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FARM OPERATING EFFICIENCY INVESTIGATIONS IN VIRGINIA
1931 - 1938

Progress Report

By A. T. Holman, Agr. Engr., Bureau of Agricultural Chemistry and Engineering, U. S. Department of Agriculture, and J. L. Maxton, Assoc. Agr. Econ., and G. D. Kite, Asst. Agr. Engr., Virginia Polytechnic Institute

United States Department of Agriculture
Bureau of Agricultural Chemistry & Engineering
H.G. Knight, Chief
and
Virginia Polytechnic Institute
Department of Agricultural Engineering
C. E. Seitz, Head
Department of Agricultural Economics & Rural Sociology
H. N. Young, Head

1940

C O N T E N T S

FARM OPERATING EFFICIENCY INVESTIGATIONS IN VIRGINIA

Progress Report

Based on investigations conducted under a cooperative agreement between the Department of Agricultural Engineering and the Department of Agricultural Economics, of the Virginia Polytechnic Institute and the Bureau of Agricultural Engineering (Now Bureau of Agricultural Chemistry and Engineering) of the United States Department of Agriculture. The project was originally called Virginia Farm Development 1/

INTRODUCTION

The principal objective of the study is to determine on typical farms practical means and methods of overall farm improvement whereby land, fences, buildings, power, machinery, labor, capital, crops, livestock, and marketing, each, are properly developed for the best use and are brought into balance for the efficient operation of the farm as a whole. The data so obtained may be used in the development of principles and practices for general improvement of various types of farms in this region. Secondary objectives include a study of the factors causing farm improvement to lag behind industrial improvement, and the obstacles that retard the improvement of farms.

Twenty-five farms were selected throughout Virginia to represent a wide range of such variable factors as topography, soil, climate, rainfall, crops, livestock, markets, size of farm, and type of farming. The State map (fig. 1), soil types, as listed in Table 2, and area of farms (fig. 2), show the general range of these factors. Since the

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1/ Cooperating Agencies and Personnel:

Bur. of Agr. Chem. and Engin., U.S. Department of Agriculture: Geo. R. Boyd, Prin. Engr.; A.T. Holman, Agr. Engr.; Geo. R. Shier, Jr.Agr. Engr.

Virginia Polytechnic Institute. Dept. of Agr. Engin.: C.E. Seitz, Head; H.H. Gordon, Agr. Engr.; J.A. Waller, Jr. Agr. Engr.; G.D. Kite, Asst. Agr. Engr.

Dept. of Agr. Econ.: H.N. Young, Head; J.L. Maxton, Assoc. Agr. Econ.; W.J. Nukolls, Jr. Farm Manag. Spec.; K.E. Loope, Farm Manag. Spec.

County Agents: P.E. Baird; S.M. Cox; J.E. Delp; H.B. Eller; E.M. Jones; R.B. Hudgins; M.G. Lewis; H.S. Lippincott; W.H. Lyne; H.W. Ozlin; and T.O. Scott.

group of farms includes only a small number of many types, it is obvious that the results of the study will be of more value in revealing the range of conditions and problems of the several types of farms than a representative study of a uniform type of farming.

The project was organized in 1931 cooperatively by the Bureau of Agricultural Engineering, United States Department of Agriculture; the Department of Agricultural Engineering, Virginia Polytechnic Institute; and the Department of Agricultural Economics, Virginia Polytechnic Institute, to study typical farms throughout Virginia to determine their engineering and economic problems and, if possible, devise methods of solution. In 1931, 17 typical dairy, beef, truck, fruit, and general farms were selected in the Coastal Plain, Piedmont and Shenandoah Valley. In 1932 and 1933, 8 additional farms were included in southwest Virginia. The last group included a number of large general farms having beef cattle as their major enterprise. The farms were selected as typical in regard to the general type of farming practiced. The types of farms and their locations are shown on the outline map of Virginia, Figure 1.

The general procedure followed in these investigations involved the selection of cooperators, the preparation of farm maps showing land features and improvements, a coordinate study of all resources, an analysis of the farm business, and the preparation of new operating plans where necessary. The new operating plan, developed with the farmer, represented the general plan he desired to follow. Provision was made in the plan for the improvement of land, buildings, equipment, and management as a whole.

The engineering improvements involve drainage and land clearing, the control of erosion, irrigation, changes in size and shape of fields, relocation of fences and roads, the efficient use of power and machinery, and the correction of defects in buildings in regard to their location, design, and equipment. These physical improvements are coordinated to improve the operating efficiency of the farm unit as a whole. Such coordination involves not only the physical factors but also the crop and livestock enterprises, marketing, and management.

The farm management phase of development comprises the maintenance of soil productivity, the balancing of farm enterprises, the improvement of farm business methods, and better marketing practices. The coordination of engineering and management increases operating efficiency of the entire farm unit.

The farms were mapped by the Bureau of Agricultural Engineering. Farm management surveys, analyses, and recommendations were made by the Virginia Department of Agricultural Economics. Technical recommendations, advice and assistance were furnished by the Virginia Department of Agricultural Engineering for such physical improvements as drainage, erosion control, land clearing, fencing, field arrangement, roads, buildings, power, machinery, and equipment. Basic operating plans were developed

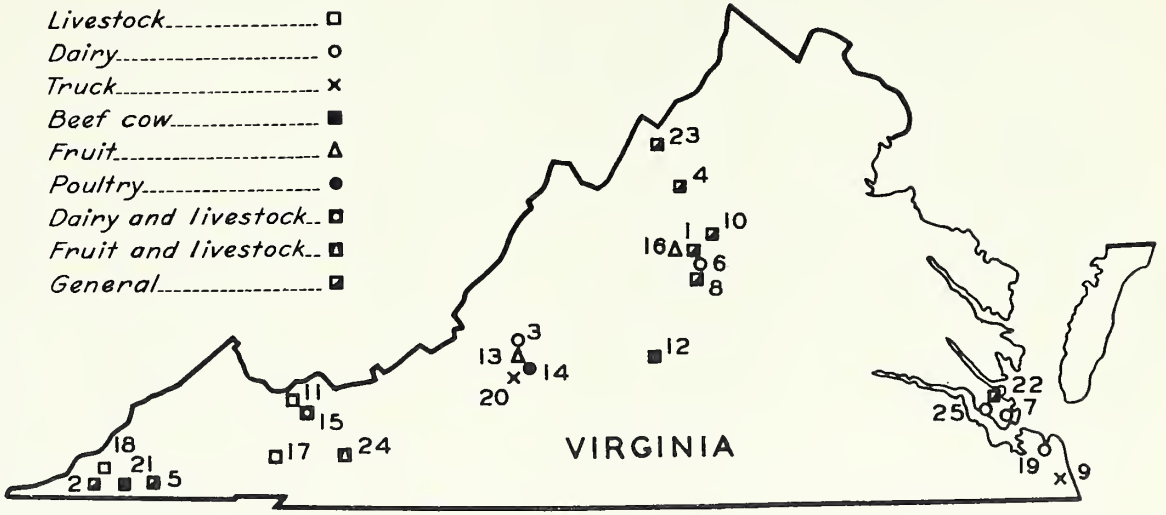


Figure 1.—Locations and types of farms

jointly by representatives of the agencies mentioned, the individual farmers, and the county agents. Additional technical advice and assistance concerning soils, crops, livestock, etc. were obtained from the Virginia agricultural extension specialists and research staff.

Mapping

Each farm was surveyed and mapped to show topography, location of roads, fields, fences, buildings, crop and field boundaries, and existing crops. The map was used as a basis for determining existing physical resources, drainage, erosion, land clearing problems, and irrigation possibilities, and as an aid in further study of farm development and organization. The same map serves as a basis for recording physical conditions as they existed at the start of the project and the changes that were made later.

Inventory of Resources

A farm management survey was taken on each farm at the start of the project. The results showed the types of farming followed, available equipment and the efficiency with which capital and labor were employed. An analysis of the farm management record was made to determine the strong and the weak points in farm business. The study in management and the study of available land, buildings, equipment, labor, and markets were used as a basis for the development of a new farm operating plan where necessary.

Operating Plan

The operating plan included the original topographic map with old field boundaries; a revised map with new field boundaries indicating the proposed improvements in land use, drainage, erosion control, fencing, field arrangement, roads, and the location of buildings; the characteristics, adaptation, and fertility requirements of the principal soils; a summary statement of the farm business record for the preceding year; recommendations for the adjustment of enterprises, improvements in livestock and crop production, and fertilizer application; the outline of a building program; provision for improving marketing methods; changes in the use of power and labor and a method of keeping farm management records.

The new operating plans were not merely general recommendations; they were practical working plans developed cooperatively by the agencies mentioned. They represented a composite of improved practices developed by experiment stations, county agents, and farmers. A representative farm operating plan is included in the appendix.

In the development of operating plans, the primary object was to utilize to the best advantage the existing farm resources. The cooperating farmers were responsible for the cost of all improvements. Each

farmer stood to gain or lose by adopting the practices developed in the plan. Since the plans were based largely upon the use of existing farm resources, major changes in area were not recommended or contemplated. Similarly, no radical changes were suggested in the type of farming. The new plan was based upon the continuance of enterprises that have proven practical in the past with any necessary changes or additions. Enterprises were adjusted and supplemented as required to provide a better balanced business with the use of available resources

GENERAL

Status of Cooperative Work

The initial work was started with the first farms in 1931 and with the last group in 1933. Farms Nos. 1, 3, 4, 6, 7, 8, 9, 10, 12, 13, 14, 16, 19, 20, 22, 23, and 25 were mapped in 1931, and Nos. 2, 5, 11, 15, 17, 18, 21 and 24 in 1933.

During the depression period and thereafter no farm was lost and none changed hands through necessity. Ownership has changed in only one instance, that of farm No. 3. In this case the original farm was expanded to take care of the necessarily increased dairy herd until further expansion seemed impractical in 1938. At that time the original small farm was sold and a much larger farm was purchased. The changes developed on the several farms have been gradual and progressive according to a systematic plan of development..

Soils, Topography, and Climate

The farms represent a wide variation in location, soils, topography, rainfall and growing season. However, these features are typical on each farm for the particular sections of the State in which the farms are located.

The principal soil types are given in Table 2 for each farm. Soil classifications were based upon detailed surveys, reconnaissance surveys, and general classifications as given in county and State soil maps. Specialists of the Virginia Department of Soils, the U.S. Bureau of Chemistry and Soils, and the Tennessee Valley Authority cooperated in soil surveys of the farms.

Soils on the farms located in the Tidewater section are typically grayish brown to black and in most instances require additional drainage. The soils of the farms in the Piedmont are grayish brown to red and the topography is rolling to hilly. In the hilly area erosion control is one of the important problems, while additional drainage is required along creek bottoms. The soils of the farms located in the Shenandoah Valley generally are yellowish brown, deep and friable and, with few exceptions, are well drained. In the southwestern part of the State, the soils vary from deep reddish brown soils in the valleys or rolling plateaus to shallow grayish brown soils on the steep slopes and hills. The latter are generally used for pasture and the former for crops.

Table 1.- Principal soil types

Farm No.	Soil types
1	Cecil loam, Durham fine sandy loam and Congaree fine sandy loam.
2	Clarksville silt loam, Westmoreland silt loam, Pope silt loam and Muskingum sandy loam.
3	Clarksville silt loam, Frederick silt loam and Pope fine sandy loam.
4	Pope fine sandy loam, Jefferson fine sandy loam and Frederick silt loam.
5	Dunmore chorty silt loam, Lebanon loam, Elober silt loam and Lodi loam.
6	Cecil loam, Cecil clay loam, Louisa loam and Congaree silt loam.
7	Lenoir gravelly silt loam and swamp.
8	Davidson silt loam.
9	Onslow fine sandy loam, Portsmouth fine sandy loam, Lenoir fine sandy loam and Bladen very fine sandy loam.
10	Cecil clay loam, Durham fine sandy loam and Congaree silt loam.
11	Hagerstown and associated soils.1/
12	Cecil sandy clay loam, Davidson clay loam and Congaree.
13	Muskingum loam, Muskingum loam - deep, Hagerstown loam and Hagerstown deep loam.
14	Clarksville silt loam, Frederick silt loam and Holston fine sandy loam.
15	Hagerstown and associated soils. 1/
16	Chester and associated soils.1/
17	Hagerstown and associated soils. 1/
18	Elk silt loam, Waynesboro silt loam, Muskingum fine sandy loam and rock land.
19	Lenoir very fine sandy loam, Bladen very fine sandy loam, Craven very fine sandy loam and swamp.
20	Hagerstown loam, Pope fine sandy loam, Clarksville silt loam and Frederick silt loam.
21	Russel silt loam, Emery silty clay loam, Melvin silty clay loam and rolling stony land.
22	Lenoir very fine sandy loam and Bladen sandy loam.
23	Frederick silt loam and Huntington silt loam.
24	Hagerstown and associated soils. 1/
25	Lenoir sandy clay loam, Bladen sandy loam and Craven silt loam.

1/ From Atlas of American Agriculture.

Rainfall and Growing Season

Rainfall records over a 20-year period indicate rather uniform rainfall for the four sections--southeast, Piedmont, Shenandoah Valley, and southwest. In the southeast and southwest the average annual precipitation is from 45 to 48 inches, while it is 40 to 45 inches in the Piedmont and Shenandoah Valley. The rainfall occurring in these areas during the growing season averages approximately 25 inches. Maximum rates of rainfall are 3 inches per hour in the eastern part of the State and about $2\frac{1}{2}$ inches per hour in the Shenandoah Valley and the southwestern part of the State. Maximum precipitation in 24 hours is 6 to 8 inches in the southeast, 4 to 6 inches in the Piedmont and Shenandoah Valley and 3 to 5 inches in southwestern Virginia. Each of the four general sections is subject to droughts of varying intensity and duration. Based upon records over a period of 20 years, the southeastern section may expect a period of 30 days with less than 0.25 inch of rainfall in 24 hours once in three years. Approximately the same condition may be expected in the Piedmont. In the Shenandoah Valley it is once in 4 years and in southwestern Virginia once in 6 years. These rainfall records aid in determining the cropping advantages, the drainage requirements, and the justification for installing irrigation.

The length of growing season varies for the different farming sections approximately as follows: Southeast, 220 days; Piedmont, 190 days; Shenandoah Valley, 175 days; and southwestern Virginia, 165 days. The average dates of the last killing frost in the spring are March 25 in the southeast, April 11 in the Piedmont, April 20 in the Shenandoah Valley, and April 25 in the southwest. The average dates of the first killing frost in the fall are November 1 in the southeast, October 20 in the Piedmont, October 10 in the Shenandoah Valley, and October 5 in the southwest.

Type of Farming

The 25 cooperating farms included 9 different types, as follows: 8 general, 5 dairy, 2 truck, 3 livestock, 2 beef cow, 2 fruit, 1 poultry, 1 dairy and livestock, and 1 fruit and livestock. These farms with few exceptions were not so specialized as to be dependent on a single enterprise. In most instances there were one or more major enterprises and two or more minor enterprises which combined to use effectively land, buildings, equipment, and labor for a balanced farm program.

Changes in Area

The area of each farm and changes in area from 1931 to 1938 are indicated in Figure 2. Seven farms increased in area by a total of 603 acres. One farm had a decrease in area of 327 acres. For the group as a whole, the net change averaged an increase of 11.1 acres per farm, or 3.7 percent.

In most instances this project is directed toward the improvement of existing farm lands rather than their expansion. The increases here

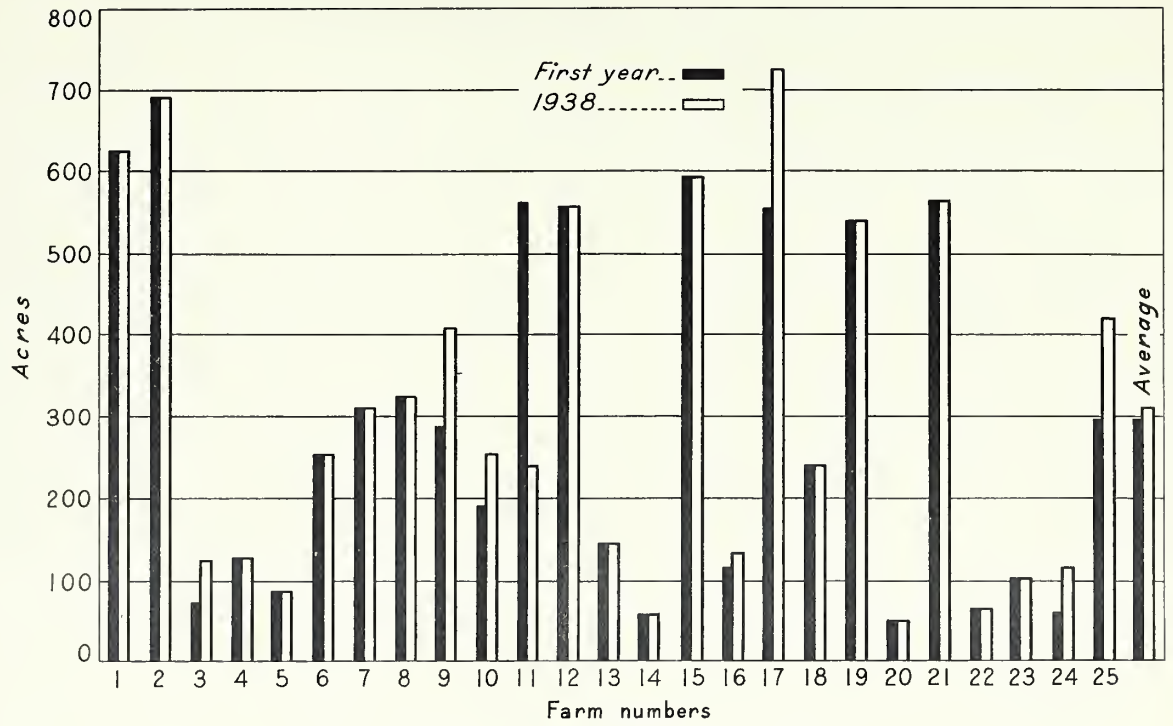


Figure 2.–Changes in farm area

were initiated entirely by the respective farmers. Analysis of the reasons for these changes in area shows that farm No. 3, a small dairy farm in the beginning, had steady and natural expansion in order to obtain adequate volume of business. The truck farm, No. 9, was increased in size to provide additional land better suited for some special truck crops and to provide a business for the son of the owner. Farm No. 10 was too small, irregular, and unproductive to provide adequate size of business for the owner. The new area purchased provided a more nearly balanced farm operating unit. Farm No. 11 was originally an estate totalling 568.1 acres. In settling the estate the area not belonging to the operator was sold and operations reduced to the operator's area of 241 acres. The fruit farm, No. 16, was largely used for apple production. It became necessary to establish a better balance between the production of apples and peaches. New land was purchased, therefore, for peach production. Farm No. 17 was enlarged by 173 acres. This expansion was forced in order to save the money loaned on the property. Farm No. 24 was enlarged for the natural expansion of the fruit and livestock enterprises and as a means of investing earned income. Farm No. 25 was expanded to produce the necessary feed for the steadily enlarging dairy herd.

Changes in Land Use

The changes in land use from the first year of operation to 1938 are shown in Figure 3. The cultivated crops, averaged for 25 farms, increased from 100 acres to 103.1. Pasture increased from 104.2 to 110.5 acres. Timber decreased from 76.5 to 72.4. The combined waste and service area decreased from 18.6 to 15.6 acres.

An analysis of changes in land use indicates that the waste per farm has been reduced by approximately 3 acres, which is equivalent to the increased cultivated area. In considering the entire group of farms, the total pasture area increased slightly more than the decrease of timber. The improvement of field boundaries, cleaning hedgerows, draining of wet spots, and other methods of reducing waste accounted for the increased area of cultivated land. The reduction in the area of timber was caused, in part, by the clearing of hedgerows, the removal of stumps, trees and boulders from cultivated land, and the removal of brush and excessive stumps from pasture.

Averaging the 25 farms shows approximately one-third of the area in crops, one-third in pasture, one-fourth in timber, and one-twelfth in service areas and waste. A balanced land use program requires such adjustment of crop land and pasture as will permit efficient farming. Also, it is necessary to provide for the profitable maintenance and utilization of the timber land. Waste land, idle land, and the areas subject to crop failure are reduced to a minimum by better land use practices, drainage, and erosion control. General improvements for the crop land include the drainage of wet spots by the use of tile drains, open ditches, or surface drains; the control of erosion by terracing, strip cropping, soil saving dams, grassed waterways, rotation and cover crops separately

or in combination, and the clearing of fields of stumps, stones, boulders, unsightly fence rows, and ditch banks. Pastures are improved by brushing, stumping, liming, seeding, mowing, and the control of gully erosion. Timber areas are improved by thinning, selective cutting, fire prevention, and restricted grazing.

Figure 3 shows that about one-fourth the average farm area is in timber or wood lots. Much of this land is unsuitable for cultivation or pasture. To a large extent the timber is cut over and of small size and inferior quality. A complicated problem of land use and timber management is involved in determining the proper care and use of the woodland, the cost of the necessary protection, and the economic value of the areas protected. Representative problems in land use and land improvement are suggested in Plates 1 and 2.

FARM DEVELOPMENT

Drainage

The determination of the drainage possibilities, the preparation of drainage plans, and the estimation of costs are primarily engineering duties. The determination of land use and cropping practices, rotations and cultural practices, and the general use of land improvement are in the field of farm management. But the farm management investigations alone do not reveal completely the possibilities and cost of drainage improvement, and the best plan to follow. Similarly, the engineer working alone cannot prepare the most economical drainage plan for the farm until the land use requirements are established and the general cropping plan is outlined. Thus the analysis of drainage requirements and the development of physically and economically sound drainage improvements involve concurrent study of the engineering and management phases of the problem.

Twenty of the 25 farms had drainage problems of varying importance as shown in Table 2. Farms Nos. 3, 4, 5, 10 and 24 had negligible drainage problems. Drainage was of major importance on farms Nos. 7, 9, 19, 22, and 25 located in the Tidewater area where the land is comparatively low and flat.

Open ditches were employed on farms Nos. 9 and 19. Both open ditches and tile were used on farms Nos. 7 and 22, while tile was used almost exclusively on farm No. 25. Tile was used on farms Nos. 7, 16, 19, 22, and 25 at the start of the project. In the last six years 30,000 feet of tile were installed on farm No. 25 and a total of 3,000 feet on farms Nos. 6, 16, and 22. Additional tile requirements and the total tile required for each farm are listed in Table 2. The table shows that 18 farms require a total of 367,300 feet of tile, averaging 20,405 feet per farm for the complete drainage of 725 acres, or 40.3 acres per farm. Approximately 37 percent of the total tile required has already been installed. Open ditches were used on a number of farms, while much of the area consisted of comparatively small wet spots on otherwise well-drained fields or farms.

Timber for farm buildings

Water for irrigation

Pasture on eroded land

Farm pond

Pasture an rock land

Brushing for pasture

Plate I.—Land, water and timber resources

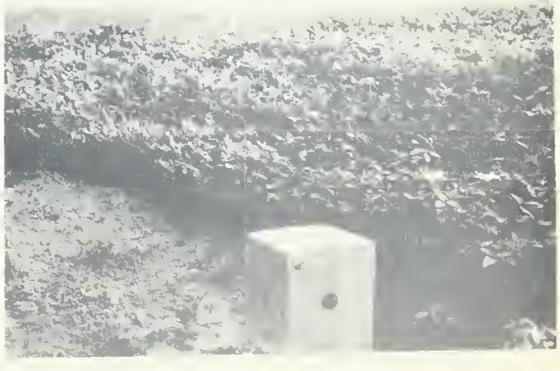
Overhead irrigation

Land clearing

Terrace

Open ditch

Strip cropping



Tiled land

Plate 2.- Land improvement

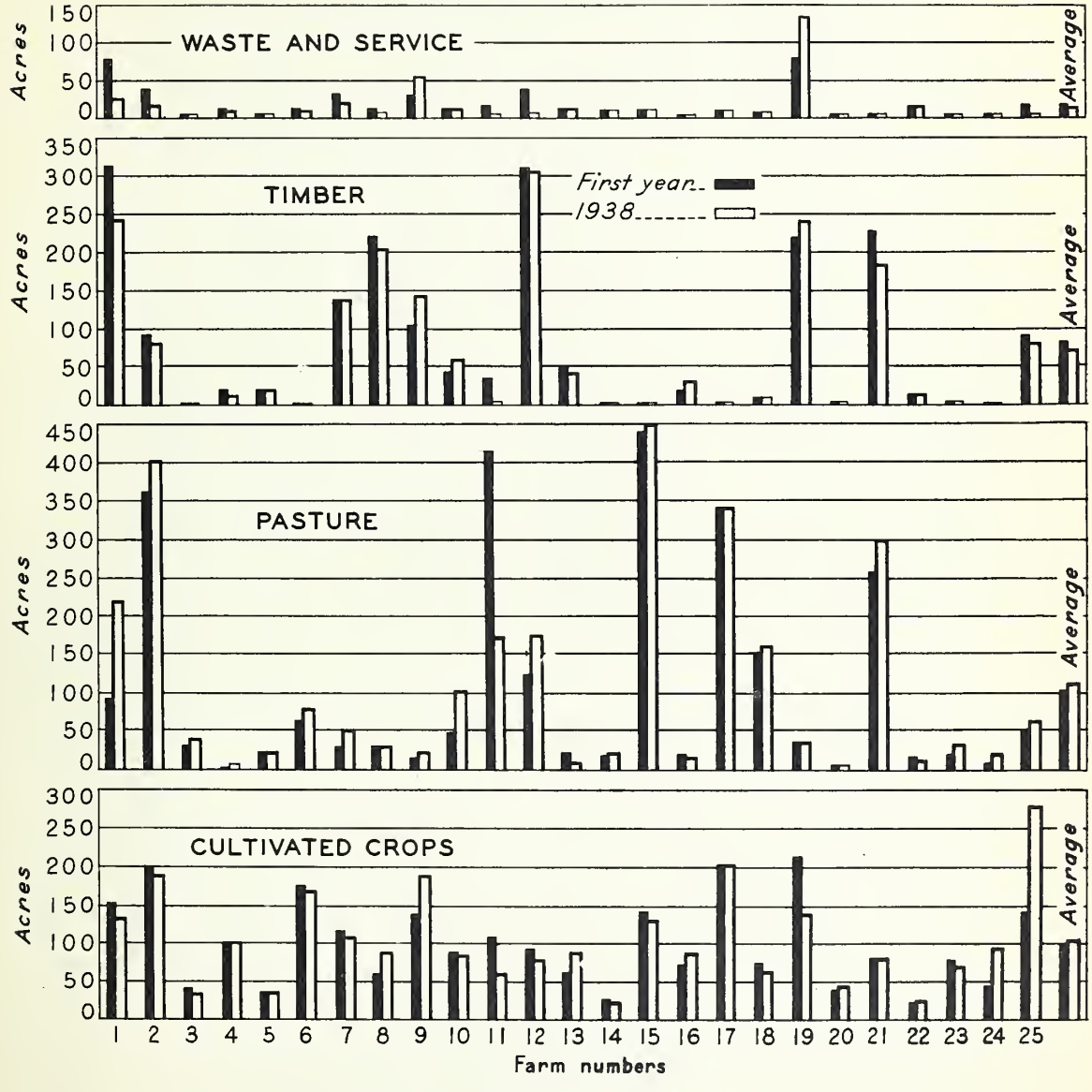


Figure 3.–Changes in land use

Table 2.- Tile Requirements.

Farm No.	Drain tile-- Installed to 1938	Drain tile-- Additional required	Drain tile-- Total	Area tiled to 1938	Additional area requiring tile	Total
	Feet	Feet	Feet	Acres	Acres	Acres
1	1,000	4,000	5,000	5	20	25
2	-	5,000	5,000	0	15	15
6	2,200	4,500	6,700	6	10	16
7	75,000	40,000	115,000	105	50	155
8	-	2,000	2,000	0	8	8
9	-	42,000	42,000	0	100	100
11	-	2,000	2,000	0	10	10
13	-	1,000	1,000	0	5	5
14	-	2,500	2,500	0	6	6
15	-	10,000	10,000	0	20	20
16	600	500	1,100	2	2	4
17	-	4,000	4,000	0	10	10
19	1,000	60,000	61,000	3	175	178
20	-	2,500	2,500	0	5	5
21	-	5,000	5,000	0	10	10
22	2,000	4,000	6,000	10	15	25
23	-	1,500	1,500	0	3	3
25	55,000	40,000	95,000	80	50	130

The tile program calls for the improvement of drainage conditions of the fields now being tilled to make them better adapted for crop production, and to eliminate open ditches that are costly to maintain and that hinder farm operations. Consideration is given first to these improvements rather than to the draining of additional land not now in cultivation.

Land Clearing

Land clearing plans provided chiefly for the improvement of the lands already in cultivation and in pasture rather than the clearing of new land. The principal type of clearing includes the removal of stray stumps and rock from cultivated land, the clearing of neglected hedgerows between fields, and the brushing of pastures. In some instances neglected fields have been brushed and stumped for either cultivation or permanent pasture. In a few cases additional land was cleared for cultivation. Plans likewise provide for the improvement of nondescript areas lying between the cultivated fields, pasture, and timber.

The status of land clearing of the several farms is shown graphically in Figure 4. Seven farms had no clearing problem. The clearing of 295 acres had been completed on 17 farms with the amount per farm varying from 1 to 100 acres. Land clearing programs had been completed on 5 farms while 13 farms had planned additional clearing, totaling 320 acres. Forty-eight percent of the clearing originally planned was completed by the end of 1938.

Pasture clearing generally involves the cutting of brush while stumps are left to decay in the ground. Stump pullers were used on farms Nos. 7 and 25. Dynamite is generally employed for cracking the large stumps and for blasting scattered stumps. Goats were used for brushing on farm No. 12. Goats eat the underbrush and the leaves and branches from felled trees. Clearing problems and activity are shown on plates 1, 2, and 8.

Irrigation

Most of the 25 cooperating farms had experienced two droughts since the project was started. Diversified crops, a combination of enterprises, timely production methods, storage facilities, and irrigation are means used to minimize the effect of droughts.

Irrigation was used on 4 of the 25 farms. The area irrigated had increased from 30 to 49 acres since the studies began, and five farmers planned to irrigate 29 acres more which would bring the total to 78 acres. Overhead irrigation, used on farm No. 20, prevented damage from frost. Three farmers used surface irrigation successfully with corn, apples, and alfalfa.

Irrigation development, plans, and possibilities are shown graphically in Figure 5. Sixteen farms had suitable land and water for irrigating about 215 acres or nearly three times the area now planned for irrigation. An overhead irrigation system is shown in Plate 2, and an irrigated crop in Plate 4.

Soil Erosion Control

Soil erosion is active on many farms, particularly those located on the Piedmont plateau. Erosion conditions are given by farms in Table 3. The study on individual farms shows a marked variation of the amount and degree of erosion. Farm No. 6 is the only one having negligible erosion. However, the eroding areas are small on farms Nos. 7, 19, 22 and 25.

Table 3 shows 12.8 percent of the area of the 25 farms is subject to severe erosion, 46.8 percent to moderate erosion, while little or no erosion occurs on 40.4 percent. Total and comparative amounts of moderate, severe, and negligible eroding land are shown graphically for each farm in Figure 6.

About 60 percent of the area of the 25 farms is subject to erosion. General methods of control are indicated in Table 3. Terracing was needed

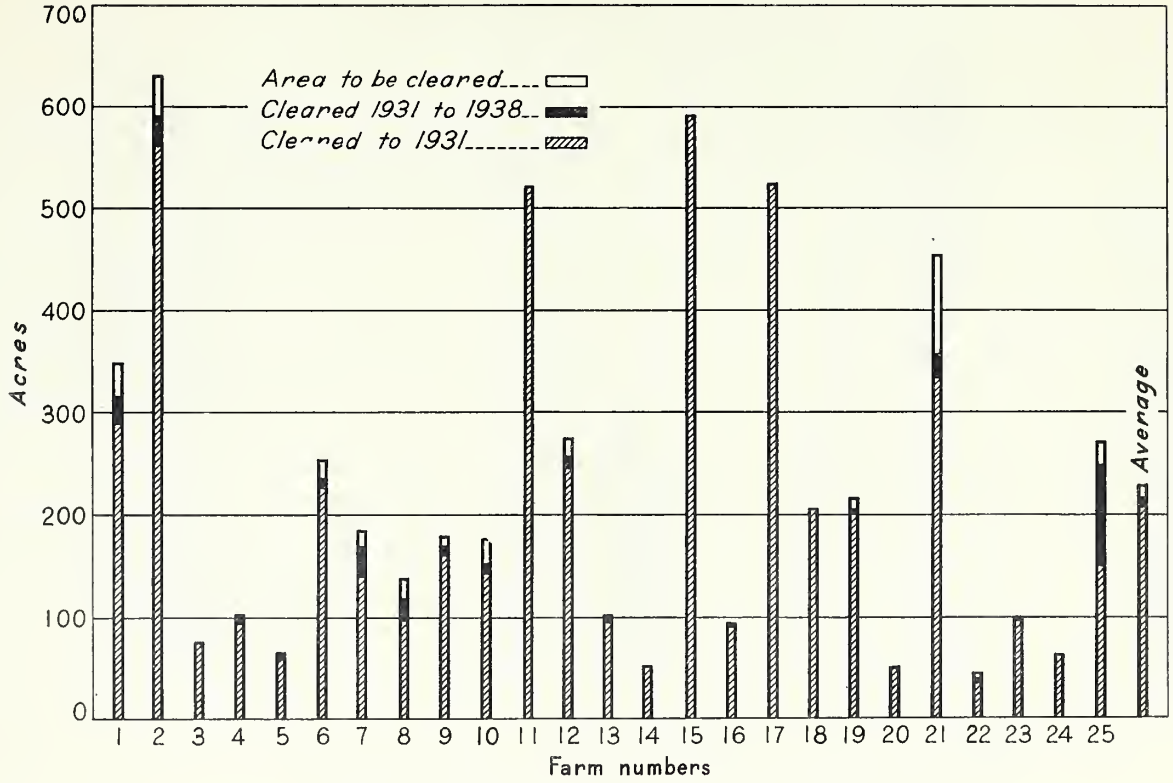


Figure 4.—Cleared land and land to be cleared

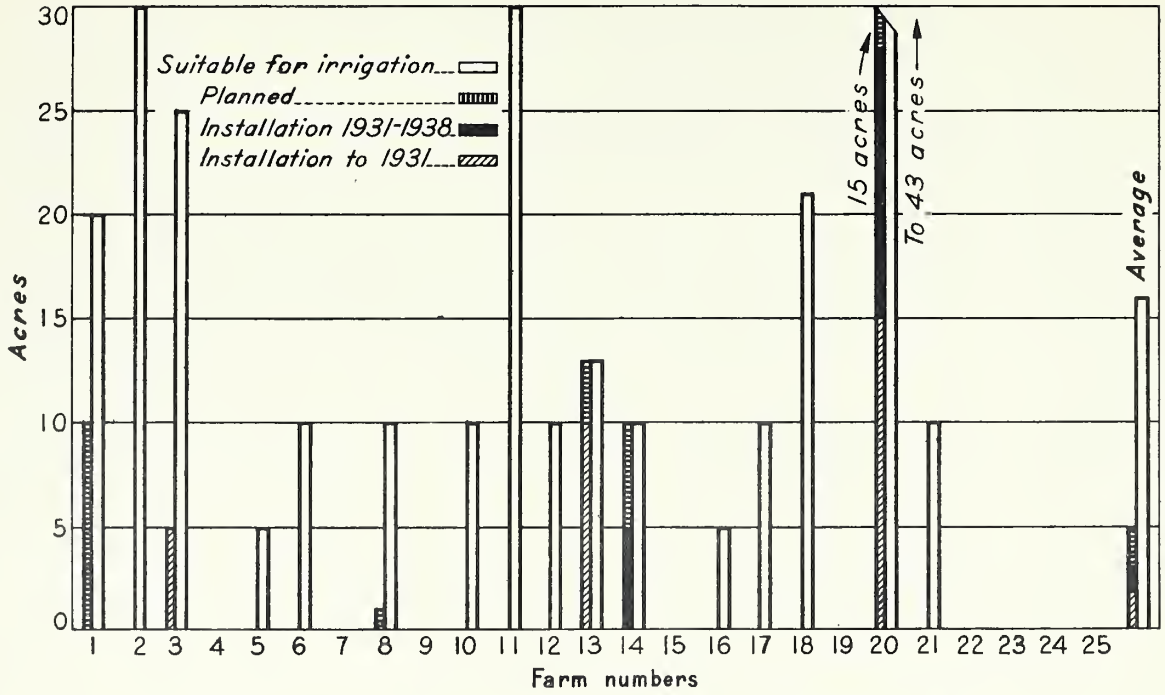


Figure 5.-Irrigation installations and land suitable for irrigation

Table 3.- Erosion Conditions (1931-1933)

Farm No.	Area Subject to Erosion			Treatment Required			
	None	Moderate	Severe	Terracing	Strip Cropping	Reforestation	Soil Saving Dams
	ACRES			ACRES			
1	350	200	75	50	50	50	25
2	90	400	200	50	50	50	20
3	10	60	0	20	20	0	0
4	38	85	5	40	40	0	3
5	3	65	5	0	20	5	1
6	50	150	55	80	80	3	10
7	175	5	0	0	0	0	0
8	20	60	60	50	50	20	5
9	285	0	0	0	0	0	0
10	20	90	10	30	20	5	5
11	40	180	20	0	20	0	5
12	20	200	25	70	60	5	10
13	15	65	20	25	0	0	2
14	25	25	5	15	10	5	3
15	580	10	2	5	0	0	1
16	20	70	10	20	0	0	5
17	50	450	50	50	100	0	20
18	15	210	13	0	40	0	2
19	200	7	2	5	0	0	1
20	10	30	10	20	5	0	3
21	55	315	200	30	30	50	20
22	45	5	1	2	0	0	0
23	5	90	5	25	20	0	2
24	20	40	0	5	0	0	0
25	290	7	0	0	0	0	0
Average for 25 Farms	97.2	112.8	30.9	23.7	24.6	7.7	5.7
Percent of Farm Area	40.4	46.8	12.8	-	-	-	-

on 592 acres on 19 farms; strip-cropping, 615 acres on 16 farms; reforesting, 193 acres on 9 farms, and gully control, 143 acres on 19 farms.

Erosion control requirements, and practices in effect in 1938 are shown comparatively in Figure 7. The conservation practices in use include 102 acres terraced on 6 farms, 226 acres strip-cropped on 8 farms, gully control structures on 118 acres on 17 farms, and reforestation of 61 acres on 5 farms. The four practices were used on 17 farms for the control of erosion on 507 acres representing slightly less than one-third the area requiring these methods of control. Erosion control methods are shown in Plates 1 and 2.

Improvement in Field Layout

One of the major purposes of the project is to change the size, number, and arrangement of fields for more efficient crop production. Such improvements generally involve the combining of two or more small cultivated patches into a field large enough for the efficient use of power and machinery. The improvements involve any one or a group of the following practices: tile drainage, terracing, the removal of small irregular areas of stumps and stone, and the relocation of fences.

Originally, there was an average of 16.6 fields per farm, averaging 7.7 acres each. In 1938 the average number of fields per farm had decreased to 11.9, averaging 11.6 acres. The plan provides for further reduction of the fields per farm to 7.3, and for increasing the size to 16.3 acres. About 50 percent of the field improvements planned had been made by 1938. The record of size, number, and changes in fields by farms is shown in Figures 8 and 9.

The benefits derived from field improvements include: (1) reduction of waste land, (2) reduction in fencing, (3) elimination of harbors for insects, disease, and rodents, (4) more efficient tillage, and (5) facilitation of crop rotations. Field improvement plans were so developed that these benefits could be obtained at minimum cost and minimum disturbance to the cropping program during the period of transition.

Fencing

The fencing of farm land varies in accordance with the amount and kind of livestock to be fenced in or out and the size, number, and arrangement of field. Frequently fencing is considered as a necessary evil of minor importance and is therefore neglected in development of plans. Fencing is an item of considerable importance as is shown in Table 4.

The amount of fence on these farms ranged from approximately one-half mile to over 11 miles with an average of 4.74 miles for the 25 farms. The new plan provided for reducing the length of fence to 4.4 miles per farm or 7.2 percent. The development of additional pasture and the necessity of fencing stock out of permanent timber combined to partly offset the reduction of fence resulting from rearrangement of fields.

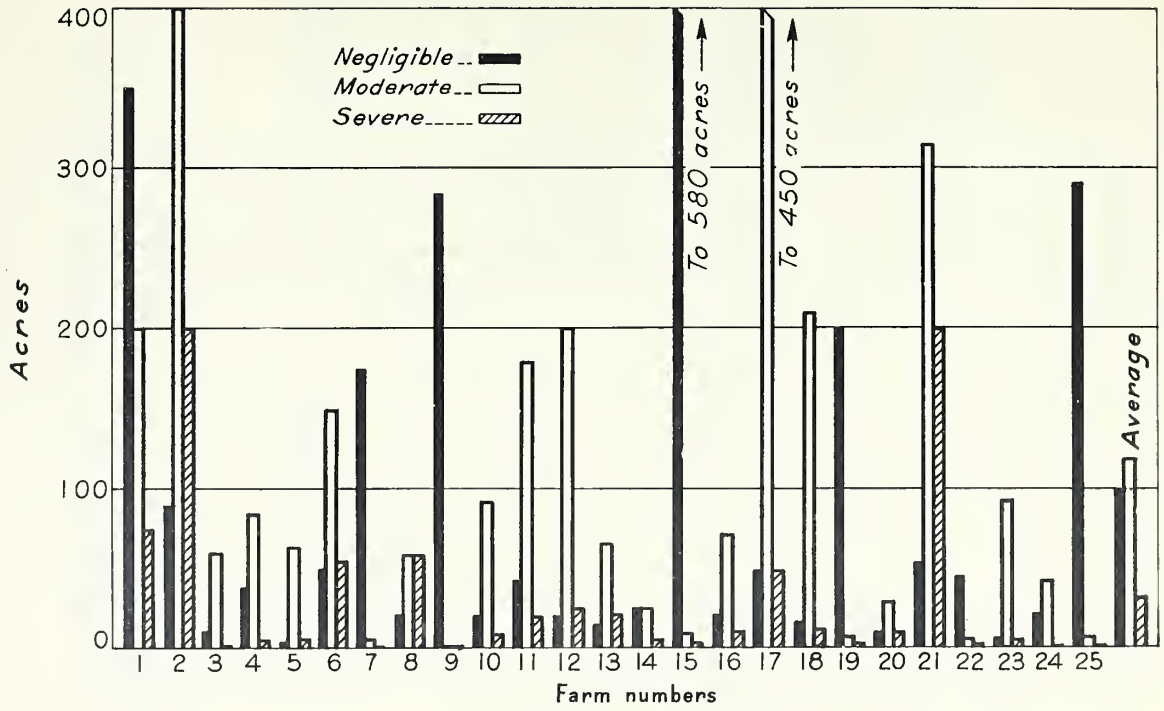


Figure 6.- Erosion conditions

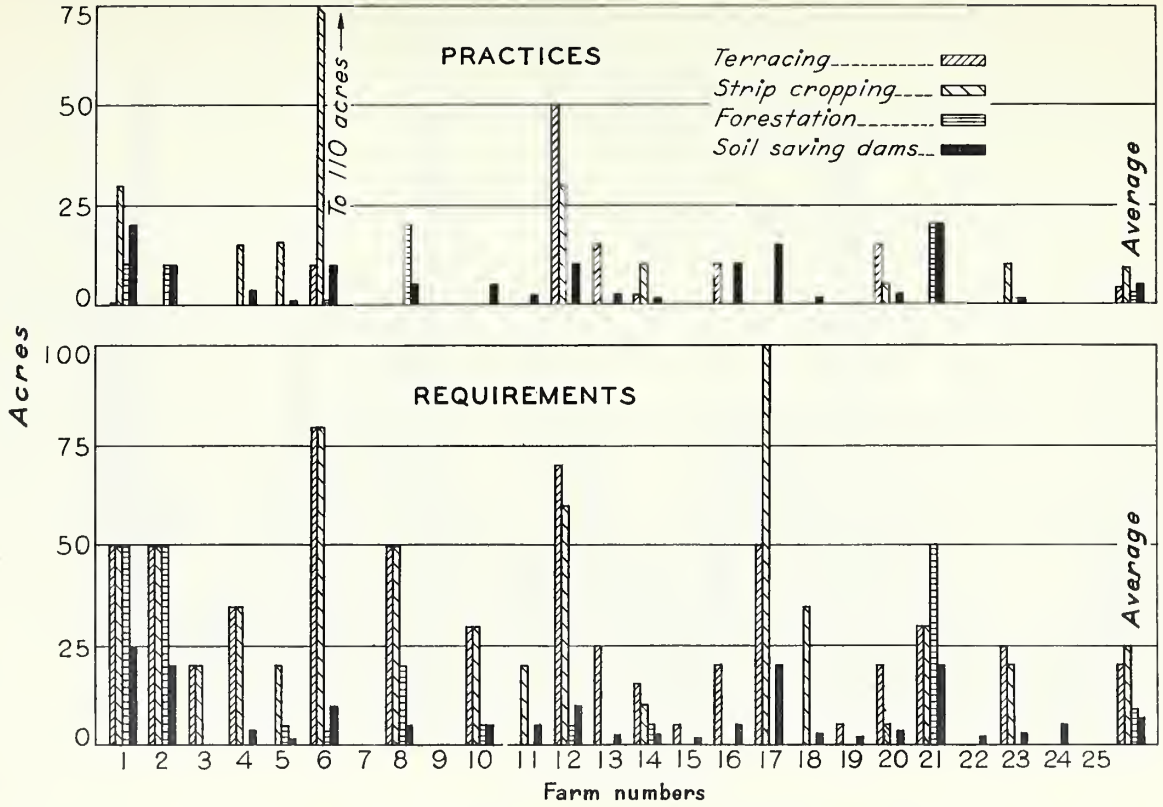


Figure 7.- Erosion control practices and requirements

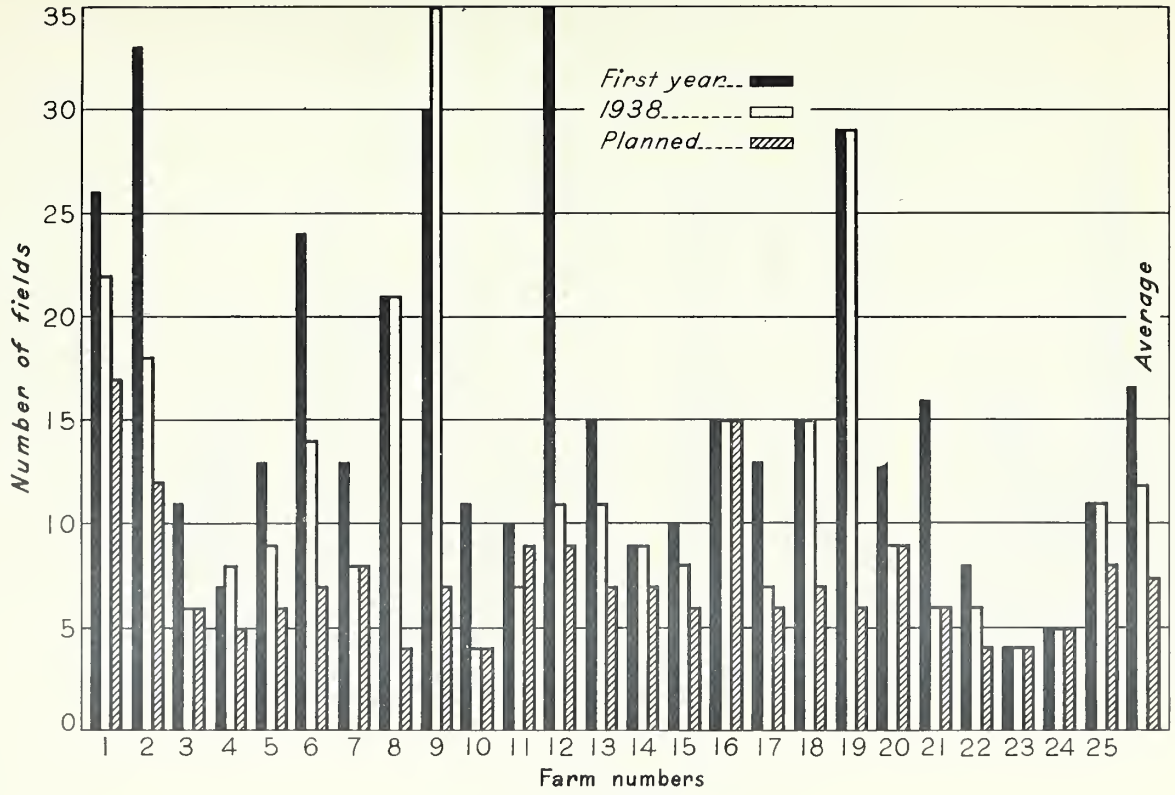


Figure 8.-Fields per farm

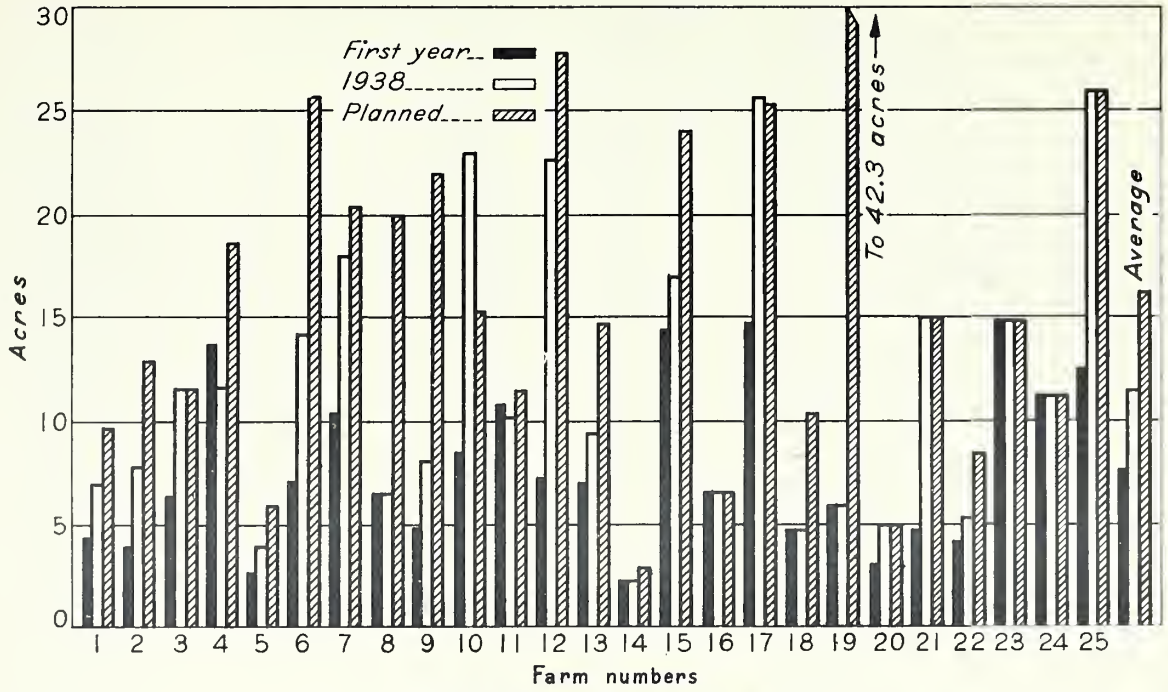


Figure 9.—Average size of fields

Table 4.- Fences Needed and Built

Farm No.	Fences In use at Beginning	Fences Needed in the New Plan	Permanent Fence Built Before Survey	Permanent Fence Built Survey to 1938	Temporary Fences Built Survey to 1938	Kind and Condition
	Feet	Feet	Feet	Feet	Feet	
1	46,800	40,400	10,000	3,000	3,000	Fair, barb wire, woven wire and rail.
2	54,500	53,500	5,000	20,000	4,000	Old fences are being replaced with good woven wire.
3	14,000	14,000	10,000	4,000	700	Good, woven wire.
4	18,000	18,000	18,000	4,200	1/ 3,000	Fences generally good woven wire.
5	13,600	13,000	10,000	2,000	0	Generally good woven wire.
6	26,300	16,300	5,000	3,000	8,000	Generally fair woven wire and barb wire.
7	21,700	23,100	8,000	2,000	0	Generally fair woven wire.
8	15,100	12,900	3,000	2,000	2,000	Fences are fair rail and woven wire.
9	23,300	23,300	4,000	2,000	10,000	Fair woven wire hog fence.
10	21,600	14,700	10,000	5,000	0	Good, including many old rail fences.
11	50,500	49,200	5,000	22,200	0	Good woven wire built on all of home place.
12	33,700	29,000	10,000	2,000	5,000	Rail, barb wire and woven wire.
13	24,000	22,500	15,000	4,000	2,000	Fair to good.
14	12,000	11,000	2,000	1,000	3,000	Generally poor woven wire.
15	58,100	57,500	35,000	15,000	0	Generally excellent woven wire fence.
16	5,900	5,900	5,900	1,000	0	Generally good woven wire.
17	30,200	57,700	20,000	20,000	0	Good woven wire, some barb.
18	21,200	19,600	12,000	7,000	0	Generally good woven wire.
19	9,400	16,000	6,000	0	1,000	Woven wire, fair.
20	2,600	2,000	1,000	1,000	0	Exclusive of line fence, good.
21	33,600	33,600	0	6,000	10,000	Fair, rail, barb and woven wire.
22	11,300	8,000	2,000	1,000	1,000	Fences generally old and poor.
23	12,200	12,000	8,000	4,000	0	Good, efficient woven wire.
24	7,300	6,500	6,000	500	0	Generally good woven wire.
25	27,800	20,400	10,000	6,000	0	Generally good woven wire.
Miles per Farm:	4.74	4.4	1.7	1.0	0.38	

1/ Electric.

Twenty-four of the 25 farms improved their fences since this project was started. Thirty-six percent of the permanent fences were built before the beginning of this study and 22 percent were built since. Fences per farm built since the project was started average 5,516 feet of permanent fence and 1,998 feet of temporary fence. Typical fences are shown in Plate 3. Rail fences were used and kept in good order on a number of the farms. Electric fence is used on one farm.

Farm Roads

The location of farm roads should be considered carefully in relation to efficient operation of the farm. Improperly located and poorly maintained roads make the movement of crops, and equipment slow and difficult and cause excessive breakage of equipment.

When the survey was made, roads per farm varied from 1/20 mile to 2-1/3 miles and averaged 3/4 mile. The total amount of roads was reduced by only 1.3 percent from the survey to the end of 1938. The plans provided for reducing the average road requirement from 0.75 mile per farm to 0.68, a reduction of 9.6 percent.

The mileage of roads per farm is of less importance than their quality and serviceability in enabling the rapid and easy movement of equipment, supplies, and products with minimum loss of time and money. Roads per farm are shown in Figure 10. Plate 3 shows a well-graded road, cattle guards, and a substantial bridge built of creosoted lumber to insure a long period of service.

Road Efficiency

The total length of roads or the length of roads per acre cultivated is not a measure of road efficiency. Steep grades must be avoided and rough and soft spots must be corrected. The efficiency of serviceable roads can be determined by computing "Acre miles of roads per acre," as follows:

1. Determine the distances in miles from the farmstead to the service point of each field.
2. For each field, multiply the area in acres by the distance in miles; the product is acre miles.
3. Add together the acre miles for each field giving acre miles per farm.
4. Divide acre miles per farm by the total area of all fields. The results is acre miles per acre.

Farm roads per acre and acre miles per acre are given in Table 5 for each farm. The summary and average show that plans provide for reducing the farm roads by 9.6 percent. The improvement of the size and shape of fields and the improved location of fences and roads provide 23 percent reduction of roads in acre miles per acre.

Figure 11 shows, for each farm, the roads in feet per acre cultivated and in acre miles per acre cultivated. Farm No. 20 affords an in-

Cattle guard

Bridge of creosoted lumber

Modern fence

Post-rail fence

Rail fence

Water in pasture

Plate 3.– Roads and fences

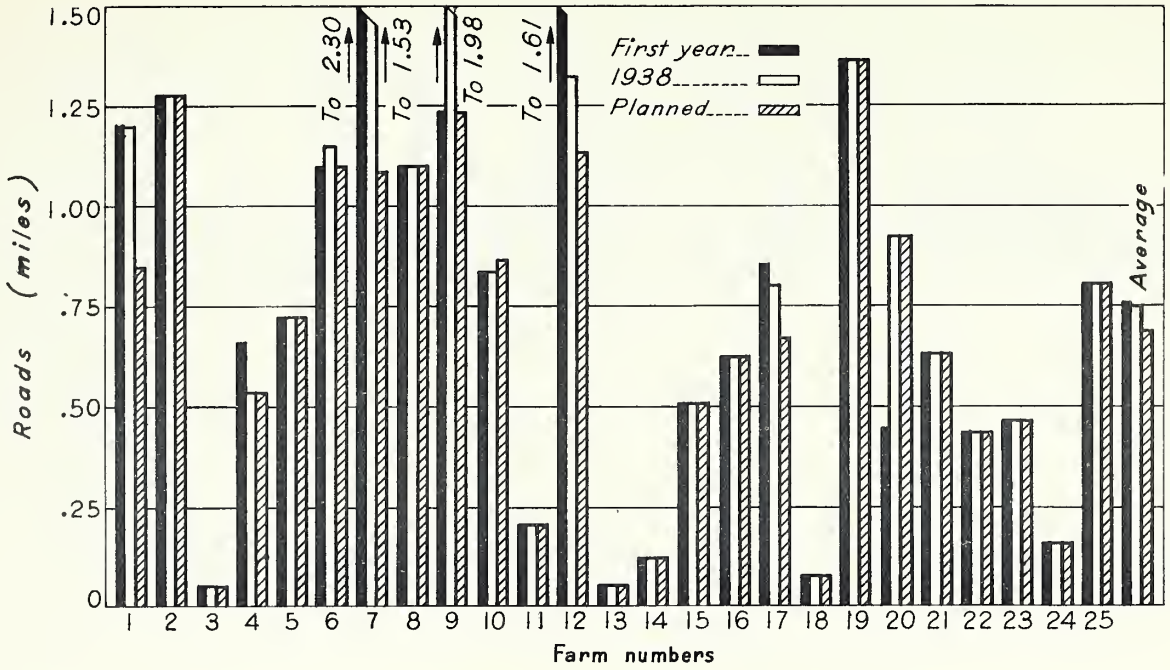


Figure 10.—Miles of road per farm

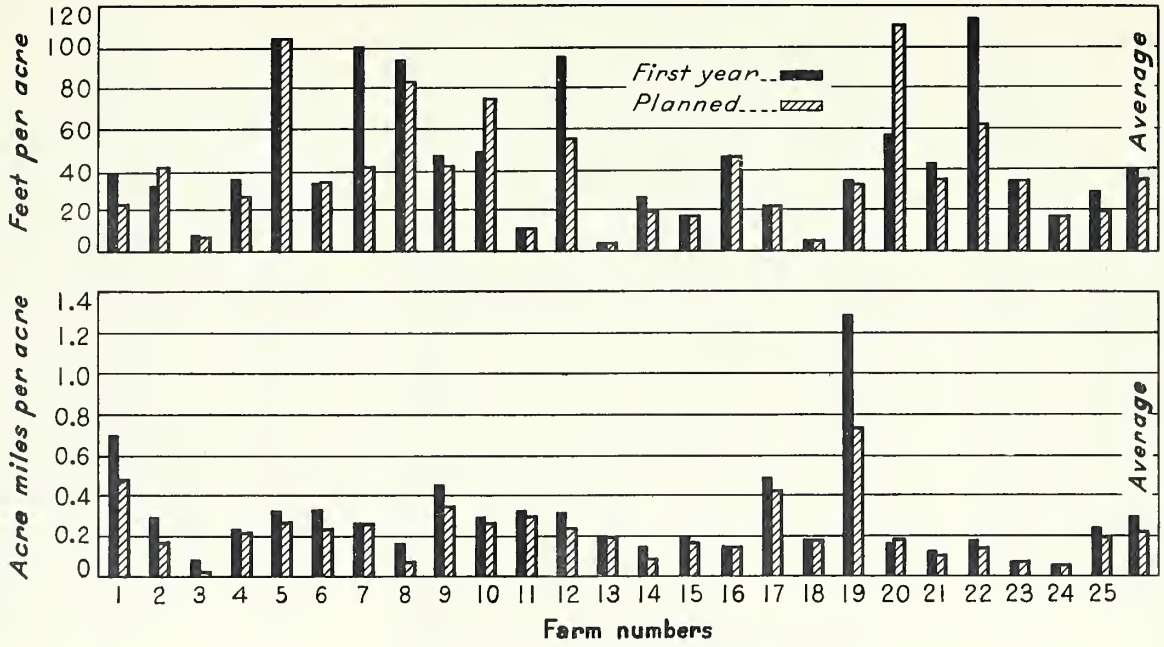


Figure 11.- Roads per cultivated acre

Table 5.- Road mileage, crop area, and acre miles per acre, first year and as planned

Farm No.	Farm roads		Crop area		Roads per acre cultivated		Acre miles per acre cultivated		Percent change
	1st Year	Planned	1st Year	Planned	1st Year	Planned	1st Year	Planned	
	Miles	Miles	Acres	Acres	Feet	Feet			
1	1.15	0.85	151.3	193.1	40	23	0.69	0.47	- 31.9
2	1.27	1.27	202.8	163.3	33	41	0.29	0.17	- 41.4
3	0.05	0.05	40.5	38.1	7	8	0.09	0.02	- 77.8
4	0.66	0.53	101.6	101.6	34	28	0.24	0.21	- 12.5
5	0.72	0.72	36.6	36.1	104	105	0.31	0.28	- 9.7
6	1.10	1.10	178.8	168.7	34	34	0.33	0.23	- 30.3
7	2.30	1.08	117.9	138.2	103	41	0.26	0.26	0
8	1.10	1.10	62.5	75.0	93	83	0.17	0.08	- 52.9
9	1.23	1.23	136.6	154.2	48	42	0.41	0.35	- 14.7
10	0.83	0.87	89.1	61.0	49	75	0.28	0.27	- 3.6
11	0.25	0.25	107.2	107.2	12	12	0.32	0.30	- 6.3
12	1.61	1.13	90.5	108.5	94	55	0.33	0.24	- 27.3
13	0.05	0.05	65.2	78.7	4	4	0.20	0.20	0
14	0.12	0.12	25.7	22.5	25	20	0.16	0.09	- 43.8
15	0.50	0.50	143.9	143.9	18	18	0.19	0.17	- 10.6
16	0.62	0.62	70.0	70.0	47	47	0.14	0.14	0
17	0.85	0.66	203.3	152.1	22	23	0.49	0.43	- 12.3
18	0.07	0.07	72.1	72.1	5	5	0.18	0.18	0
19	1.36	1.36	208.8	217.4	34	33	1.27	0.72	- 43.3
20	0.44	0.92	40.0	43.5	58	111	0.16	0.18	+ 12.5
21	0.62	0.62	78.4	90.3	42	36	0.12	0.10	- 16.7
22	0.43	0.43	19.6	37.0	116	62	0.10	0.15	+ 50.0
23	0.46	0.46	75.3	70.3	32	35	0.07	0.07	0
24	0.15	0.15	44.2	43.2	18	18	0.05	0.05	0
25	0.80	0.80	139.0	209.9	30	20	0.23	0.19	- 17.4
Total, 25 farms	18.74	16.94	2,500.9	2,595.9	--	--	0.08	5.55	--
Ave. per farm	.75	.68	100.0	103.8	40	34	0.29	0.22	- 23.0
Percent	100.00	90.39	100.0	103.8	100	85	100.00	77.00	--

teresting comparison between the two methods used in studying the relation of roads to area cultivated. The roads were practically doubled in feet per acre from 1931 to 1938, but the area of cultivated land was increased, the roads better located, and improvements were made in the size and shape of fields, resulting in only 12.5 percent increase of roads in acre miles per acre.

CROPS

The crops grown on the 25 farms included corn, oats, wheat, barley, rye, alfalfa, red clover, timothy, orchard grass, oat grass, soybeans, cowpeas, lespedeza, sugar cane, potatoes, sweetpotatoes, various truck crops, small fruit, apples, peaches, and tobacco. Representative crops are shown in Plates 1, 2, and 4.

The crop acreage is summarized in Table 6 with similar crops grouped in classes. The table gives the crops grown the year the study was started and in 1938, and the crops outlined in the original plan. Double cropping was practiced on 5 to 10 percent of the crop land.

Feed crops occupied 89.6 percent of the crop land the first year of the project and 91.4 in 1938. The comparison of feed crop area used for corn, small grain, and hay is given at the bottom of Table 6. The farms are being developed to produce and use more home-grown feeds. The cropping area for individual farms is shown in Figure 12 for the first year of the project and 1938.

Crop Rotations

Good rotations had been used on many of the cooperating farms but in numerous instances crop rotation was practiced on only part of the cropped area. Small fields of irregular shape, gullies, wet spots, stumps, and improperly located fences combined to make systematic crop rotation difficult. Rotations were developed for each farm to provide better use of land, labor, and equipment, better crop production schedules, and protection of the land against erosion and depletion of plant food. The rotations were based upon the results of the State experiment stations and adapted to the particular requirements of the farms concerned.

The principal crop rotations developed in the initial operating plans are listed in Table 7. They were planned to provide the necessary feed, and adjusted to fit into the new field plan so the rotation will be automatic after it is established. In some instances two or more rotations were established to provide for tobacco, truck, and other special crops.

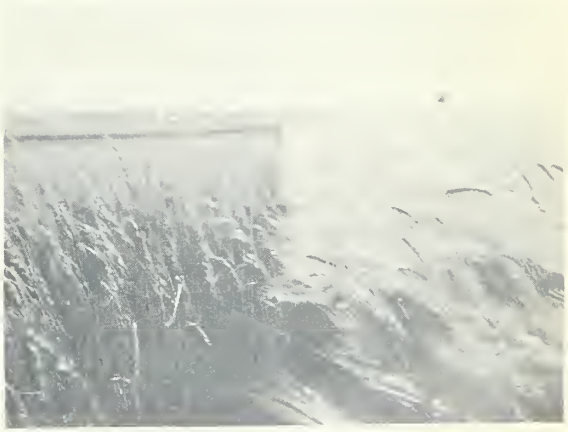
Soil Fertility Practices

The control of soil erosion, the rotation of crops, and the use of legumes, cover crops, lime, fertilizer, and manure combine for the general improvement of soil fertility. The value of lime, fertilizer, and manure used on 12 farms is given for 1931 and 1937 in Table 8. The table shows 59 percent increase in the value of lime, 45 percent increase in fertilizer

Burley tobacco

Irrigated squosh

Corn ond clover



Oat-grass and borley

Wax beans

Cobboge

Plate 4.- Farm crops

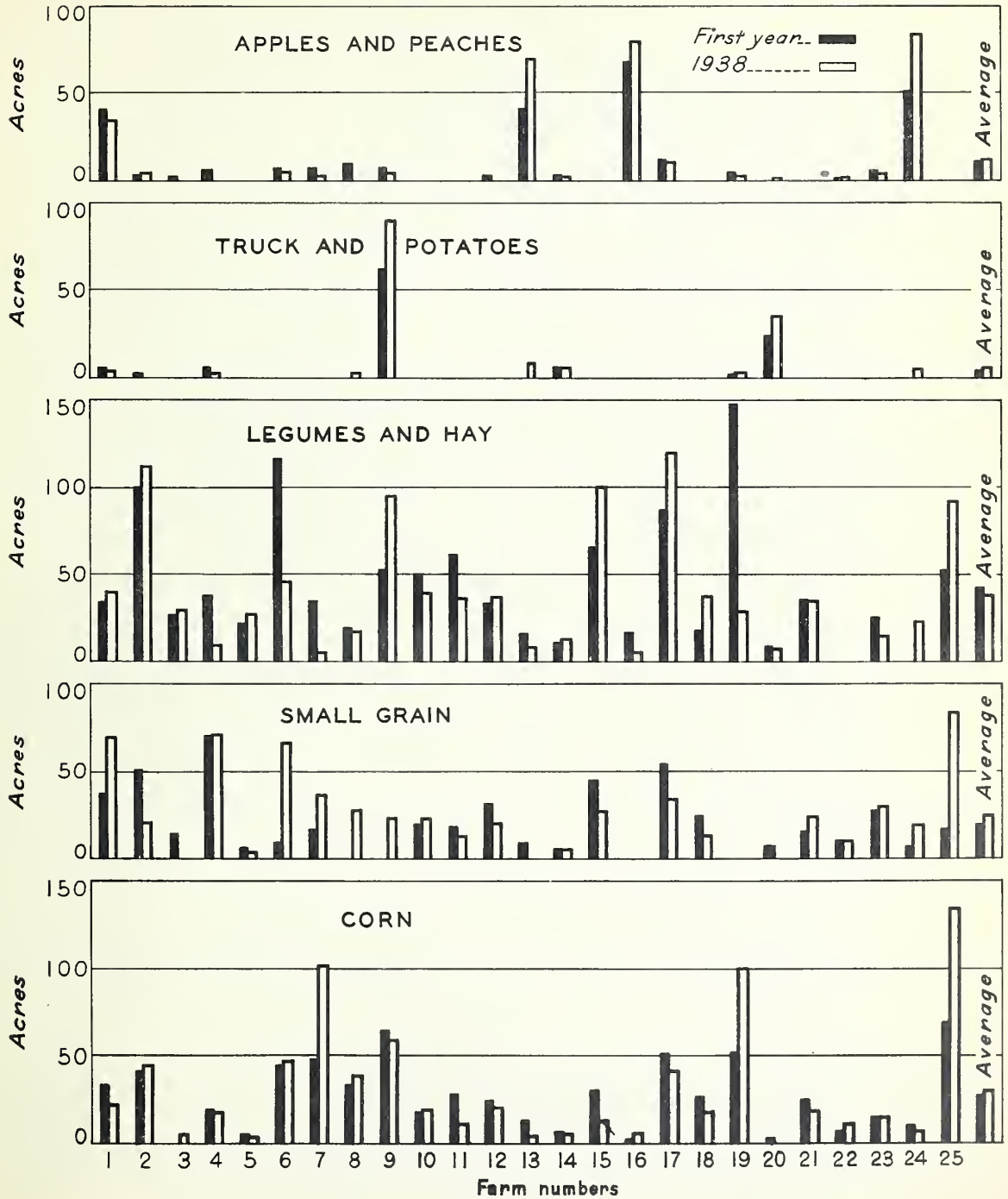


Figure 12.- Acreage of different crops

Table 6.- Comparison of acrease in various crops

Crops	First year	1938	Planned
	Acres	Acres	Acres
Corn	684.7	761.6	636.2
Small Grain	497.0	631.2	651.1
Hay (Legumes and Grain)	1,060.8	964.5	926.7
Tobacco	17.8	16.0	17.1
Truck	103.0	150.5	114.0
Fruit	268.5	311.3	241.0
Total Acres Crops	2,631.8	2,835.1	2,586.1
Less Double Cropping	130.9	257.2	--
Acres Cultivated	2,500.9	2,577.9	2,586.1
Comparison of Feed Crops Only			
Total Corn, Small Grain and Hay, Acres	2,242.5	2,357.3	2,214.0
Percent of Total	100	100	100
Corn	30.5	32.3	28.7
Small Grain	22.2	26.8	29.4
Hay	47.3	40.9	41.9

and a slight increase in the value of manure, while the combined values show an increase of 22 percent.

Crop Index

An index of crop yields of 12 of the farms is given in Table 9 for the years 1931 and 1937. The index averaged 10 percent higher in 1937 than in 1931. Additional records are being obtained for all farms over a longer period to determine accurately the trend of yields.

LIVESTOCK

Kind and Number of Livestock

Adjustments in the kind and number of livestock have been made. The number of each kind recommended in the plan and the number on the 25 farms in 1938 are given in Table 10.

Table 7.- Crop Rotations

Farm No.	First Year	Second Year	Third Year	Fourth Year
1	Corn	Small Grain	Clover & Timothy	-
2[1] (1	Corn	Small Grain	Clover & Timothy	Timothy
(2	Tobacco	Wheat	Clover	-
3[1]	Corn	Alfalfa	Alfalfa	Alfalfa
4[1]	Corn	Wheat	Clover & Oat Grass	Oat Grass
5	Corn	Small Grain	Clover & Timothy	-
6[1] (1	Corn	Small Grain	Small Grain	Clover & Timothy
(2	Corn	Soybeans	-	-
(3	Corn	A l f a l f a -- S e v e n Y e a r s		
7 (1	Corn-Rye	Soybeans	-	-
(2	Corn	Oats	Lespedeza	-
8	Corn	Small Grain	Lespedeza	Lespedeza
9	Corn-Rye	Soybeans	-	-
10	Corn	Small Grain	Lespedeza	Pasture
11	Corn	Small Grain	Clover & Timothy	-
12 (1	Corn	Wheat	Clover & Timothy	-
(2	Tobacco	Barley	Clover	-
13	Apples and Peaches with cover crops of Lespedeza and Cowpeas			
14[1]	Corn	Small Grain	Lespedeza	-
15[1]	Corn	Small Grain	Clover & Timothy	Clover & Timothy
16	Apples and Peaches with Soybeans, Rye and Lespedeza Cover.			
17	Corn	Small Grain	Clover & Timothy	Mixed Hay
18[1] (1	Corn	Small Grain	Clover & Timothy	-
(2	Tobacco	Small Grain	Clover & Timothy	-
19 (1	Corn-Rye	Sudan Grass	-	-
(2	Corn & Soybeans	Oats & Lespedeza	Lespedeza Pasture	-
20	Truck followed with Legumes and Rye Cover Crops.			
21[2]	Corn	Rye & Lespedeza	Barley	Lespedeza & Timothy
22	Corn & Soybeans	Small Grain	Lespedeza	-
23	Corn	Wheat	Barley	Clover & Timothy
24	Apples and Peaches with cover of Lespedeza and Rye.			
25[1] (1	Corn	Oats	-	-
(2	Corn	Oats	Clover & Lespedeza	Pasture

1/ Alfalfa acreage provided in area distinct from regular rotations listed.

2/ Five-year rotation--Lespedeza and timothy in fifth year.

Table 8.- Value of Lime, Fertilizer and Manure Used

Farm No.	1931					1937				
	Lime	Fertilizer	Manure		Total	Lime	Fertilizer	Manure		Total
	Dollars	Dollars	Tons	Dollars	Dollars	Dollars	Dollars	Tons	Dollars	Dollars
1	90	274	249	374	738	150	135	303	454	739
4	10	137	126	189	336	-	131	143	214	345
6	160	368	439	658	1,186	94	531	648	972	1,597
9	75	879	140	210	1,164	352	1,412	189	284	2,048
10	54	40	140	210	304	84	53	167	250	387
12	80	365	308	462	907	35	322	322	483	840
13	--	80	106	159	239	--	124	42	63	187
14	20	17	364	546	583	--	20	212	318	338
19	--	24	219	328	352	36	300	211	316	652
20	--	300	30	45	345	--	598	32	48	646
22	--	--	123	184	184	--	63	81	122	185
23	--	155	267	400	555	28	134	178	267	429
Percent	100	100	100	100	100	159	145	100.7	100.7	122

Table 9.- Index of Crop Yields in Terms 1931 Average Yield of 12 Farms

Farm No.	1931	1937
1	85	99
4	120	79
6	108	155
9	104	84
10	83	108
12	86	131
13	108	133
14	119	88
19	99	75
20	95	153
22	90	101
23	103	118
Average per farm	100	110

Table 10.- Kind and average number of livestock recommended and on farms in 1938

Kind	Recommended	1938	Difference	
	Number	Number	Number	Percent
Horses	3.3	3.7	+ 0.4	+ 13.4
Mules	1.0	1.7	+ 0.7	+ 65.4
Beef cattle	25.0	22.2	- 2.8	- 11.2
Dairy cattle	18.6	25.4	+ 6.8	+ 36.5
Sheep	39.0	16.3	- 22.7	- 58.2
Hogs	29.4	25.7	- 1.9	- 6.4
Chickens	686.0	347.2	- 338.8	- 49.4
Turkeys	34.0	22.3	- 11.7	- 34.5

The livestock record as given in Table 10 shows more horses, mules, and dairy cattle and fewer beef cattle, sheep, hogs, and poultry than recommended. Types of livestock are shown on Plate 5. Horse production represents a farm enterprise on several farms. The raising of horses, beef and dairy cattle, poultry, and hogs is practiced on all farms except those specializing in fruit and truck.

Animal Units[2/] Number and Kind

The number of animal units on farms is a better index for comparison than the number of animals and poultry. The number and kind of animal units recommended in the plans and recorded number in 1938 are given in Table 11. The data are presented graphically in Figure 13 which includes the first year record, as well as the record of 1938, and the recommendations in the original plans. There was an average of 51.4 animal units per farm the first year, 56.4 in 1938, while the recommendation called for 58.4. The number of livestock should be adjusted to the farm needs and the available feed.

2/ One animal unit equals each of the following: 1 horse, 1 mule, 2 colts, 1 dairy cow, 1 steer, 1 beef cow, 1 bull, 2 young cattle, 5 sows, 10 pigs, 7½ sheep, 15 lambs, and 100 hens.

Horse breeding

Fattening beef cattle

Herd and pasture improvement

Dairy herd

Turkey production

Sheep grazing

Plate 5.— Livestock production

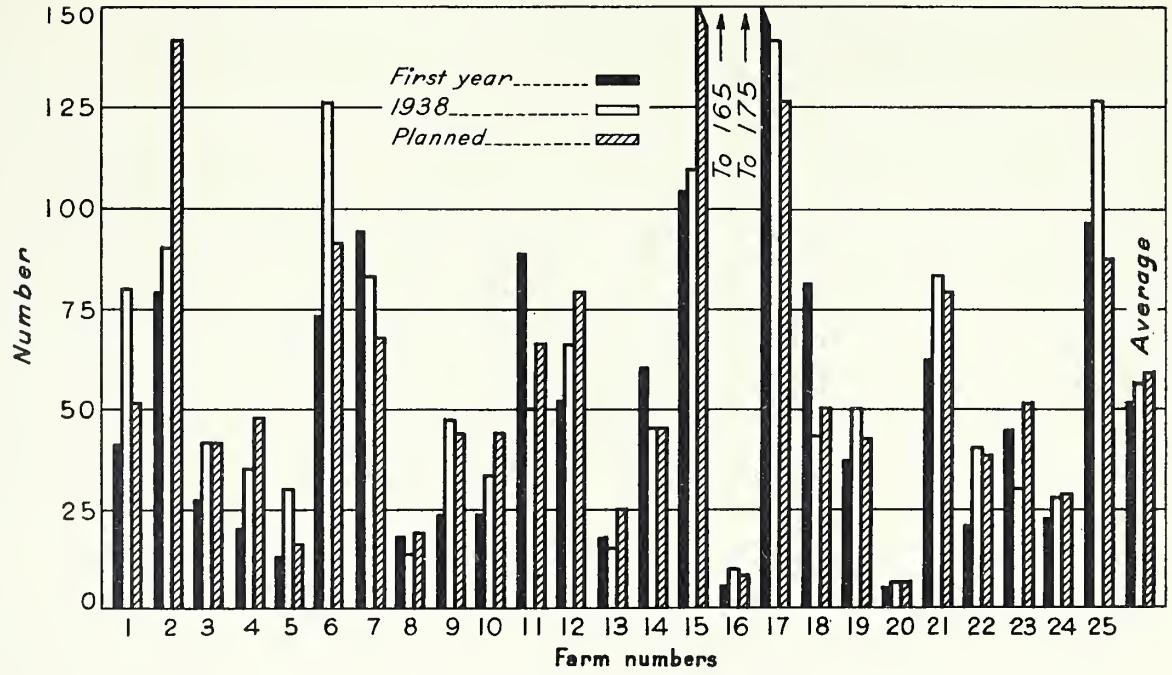


Figure 13. - Animal units

Table 11.- Animal units [1] of different farm animals.

Farm No.	Horses and Mules	Beef	Dairy	Sheep	Hogs	Poultry	Total	Horses and Mules	Beef	Dairy	Sheep	Hogs	Poultry	Total	Difference
	Recommended (1931-1933)							1938							
1	8	25	4	-	10	4	51	8	50	4	-	15	3	80	+ 29
2	6	113	-	16	6	1	142	6	70	-	4	9	1	90	- 52
3	2	-	35	-	3	1	41	2	-	35	-	3	1	41	0
4	2	5	3	-	18	20	48	5	-	13	3	9	5	35	- 13
5	3	3	5	-	3	2	16	3	3	3	-	3	1	13	- 3
6	7	-	75	-	6	3	91	8	-	100	3	12	3	126	+ 35
7	4	-	50	-	3	10	67	5	-	75	-	-	7	87	+ 20
8	2	10	2	-	3	2	19	2	-	10	-	-	1	13	- 6
9	6	-	3	-	25	9	43	6	-	3	-	34	4	47	+ 4
10	4	18	2	-	1	19	44	5	12	4	-	3	9	33	- 11
11	2	40	2	15	6	1	66	4	30	2	10	3	1	50	- 16
12	4	50	2	[2] 3	15	5	79	4	50	2	[2] 3	6	1	66	- 13
13	3	8	3	-	6	5	25	2	-	6	-	6	1	15	- 10
14	2	-	3	-	-	40	45	3	-	8	-	4	30	45	0
15	10	65	70	13	6	1	165	8	26	65	4	6	1	110	- 55
16	2	-	4	-	1	1	8	2	-	4	-	3	1	10	+ 2
17	15	75	-	30	6	1	127	35	100	-	-	6	1	142	+ 15
18	4	30	2	7	6	1	50	4	30	-	5	3	1	43	- 7
19	4	-	35	-	2	2	43	4	-	45	-	-	1	50	+ 7
20	2	-	2	-	-	2	6	4	-	1	-	-	1	6	0
21	2	60	-	10	6	1	79	2	75	-	6	-	-	83	+ 4
22	2	-	8	-	3	25	38	1	-	9	5	3	22	40	+ 2
23	4	-	2	3	3	39	51	4	5	5	5	3	8	30	- 21
24	2	-	13	-	3	10	28	2	-	15	-	3	7	27	- 1
25	6	-	80	-	-	1	87	6	-	120	-	-	1	127	+ 40
Average	4.3	20.1	16.2	3.9	5.6	8.2	58.4	5.4	18.0	21.2	1.9	5.4	4.5	56.4	- 2
Change in number per farm	-	-	-	-	-	-	-	+1.1	-2.1	+5.0	-2.0	-0.2	-3.7	-2.0	-
Change in percent per farm	-	-	-	-	-	-	-	+25.6	-10.4	+30.9	-51.3	-3.6	-45.1	-3.4	-

[1] One animal unit equals each of the following: 1 horse, 1 mule, 2 colts, 1 dairy cow, 1 steer, 1 beef cow, 1 bull, 2 young cattle, 5 sows, 10 pigs, 7½ sheep, 15 lambs, 100 hens.

[2] Goats.

Table 12.- Feed Production Record

Farm No.	1931 Corn	1931 Small grain	1931 Ensilage	1931 Hay	1937 Corn	1937 Small grain	1937 Ensilage	1937 Hay
	Pounds	Pounds	Tons	Tons	Pounds	Pounds	Tons	Tons
1	39,200	38,400	48	40	78,400	2,804	-	90
4	30,240	86,400	100	30	25,200	39,000	30	12
6	16,800	86,800	450	144	35,000	78,900	550	256
9	156,800	-	-	25	112,000	-	-	22
10	44,800	24,900	-	33	41,400	23,456	-	70
12	22,400	61,740	-	190	30,800	11,040	-	94
13	16,800	6,016	-	26	13,440	15,000	-	19
14	-	-	40	30	5,600	5,820	40	42
19	5,880	-	100	80	33,600	-	100	64
20	-	-	-	17	-	-	-	20
22	14,560	16,920	-	-	30,240	11,340	-	15
23	43,120	52,480	-	18	5,040	79,560	-	21.5
Percent	100	100	100	100	105.1	71.4	97.6	114.6

The increase in the number of livestock by approximately 14 percent, as planned, should aid materially in the improvement of the farm business and soil productivity. Plans and progress have been made in the improvement of the kind and quality of livestock. Major changes include improvements in feeding, breeding, and general care of all kinds of livestock.

Feed Production

Feed production schedules are developed for the production of most of the grain, hay, and ensilage required by the livestock. Feed purchased include minerals, mash, and tankage required in special feeding or as supplements to home-grown feeds. Table 12 shows comparatively the feed production records of 1931 and 1937 on 12 farms. The 1937 record compared with 1931 showed 5.1 percent increase in the production of corn, 28.6 percent decrease in small grain, 2.4 percent decrease in ensilage, and 14.6 percent increase in hay.

Crop-Livestock Balance

The farm programs are so developed as to stabilize and balance crop and livestock programs. Small adjustments are made to take advantage of favorable prices for either the sale of surplus grain or the purchase of feed.

Table 13.- Feed Production-consumption Balance

Farm No.	1931						1937					
	Surplus			Deficit			Surplus			Deficit		
	Grain	Hay	Ensilage	Grain	Hay	Ensilage	Grain	Hay	Ensilage	Grain	Hay	Ensilage
	Pounds			Pounds			Pounds			Pounds		
1	6,950	-	-	-	49,000	70,500	4,604	31,500	-	-	-	176,000
4	72,965	-	119,500	-	5,000	-	-	-	-	5,900	44,000	42,000
6	-	50,000	448,250	40,875	-	-	-	168,100	483,600	79,810	-	-
9	100,975	7,000	-	-	-	33,000	43,400	5,000	-	-	-	24,000
10	16,000	-	-	-	2,000	94,000	-	71,500	-	13,234	-	106,000
12	34,240	29,600	-	-	-	180,000	-	1,400	-	7,060	-	217,000
13	-	-	-	9,084	500	93,000	17,540	25,000	-	-	-	8,000
14	-	-	-	194,250	61,000	82,000	-	-	-	139,800	29,100	13,500
19	-	44,000	-	67,720	-	49,000	-	15,500	-	37,760	-	35,000
20	-	-	16,000	17,000	-	8,000	-	19,500	-	16,560	-	8,000
22	-	-	-	18,220	54,000	98,500	5,390	2,700	-	-	-	32,500
23	17,775	-	-	-	58,400	136,000	10,750	-	-	-	28,700	86,500
Total	284,905	130,600	383,750	347,149	229,900	844,000	81,684	340,200	483,600	300,124	101,800	748,500
Net Difference	-	-	-	62,244	99,300	460,250	-	238,400	-	218,440	-	264,900

Table 14.- Labor Efficiency

Farm No.	1931			1937		
	Total productive man-work units 1/	Man equivalent	Productive man-work units per man	Total Productive man-work units 1/	Man equivalent	Productive man-work units per man
1	1,015	3.5	290	768	3.0	256
4	388	2.3	169	603	2.5	241
6	1,423	5.2	274	1,860	9.3	200
9	1,499	5.0	300	1,732	4.9	353
10	390	2.1	186	612	2.7	227
12	700	3.2	219	440	3.2	137
13	718	2.5	287	1,332	5.2	256
14	658	2.5	263	607	3.9	156
19	801	2.2	364	996	3.6	277
20	742	3.8	195	1,328	7.4	179
22	356	2.6	137	328	1.8	182
23	464	1.7	273	484	2.1	230
Average per farm	763	3.05	250	924	4.13	224
Percent	100	100	100	121.1	135.4	89.6

1/ Productive man-work units represents the average or normal number of man days required on Virginia farms for the production of crops and the caring for livestock. Labor required in the improvement of drainage, erosion control, stumping, fencing, buildings, machinery, equipment and similar physical improvements is not included in productive man work units but it is included in man equivalent.

A feed production-consumption balance is given in Table 13 for 12 of the original farms. The surpluses and deficits shown are based upon the crop production records and uniform feeding schedules for two years. The livestock maintained on these farms was slightly higher than it was in 1931 although the increase was less than 1 percent. The table shows, in 1931, deficits of grain, hay and ensilage; in 1937 there was a surplus of hay and deficits of grain and ensilage. The net changes show that the grain deficit for the 12 farms increased by 156,196 pounds; a surplus of 119 tons of hay existed in 1937 against a deficit of 50 tons in 1931. The ensilage deficit of 230 tons in 1931 was reduced to 132 in 1937.

LABOR EFFICIENCY

One of the purposes of the improvement in farm development is to increase labor efficiency. Labor efficiency may or may not reduce the required labor for a given schedule of crop production and livestock maintenance. Improved quality of products and improvement in their processing, packaging, and marketing may actually increase the labor requirements. Another increase of required labor is the increased intensity of operation.

A labor record is given for 12 farms in Table 14. This table shows that the productive man-work units per farm increased from 763 in 1931 to 924 in 1937 or 21.1 percent.

Average man equivalent per farm increased from 3.05 to 4.13, an increase of 35.4 percent. The productive man-work units per man decreased from 250 in 1931 to 224 in 1937, a decrease of 10.4 percent. The decrease of 10.4 percent in productive man-work units per man may represent less efficient work, a tendency toward less hard farm work and more thorough work or effort used in the maintenance of the physical plant.

Increased man equivalent occurring on farm No. 23 results from the maturity of the young men on the farm. If the boys remain on the farm the farm business must be enlarged to maintain uniform labor efficiency-productive man-work units per man. Normal increase of business caused the increase of productive man work units on farms Nos. 4, 6, 10, 13, and 20.

POWER

Drawbar Power

The amount, type and use of farm power influences materially the amount, quality, and timeliness of work performed, and the combined cost of power and labor. There are two principal approaches to the solution of the power problem. One consists of providing the minimum amount of power needed to accomplish the required work during normal or favorable seasons. This plan permits low overhead, low operating cost, and the use of power the maximum number of days throughout the year.

Three criticisms of this approach are: (1) There is not sufficient reserve power to accomplish the required work during adverse seasons, (2) the plan does not provide for accomplishing the work during optimum periods and, (3) the low power cost may require increased cost of labor.

The second approach is based upon the use of ample power for the accomplishment of the necessary operations during adverse seasons and in normal seasons accomplishing the work during optimum conditions. The reserve power which this plan provides may effect sufficient savings in the cost of labor to more than offset the increased cost of power. The corresponding saving in labor should result in the reduction of power and labor costs and assure fewer crop failures and better production.

The initial power studies on the 25 cooperating farms showed a good use of both horse and tractor power. Ample power was available, and with few exceptions the power costs were not excessive. The operating plans provided for changes in type of power rather than a change in amount. The greatest change in power was effected by the replacement of standard tractors with general purpose types.

Table 15 shows the number of horses and the number and kinds of tractors on the cooperating farms the first year of study and in 1938. In this period the number of work horses decreased from an average of 4.04 per farm to 3.84. The number of tractors increased from 18 to 22 on the 25 farms. The type of tractors changed from 15 standard, 2 general purpose and 1 crawler to 9 standard, 10 general purpose and 3 crawlers.

Table 15.- Available Drawbar Power

Farm No.	Work Horses and Mules: First Year	Work Horses and Mules: 1938	TRACTORS: First Year: No.	TRACTORS: First Year: Size	TRACTORS: First Year: Type 1/	TRACTORS: 1938: No.	TRACTORS: 1938: Size	TRACTORS: 1938: Type	Total Animal & Tractor Power: D.B.H.P. Equivalent: First Year	Total Animal & Tractor Power: D.B.H.P. Equivalent: 1938	Change: Per cent
1	8	8 2/	1	10-20	Std.	1	10-20	Std.	23.3	23.3	0
2	6	6	1	8-16	Std.	1	8-16	G.P.	18.0	18.0	0
3	2	2	1	10-20	Std.	1	10-20	Std.	13.3	13.3	0
4	4	4	1	15-30	Std.	1	15-30	Std.	21.7	21.7	0
5	2	2 2/	-	-	-	-	-	-	3.3	3.3	0
6	8	8 2/	1	15-30	Std.	1	8-16	G.P.	28.3	21.3	-24.7
7	6	4	1	15-30	Std.	1	15-30	Std.	25.0	21.7	-13.2
8	3	3	1	10-20	Std.	1	10-20	Std.	15.0	15.0	0
9	6	6	1	10-20	Std.	1	10-20	G.P.	20.0	20.0	0
10	4	4	-	-	-	-	-	-	6.7	6.7	0
11	4	4	-	-	-	-	-	-	6.7	6.7	0
12	4	4	1	15-30	Std.	1	10-20	G.P.	21.7	16.7	-23.0
13	2	2	-	-	-	1	15-30	Cr.	3.3	18.3	+454.5
14	2	2	-	-	-	-	-	-	3.3	3.3	0
15	6	6 2/	1	10-20	G.P.	1	10-20	G.P.	20.0	20.0	0
16	2	2	1	15-30	Cr.	1	15-30	Cr.	18.3	18.3	0
17	6	6 2/	1	10-20	Std.	1	10-20	G.P.	20.0	20.0	0
18	4	4 2/	-	-	-	-	-	-	6.7	6.7	0
19	3	2	2	(15-30	G.P.)	2	(15-30	G.P.)	35.0	26.3	-24.9
				(15-30	Std.)		(8-16	G.P.)			
20	4	2	-	-	-	1	8-16	G.P.	6.7	11.3	+68.6
21	2	2	-	-	-	-	-	-	3.3	3.3	0
22	1	1	1	15-30	Std.	1	15-30	Std.	16.7	16.7	0
23	4	4	-	-	-	1	5-10	Std.	6.7	11.7	+74.6
24	2	2	1	15-30	Std.	1	15-30	Std.	18.3	18.3	0
25	6	6	2	(15-30	Std.)	3	(15-30	Std.)	40.0	50.0	+25.0
				(15-30	Std.)		(15-30	Cr.			
							(10-20	G.P.)			
Total	101	96	18			22			401.3	411.9	+2.6
Ave. Farms	4.04	3.84	0.72			0.88			16.05	16.48	+2.6

1/ Std = Standard; Cr. = Crawler; G.P. = General Purpose.

2/ Additional horses and colts bred and raised by these farms are not computed in available power.

On most farms draft horses and tractors are used together to provide the most satisfactory power combination. Types of teams are shown on Plate 6, and the various sizes and types of tractors are shown on Plate 7. Available field power is shown graphically in Figure 14. Power for each farm is shown in number of horses, number of tractors, and their combined power equivalent in terms of horses and tractor drawbar-horsepower (D.B.H.P.)

Power Equivalents

Special studies were made to obtain factors for converting tractor power into animal power and vice versa. Comparisons of data from independent sources showed:

1 Horse 3/ (or mule) equivalent to 1.67 tractor drawbar horsepower (D.B.H.P.)

1 Tractor D.B.H.P. equivalent to 0.6 horse.
Accordingly, in this study the following conversion factors have been used:

Drawbar horsepower (D.B.H.P.) = Tractor D.B.H.P. + 1.67 x number of work animals.

Horse equivalent = Number of work animals + 0.6 (tractor D.B.H.P.).
By these measurements the total power per farm of tractors and work animals increased from 16.05 D.B.H.P. to 16.48, or 2.6 percent. The small increase is due to the smaller type of general purpose tractor replacing the large standard tractors. The present power is more adaptable to various tasks than the power units replaced. The tractor power in percent of total animal and tractor power increased from 58 percent the first year to 61 percent in 1938.

Belt Power

Most of the 22 tractors listed on Table 15 were used for both drawbar and belt work. Their combined belt power represented 494 horsepower. Other forms of belt or stationary power included electric motors and gasoline engines. Gasoline engines have been replaced almost entirely by tractors and electric motors for belt work. The farms on which tractors, gasoline engines, and electric motors used for belt work are indicated in Table 16. This table shows that 18 farms had tractor power, 1 had a gasoline engine, and 13 had electric motors.

There were 47 electric motors ranging from 1/8 to 15 horsepower totaling 96.45 horsepower. The combined tractor, gasoline engine, and electric motor power totaled 610.45 horsepower on 20 of the 25 farms. This list does not include all small motors used with minor household appliances.

3/ Assumed weight of draft horses 1400-1600 pounds.

Table 16.- Available Belt Power, 1938

Farm No.	Tractor	Gasoline Engine	Electric Motor	Total	Electric Motors 1/ Number	Electric Motors 1/ H.P.
	Horsepower					
1	20	-	-	20.0	-	-
2	16	-	-	16.0	-	-
3	20	-	5.0	25.0	1	5
4	30	-	4.25	34.25	4	3,3/4. ¼,¼
5	-	-	-	-	-	-
6	16	-	1.75	17.75	2	1, 3/4
7	30	-	3.75	33.75	2	3, 3/4
8	20	-	-	20.0	-	-
9	20	-	-	20.0	-	-
10	-	-	-	-	-	-
11	-	-	0.75	0.75	1	3/4
12	20	-	-	20.0	-	-
13	30	-	5.0	35.0	1	5
14	-	20	0.75	20.75	2	1/2, 1/4
15	20	-	-	20.00	-	-
16	30	-	12.0	42.0	5	5,3,2,1, 1
17	20	-	0.33	20.33	1	1/3
18	-	-	-	-	-	-
19	46	-	3.75	49.75	4	2, 1, 1/2, 1/4
20	16	-	17.50	33.50	3	15, 1 1/4, 1 1/4.
21	-	-	-	-	-	-
22	30	-	-	30.0	-	-
23	-	-	-	-	-	-
24	30	-	24.50	54.5	4	15, 7 1/2, 1, 1
25	80	-	17.12	97.12	17	5,5,2,2, ½. ½, ¼, ¼, ¼,¼ ¼, ¼, 1/8, 1/8, 1/8 1/8, 1/8
Total	494	20	96.45	610.45	47	

1/ - Does not include all the small motors used for minor household appliances.

Pulling apple sprayer

Grading a terrace

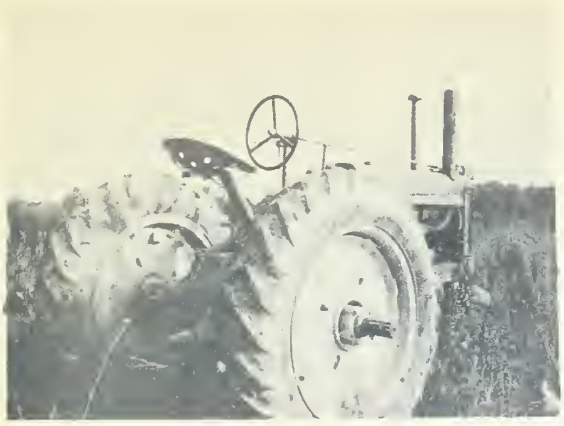
Clipping pasture

Harrowing

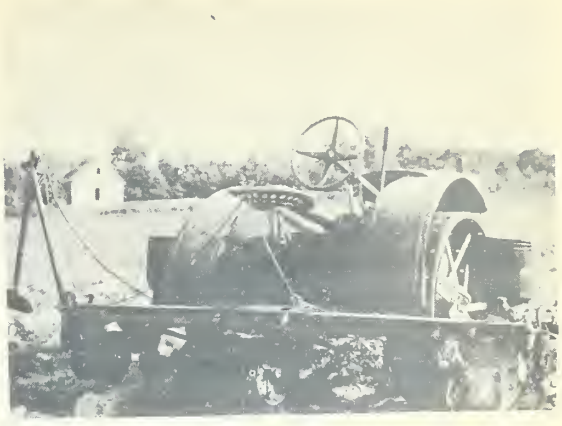
Spreading manure

Cultivating soybeans

Plate 6.- Animal power in use



New tractor



Three-row planter

Plowing

Portable sprayer

Cultivating and fertilizing

Serviceable old tractor

Plate 7 – Tractors and equipment

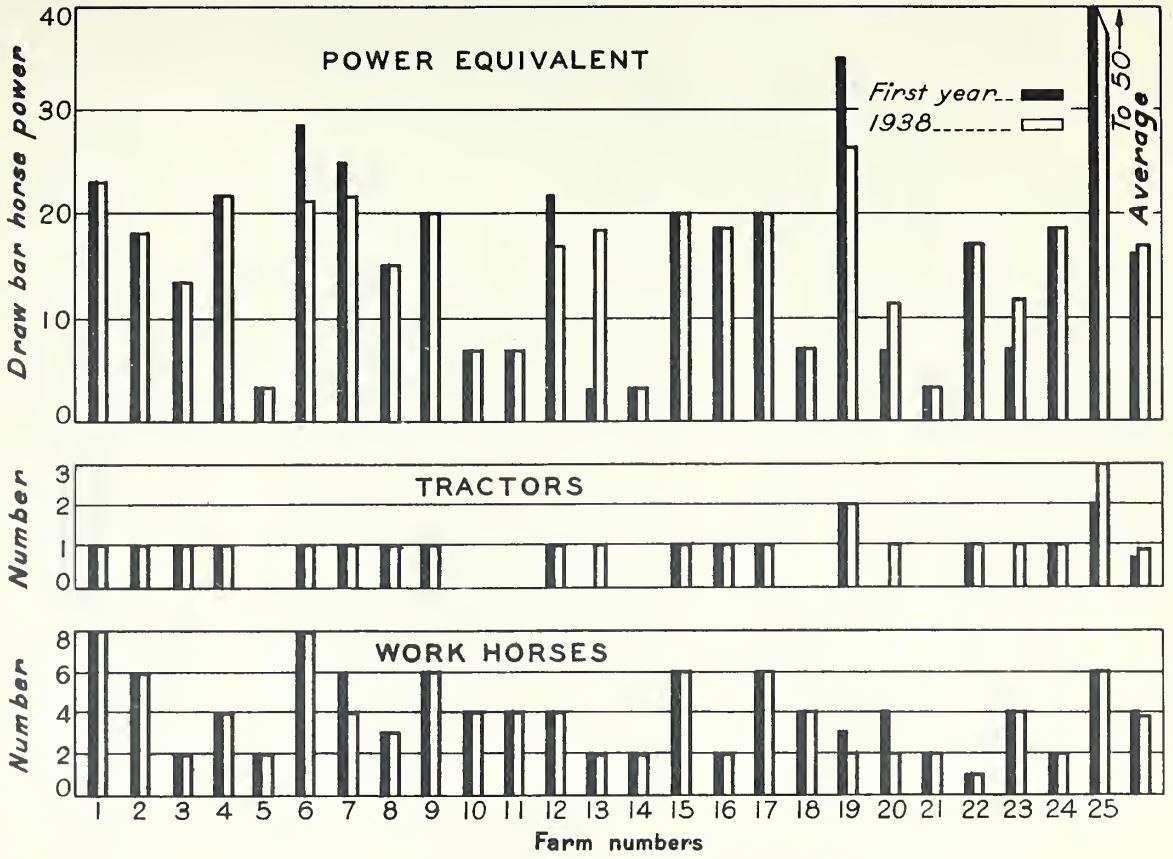


Figure 14. – Tractor and animal power

The chief uses of electric motors are the operation of ensilage cutters, feed grinders, corn shellers, seed cleaners, milking machines, refrigerators, ice machines, water pumps, stationary spray pumps, irrigation pumps, fruit graders, hay hoists, and shop tools.

FARM EQUIPMENT

The 25 farms had available such general equipment as plows, harrows, planters, cultivators, haying equipment, and minor farm tools Special equipment is listed in Table 17. Seventeen trucks were used on 13 farms. Crawler tractors were used only on two hilly fruit farms for operating portable sprayers. General-purpose tractors were operated on 9 farms, but tractor planters were used on only 2 farms and tractor cultivators on 3 farms. The push rake was used only on farm No. 17. A combine was used on farm No. 9. Portable sprayers were used for spraying fruit on three farms and truck crops on one farm. Two farms, Nos. 13 and 24, had stationary spray equipment. This equipment not only saves labor but permits spraying when portable equipment cannot be used.

Stump pullers were used on farms Nos. 7 and 25, Farms Nos. 15 and 25 had sawmills. Power operated drums and cables were used for pulling and piling stumps on farms Nos. 7 and 25. A power ditcher was used on farm No. 25. Eleven farms had ensilage cutters. Milking machines were used on two farms, three farms had irrigation equipment, two farms had farm refrigeration for fruit and vegetables. Fifteen farms each, had from one to ten types of the special equipment listed. In each instance the equipment serves a distinct purpose in making possible improvements in the development or operation of the farm. Examples of special equipment are shown on Plate 8. The power ditcher, and the power drum and cable, are used for making physical improvements in the land, the lime grinder aids in making possible more productive land, the stationary spray outfit and the portable sprayer, are used for the improvement of quality of fruit, while the cold storage aids in maintaining quality products and permits orderly marketing.

Kind and Number of Farm Buildings

The kind and number of principal farm buildings are listed in Table 18. Additional information concerning the type and size of buildings will be given later. The largest number of buildings is 24 on farm No. 6 with an average of 13.4 on the 25 farms.

The number of principal kinds of structure include 47 tenant 4/ houses, 28 general purpose barns, 32 other barns, 25 silos, 40 hen houses, 23 machine sheds, 22 garages, and 24 owners' dwellings. Special buildings include greenhouses, sweetpotato curing house, pack houses, and cold storages.

4/ "Tenant" as used in this report refers to actual tenants, sharecroppers and laborers. With few exceptions occupants of tenant houses are farm laborers.

Table 17.- Special Equipment on Farms (1938)

Farm No.	Truck	Crawler tractor	G.P. tractor	Tractor plant-er	Tractor culti-vator	Push rake	Com-bine	Grad-er	Port-able spray	Sta-tion-ary spray	Stump pull-er	Saw mill	Power drum and cable	Ditch-ing Ma-chine	Ensil-age cutter	Milk-ing Ma-chine	Irri-ga-tion Equip-ment	Cold storage
										Acres								
1	1								1						1			
2			1															
3	1														1		1	
4															1			
6	2		1												1	1		
7	2		1		1						1		1		1			
9	1		1				1											
12			1															
13	1	1							1	40							1	
14	1														1			
15	1		1									1			1			
16	1	1						1	2									
17	1		1			1									1			
19			2	1	1										1	1		
20	2		1						1								1	1
24	1									35					1			1
25	2		2	1	1							1	1	1	1	1		
Total	17	2	12	2	3	1	1	1	5	75	1	2	2	1	11	3	3	2

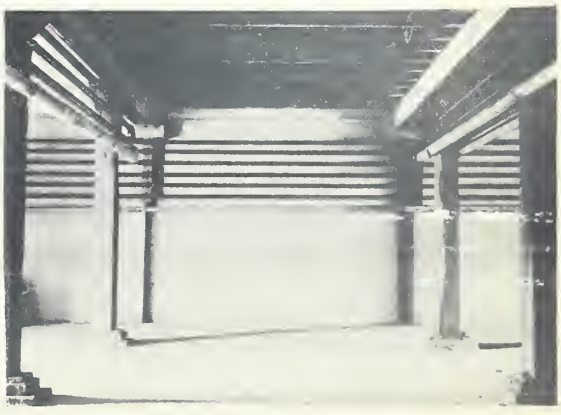
Stationary spray unit

Portable sprayer

Tiling land

Piling stumps

Grinding limestone



Cold storage room

Plate 8.- Special farm equipment

Table 18.- Kind and number of principal farm buildings 1/ 1938

Farm No.	Owner dwelling	Tenant houses 2/	BARNS: General purpose	Horse	Dairy	Lounge	Milk	Beef	Sheep	Hay	Straw shed	Hog house	Hen house	Brooder	Turkey	Bull pen	OTHER: Silo	Corn crib	Granary	Pack house	Sweetpotato storage	Machine shed	Shop	Garage	Ice house	Smoke house	Milk house	Greenhouse	Pump house	Total
1	1	3	1	1					1				2				1	4		1		2		1	1	1			1	21
2		4	2						1				2						1			1		1						13
3		1	1			1	1					1	1				2	1				1		1			1			13
4		1	1								1	2	2	1			1	1	1			2	1	1					1	17
5		1	1										2						1			1								7
6		4		1	1	2			1	1			1	1		1	4	1				1	1	1		1	1			24
7		2		1	1								2	3								1	1				1			13
8		2	1			1		1					1	1				1				1		1		1				12
9 3/		2	1	1								1	1	1	1						1	1		1		1				13
10		1	1	1		1		1		1			3	2				1	1			1		1	1	1				18
11		1	1						1				1	1								1		1	1	1				9
12		1	1					1		1			1									1								7
13		1	2									1	1					1	1	1		1		1		1				12
14		1	1							1		1	3	5			3					1		1		1				19
15		4	1	1	1							1	1				2	1	1			1	1	1			1			18
16		5	1										1							1		1	1	1						12
17		2	2					1					1				2					1		1						11
18		2	2										2				2					1		1						11
19		1	2		1		1						1				1							1			1			10
20		4	1										1					1		1		1	1	1				2		14
21 4/		1	1																											2
22	1	1	1									1	2	1	1			1						1						10
23	1		1								1	1	4	2				1						1		1				13
24 3/	1	1	1									1	3	2			1	1		1		1		1		1	1			16
25	1	1	1		1	1	1						1			1	6					1	1	2			1			19
Total	24	47	28	6	5	6	3	4	2	6	2	10	40	19	3	2	25	15	6	5	1	23	7	22	2	10	7	2	2	334

1/ This list includes the principal farm buildings of 1938. It does not include all of the small miscellaneous structures and the obsolete or abandoned buildings. 2/ "Tenant houses" used for tenants, sharecroppers and laborers. 3/ Home place only. 4/ Absentee landlord - tenant uses the farm dwelling.

The type of farming has greater influence on building requirement than has the size of the farm. Examples are farms Nos. 20 and 21. There were 14 buildings on the former, one of the smallest farms, but only two serviceable structures on No. 21 which is one of the largest farms. Dairy, poultry, fruit, and truck farms have heavy building requirements, while beef cattle farms and some of the general farms are operated with smaller investment in buildings.

Each type of farming has more or less exacting building requirements in regard to the size and type of structures. For instance, milk ordinances affect the type of structures on the dairy farms. Apple and peach grading, washing, drying, and storing have exacting structural and equipment demands. Farm No. 25 is an example of a dairy farm with good engineering and management, No. 17 is a well organized fruit farm, No. 20 is an example of good engineering and management on a truck farm, and No. 24 represents good development of a fruit and dairy farm.

In the development of suitable building programs for these farms the type of farming and the requirements of the principal enterprises were given first consideration. Convenience, economy, durability and the appearance of the structures were other considerations. Farm service buildings are usually grouped around the barn which serves as the principal structure. Six barns of different size and type were shown as Plate 9. The cinder-block dairy barn and brick silo were new. The new general-purpose barn had been used for dairy cattle, beef cattle, horses, feed storage, and tobacco curing. The two gambrel roof barns were used for the dairy herd. The new barn and a new vegetable grading and storage building were built to serve exacting farm and market requirements. The old bank barn shown is serviceable and in good repair. When the milking barn and the small silo were outgrown this barn was enlarged and a new large tile silo was built.

Special buildings are shown on Plate 10. These buildings include combined milking parlor and dairy, a battery of silos for summer and winter feeding, an apple loading and grading building and a vegetable storage structure. The gambrel roof structure was built for the loading, washing, grading, packaging, and cold storage of vegetables. Buildings and marketing frequently go hand in hand. The good poultry house was built to house a flock of hens used for producing eggs for sale to a large hatchery. The premium above the market price of eggs paid for the building.

Building Construction

New building construction is summarized by farms in Table 19. In the covered period, varying from 4 to 7 years, new construction included 7 barns, 12 silos, 5 fruit and vegetable storage buildings, 2 corn-cribs, 2 hay barns, 1 straw shed, 3 garages, 3 implement sheds, 9 poultry houses, and 1 greenhouse. Nine new tenant houses had been built and one rebuilt, Eight owners' residences had been remodeled, and one new house was built.

Cinder block dairy barn

General purpose barn

Dairy barn

Barn and truck storage

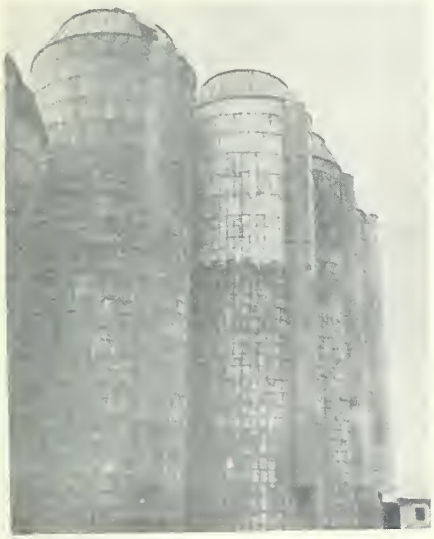
Good bank barn

Milking barn

Plate 9.– Barns

Milk combine and dairy

Apple pack house



Silos - 3,000 ton

Cold storage for vegetables

Poultry house - 400 hens

Poultry house - 2,000 hens

Plate 10. - Special buildings

Table 19.- Record of building construction and renovation

(All buildings listed are new except those indicated as remodeled)

Farm	Barns and stables			Crop processing and storage		
No.	Kind	Type	Size	Kind	Type	Size
1				Corncrib & shed	1 story	30x32
2				Tobacco & hay	2 story	30x48
3	Dairy	1 story gable	16x48	Silo	Tile	14x35
				Corncrib	Round-galv.	10x30
4				Straw shed	2 story gable	20x45
5						
6	Gen.purpose	2 story gambrel	36x60	Hay, barn and cattle shed	2 story gable	28x62
				Silo	Concrete block	12x30
7				Silo	Concrete Stave	14x40
8	Gen.purpose	2 story gambrel	38x45	(G.P. barn serves for tobacco curing)		
9				S.potato storage	Cinder block	20x40
						2500 bu.
10						
11						
12						
13				Apple storage (common)	2 story gambrel	36x74
14				Hay storage	2 story frame gable	20x32
15	Gen.purpose (sheep or cow)	2 story gambrel	34x60			
16				Enlarged apple and peach pack house		
17	Gen.purpose (enlarged)	2 story gable	36x80	Silo	Brick	14½x32
				Silo	Brick	16x40
				Corncrib	1 story gable	
18				Silo	Wood stave	12x30
19						
20	Gen.purpose	2 story gambrel	34x40	Pack, grading, storage	2 story gambrel (tile & frame)	34x60
21						
22	Gen.purpose	1½ story shed	24x35			
23						
24	Gen.purpose and dairy	2 story gambrel (cinder block)	36x60	Silo,	Brick	12x30
				Grading bldg.	2 story frame and tile	40x40
25	Dairy	2 story gothic	36x138	2 silos	Concrete stave	16x50
	Bull pen	1 story	16x26	2 silos	Concrete stave	18x50
				1 silo	Wood stave	12x36

Table 19.- Record of Building Construction and Renovation (Cont'd)

Farm No.	Miscellaneous			Dwellings (owner and tenant)	
	Kind	Type	Size	Kind and Type	Size
1	Garage	Shed	3-car		
2				1 story frame tenant	4 room
3					
4					
5				Owner's home remodeled	
6				2-story frame tenant	4 room
7				Owner's home remodeled	
8				Owner's home remodeled	
				1 story frame tenant	4 room
9	Garage	Frame gable	2-car	Owner's home	
				1-story frame tenant	4 room
10				Home renovated	
11				Owner's home remodeled	
12				1-story frame home	6 room
13	Truck garage	Frame shed	2 trucks		
14	5 poult.& brooder	do	500 hens 200 chicks	Owner's home remodeled	
15	Shop	2-story frame	24 x 40		
16				2-story cinder block, tenant	6 room
17	Garage	1 story brick	2 car	Owner's home renovated	
	Machine shed	1 story frame	20x40		
	Poult.& brooder	do	20x20		
18	2 poult. houses	Wood shed	18x20		
19					
20	Garage & storage	2 story frame	20x23	Owner's home renovated	
	Poult.house	1 story "	14x40	Frame tenant remodeled	4 room
	Greenhouse	tile walls	10x138	2-story frame, foreman	8 "
				2-1 story frame tenant	4 ", each
21					
22					
23					
24	Poultry house	Shed	22x80	2-story tile & frame store and quarters	40x40
25	Implement shed and shop	Frame	50x64		
	Milk parlor	Tile	16x40		
	Dairy	Tile	30x40		

Table 19.- Record of building construction and renovation (Con'd)

Farm No.	General condition of buildings
1	Building program needed
2	Generally good, improvements being made
3	Serviceable but in need of repair
4	Adequate and in good repair
5	Adequate and in good repair
6	A farmstead plan and building program are needed
7	Improvements made as rapidly as possible
8	Improved by building and remodeling
9	Generally good and in good repair
10	Improved existing buildings
11	Adequate and in good repair
12	Service buildings old but adequate
13	Buildings are being repaired
14	Servieable but need repairs
15	Adequate buildings - need additional repair
16	All buildings in excellent shape
17	Putting in A-1 shape old building
18	Adequate repairs and paint needed
19	Repairs generally needed
20	All other buildings are being remodeled
21	Serviceable but need repairs and paint
22	Need of repair and paint
23	Generally good and in repair
24	Excellent, mostly new, well planned
25	Old buildings replaced with new

Improvements of buildings by new construction or rebuilding represented approximately 20 percent of all the farm buildings. Several of the barns were new. Silos were doubled in number and more than doubled in capacity and the durable construction materials assure that the new silos will last much longer than the older structures. About one-fourth of the poultry houses were new.

One of the best measures of progress is the improvement of the farm homes and tenant houses. With few exceptions the owners' homes and tenant houses have been improved in comfort and convenience. Approximately one-fifth of the tenant houses were new structures, while minor repairs had been made on others. Ten of the owners' residences had been completely renovated. The repairs include rearrangement for comfort, convenience, and improved appearance. New equipment included heating systems, electric lights, water, and bath. Exterior improvements included lawns, fences, walls, walks, trees shrubs, and flowers to provide serviceable and attractive grounds.

Electric Equipment

Seventeen of the 25 cooperating farms were using electric current from highline service and two had unit lighting plants. Seven farmers were attempting to obtain electric service. Current was available but not used on farm No. 21. The owner was willing to have current installed whenever the tenant wanted it. The farms having electricity available and the purposes for which it is used are given in Table 20. The table also shows other special equipment, including unit lighting plants, hydraulic rams, gravity water systems, and acetylene plants. All farms except 21 and 22 had equipment for many modern conveniences. The symbols used in Table 20 are interpreted as follows: Ac-Acetylene, E-Unit lighting plant, Ec-Commercial storage and refrigeration of fruit, EE-Highline service (110-220 volt), Gc - Gravity water - city line. G- Gravity water. HR - Hydraulic ram. K - Kerosene.

Electricity is used chiefly in the homes for lighting, refrigeration, washing, ironing, pumping, etc. But on a number of farms it is also used in the improvement of farm production, processing, and storages. For example, on farm No. 20 electricity is used for lighting all buildings, including four tenant houses, irrigating 30 acres of truck, and cooling vegetable storage rooms. On farm No. 24 electricity is used for apple refrigeration and for operating a stationary spray plant. Electricity is used on farm No. 16 for operating special fruit graders, washers, and dryers, while the actual cold storage facilities are used in commercial plants. On farm No. 25 electricity is used for such operations as lighting, household appliances, hay hoisting, feed mixing, milking, milk cooling, bottling, refrigerating, ice making, and fire protection.

The present trend is toward the more general use of electricity for brooders, lighting poultry houses, feed grinding, ensilage cutting, hay hoisting, garden irrigation, cooking, and water heating. In some instances the type of service and rates should be adjusted to use current to the best advantage.

Eighteen tenant houses are equipped with electricity on 8 of the 17 farms having current. In many instances laborers and tenants use electricity for lights, radio, washer, iron, and other household conveniences.

Table 20.- Electrical and Other Special Equipment, 1938

Farm No	Lighting			Refrigerating			Water Systems								Other Uses									Remarks
	When Current was obtained	Owner's home	Tenant houses	Barn	Other bldgs.	Owner's home	Milk	Fruit	Vegetables	Owner's home	Tenant houses	Livestock	Irrigation	Milking machi	Milk cooler	Bottler	Feed grinder	Ensilage cutt	Shop	Electric fence	Stationary	General household use	
1		E				K				Gc		Gc	Gc											Attempting to obtain current 1939
2		E		E																				" " " " "
3	1930	EE	EE	EE	EE	EE	EE			EE	EE	EE	EE	EE	EE		EE	EE		EE			EE	
4	1925	EE	EE	EE	EE	EE	LE			EE	EE	HR					EE	EE					LE	
5		Ac																						Current will be available and used in 1939
6	1926	EE		EE	EE	EE	EE			EE		EE			EE								LE	
7	1927	EE		EE	EE	EE	EE			EE		EE			EE	EE	LE	EE		EE			EE	
8	1936	EE				EE				G	G	G											EE	
9	1929	EE		EE	EE	EE				EE		EE											LE	Electric stove used.
10		Ac				K				HR	HR	HR												Attempting to obtain electricity
11	1925	EE	EE		EE	EE				G							EE	EE					LE	
12										HR		G												Hope to obtain highline service
13	1925	EE	EE	EE	EE	EE		Ec		G	G	G	G								EE		LE	
14	1926	EE		EE	EE	EE				EE		EE	G										EE	2 electric stoves used
15	1937	EE		EE	EE	EE				G	G	G			G								EE	Will expand uses of current
16	1926	EE	EE	EE	EE	EE		Ec		HR	HR	HR								EE		HR	EE	
17	1928	EE	EE	EE	EE	EE				G													EE	
18										G	G	G												Will probably obtain current, 1939-40.
19	1926	EE		EE	EE	EE	EE			EE		EE		FE	EE					EE	EE		EE	
20	1927	EE	EE	EE	EE	EE			EE	EE		G	EE										EE	
21																								Current available 1938
22																								Possibility of obtaining current after 1939
23	1938	EE		EE	EE	EE				G		G											EE	
24	1928	EE	EE	EE	EE	EE	EE	EE		EE	EE	EE	EE				EE	EE	EE	EE		EE	EE	
25	1930	EE	EE	EE	EE	EE	EE			EE	EE	EE		EE	EE	EE	EE			EE	EE		EE	Also fire protection

FINANCES

Capital

The preceding part of this report largely concerned the physical aspects of the farm and farm enterprise. The economic problems were mentioned only in a general way as they influence the farm unit as a whole. It is proposed to present here the amount, use, and trend of capital, receipts, expenses, farm income, labor income, and returns on capital.

Each of the 25 farms must pay its own way. In no instance are the improvements made by subsidizing with outside capital. For improvements made with borrowed money the farm is expected to pay the interest and repay the principal.

The amount and change in capital are summarized in Table 21. Figure 15 shows graphically total farm capital the first year and in 1937, and 1938 shows a continuation of the rising trend in the use of capital. In the period of development, capital increased on 16 farms and decreased on 7 farms. Complete records are not available for farms Nos. 2 and 16, hence these farms are not used in the summaries and averages. The amount of capital varied from $5,904 to $75,982 the first year and averaged $28,825 for the 23 farms. In 1937 the capital ranged from $10,500 to $113,882 and averaged $34,774 on the 23 farms. The increase of capital averaged $5,949 per farm, an increase of 20.6 percent. Changes in the use of capital show increases of 14.3 percent in land and buildings, 29.3 percent in power and machinery, 55.2 percent in livestock and 35.3 percent in feed, seed, and miscellaneous supplies.

The distribution of capital has changed, there being a decrease from 78.9 to 74.8 percent in land and buildings; an increase from 5.4 to 5.8 percent in power and machinery; an increase from 11.1 to 14.3 percent in livestock and an increase from 4.6 to 5.1 in feed, seed, and miscellaneous supplies. Relative changes represent a decrease of 5.3 percent in land and buildings and increases of 7.4 percent in power and machinery, 28.8 percent in livestock and 10.9 percent in feed, seed, and supplies.

The use of capital falls in three general classes: (1) the use of all capital and credit that can be obtained, (2) operating on a pay-as-you-go basis, and (3) the investment of surplus income in farm improvements.

Some farmers are making comparatively slow progress because they have insufficient capital and credit for making necessary improvements to operate to the best advantage. Many of the farms are free from encumbrances. Generally, these farmers have adopted a conservative program of improvement and make such improvement as they deem advisable from their net income without borrowing.

Some farmers have substantial cash reserves for operating expenses and improvements. The investment of surplus returns is a problem with these farmers. For example, one farmer increased his farm capital from about $5,000 to $70,000 in 18 years. Supposedly safe outside investments formerly were made but they resulted in large losses. This farmer is now

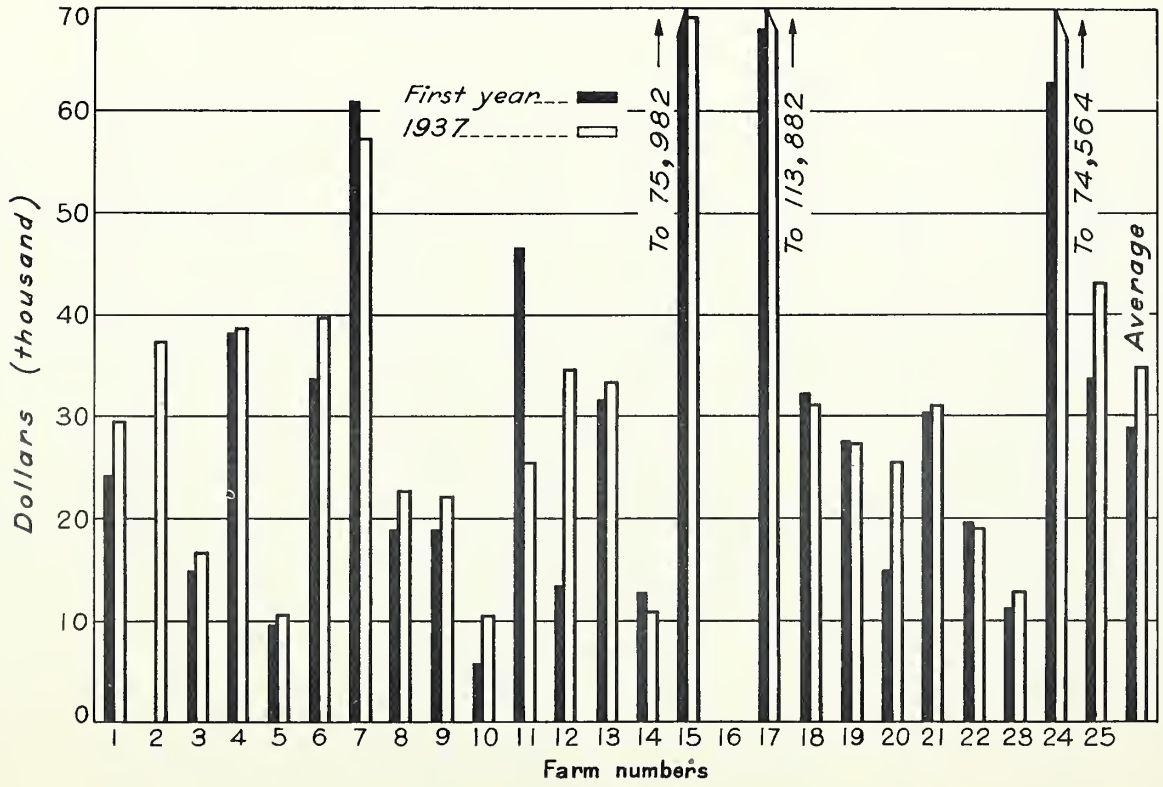


Figure 15. — Capital Investment

Table 21. Capital Investment

Farm No.	Land and buildings		Power and machinery		Livestock		Feed, seed and miscl. supplies		Total		Change "+" or "-"	
	1st year	1937	1st Yr.	1937	1st Yr.	1937	1st Yr.	1937	1st Yr.	1937	Dollars	Percent
	Dollars	Dollars	Dollars	Dollars								
1	20,000	20,250	1,350	1,860	2,244	4,136	550	3,171	24,144	29,417	+5,273	+21.8
2	-	26,400	-	1,391	-	7,480	-	1,859	-	37,120	-	-
3	11,000	12,250	1,553	1,778	1,515	1,974	548	616	14,616	16,618	+2,002	+13.7
4	34,750	34,750	1,140	1,250	1,094	1,529	1,045	1,035	38,029	38,564	+535	+1.4
5	7,705	8,025	524	570	1,021	1,339	310	374	9,560	10,308	+748	+7.8
6	22,000	22,209	2,145	2,342	7,657	11,904	2,080	3,330	33,882	39,785	+5,903	+17.4
7	45,350	45,600	3,774	3,972	7,434	5,059	4,402	2,870	60,960	57,501	-3,459	-5.7
8	18,125	19,885	94	632	424	1,685	19	439	18,662	22,614	+3,952	+21.2
9	15,000	15,000	700	1,625	1,673	3,440	1,290	2,050	18,663	22,115	+3,452	+18.5
10	4,000	7,050	163	303	415	1,790	1,326	1,357	5,904	10,500	+4,596	+77.8
11 1/	40,082	20,560	647	398	4,075	3,312	1,992	1,430	46,796	25,700	-21,096	-45.1
12	10,000	29,250	513	550	2,560	3,773	269	1,018	13,342	34,591	+21,248	+159.3
13	30,000	31,000	1,118	1,450	610	958	112	174	31,841	33,582	+1,741	+5.5
14	7,505	7,280	1,007	513	3,508	2,797	641	184	12,661	10,774	-1,887	-14.9
15	59,200	50,000	4,566	5,111	8,026	9,254	4,190	4,449	75,982	68,814	-7,168	-9.4
16	-	-	-	-	-	-	-	-	-	-	-	-
17 2/	55,000	77,650	931	1,214	6,962	29,001	3,280	6,017	66,183	113,882	+47,699	+72.1
18	22,625	22,710	820	639	7,003	6,525	1,898	1,528	32,346	31,402	-944	-2.9
19	22,000	22,150	3,432	1,525	1,785	3,119	265	551	27,482	27,345	-137	-0.5
20	13,800	22,628	250	2,350	400	427	48	180	14,498	25,585	+11,087	+76.5
21	25,500	25,000	282	345	3,596	4,305	904	1,163	30,282	30,813	+531	+1.8
22	15,000	15,800	1,604	1,561	2,248	1,161	710	642	19,562	19,164	-398	-2.0
23	8,650	8,500	300	1,040	1,792	2,014	472	1,362	11,214	12,916	+1,702	+15.2
24 3/	17,000	57,663	4,476	8,384	773	5,742	506	2,775	22,755	74,564	+51,809	+227.7
25	19,000	23,129	4,243	6,652	6,877	9,113	3,500	4,360	33,620	43,254	+9,634	+28.7
Ave. 23 farms 4/	22,752	26,015	1,549	2,003	3,204	4,972	1,320	1,786	28,825	34,774	+5,949	+20.6
Change Per farm 4/		+3,263		+454		+1,768		+466		+5,949		
Percent 4/	100	114.3	100	129.3	100	155.2	100	135.3	100	120.6		
Percent of Inv. 4/	78.9	74.8	5.4	5.8	11.1	14.3	4.5	5.1	100	100		

1/ Sale and division of estate largely responsible for decrease. 2/ Purchase of additional farm partially responsible for increase. 3/ Including second farm in records is responsible for about $40,000 increase

4/ Average and percentages based upon 23 farms omitting Nos. 2 and 16.

using his surplus capital to make the farm as independent as possible of weather hazards and market variations. The land is clean and fertile, well drained, and free from erosion. Good thrifty orchards have been established. The use of both stationary and portable spray plants assure proper care of trees and fruit. Buildings are good, durable structures with ample facilities for properly processing and storing products, supplies and equipment, and the maintenance of livestock. Cold storage is provided for fruit. The development of wholesale and roadside markets provides more independent and profitable marketing facilities. Further improvement will include the installation of irrigation. The whole program of development and operation provides better labor distribution throughout the year.

Receipts

The amount and change of farm receipts generally indicate the extent of improvement in farms and markets. Receipts have shown a steady and marked increase for most of the farms, and the average for the group is definitely upward. Part of the advancement is due to the improvement in prices of products and part is due to the improvement in production and marketing methods on the individual farms.

Receipts are given in Table 22 for the first year and 1937. Gross receipts increased on 16 farms and decreased on 5 farms. The average of all farms recorded represents an increase of $2,593 per farm or an increase of 35.9 percent. The range of receipts the first year varied from $180 to $26,458 and averaged $7,227. In 1937 the range was from $504 to $38,446 and averaged $9,820.

Expenses

The amount of farm expense is given in Table 23. Expenses increased from $5,619 to $6,657 as an average for the 21 farms. The change represents an average increase of $1,038 or 18.5 percent. These increases of expenses compare favorably with the increases of receipts averaging for the same farms $2,593 or 35.9 percent. Expenses are shown comparatively on Figure 19.

Increases in expenses reflect increased costs of farm supplies, materials, labor, and equipment for making permanent improvements. The program of development entails large expenditures for field improvement, fencing, buildings, power, machinery, and livestock to reduce the farm operating costs. In some instances the expansion and intensification of operations has increased costs per farm.

Farm Income

Records of receipts and expenses show the former had increased 35.9 percent and the latter 18.5 percent, thus indicating a larger farm income. The farm income 5/ is shown in Figure 16. For the nine farms having complete

5/ Farm income = Gross sales + increased inventory) - (total expenses + decreased inventory).

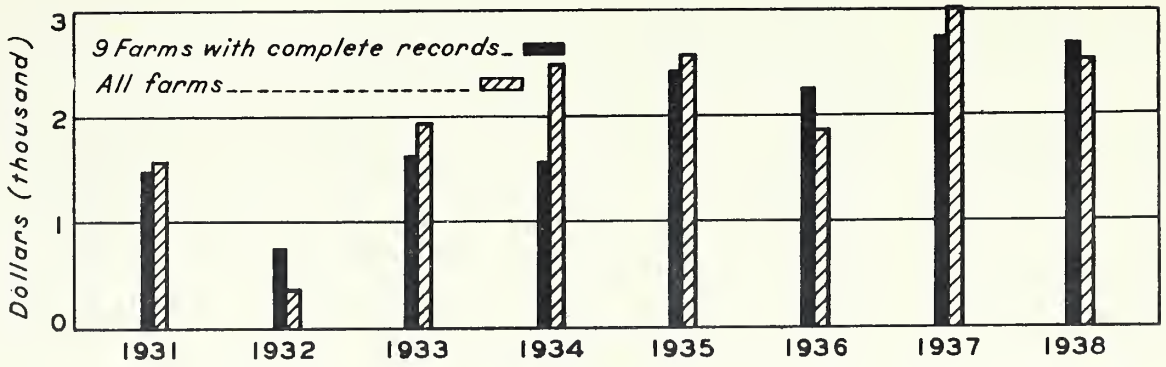


Figure 16.– Farm income

Table 22.- Farm Receipts

Farm No.	Livestock and Livestock Products		Crops		Other		Total		Change	
	First Year	1937	First Year	1937	First Year	1937	First Year	1937	Dollars	Percent
1	$3,019	$5,042	$2,296	$2,080	$ 138	$972	$5,453	$8,094	+ 2,641	+48.4
2	-	4,552	-	2,405	-	398	-	7,355 1/	-	-
3	-	-	-	-	-	-	5,959 1/	-	-	-
4	-	2,300	-	742	-	-	2,793	3,042	+249	+8.9
5	1,063	855	795	450	-	678	1,858	1,983	+125	+6.7
6	-	18,180	-	960	-	1,443	14,075	20,583	+6,508	+46.2
7	-	-	-	-	-	-	19,778 1/	-	-	-
8	-	476 2/	164	28 2/	16	0 2/	180	504 2/	+324	+180.0
9	-	5,510	-	5,706	-	1,682	8,067	12,898	+4,831	+59.9
10	-	2,182	-	65	-	625	1,947	2,872	+925	+47.5
11	5,148	6,029	1,474	532	19,836	0	26,458	6,561	-19,897	-75.2
12	-	2,985	-	1,024	-	2,040	2,059	6,049	+3,990	+193.8
13	-	400	-	4,484	-	35	6,625	4,919	-1,706	-25.7
14	-	8,405	-	480	-	0	7,286	8,885	+1,599	+21.9
15	7,584	-	0	-	772	-	8,356	14,983	+6,627	+79.3
16	NOT AVAILABLE									
17	1,579	21,823	925	855	0	15,768	2,504	38,446	+35,942	+1,435.4
18	179	2,699	1,161	1,109	1,861	639	3,201	4,447	+1,246	+38.9
19	-	4,596	-	255	-	1,190	4,113	6,041	+1,928	+46.9
20	-	237	-	9,935	-	0	8,602	10,172	+1,570	+18.2
21	2,622	787	359	833	112	1,664	3,093	3,284	+191	+6.2
22	-	2,407	-	436	-	1,097	4,315	3,940	-375	-8.7
23	-	2,856	-	305	-	663	4,254	3,824	-430	-10.1
24	2,595	-	4,521	-	70	-	7,186	24,462 3/	+17,276	+240.4
25	-	19,359 2/	-	866 2/	-	0	29,339	20,225 2/	-9,114	-31.1
Average 21 farms omitting Nos. 2, 3, 7 and 16							7,227	9,820	+2,593	+35.9

1/ Incomplete records not used in average. 2/ 1935. 3/ Complete farm.

Table 23.- Farm Expenses

Farm No.	Current		Livestock Decrease		Feed & Supply Decrease		Real Estate and Equipment		Total		Change	
	First Year	1937	First Year	1937	First Year	1937	First Year	1937	First Year	1937	Dollars	Percent
1	$3,732	$2,498	$58	$0	$0	$0	$0	$0	$3,790	$2,498	-1,292	-34.1
2	-	-	-	-	-	-	-	-	-	5,422 1/	-	-
3	-	-	-	-	-	-	-	-	4,333 1/	-	-	-
4	-	3,038	-	0	-	591	-	0	2,806	3,129	+323	+11.5
5	449	814	0	0	91	0	21	0	561	814	+253	+45.0
6	-	12,331	-	0	-	1,660	-	0	8,876	13,218	+4,342	+48.9
7	-	-	-	-	-	-	-	-	19,339 1/	-	-	-
8	1,429	993 2/	11	0	0	88 2/	0	120 2/	1,440	1,201 2/	-239	-16.6
9	-	7,050	-	0	-	0	-	0	5,778	7,050	+1,272	+22.0
10	-	2,233	-	9	-	180	-	40	1,423	2,462	+1,039	+73.0
11	2,322	4,939	0	0	0	0	19,933	0	22,255	4,939	-17,316	-77.8
12	-	2,403	-	64	-	0	-	1,500	2,069	3,967	+1,898	+91.7
13	-	6,671	-	4	-	5	-	0	5,841	6,480	+639	+10.9
14	-	6,715	-	0	-	63	-	220	4,589	6,998	+2,409	+52.5
15	3,984	5,728	0	0	40	0	435	1,829	4,459	7,557	+3,098	+69.5
16	-	-	-	-	-	-	-	-		1/ -	-	-
17	3,063	25,181	0	0	0	0	88	0	3,151	25,181	+22,030	+699.1
18	2,290	-	0	-	0	-	220	-	2,510	3,183	+673	+26.8
19	-	4,354	-	0	-	0	-	100	5,093	4,454	-639	-12.5
20	-	2,781	-	0	-	0	-	0	7,981	6,714	-1,267	-15.9
21	1,053	-	0	-	377	-	4	-	1,434	1,210	-224	-15.6
22	-	2,675	-	0	-	0	-	0	3,602	2,675	-927	-25.7
23	-	1,628	-	273	-	92	-	97	2,056	2,090	+34	+1.6
24	4,358	-	0	-	0	-	0	-	4,358	21,496 3/	+17,138	+393.2
25	-	10,287	-	0	-	1,899	-	301	23,924	12,487	-11,437	-47.8
Average 21 farms (Farms 2, 3, 7, 16 not used)									5,619	6,657	+1,038	+18.5

1/ Incomplete record not used in average.
2/ 1935
3/ Complete farm.

records for seven years, the average farm income was as follows: $1,472, $701, $1,630, $1,523, $2,474, $2,268, $2,765, and $2,710 for the eight consecutive years 1931 to 1938. The entire group of farms showed a similar trend averaging by years from 1931 to 1938: $1,588, $322, $1,912, $2,505, $2,607, $1,824, $3,065, and $2,524.

Labor Income

Returns in terms of labor income are given in Table 24. Labor income 6/ varied a great deal from one farm to another and from year to year on the same farms. However, the trend is definitely upward. Several definite trends can be visualized from the graphs in Figure 17. Labor income in 1931 was from $389 and dropped to $354 in 1932, for the nine farms having complete records. A consistent rise occurred from 1932 to 1935. The average reached a peak of $1,443 in 1937. The labor income averaged for all farms followed somewhat the same trend as the 9 farms with complete record. The average labor income of $844 for all farms for the four years 1935 to 1938 compares favorably with the corresponding average of $250 for the first four years 1931 to 1934. The average increase for the entire group is $594. The nine farms with complete records had average labor incomes of $262 in the four years 1931 to 1934 and $1,279 in the period 1935 to 1938.

Return on Capital

Farm capital increased $5,949 per farm from 1931 to 1937. The change represents an increase of 20.6 percent. Changes in percent return on capital as shown in Table 25 apply to not only the initial capital of $28,825 but also to the progressive increase of capital which averaged $34,774 in 1937.

Returns on capital averaged for all farms in 1931, 3.7 percent, 1932, -1.1; 1933, 3.3; 1934, 5.5; 1935, 8.6; 1936, 5.2; 1937, 6.8; and 1938, 5.7. The average returns for the four years 1931, 1932, 1933, and 1934, was 3.1 percent, and for 1935, 1936, 1937, and 1938 6.6 percent. Comparative returns from the nine farms having complete records show similar but slightly higher returns averaging 2.1 percent for the first four years against 7.9 percent for the last four years. The returns on capital are shown for the eight year period in Figure 18. Trends show an average downward movement of returns for 1931 and 1932, a steady rise from 1932 to 1935 and nearly uniform returns from 1935 to 1938. The returns during the last four years are not only higher than during the first four years but they show less fluctuation, particularly in the lower income range.

6/ Labor income is the earnings the farmer receives for his labor and management after deducting all business expenses and interest on average capital. In addition to these earnings the farmer receives the benefit of his house and the farm products furnished by the farm.

Table 24.- Labor Income (Dollars)

Farm No.	1931	1932	1933	1934	1935	1936	1937	1938
1	456	-49	3,756	1,584	2,700	3,956	4,125	4,350
2	1/	1/	NR	NR	NR	NR	77	-1,183
3	895	701	NR	NR	NR	NR	NR	NR
4	-1,914	-2,483	-888	-2,251	-249	-1,116	-2,015	-1,343
5	1/	1/	NR	NR	NR	819	653	436
6	3,505	1,400	3,416	2,355	2,592	2,781	5,388	4,651
7	-3,109	-8,506	NR	NR	NR	NR	NR	NR
8	NR	-2,193	-1,043	-1,829	NR	NR	NR	NR
9	1,356	1,747	3,997	4,511	NR	NR	4,742	2,488
10	229	-332	NR	NR	845	-201	-115	216
11	1/	1/	NR	NR	NR	1,863	337	355
12	-677	-842	-2,038	-173	606	-2,900	352	-1,196
13	-808	-349	NR	NR	NR	-337	-3,240	426
14	2,064	-2,685	-945	84	287	1,980	1,347	1,026
15	1/	1/	98	1,971	NR	NR	3,985	4,993
16			N O R E C O R D					-549
17	1/	1/	-3,956	7,326	NR	-2,846	7,572	-2,926
18	1/	1/	NR	NR	NR	-926	-308	NR
19	-1,197	-802	50	-88	398	-1,678	220	-122
20	-104	3,266	2,564	3,199	5,214	4,740	2,179	3,279
21	1/	1/	NR	NR	145	39	533	648
22	-265	-1,766	-1,388	-1,348	-266	-1,074	307	401
23	1,637	776	614	633	954	2,023	1,088	1,077
24	1/	1/	-2,941	1,375	-2,639	-4,040	-737	-4,490
25	3,734	NR	5,497	-2,842	5,575	NR	NR	NR
Average 9 farms	389	-354	571	444	1,360	968	1,443	1,347
Average all records	387	-808	453	967	1,243	181	1,325	627

1/ Project not started
(NR) No record

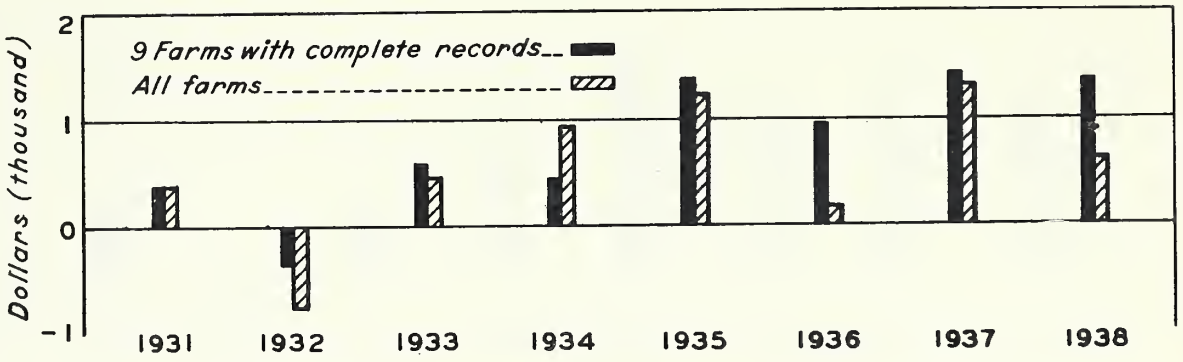


Figure 17.—Labor income

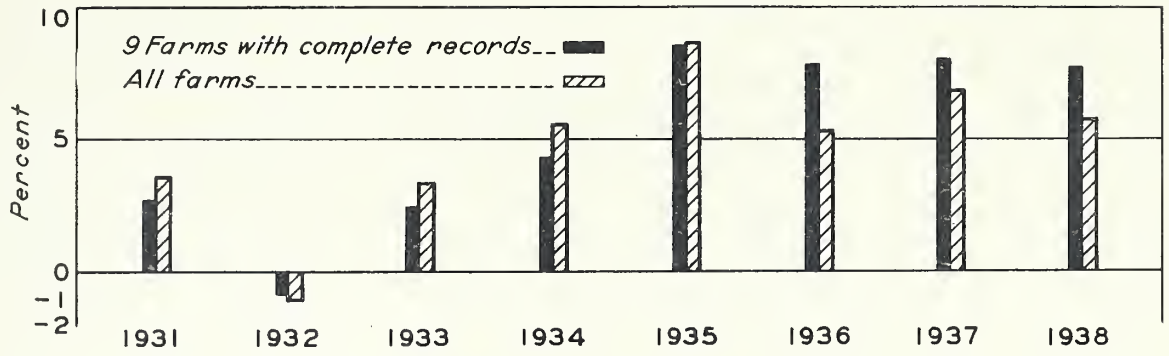


Figure 18.— Returns on capital

Table 25.- Returns on Capital in Percent

Farm No.	1931	1932	1933	1934	1935	1936	1937	1938
1	4.8	2.2	21.8	10.3	15.1	14.5	14.9	16.8
2	1/	1/	NR	NR	NR	NR	4.5	0
3	8.0	6.5	NR	NR	NR	NR	NR	NR
4	-16.1	-3.2	1.1	-2.0	2.9	0.6	-2.0	0
5	1/	1/	NR	NR	NR	8.3	5.5	4.4
6	10.9	4.7	10.8	7.4	7.9	8.3	14.9	12.6
7	-3.0	-12.9	NR	NR	NR	NR	NR	NR
8	1/	-10.0	-2.8	-5.7	NR	NR	NR	NR
9	9.0	11.1	22.6	24.8	NR	NR	21.9	11.7
10	1.8	-7.2	NR	NR	14.2	-0.7	0.5	2.4
11	-	-	NR	NR	NR	7.1	4.8	4.7
12	-3.7	-5.9	-20.3	2.8	10.2	-4.1	5.2	1.2
13	2.2	3.6	NR	NR	NR	2.1	-6.4	5.1
14	15.6	-23.6	-10.2	-2.8	-0.8	15.0	9.2	6.1
15	1/	1/	4.0	6.4	NR	NR	10.1	9.7
16			N O R E C O R D					1.2
17	1/	1/	1.8	14.1	NR	0.2	11.2	2.2
18	1/	NR	NR	NR	NR	-1.8	3.4	NR
19	-2.0	-0.6	2.6	2.1	3.9	-3.7	3.2	2.1
20	-2.0	17.8	13.2	15.6	23.6	21.2	10.0	13.3
21	1/	1/	NR	NR	5.5	4.8	6.4	6.0
22	+0.0	-7.8	-4.9	-3.0	3.6	-0.6	6.6	6.5
23	16.3	8.7	7.3	7.4	10.4	19.1	9.6	9.3
24	1/	1/	-9.2	8.7	-0.8	-2.7	2.7	-2.2
25	13.5	NR	16.1	-3.2	15.9	NR	NR	NR
Average 9 farms	+2.8	-0.85	+2.4	+4.2	+8.5	+7.8	+8.0	7.5
Ave. all farms	+3.7	-1.1	+3.3	+3.5	8.6	5.2	6.8	5.7

1/ Project not started
(NR) No record

LIVING CONDITIONS

This report has considered primarily physical and economic problems and changes. Better living conditions are made possible in a large measure by the improvement of physical and economic conditions. Physical improvements provide better homes with less drudgery; economic improvement makes possible home conveniences and better educational, medical, and recreational facilities.

Farm improvement depends upon the achievement of good proportion in the development of physical, social, and economic phases of farming. Improvement of the individual farms is one problem combining these phases, rather than three separate problems. These features must be properly developed to achieve balance. The human side of farming must be considered in two ways: (1) labor is a resource, a source of energy to be employed to the best advantage, and (2) the farm folks are recipients of the fruits of their own energy, industry and ability in the development, conservation, and use of their resources.

The welfare of the farm family necessarily comes first. Drudgery is eliminated from the farm and farm home by the use of more and better power and machinery, conveniently arranged buildings, and labor saving equipment. These improvements reduce fatigue and provide more leisure for mental and spiritual enjoyment.

Physical improvements make possible the release of energy for the development at home of art and crafts such as gardening, landscaping, painting, and decorating while economic improvements provide the necessary means for their development and enjoyment.

The cooperating farmers place high values on these factors. They are interested in their homes, their families, and their tenants' welfare. Many farm homes were improved and modernized before the beginning of the project. Others have been modernized more recently. These include: (1) the complete remodeling, redecorating, and landscaping of 9 farm homes and the construction of one new house, (2) the building of 9 new tenant houses, increasing the number from 38 to 47 on the 25 farms, (3) increase in the number of farms with electric power from 14 to 17. (4) installation of running water in 21 of the 25 farm homes and in about one-half the tenant houses, (5) providing electricity for 17 tenant houses on eight farms, and (6) telephones on all but one farm.

The equipment includes electric irons, washers, churns, refrigerators, water heaters, electric and gas stoves, toasters, and cleaners, which add to the convenience and comfort of the home.

Indications of the appreciation of home life and good living conditions are suggested in Plate 11. In many instances these farm homes are old but they are kept in good repair and painted in harmonizing colors. Careful planning and planting of trees, shrubs, and

Plate 11.— Farm homes

Plate 12.- Tenant houses

flowers in keeping with the requirements and natural setting add to the attractiveness of the home and its environment.

The owners show an appreciation of the requirements of labor. In most instances good tenant houses are provided. The owners are interested in providing good houses and making available for responsible tenants running water and electricity. A group of tenant houses is shown in Plate 12.

SUMMARY

Careful study of a wide range of typical livestock, dairy, fruit, truck, and general farms throughout Virginia shows each and every one capable of improvement in their physical plants and their management regardless of size, type, and location.

Some of the factors that reduce the efficiency of farm operations are: too much or too little land; unbalanced land use, neglect of soil improvements; improper cropping practices; poor field arrangement; improperly located roads, lanes, fences, and ditches; unbalanced crop and livestock schedules; lack of satisfactory power, machinery, and equipment; costly use and poor distribution of labor; inadequate service buildings, inconvenient farmstead and buildings; inadequate tenant houses; lack of adequate farm business records, and lack of long-time objectives and of determination to carry out a definite program of permanent improvement.

Plans can be developed for the whole farm to achieve good balance in the development, use, and conservation of land, buildings, power, machinery, capital, and labor, and a program of permanent improvement can be carried out for the more efficient operation of the farm and to provide more wholesome working and living environment for the farm people.

Since the project started in 1931, seven farms were increased in size and one decreased. For the 25 farms there was an average increase of 11.1 acres per farm or 3.7 percent.

Changes in land use represent an average increase from 33.4 to 34.2 percent in crops, an increase from 34.8 to 36.6 percent in pastures, a decrease from 25.6 to 24 percent in timber and a decrease of service and waste land from 6.2 to 5.2 percent. Approximately one-third of the land is used from crops, one-third for pasture, one-fourth for timber and one-twelfth for service and waste. General improvement in fields and roads is summarized in Table 26.

Drainage problems of varying importance were found on three-fourths of the farms. Drainage was needed over almost the entire area of five farms. Four farmers installed 33,000 feet of drain tile from 1931 to 1938. This installation represented about 12.5 percent of the total tile required for adequate drainage.

Table 26.- Percent of program for land improvement completed to 1938

Type of improvement	Farm numbers - 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Ave
Drainage	20	0	N	N	N	41	65	0	0	N	0	N	0	0	0	55	0	N	2	0	0	34	0	N	46	12
Land clearing	45	43	N	100	100	37	67	52	50	15	N	33	100	N	N	100	N	N	33	N	17	27	100	N	83	48
Irrigation	0	0	0	N	0	0	N	0	N	0	0	0	0	100	N	0	0	0	0	100	0	N	N	N	N	33
Erosion control	34	12	0	25	80	77	N	20	N	14	8	63	50	43	0	80	9	8	0	70	30	0	20	0	N	32
Increase in size of fields	45	44	100	0	37	38	73	0	20	100	0	76	31	0	26	N	100	0	0	100	100	25	N	N	100	45
Decrease in number of fields	44	46	100	0	57	59	100	0	0	100	100	92	50	0	50	N	85	0	0	100	100	50	N	N	0	51
Permanent fence	10	41	100	100	67	26	13	20	10	100	50	10	53	11	66	100	53	92	0	100	18	17	100	100	58	38
Roads	0	N	N	100	N	0	63	N	0	0	N	60	N	N	N	N	26	N	N	100	N	N	N	N	100	13

N = No change needed or planned.

Land clearing was needed on 18 of the 25 farms. An area of 295 acres was cleared on 17 farms, the area cleared per farm varying from 1 to 100 acres. Clearing schedules had been completed on 5 farms while the additional clearing of 320 acres was planned on 13 farms.

At the beginning of the project, 30 acres were irrigated on 4 farms. The area was increased to 49 acres by 1938 while plans provided for increasing the irrigated area to 78 acres on 5 farms. Sixteen of the 25 farms had suitable land and water for irrigating about 215 acres. This represented 7 times the area initially irrigated and 3 times the area planned for irrigation in the immediate future.

Soil erosion affected in varying degrees 24 of the 25 farms. About 47 percent of the farms were subject to moderate erosion and 13 to severe erosion, while about 40 percent had negligible erosion. Erosion control work accomplished includes: 102 acres terraced on 8 farms, gully control of 118 acres on 17 farms and the reforestation of 61 acres on 5 farms. The erosion control practices effected on 507 acres of the 17 farms represented about one-third the area needing this treatment.

About 50 percent of the improvements planned in field arrangement had been completed. Originally the size of fields averaged 7.7 acres. In 1938, the average size was 11.6 acres, while the plans provided for increasing the average size to 16.3 acres. The number of fields per farm averaged 11.9 in 1938 against 16.6 in the beginning and 7.3 as outlined in the plans.

Plans provided for reducing the required fences per farm from 4.74 to 4.4 miles. Permanent fences have been increased from 1.7 miles per farm to 2.7 since the project was started.

Service roads were improved but the amount per farm changed very little. In the beginning of the project there was 0.75 mile of roads per farm and in 1938, 0.74, while plans provided for reducing the roads to 0.68 mile per farm, a decrease of 9.6 percent.

Road efficiency is of more importance than the mileage of roads. Road improvements include the elimination of bogs, the reduction of grades and shortening the distance from the points of operation on the farmstead to the several fields. The plans provided for reducing field travel distance by 23 percent on the basis of acre miles per acre.

Rotations and cropping schedules were developed in the orinal plan. Small changes were made in the areas of different crops with small increases of corn and small grain.

Changes in fertility practices showed a 59 percent increase in the value of lime applied, a 45 percent increase in the value of fertilizer used, and slight increase in the application of stable manure.

Changes in the crop index on 12 farms showed 10 percent increase.

There was not a large change in the number of animals and their equivalent in animal units. In 1938 there were 56.4 animal units per farm against the recommendation of 58.4 and an original number of 51.4

Feed production from 1931 to 1937 represented increases of 5.1 percent in corn and 14.6 in hay and reduction of 28.2 percent in small grain and 2.4 in ensilage.

Feed production-consumption balances on 12 farms showed in 1931 deficits in hay, grain, and ensilage; in 1937 there was a surplus of hay, smaller deficit of ensilage and greater deficit of grain.

Changes in available drawbar power showed work horses decreased from 4.04 to 3.84 per farm and tractors increased from 0.72 to 0.88 per farm. The number of general purpose tractors increased from 2 to 10 on the 25 farms. The combined animal and tractor power increased from 16.05 to 16.48 drawbar horsepower equivalent.

Belt power was available on 20 of the 25 farms. The horse units included 22 tractors, 1 gasoline engine, and 47 electric motors. The belt power represented about 610 horsepower.

Special mechanical equipment included trucks, crawler tractors, general purpose tractors, tractor planters and cultivators, push rakes, combines, terracers, portable sprayers, stationary spray plants, stump pullers, sawmills, power hoists, power ditchers, milking machines, overhead irrigation systems, fruit graders, washers and driers, and cold storage equipment.

The number of separate structures included 28 general purpose barns and 32 other barns, 25 silos, 40 poultry houses, 23 machine sheds, 22 garages, 47 tenant houses and 24 owners' dwellings. Special buildings included greenhouses, sweetpotato curing houses, apple and peach packing houses, common apple storages and cold storage buildings.

The following buildings had been erected since the start of the project: 7 barns, 12 silos, 5 fruit and vegetable storage buildings, 2 corncribs, 2 hay barns, 1 straw shed, 3 implement sheds, 9 poultry houses, 1 greenhouse, 9 tenant houses and 1 owners' residence. Eight owners' residences were completely renovated and modernized. This construction represented in amount and value approximately 20 percent of all buildings.

Electricity was used on 17 of the 25 farms. Seventeen tenant houses were served with electricity on 8 farms. In addition to small household equipment, there were 47 electric motors ranging from one-eighth horsepower to 15 horsepower used for operating refrigerators, milking machines, churns, pumps, feed grinders, ensilage cutters, hay hoists, stationary spray plants, and shop tools. Special equipment included hydraulic rams, unit lighting plants, acetylene plants, cold storage plants, milk coolers, milk bottles, fire protection pumps, and electric fences.

The amount of farm capital increased on 16 farms and decreased on 7. The average capital per farm for 23 farms increased from $28,825 the first year to $34,774 in 1937. The increase represented 20.6 percent of the original capital.

The distribution of capital the first year and in 1937 was as follows: land and buildings, 78.9 to 74.8 percent; power and machinery, 5.4 to 5.8 percent; livestock, 11.1 to 14.3 percent; and feed and supplies, 4.6 to 5.1 percent.

Gross receipts from 1931 to 1937 increased on 16 farms and decreased on 5. The 21 farms averaged show increased receipts of $2,593 per farm, or 35.9 percent.

Expenses increased from $5,619 to $6,659 on 21 farms or 18.5 percent and averaged $1,038 per farm.

The average farm income from nine farms having continuous records was $1,472, $701, $1,630, $1,523, $2,274, $2,268, $2,765, and $2,710 for the eight consecutive years 1931 to 1938.

The average labor income was $389 in 1931; $-354 in 1932, $571 in 1933, $444 in 1934, $1,360 in 1935, $968 in 1936, $1,443 in 1937, and $1,374 in 1938 for the nine farms having continuous records.

The average returns on capital for all farms were:1931, 3.7 percent; 1932, -1.1; 1933, 3.3; 1934, 5.5; 1935, 8.6; 1936, 5.2; 1937, 6.8; and 1938, 5.7.

Many of the physical and economic improvements previously listed contributed directly to better living conditions. Thirty-five percent more farm workers have been provided employment and nine more tenant families are provided homes and employment.

Both owners' homes and tenant homes have been improved through construction, remodeling, and rebuilding and the installation of water and electricity. The increased use of more flexible power, better machinery, and labor saving equipment have reduced drudgery on the farm and in the home. The general use of telephone, radio, modern lighting, heat, and refrigeration, contribute to more attractive living.

APPENDIX

Proposed Farm Operating Plan

This farm is located on the Piedmont Plateau. It is typical of the area in that the farm is comparatively large, the boundaries are irregular, the topography is rolling to rough with irregular areas of streams, gullies, and woodland cutting the farm into a series of fields of irregular size and shape. Variation of soil and irregularly located roads and fences add to the patchy field arrangement.

The farm map, Figure 19, shows property and field lines of 1931, the topography, roads, fences, and buildings. This map serves as a record of conditions at the start of the study and as a basis for soil surveys and reorganization. A reconnoissance survey 7/ was made of the soils. There are four principal soil types; Cecil loam, Cecil clay loam, Louisa loam, and Congaree.

Various types of Cecil soil predominate. They include shallow and deep phases of Cecil loam, Cecil clay loam, and Cecil clay. Erosion is largely responsible for the variations. Cecil soils respond well to good treatment including erosion control, crop rotation, lime, legumes, manure, and fertilizer.

Louisa loam is considered a poor type of Cecil soil. It is generally thin and irregular and occupies the steep eroded hills or bluffs with frequent rock outcrop and gullies.

The soil along bottom lands is Congaree. It is an alluvial soil derived largely from material eroded from the Cecil and Louisa soils. This soil has a loamy surface and a sandy loam subsoil. It is generally well drained but creek overflow and seepage from higher land combine to make a drainage problem. It yields good crops of corn, small grain, and hay.

The plan provides for utilizing the land for the production of feed crops and pasture in furthering the existing dairy program. Attention is given to land use, erosion control, drainage, pasture improvement, soil improvement, field arrangement, crop and livestock production, buildings, and general organization.

7/ Soil survey and soil fertility recommendations were made by the Department of Agronomy, Virginia Polytechnic Institute.

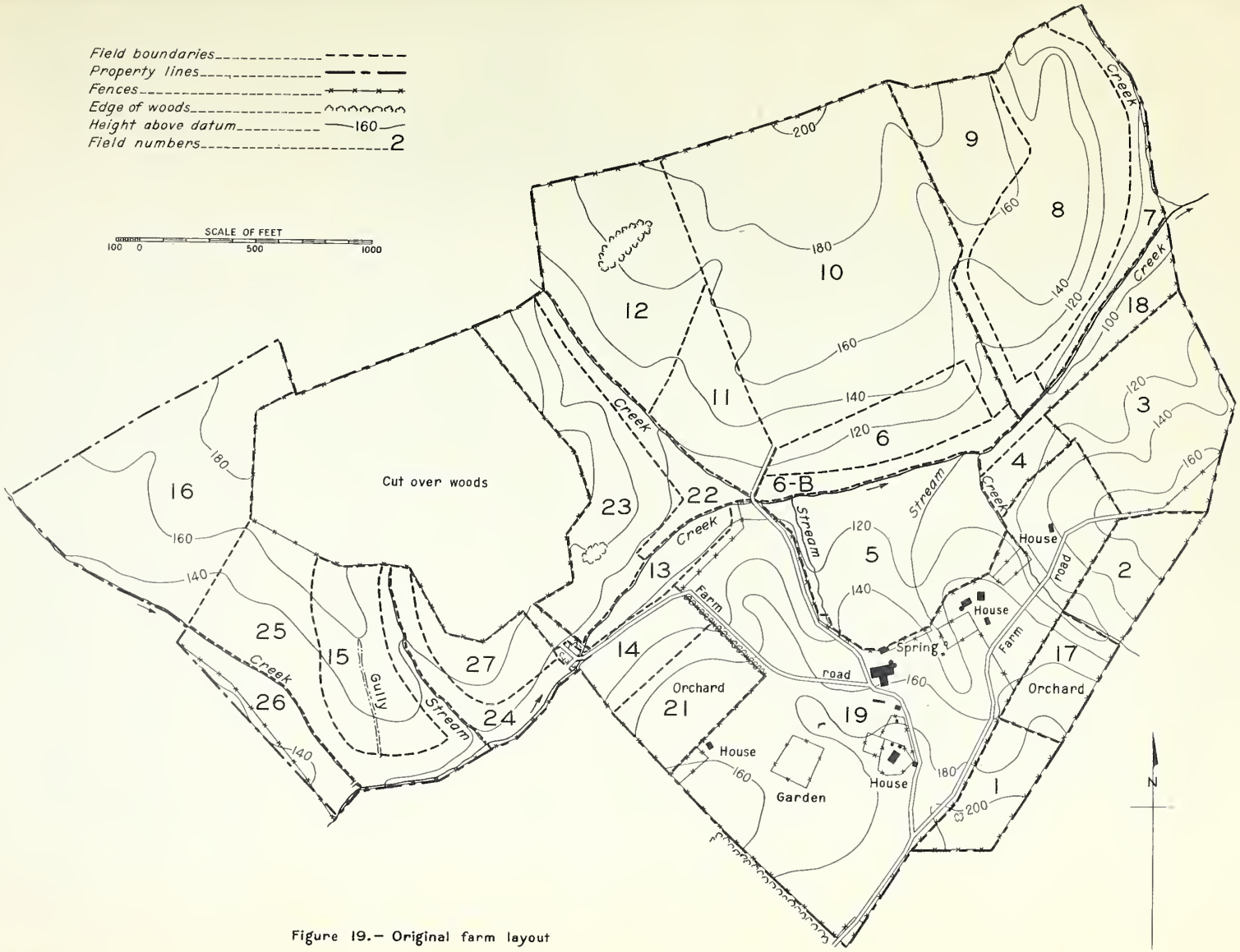


Figure 19.— Original farm layout

Summary of Receipts and Expenses for
the year ended December 31, 1931

Average Capital	$33,882
Receipts:	
Increase in Capital	906
Livestock Sold	1,162
Livestock Products Sold	12,007
Total Receipts	$14,075
Expenses	
Livestock Purchased	$ 56
Current Expenses	8,820
Total Expenses	8,876
Farm Income:	$ 5,199
Interest on Average Capital @ 5%	1,694
Labor Income	3,505

Strong Points of Business:

1. Very good size
2. Good crop yield
3. Good production per cow
4. Favorable milk prices
5. Good labor distribution

Weak Points:

1. Rapid turnover of labor
2. Large losses of cows
3. Excessive damage to machinery
4. Farm suffering from effects of the drought of 1931
5. Inconvenient arrangement of buildings
6. Irregularities of fields and farm layout

General Recommendations:

1. Maintain a herd of 60 milking cows and 20 head of young stock
2. Grow 70 acres of alfalfa
3. Produce about 20 acres of ensilage near barns
4. Establish a four year rotation on four 15-acre fields.
5. Improve the pastures.

The new field plan is shown on the farm map, Figure 20. The cropping plan is summarized in Table 27.

Table 27.- Cropping plan and estimated yields and production

Field	Area Acres	Crop		Estimated	
		Kind	Acres	Yield per acre	Production
A	80.7	Alfalfa	70.6	4 tons	282 tons
		Corn	10.1	50 bu.	505 bu.
B, B1, B2	20.6	Corn ensilage	20.6	15 tons	309 tons
C	20.3	Barley 1/	20.3	40 bu.	812 bu.
D,E,F,G,	60.0	Corn	15.0	50 bu.	750 bu.
		Barley 1/	30.0	40 bu.	700 bu.
		Clover, timothy and lespedeza	15.0	1.5 tons	23 tons
H	20.5	Permanent pasture			
I	4.5	Apples			
J	48.0	Permanent pasture			
Total	254.6				

1/ Barley or other small grain may be followed with lespedeza for a fall hay crop or crimson clover and vetch for a winter cover crop.

The maintenance of the yields and production estimated in Table 27 will require the use of lime, stable manure, and fertilizer. Sufficient lime should be applied to permit the growing of alfalfa and red clover. Soils that have not been limed will require 3 to 4 tons of ground limestone per acre before alfalfa is seeded. About 600 tons of stable manure will be available annually for building up select areas or applying uniformly to crop and pasture land. Commercial fertilizer recommendations are given in Table 28.

Table 28.- Fertilizer recommendations

	Nitrogen	Phosphoric Acid	Potash
		Pounds per Acre	
Corn	8 1/ to 12	32	8
Small grain	8 1/ to 12	32	8
Alfalfa	0	48	16
Grass and Clover	8 1/ to 12	32	8
Pasture	0	48 to 80	0

1/ Top or side dress with 100 pounds quick-acting nitrogen fertilizer where no manure is used.

Rotation:

Field A, 80.7 acres. This field is to be used for alfalfa. About 7/8 of the field will be in alfalfa and 1/8 in corn, and operated so as to renew the seeding of alfalfa following corn.

Field B, B1, and B2, will be cropped as one field and used with Field C in a two-year rotation of silage corn and small grain.

Fields D, E, F, and G, each 15 acres, should be cropped in accordance with a good four-year rotation. The cropping plan given in Table 27 may be modified to balance feed requirements as between ensilage corn, grain, and hay. The following variations are suggested:

First Year	Second Year	Third Year	Fourth Year
Corn	Small Grain	Small Grain	Hay
Corn	Soybeans	Small Grain	Hay
Corn	Corn	Small Grain	Hay
Corn	Small Grain	Hay	Hay

The above cropping plans and the field plan shown on the map, Figure 20, require some physical adjustments.

Land Clearing.

The western and southern edges of the cutover woods will be cleared to enlarge fields D, E, F, and G, by 8 acres, as indicated on the map, Figure 20. This clearing will increase the size of the rotated fields, improve their shape and provide each field with equal acreage. The prevalence of large stumps in the remaining 20.5 acres designated as Field H, will make immediate clearing costly. As an alternative, it is recommended that this area be prepared for permanent pasture.

Drainage.

The flooding of fertile bottom lands can be made less frequent and less damaging by clearing the creek channels of fallen or overhanging trees, logs and other debris.

Drain tile should be installed at the following places (See Fig. 19)

1. Field 25. Western edge along creek.
2. Field 24. Stream that extends from woods to creek.
3. Fields 11 and 12. In the depression marked by the field boundary.
4. Field 5. Stream at west side.
5. Field 5. Stream from spring to creek.

Erosion Control.

This plan provides for the control of erosion by crop rotation, legumes, lime, manure, fertilizer, and gully control. If these practices are inadequate they may be supplemented with terraces, strip cropping, and contouring. Gully control with dams and seeding should be provided for the large gully in Field 15 and other small gullies.

Field Arrangement and Fencing.

When the land clearing, drainage, and erosion control practices are completed fields may be rearranged as indicated on the farm map, Fig. 20. The plan provides more economical fencing.

Power.

Farm operations could be accomplished better and with less cost by using four good horses or mules and a general purpose tractor than by using 7 to 8 horses, as at present. The use of electric power is recommended for lighting, pumping, milking, refrigeration, and feed grinding.

Machinery.

The farm has adequate machinery but it is not all in good working order. Appearances indicate that excessive damage to machinery is caused by the lack of adequate shelter and systematic repairs, by rough fields, rough roads, and rough handling. To overcome these losses, fields and roads should be smoothed, adequate shelter provided and systematic repairing practiced.

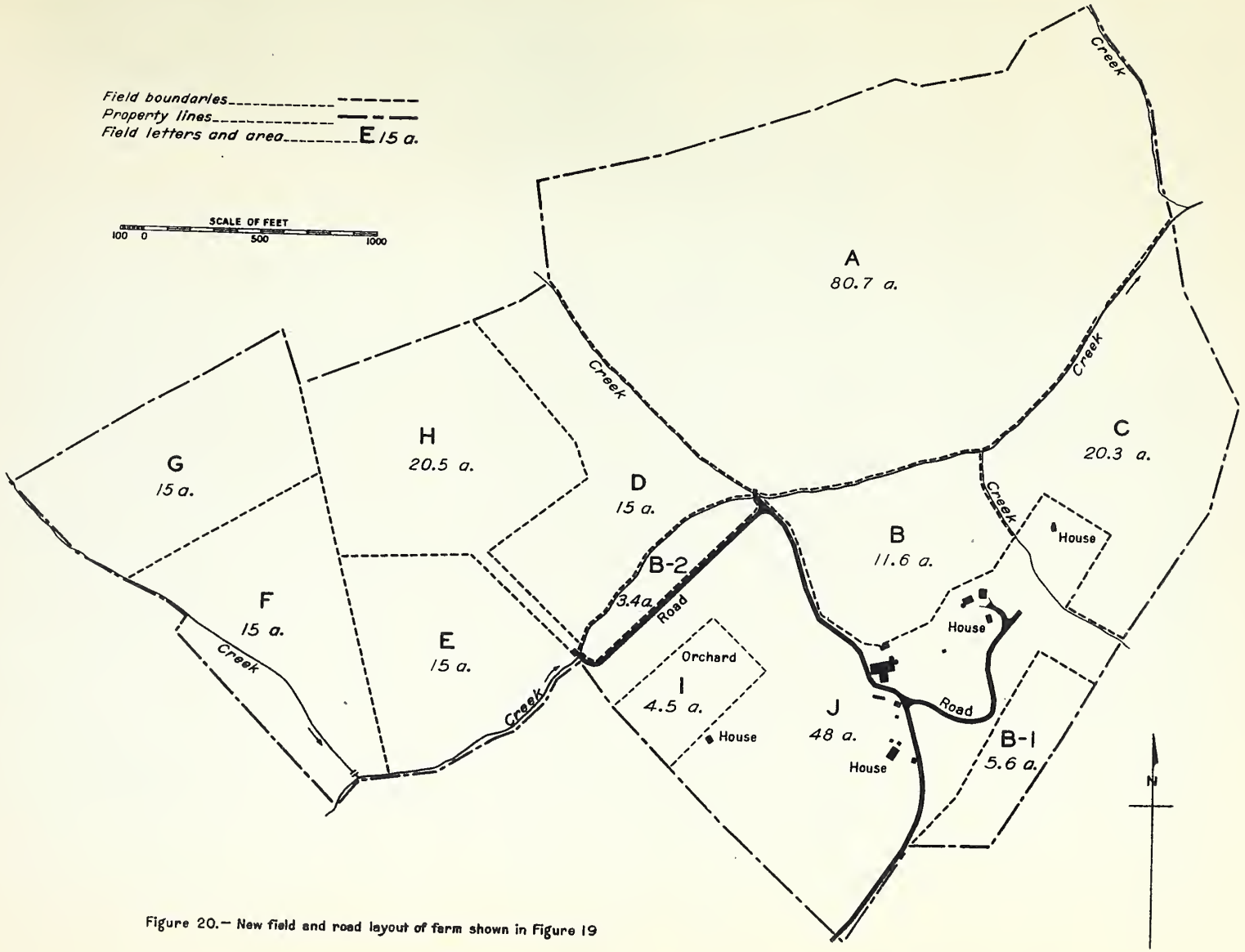


Figure 20.— New field and road layout of farm shown in Figure 19

Buildings.

Good buildings include owner's residence, 44-cow dairy barn, and three silos. The general barn is suitable for horses, young cattle, and dry cows.

Building improvements needed include:

1. Repairs and improvement to tenant houses
2. Pen space for 20 cows
3. Storage space for 50 tons of hay
4. Machinery shelter

A farmstead plan and a building program should be developed to provide economically adequate shelter as the farm plan is developed.

Assistance.

This is a general plan. It does not include all details that are necessarily encountered in the course of development. It is presumed that close contact will be maintained with the Agricultural Extension Service, County Agents, and Specialists. The Farm Management Specialist will summarize and analyze farm management records and advise in regard to the organization and adjustment of enterprises. The Virginia Department of Agricultural Engineering will aid in the preparation of detail plans and estimates for carrying out the proposed improvements in land clearing, drainage, farm buildings, and equipment.