 1926-1945 were used as basis for this second adjustment. For the 20 years they were 72.7 percent as high as the earnings for 1935-1944.

[e] Uncorrelated brown silt loam and black clay loam associated. No official names assigned.



Among these upland loess-derived soils, earnings from real estate were highest on those that had the deepest loess and were most nearly level. (Fig. 5)



On these upland soils derived from glacial till, earnings from real estate were highest where the till was permeable. (Fig. 6)

directly interested in the productivity of land must recognize the importance of these three soil characteristics.

On the soils in this study that developed from loess, earnings from real estate declined as the loess covering became thinner.[1] The Harrison-Herrick soils, where the loess is thin, earned only 62 percent as much as the Muscatine-Sable soils, where the loess is thick.

The three soil associations containing Tama, Muscatine, and

[1] Differences in depth of loess, as discussed here, mean differences in the amounts originally deposited, not differences caused by recent erosion. Under comparable conditions, soils that developed from thinner loess are more highly weathered and less productive than soils that developed from thick loess.

Sable soils showed the influence of variations in the slope of the land. As the percentage of Tama silt loam, a sloping soil, increased, earnings decreased, as shown by the fact that the unadjusted index of earnings from real estate dropped from 100 to 73 (Table 6 and Fig. 5).

As the till changed from a loam to a clay texture, earnings decreased, as three soil associations which occur in northeastern Illinois on a comparable range of slopes demonstrated. On Saybrook-Lisbon-Drummer soils, developed from loam till, the unadjusted index of earnings was 94; on Elliott-Ashkum soils, developed from silty clay loam till, it was 86; and on Swygert-Bryce soils, developed from silty clay till, it was 62 (Table 6 and Fig. 6).

Earnings adjusted for uniform level of soil management. As was previously pointed out, the level of soil management varied among the different soils. Net earnings from real estate reflect these variations and show the relative productive capacity of these soils as they were actually farmed. But from the point of view of the farmer who wants to buy a farm for his own use, such an index contains a weakness since he can, within limits, give any soil type he buys equally good management.

In order, therefore, to give a prospective buyer an idea of what a given soil type under good soil management may be expected to earn, an adjusted index of earnings was calculated (Table 6). In this adjusted index, the Muscatine-Sable association was again used as the base, differences in soil management eliminated, and the relative earning capacity of the various soil associations approximated.[1]

This adjusted index of earnings raises the earnings for all associations that had a soil-management index of less than 85. It lowers it for the MuscatineX-SableX soils, since these were the only farms that had a higher soil-management index than the Muscatine-Sable farms.

To the extent that it is more costly to achieve good soil management on some soils than on others, such an adjustment is invalid. Whether soil management is good, fair, or poor for a

[1] For explanation of how this adjustment was made, see Table 6, footnote b.

given soil depends on the extent to which the operator has put into effect the treatment and practices necessary to control erosion and put that particular soil at its most *economical* level of productivity.

Earnings adjusted to the 20-year level. Because the 1935-1944 earnings are thought to be higher than farmers will receive over a long future period (in terms of purchasing power if not in dollars), earnings per acre were adjusted to the 1926-1945 level by multiplying the earnings of the 1935-1944 period by 72.7 percent. (Farmers in Farming-Type Areas 3, 4, and 5 who kept accounts in cooperation with the University earned per acre in the 20-year period only 72.7 percent of what they earned in the 10-year period, as pointed out on pages 368-369). The adjusted earnings per acre are shown for each soil association in Table 6.

These adjusted earnings, however, still include returns from management as well as an amount covering some loss of land value in cases of soil deterioration. They also include earnings from livestock above the cost of production, which includes an interest charge of 5 percent on the investment in livestock, feed, and equipment.

INCREASE OF EARNINGS WITH GOOD SOIL MANAGEMENT

Findings in General

As the level of soil management improved, these things are to be noted:

1. Net earnings increased more rapidly than corn yields.
2. On the better soils both corn yields and net earnings per acre increased at a faster rate than on the poorer soils.
3. These farmers were well repaid for the costs of better soil management.

Corn Yields and Net Earnings

Corn yields generally increased as soil management improved. On four of the five selected soil associations named below, corn yields increased with improved soil management but the rate of change was not the same for all four. These increases in yields for each 10 points of increase in the soil-management index are summarized here:

Soil association	*Derivation*	*Increase in corn yields for each 10 points' increase in soil-management index, bushels per acre*
Tama-Muscatine-Sable............	Loess 8-25 feet thick	5.6
Harrison-Herrick................	Loess 4½-7½ feet thick	3.2
Saybrook-Lisbon-Drummer........	Permeable loam till	5.9
Elliott-Ashkum..................	Less permeable silty clay loam till	2.0
Swygert-Bryce...................	Slowly permeable silty clay till	0

(Note that two associations, Tama-Muscatine-Sable and Harrison-Herrick, developed from loess of different thicknesses; and three, Saybrook-Lisbon-Drummer, Elliott-Ashkum, and Swygert-Bryce, developed from glacial till differing in permeability and texture. For a discussion of these soils, see pages 352-354).

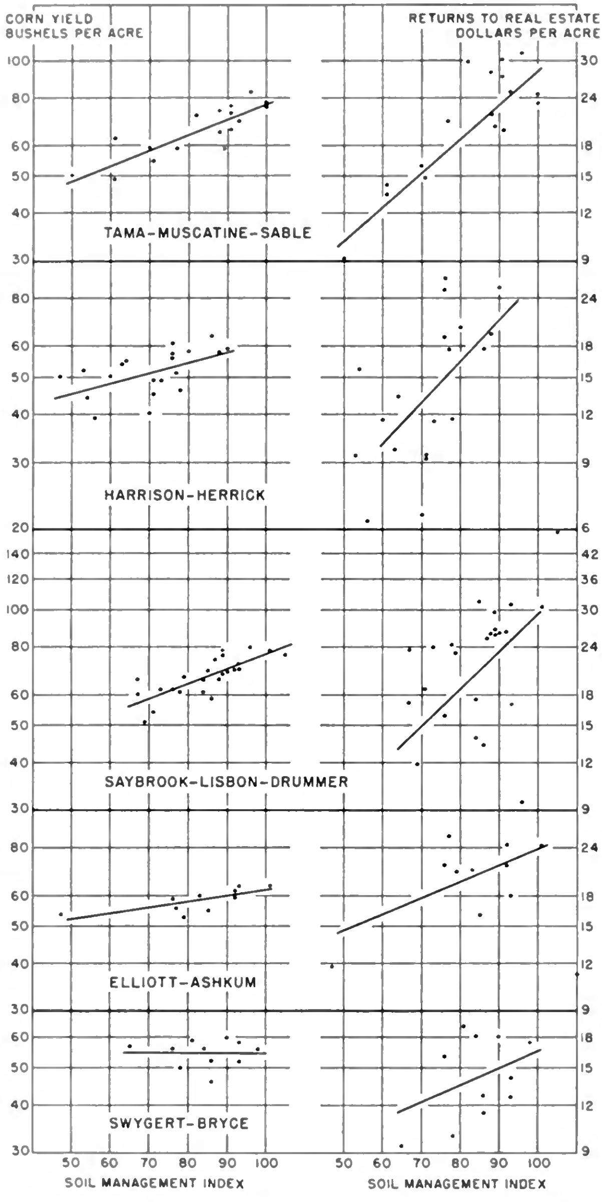
On the Swygert farms, corn yields did not increase with increases in the soil-management index. It may be that the physical properties of these soils placed a yield ceiling on them. As the range in soil management on them was narrow and the level high, it is possible that yields had reached their peak and had leveled off.

On the other associations in this study, corn yields and earnings also increased as soil management improved.

More detailed information concerning the relation of corn yields to the soil-management index is given in Fig. 7. The logarithmic scale shows differences in the *rate* at which corn yields changed with changes in soil management.

As level of soil management improved, earnings increased. On the farms in this study the range in soil management was smaller than it was on farms in general in central and north-central Illinois. Even so, it was higher on some soil associations than on others. For Saybrook-Lisbon-Drummer soils it was high, whereas for some associations with higher fertilizer requirement, such as Harrison-Herrick, it was low (Table 6).

Net earnings on the Saybrook-Lisbon-Drummer farms were likewise high, being half again as much per acre as those on the



On all soils except Swygert-Bryce, corn yields increased with better soil management. Earnings likewise increased with better soil management, and they increased faster than did corn yields. (On the Harrison-Herrick association, returns from real estate for one farm with an annual soil-management index of 47 and returns to real estate of $1.16 per acre could not be shown on the graph.) (Fig. 7)

Harrison-Herrick farms (Table 5). This contrast suggests that some farmers on the poorer soils may not have capital readily available for the best soil management. Such reasoning, however, does not explain the low soil-management index of Flanagan-Drummer soils. These are high-yielding soils, with a low fertilizer requirement. Moreover, corn yields remained relatively high on them even when a high percentage of the land was kept in soil-depleting crops, a minimum of legumes was grown, and a minimum of manure and minerals used. These soils are preferred by many landowners because the risk of erosion is small and yields hold up well with only fair soil management.

With better soil management, earnings increased faster than corn yields. The fact that net earnings per acre on all associations increased under improved soil management faster than corn yields suggests three things: (1) that these farmers were well repaid for the costs of better soil management; (2) that except for the direct costs of soil treatment, the cost of producing and harvesting a high yield differed little from the costs for an average yield; and (3) that the over-all managerial ability of these farm operators was positively associated with soil management. In other words, farmers who did a good job of managing their soils appeared to succeed in getting a good combination of land, labor, and capital; they managed their livestock well; and they tended to keep labor, power, and machinery costs low in relation to the amount of work to be done.

In proportion to the improvement in soil management, net earnings per acre increased more rapidly on good soils than on poor ones (Tables 5 and 6). The Saybrook-Lisbon-Drummer, Elliott-Ashkum, and Swygert-Bryce associations — all soils that varied in the texture of the till from which they developed — showed this clearly. For each 10 points of increase in the soil-management index, increases per acre in returns from real estate were: Saybrook-Lisbon-Drummer, $3.94; Elliott-Ashkum, $1.82; and Swygert-Bryce, $1.33 (Fig. 7).

SUMMARY AND CONCLUSIONS

Value and earnings of soils. Of the 203 central and north-central Illinois farms included in this study, those on the best soils earned almost twice as much an acre during the years 1935-1944 as those on the poorest soils. These farms were located on twelve soil associations common to the area.

While the earnings reported in this study must not be interpreted as predictions of future earnings, they should, with certain adjustments to uniform soil management prove a reliable guide to the *relative* worth of these soil associations. When such adjustments are made, the soil associations fall into the following rankings, Muscatine-Sable, which had the highest earnings, being rated as 100:

Muscatine-Sable	100	Elliott-Ashkum	90
Tama-Muscatine-Sable	94	Proctor-Brenton-Drummer	82
Tovey-Bolivia-Ipava	94	Harrison-Herrick	76
Saybrook-Lisbon-Drummer	94	Tama-Muscatine	74
Flanagan-Drummer	93	Swygert-Bryce	62
Muscatine X-Sable X	92	Clinton	55

Thus if a group of Muscatine-Sable farms were worth $400 an acre, a group of Proctor-Brenton-Drummer farms would be worth $328 an acre, and Clinton farms $220.

The above adjusted index may also be used as a rough guide to the relative value of other soils comparable to those included in this study.

High net earnings were obtained from soils that could produce high crop yields when a relatively large proportion of the farm was kept in corn and soybeans. Earnings were also high on sloping land when the rotation provided cover and the forage was efficiently converted to livestock and livestock products. In general, however, earnings declined as the loess covering became thinner, as the slope increased, and as the till changed from loam to clay.

Systems of farming. Since slope affects the proportion of land that must be kept in forage crops to control erosion, it is of particular importance in determining cropping systems and the kinds and amounts of livestock kept.

The location of the land with reference to markets and transportation is another factor, aside from soil characteristics, that influences farming systems, and hence earnings and the value of farm lands. Land values may also be affected by matters of location that are not directly related to farm earnings.

Soil quality and operating capital. Since the rolling farms had to grow large amounts of roughage in order to control erosion, the cost of improvements, livestock, and feed was higher on them than on grain farms. The cost of labor, power, and machinery per crop acre was also higher on the livestock farms than on grain farms.

Soil management and farm earnings. On all twelve soil associations good soil management paid off in higher earnings. With better management, the increase in net earnings was greater proportionately than the increase in corn yields. It was also greater on the better soils than on the poorer soils.

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