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Adjustments in dairy farm organization, Greeneville, Tennessee area

Harold Alpheus Henderson

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To the Graduate Council:

I am submitting herewith a thesis written by Harold Alpheus Henderson entitled "Adjustments in dairy farm organization, Greeneville, Tennessee area." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural and Resource Economics.

W. P. Ranney, Major Professor

We have read this thesis and recommend its acceptance:

Thomas J. Whatley, Frank Williams

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

June 4, 1951

To the Graduate Council:

I am submitting herewith a thesis written by Harold Alpheus Henderson entitled "Adjustments in Dairy Farm Organization, Greeneville, Tennessee Area." I recommend that it be accepted for eighteen quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural Economics.

W. P. Ranney
Major Professor

We have read this thesis
and recommend its acceptance:

Thomas J. Whalley

Donn Gilliam

Accepted for the Council:

E. G. Waters
Dean of the Graduate School

ADJUSTMENTS IN DAIRY FARM ORGANIZATION,
GREENEVILLE, TENNESSEE AREA

A THESIS

Submitted to
The Graduate Council
of
The University of Tennessee
in
Partial Fulfillment of the Requirements
for the degree of
Master of Science

by

Harold Alpheus Henderson

June 1951

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TABLE OF CONTENTS

CHAPTER	PAGE
I. THE PROBLEM.	1
Introduction	1
Statement of the problem	1
Scope of the study	2
Need for the study	2
Review of literature	4
Procedure.	4
Sampling	5
Method of analysis	5
Application of data.	5
Limitations of the study	7
II. THE UNIVERSE - PHYSICAL AND ECONOMIC	8
Description of the area.	8
Location	8
Climate.	8
Soils.	8
Markets.	9
Transportation	10
Types of farming	10
Normality of prices and production of major farm products, 1949	14

CHAPTER	PAGE
III. BASIC RESOURCE COMBINATION	17
Size of farms.	17
Labor available.	19
Real estate, family labor, and investment.	20
Profit measure	20
Characteristics of operators	23
Relation of investment to income	27
Labor intensity.	27
IV. COMBINATION OF ENTERPRISES	30
Dairy and livestock specialization and intensity	30
Size of dairy enterprise	39
Size of tobacco enterprise	42
Pasture use.	42
V. PROPOSED ADJUSTMENTS	46
Large and medium sized farms	46
Small farms.	47
Economic effect of adjustments to dairying	48
BIBLIOGRAPHY	49
APPENDIX	51

LIST OF CHARTS

CHART	PAGE
1. Greene County, Tennessee, Greendale-Dunmore and Dunmore-Groseclose Soil Associations, and Areas Sampled	6
2. Livestock on Farms as Reported by U. S. Department of Commerce, Bureau of the Census, 1935, 1940, 1945, Civil Districts 9, 13, 14, 15, and 24, Greene County, Tennessee, by Kind of Livestock	12
3. Land Use Civil Districts 9, 13, 14, 15, 24, Greene County, Tennessee Reported in 1935, 1940, and 1945.	13
4. Yield per Acre of Tobacco, Type 31, Tennessee, 1924 to 1949 by Years and Log ₁₀ Trend	16
5. The Relationship of Real Estate Values to Family Labor Supply, 82 Owner Operated Farms, Greeneville, Tennessee Area, April 1, 1949 to March 31, 1950, by Size of Farm.	21
6. Profit, 82 Farms Greeneville, Tennessee Area, April 1, 1949 to March 31, 1950 by Size of Farm and Characteristics of Operator	25
7. The Relation of Income (returns to unpaid family labor, investment and management) to Size of Investment (dollars of interest charge), 82 Farms Greeneville, Tennessee Area, April 1, 1949 to March 31, 1950	28

CHART

PAGE

8. Relation of Profit to Dairy Specialization (percent of receipts from milk), 20 Large Farms Greeneville, Tennessee Area, April 31, 1949 to March 31, 1950. 31
9. Relation of Profit to Livestock Intensity (100 pounds of TDN required per acre of cropland), 20 Large Farms Greeneville, Tennessee Area, April 1, 1949 to March 31, 1950. 33
10. The Relationship of Livestock Intensity (100 pounds of total digestible nutrients required per acre) and Dairy Specialization (percent of receipts from milk) to Farm Profit, Twenty Large Farms Nolichucky River Valley, Greene County, Tennessee, April 1, 1949 to March 31, 1950. 35
11. Relation of Profit to Livestock Specialization (percent of receipts from livestock) 28 Medium Sized Farms, Greeneville, Tennessee Area, April 1, 1949 to March 31, 1950. 36
12. The Relationship of Percent of Receipts From Milk to Profit, 34 Small Farms, Greeneville, Tennessee Area, April 1, 1949 to March 31, 1950 38
13. Relation of Profit to Livestock Intensity (100 pounds of TDN required per acre) 34 Small Farms, Greeneville, Tennessee Area, April 1, 1949 to March 31, 1950 40

CHART

PAGE

14. Relation of Profit to Size of Tobacco Enterprise, 34
 Small Farms Greeneville, Tennessee Area, April 1, 1949
 to March 31, 1950 43



CHAPTER I

THE PROBLEM

Introduction

There is a vast amount of technical knowledge on physical production of farm products. It is the major objective of workers in the field of Farm Management to present an over-all picture of how this knowledge should fit together and help to attain the joint goal of all agricultural workers: More productive farms and a more abundant life for the farmer and all people in the country in which he lives. One objective of this study is to help present this over-all picture, by trying to piece together information from the economic theorist, production specialists, and the farmers who contributed the data for this analysis.

Statement of the Problem

This is an attempt to determine the need for adjustments in the organization of dairy farms in the Greeneville, Tennessee area. The criteria to be used in determining a need for adjustments will be the relationship of farm type to farm profit, the requirements of productive services, and the difficulties of changing existing farms into farms that are apparently more profitable.

An attempt was made to answer the following specific questions:

- (1) What is the influence of different degrees of dairy specialization upon farm profits?
- (2) What is the influence of livestock intensity and specialization upon farm profits?
- (3) What is the influence of different degrees of pasture use on farm profits?
- (4) How does type of farming influence the requirements for productive resources including land, labor, and capital?

Scope of the Study

This study is limited to the business operations of a sample of farms located on the Greendale-Dunmore and Dunmore-Groseclose soil association groups in the Nolichucky River Valley in Greene County, Tennessee during the year April 1, 1949 to March 31, 1950.

Results of this study will be applicable to other areas and times if the influence of different physical and economic conditions are considered.

Need for the Study

There has been a tendency for farms in this area to adjust toward dairy specialization and increased use of improved pastures in this area, and it is desirable to know if this trend should be encouraged or dis-

couraged. If this adjustment toward dairying should be discouraged, what enterprise should replace dairying? Conservation of soil resources depends largely upon the production of close growing crops, and it is desirable to know if these crops can be produced and marketed through dairy products profitably.

Tobacco production is being reduced or held constant on many farms by government control programs, and it is desirable to know how the farmers can replace the loss of potential income caused by the restriction of tobacco acreage. It will also be desirable for persons interested in policies of the tobacco control program to know how restriction of the tobacco acreage affects the farmers concerned.

Since this study was undertaken the development of an international and national emergency has changed the justification for the study and the results desired. Many segments of the economy have indicated that there is less public desire to increase the farmers' profits, yet greater desire for agricultural products. If the public desire is to increase production, then this study should serve as an implement to encourage farmers in the area studied to increase production, as production and profits are often directly related. Although farmers may be sympathetic with public interest, they will probably respond to the profit incentives studied in this paper. Since profits represent value of products above cost of production, increases in agricultural production will cost society least if the increases are made on the farms that will increase their profits by making the increase. Societies'

real income can be maximized if production takes place on the units with the greatest relative efficiency of production.

Review of Literature

The relationship of farm adjustments to changes in labor income of 45 T.V.A. test demonstration farms in the Upper East Tennessee Valley from 1937 to 1948 has been studied by Ranney.¹

He found that nine farms that had raised their rank in labor returns most had changed to more intensive operations, especially with an increase in cattle and intensive hay crops. One-third of the farms rising most in rank had increased their number of animal units of dairy cows eleven or more, and only one of the farms decreasing in rank had increased the number of animal units of milk cows more than two. Of the nine rising most in rank of returns, five had increased their cattle by 18 or more animal units, while only two of the farms decreasing in rank of returns had increased their cattle more than five units. There was only one acre difference in average change in land.

Procedure

The procedure used in enumerating and summarizing business schedules is similar to general practice in farm management business

¹W. P. Ranney, Farm Adjustments Related to Changes in Farm Returns in East Tennessee, Rural Research Series Monograph No. 261 (Knoxville: The University of Tennessee Agricultural Experiment Station, 1950).

analysis. Pertinent deviation from general practice is noted in the discussion as appropriate.

Sampling

Sampling was limited to the Dunmore-Greendale and Dunmore-Groseclose soil association groups. These soils were selected because they are the most extensive groups of relatively homogeneous soils located in the area. A large number of milk producing farms are located therein.

Farms were selected by random selection of mile square areas. Business operations and inventories of 82 owner operated farms selling milk were enumerated by personal examination of farm records and interview of the farm operator at the end of the farming year. Schedules obtained covered the farming year from April 1, 1949 to March 31, 1950.

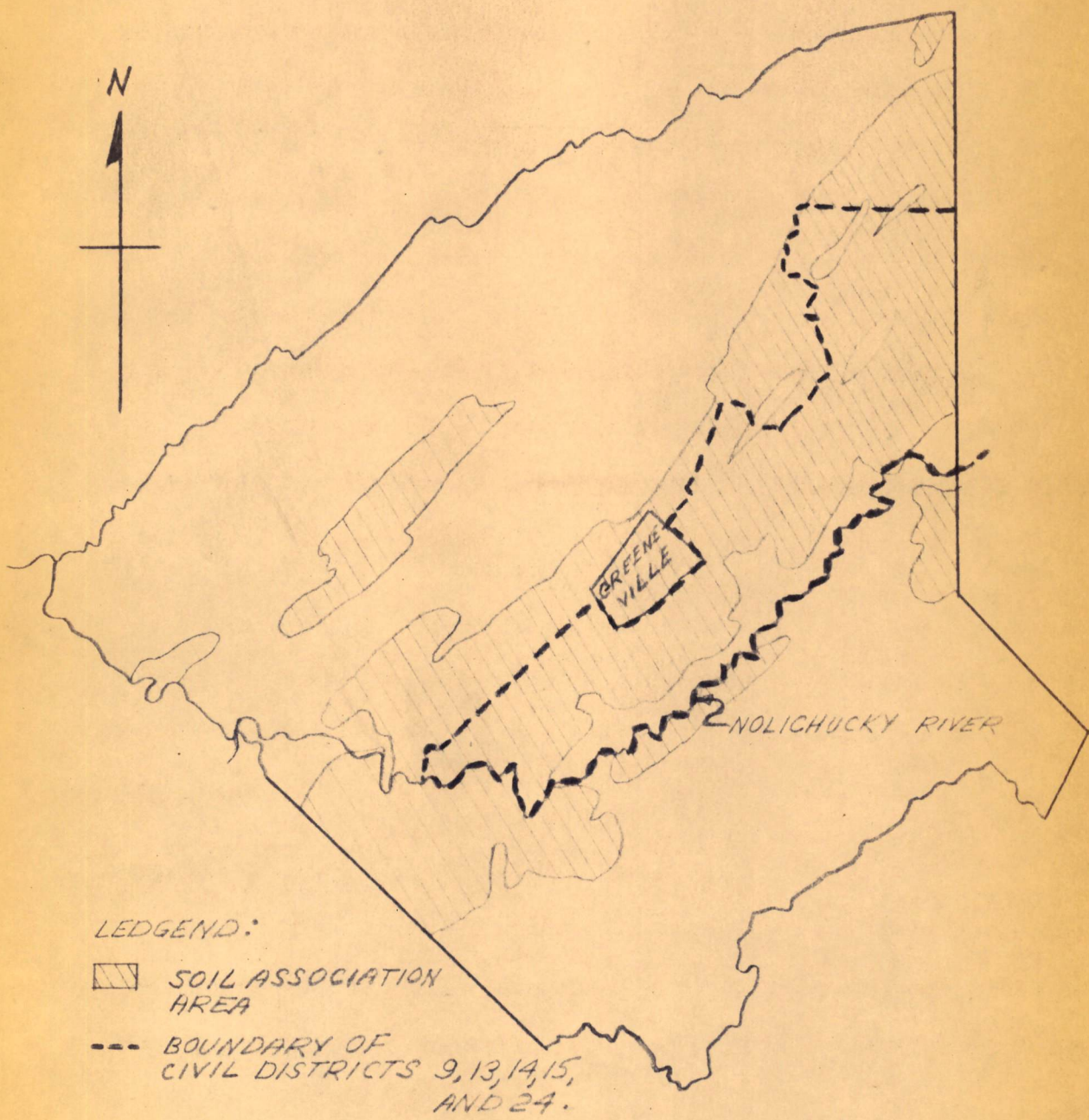
Method of Analysis

The analysis is primarily a comparative study of the farm types actually existing in the sample. Regression lines were fitted to most of the data secured, and equations were used to express the relationships.

Application of Data

Possibilities of existing farm adjusting to the more profitable farm types are discussed. Consideration is given to the relationships found to exist between farm type and profits, and the requirements for productive services and materials.

CHART 1 - GREENE COUNTY, TENNESSEE,
GREENEDALE-DUNMORE AND DUNMORE-
GROSECLOSE SOIL ASSOCIATIONS, AND
BOUNDARY OF CIVIL DISTRICTS 9, 13,
14, 15, AND 24.



Limitations of the Study

A one visit enumeration is inadequate for accurate observation and somewhat biased toward the farmers' supposition of fact. It does not give sufficient evidence of how a situation is reached so that future movement can be predicted, i.e., we have located a point, but we have little or no information as to the direction or speed of change.

A method of using accurate records kept current over a period of years is suggested to alleviate many of the weaknesses of this study. The observations will become dynamic rather than static. The results of one year's study can be tested in subsequent years, and it will give some empirical basis for predicting changes in relationships.

This study has been largely limited to factors over which the farmer has control. The effect of changes in the general economy on his actions has received only minimum attention. The personal interests and capabilities of individual operators and farmers has received little attention in this study compared to their recognized importance. It is assumed that the individual operator will have the final decision on adjustments to be made on individual farms. The operator will have the responsibility of weighing the central tendencies found here with his own knowledge of himself and his farm.

Price and other economic changes will materially affect the relationships pointed out in this study. Probably the greatest weakness of this study is the difficulty in adapting it to these changes.

CHAPTER II

THE UNIVERSE - PHYSICAL AND ECONOMIC

Description of the Area

Location

Greene County is located in the Upper East Tennessee Valley and is drained by the Nolichucky River. It is bounded on the Southeast by the top of the Unaka Mountains and the state of North Carolina.

Climate

Annual precipitation as reported at the Experiment Station in Greene County is 42.7 inches. Temperatures range from 2° F to 100° F with an average of 57.9° F. There is an average of 163 days between freezes.¹

Soils

The soils in the area sampled are of the Greendale-Dunmore and Dunmore-Groseclose soil association groups. They consist primarily of residual soils arising from interbedded limestone and shale with small areas of alluvial soils at the footslopes and in the numerous sinks.

Surface drainage is good and internal drainage is fair to good. Most water is removed by subterranean drainage. These soils have a natural coverage of hardwoods, mainly oaks. These soils are recommended

¹United States Department of Commerce, "Annual Summary, 1948," Climatological Data, Vol. LIII, No. 13 (Chattanooga, Tennessee, 1949).

for most agricultural uses, especially pasture.

The area sampled is mainly rolling land with numerous sinks and small streams. Other areas in the county vary from river bottom to mountainous.² There are 57,000 acres of these soils in Greene County alone. These and similar soils make up a major portion of the agricultural lands in the East Tennessee Valley.³

Markets

Markets are available for manufacturing grades of milk, a limited amount of fluid milk, tobacco, livestock, grains, some fresh vegetables, and some vegetables for canning. Some of the bulkier feeds may be sold locally to other farmers.

During the year of 1949, 127,000,000 pounds of manufacturing grade milk was sold by farmers in the Greeneville milkshed of 12 counties, for \$4,260,000. In the early part of 1950 the major company buying this milk doubled its plant capacity, which should provide an outlet for any reasonable amount of milk that will be produced in this area.⁴

Tobacco markets located at Greeneville have facilities to handle all tobacco that can be produced under existing tobacco marketing control programs.

²United States Department of Agriculture, Division of Soil Survey, Various unpublished mimeographed reports.

³University of Tennessee, Agricultural Experiment Station, Department of Agronomy, Unpublished data.

⁴A. J. Garbarino, University of Tennessee, Agricultural Experiment Station, Unpublished data, 1950.

Livestock may be sold through markets located in Greeneville, to local buyers, to several other markets within trucking distance, or may be shipped by train from Greeneville, or other loading stations in the county.

Some farmers sell fresh vegetables in a market in Greeneville, some sell directly to stores, and others peddle to the housewife. These fresh vegetable outlets probably cannot be expanded to any great degree. Food processers located in near by counties will buy vegetables of specified grades.

Transportation

A railroad, four state highways, a Federal aid highway, and numerous hard surfaced and graveled county roads provide adequate transportation facilities for the area.

Types of Farming

General farming is the predominant type of farming in most of the East Tennessee Valley.⁵ The sub-area consisting of Greene County, and parts or all of five adjacent Tennessee counties are classified as general farming producing burley tobacco, dairy, poultry, and wheat. This sub-area has the most commercialized agriculture in East Tennessee as indicated by gross value of products per acre of cropland.

⁵B. H. Luebke, et. al., Types of Farming in Tennessee, Bulletin No. 169 (Knoxville: Tennessee Agricultural Experiment Station, University of Tennessee, 1939), pp. 83-90.

Farms in this sub-area have always sold more livestock than crops. This has been a livestock producing section since earliest settlement. This sub-area has the thickest dairy cow population of any sub-area in East Tennessee except the one around Knoxville.

This is a leading commercial poultry sub-area, having one-third of the large commercial flocks and one-sixth of the value of eggs in the entire area. This is the leading turkey producing sub-area in the state.

One-fourth of the total gross income in the sub-area is from burley tobacco, and this is the major source of income on over one-sixth of the farms.⁶

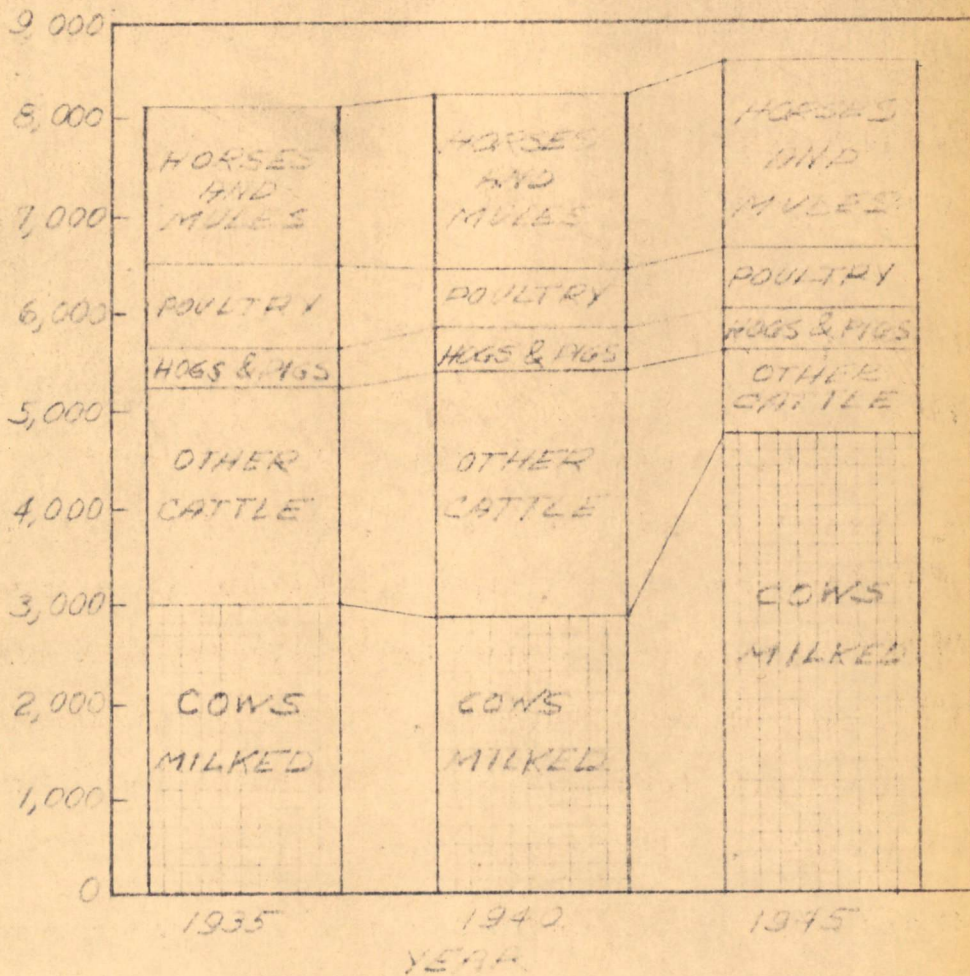
Land use as reported by the census⁷ in 1935, 1940, and 1945 in civil districts representing the sampled area is shown in chart 2. The greatest changes from 1935 to 1945 are 77 percent increase in hay, 31 percent decrease in tobacco, and 16 percent decrease in small grain. Livestock changes are shown in chart 3. Cattle numbers have increased gradually, but cows and heifers milked replaced about two-thirds of the other cattle from 1940 to 1945. Personal observations are that this is due to farmers milking cows that were formerly kept for beef and not due to the sale of beef and purchase of dairy cows. Horses and mules

⁶Luebke, loc. cit.

⁷United States Bureau of the Census, U. S. Census of Agriculture, 1938, 1940, and 1945 Civil District Data (Washington, D. C.).

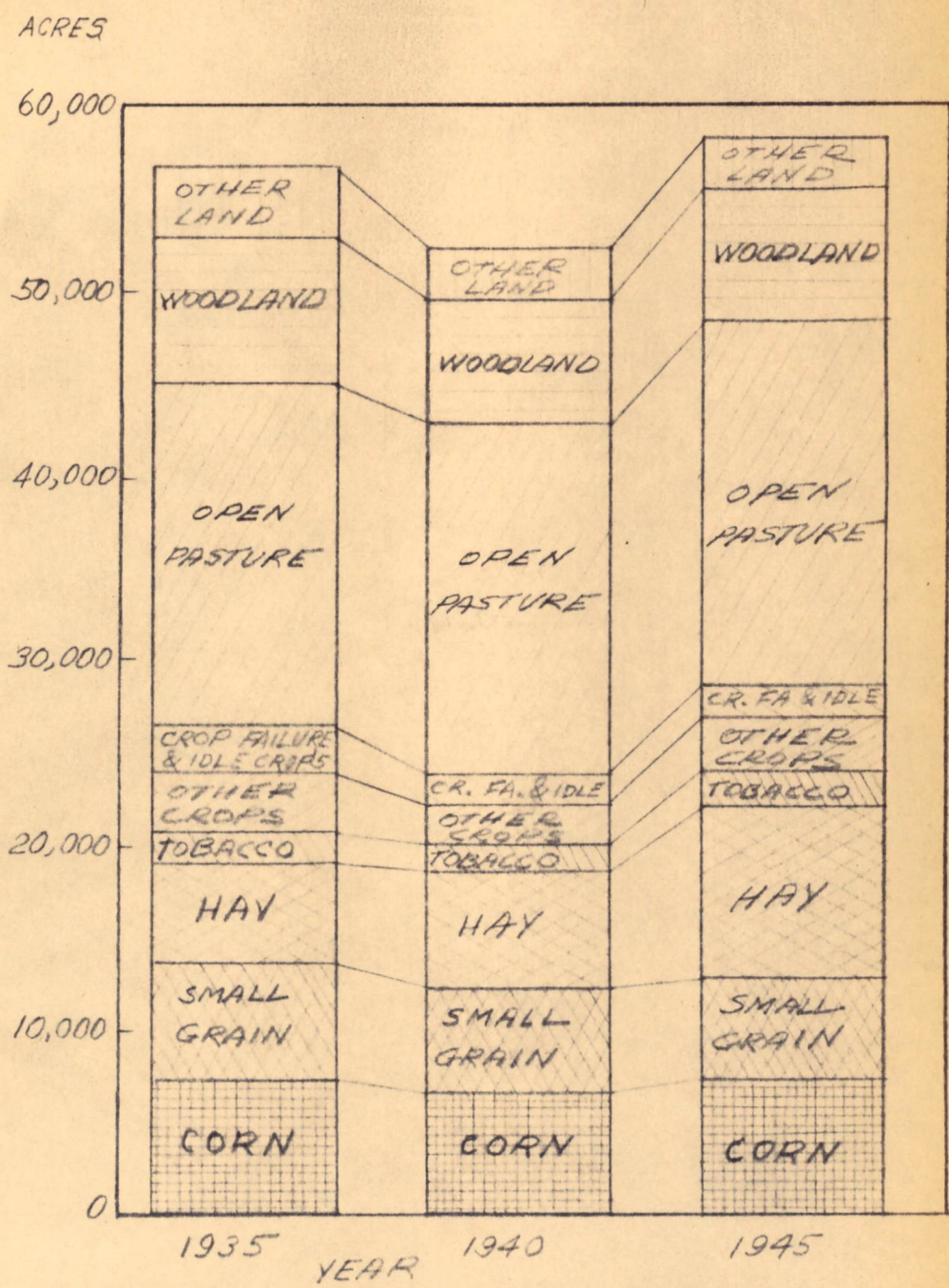
CHART 2 - LIVESTOCK ON FARMS AS REPORTED BY U.S. DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS, 1935, 1940, 1945, CIVIL DISTRICTS 9, 13, 14, 15, AND 24, GREENE COUNTY, TENNESSEE, BY KIND OF LIVESTOCK.

ANIMAL UNITS



SOURCE: U.S. DEPARTMENT OF COMMERCE, CENSUS OF AGRICULTURE, 1935, 1940, AND 1945

CHART 3 - LAND USE CIVIL DISTRICTS 9, 13, 14, 15, 24, GREENE COUNTY, TENNESSEE REPORTED IN 1935, 1940, AND 1945



SOURCE: U.S. DEPARTMENT OF COMMERCE, CENSUS OF AGRICULTURE, 1935, 1940, AND 1945

are still increasing in spite of the observed increase in use of power equipment. This trend may have been reversed since 1945. Some decrease is noted in poultry kept.

Normality of Prices and Production of Major Farm Products, 1949

Milk prices and production were relatively favorable in Tennessee in the calendar year 1949⁸ as compared with some of the other important farm products.

Milk prices in Tennessee were only about 6 percent below normal⁹ while tobacco was about 12 percent below normal, and oats as a feed grain was 20 percent below normal. Veal prices were 20 percent above normal.

Yields of tobacco were 8 percent below normal while the yields of grain crops were about normal (corn 12 percent above, wheat 4 percent above, and oats 3 percent below). The deviations from normal crop yields are largely explained by excessive rains in the summer of 1949.

The trend values of tobacco index of prices increased 11 percent while the trend of the index of prices received for milk decreased 6

⁸The calendar year 1949 was used because of unavailability of data for the crop year studied. The available comparisons indicate that there was little difference that would affect the conclusions of this study between January, February, and March of 1949 and those months of 1950.

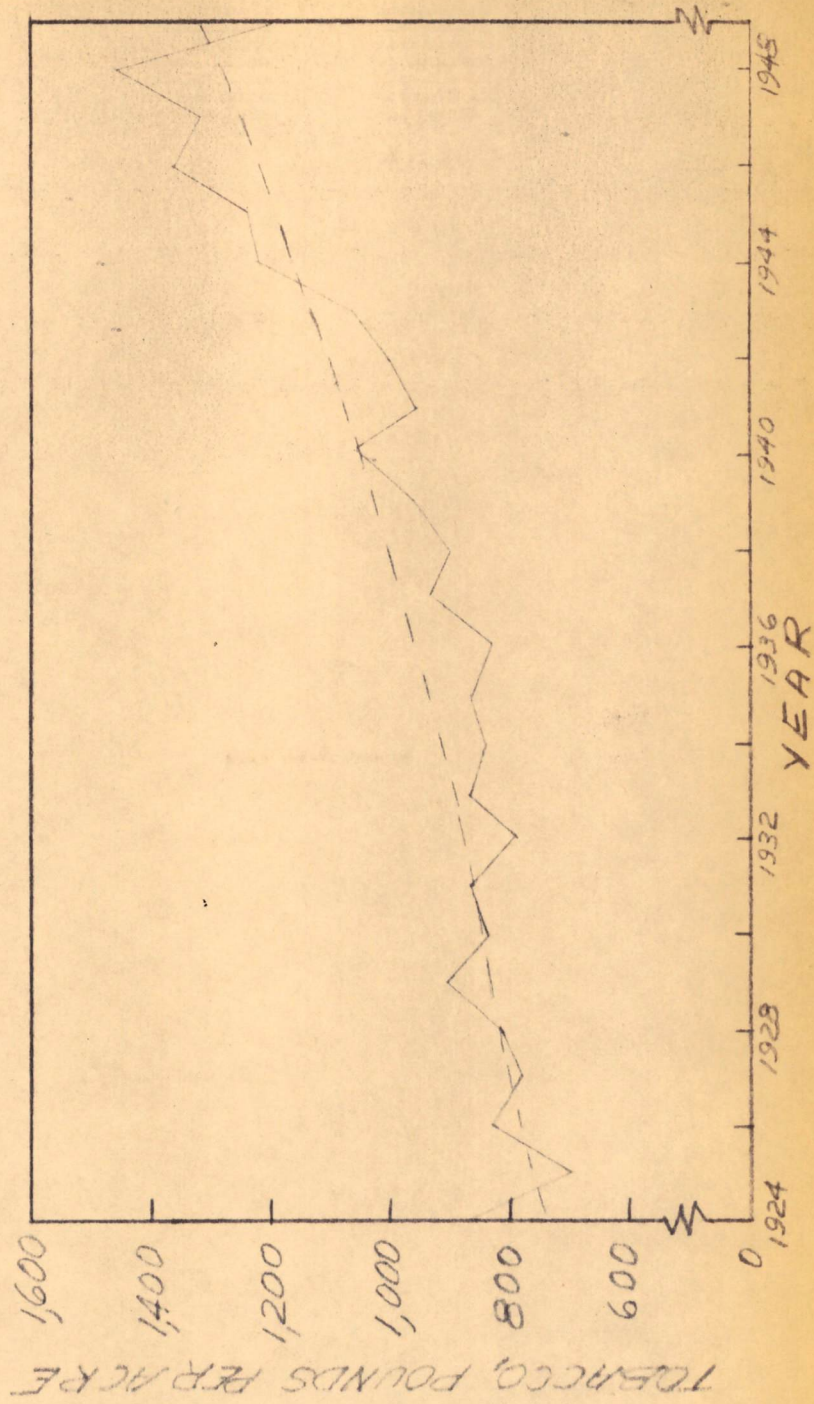
⁹Index of prices for given commodities (1935-39 base) were deflated with the U.S.D.A. prices received by farmers Index (1935-39 base). A least squares trend line was computed from 1924 to 1949. The 1949 trend value is considered normal for this discussion. Trend values were likewise computed for acreage yields to determine normal yields for 1949.

percent from 1924 to 1949. This trend indicates that tobacco may be comparably more favorably priced in the future than at present.

The yields per acre of tobacco have risen since 1924 and are still increasing at an increasing rate (see chart 4). This increase in yields is, in part, a result of farmer response to acreage restrictions and higher prices. It indicates that production technology is being put to greater use. The point when yields will level off is not known, but the definite decrease in yields of 1949 indicates there is considerable risk with the higher yields.

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CHART 4 - YIELD PER ACRE OF TOBACCO, TYPE 31, TENNESSEE
1924 TO 1949 BY YEARS AND LOG₁₀ TREND.



SOURCE: COMPUTED FROM DATA IN: MARSH, S.T., ET AL., *ROCK CULLIVER*.
TRENDS IN TENNESSEE, (NASHVILLE, DEPARTMENT OF AGRICULTURE AND
STATISTICS SERVICE, 1948). MARSH, S.T. *TECHNICAL COMMUNICATION* (S.C.S., DR)

CHAPTER III

BASIC RESOURCE COMBINATION

The purpose of this study was not to determine general adjustments in basic resources; however, these adjustments cannot be ignored, nor can adjustments concerning livestock specialization be intelligently discussed without some knowledge of basic resource use. The discussion here is not intended to be complete, but to furnish information essential to the problem as stated.

Size of Farms

There was a large range in size of farms represented in the sample (see Appendix A).

The real estate per farm ranged from 7 to 187 acres with values from \$2,500 to \$26,000. The real estate values were widely dispersed and skewed toward the higher values, with a mode about \$9,000 and median at \$10,000.

Investment, as measured by interest charge (4.5 percent on real estate and 5.0 percent on other), ranged from \$119 to \$1,827. The median was \$697, and there was a tendency for major concentration between \$300 and \$800 with minor concentrations around \$1,050 and \$1,450.

The farmer usually has a given amount of capital and a family labor supply that is relatively fixed, especially in the short

run.¹ Variation in size of the family labor supply is influenced and largely determined by social factors, while the allocation of existing capital and the employment of the given labor supply are primarily an economic decision. It appears then that investment is the primary fixed economic factor that determines the size of the farming operation.

Total dollars of investment is not completely satisfactory as a measure of size because investment in real estate is comparatively more secure, and does not require as much management skill as the same amount of investment in livestock, equipment, and other working capital. The interest rate is greater for working capital than for real estate investment, therefore, total interest chargeable was selected as the size measure.

Interest rates used were 4.5 percent for real estate and 5.0 percent for other investment. The rates assigned were largely arbitrary, and constituted a compromise of rates on money borrowed and loaned by these farmers.

This measure includes interest on all investment including real estate, equipment, livestock, materials, and services. It was assumed that all operators owned the entire farm business.

¹This statement does not justify the assertion that capital and labor forces are not dynamic factors. It does justify the assertion that the farmers business is built around these factors rather than the number of cows, acres, or other factors that are more easily controlled. The farmer is considered in the short run, because these factors are fixed. By considering only these two factors fixed, he is in a long run position compared to the farmer that considers land, crops, or livestock as fixed factors.

When farms are divided according to size they are given the following designations:

\$119 to \$547	chargable interest	- Small;
\$548 to \$978	" "	- Medium; and
\$979 to \$1829	" "	- Large.

Labor Available

Family labor, as able bodied full time man equivalent, and the operators' estimate of alternative labor opportunities as farm laborers or industrial workers were enumerated. Able bodied man equivalent² ranged from 0 to 2.9, and the average dollar estimate of alternative employment was \$1,132 per year. The labor on large farms was more fully employed than on the smaller farms as measured by man work units³ per man.

It was observed that most operators, especially on the small farms, exchanged both labor and equipment with neighboring operators. When equipment and services were exchanged without payment, no enumeration was made of the exchange. It was assumed that the exchanged services were equal in value.

²Hereafter the word "man" will be used to indicate the equivalent of a full time able bodied man.

³"Man Work Unit" is the average amount of work accomplished by one man in ten hours under ordinary conditions.

Real Estate, Family Labor, and Investment

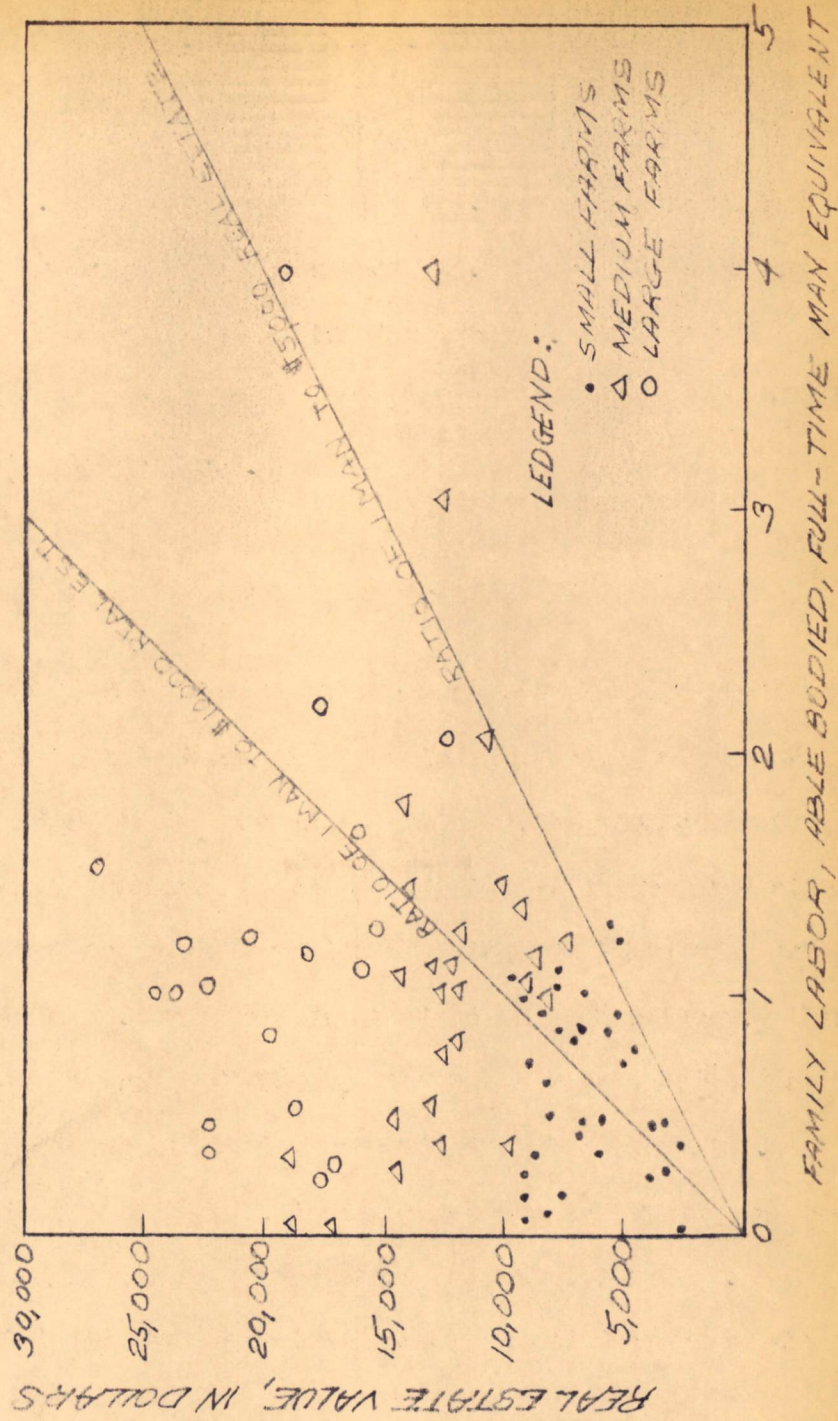
The relation of real estate values to available family labor is shown in chart 5. All farms except 1 large, 2 medium, and 2 small farms had \$5,000 or more real estate for each man. There was no concentration of cases within the small and medium farm groups. All except four of the large farms had more than \$10,000 investment in real estate for each man in the family labor force.

Profit Measure

Relations of farm size to farm returns (or losses) have been repeatedly demonstrated since the beginning of farm management research. Since this relationship is so well established, it appears that the gross influence of farm size should be eliminated before comparing farms on the basis of other characteristics of which the influences are not so firmly established, or have a lesser influence on returns. This should be done so that the true influence of these minor or unknown factors will not be hidden or magnified by intercorrelation with farm size.

As previously discussed, family labor and investment are relatively fixed measures of size as compared to other measures. An attempt was made to eliminate the gross influence of these factors by the following procedure:

CHART 5. THE RELATIONSHIP OF REAL ESTATE VALUES TO FAMILY LABOR SUPPLY, 82 OWNER OPERATED FARMS, GREENEVILLE, TENNESSEE AREA, APRIL 1, 1949 TO MARCH 31, 1950, BY SIZE OF FARM



(1) Within the three size groups, based on interest charge, a least squares correlation analysis indicated that income⁴ based on size of family labor force was:

for large farms: \$1,161 + \$1,142.19 (No. of men in family labor force),⁵
 ($r^2 = .29$ $P = < .02$)
 for medium farms: \$1,031 + \$ 635.62 (No. of men in family labor force),
 ($r^2 = .44$ $P = < .001$)
 and for small farms: \$ 551 + \$ 808.93 (No. of men in family labor force).
 ($r^2 = .32$ $P = < .001$)

(2) The deviation of individual gross income from the estimated gross income was divided by the interest charge.

This profit measure is "dollars deviation from estimated gross income (based on size of family labor) per dollar of interest charge." Since adjustments have been made for size of labor force and size of

⁴Returns to family labor, investment and management.

⁵An understandable and very important question of many associates and advisors has been "How can this measure be explained to farmers?" If this work is to be presented to the public it is suggested that estimates be converted into dollars per farm as follows:

1. Assume zero according to the measure to be the average management returns to the size groups studied (see Appendix A).
2. For deviations between points, multiply the given deviation by the average interest charge for that group of farms (see Appendix A).

As an example assume the equation $Y = -1 + 2X$ for large farms is to be converted to dollars per farm. Average management returns is \$-64 and average interest charge is \$1,286 then: $A = -64 - (1 \times 1,286)$ or \$-1,350 and $b = 2 \times 1,286$ or 2,572 and the resulting equation is $Y = -1,350 + 2,572X$. The resulting estimations will have the same statistical inference, because only units of measurements are changed.

investment the resulting measure is believed to be a fairly accurate indication of the influence of management upon income. This measure hereafter will be referred to as profit.⁶ This profit measure, after it has been adjusted for size of labor force, is actually a measure of efficiency in use of investment.

Characteristics of Operators

Most operators could be described and categorized as follows:

Full time farmer - able bodied male with no off-farm occupational interest.

Employed off farm - able bodied male with full time employment off farm who performed routine chores and management, and usually had sons in school who helped with farm work.

Employed part-time - able bodied male who worked two months or more off farm during slack farming season, but whose interests were primarily in their farm businesses.

Aged men - men who reported or appeared to be in declining physical condition. These men, if employed in industry, would probably have been retired.

Women - all women were middle aged or past, mostly widows whose husbands operated the same farm before their deaths. This group also included two elderly single ladies and one woman whose husband had no interest in the farm.

⁶Ibid.

The number in each group were:

Full time farmer - - - - -	26
Full time employed - - - - -	11
Part time off farm - - - - -	11
Aged men - - - - -	26
Women- - - - -	8

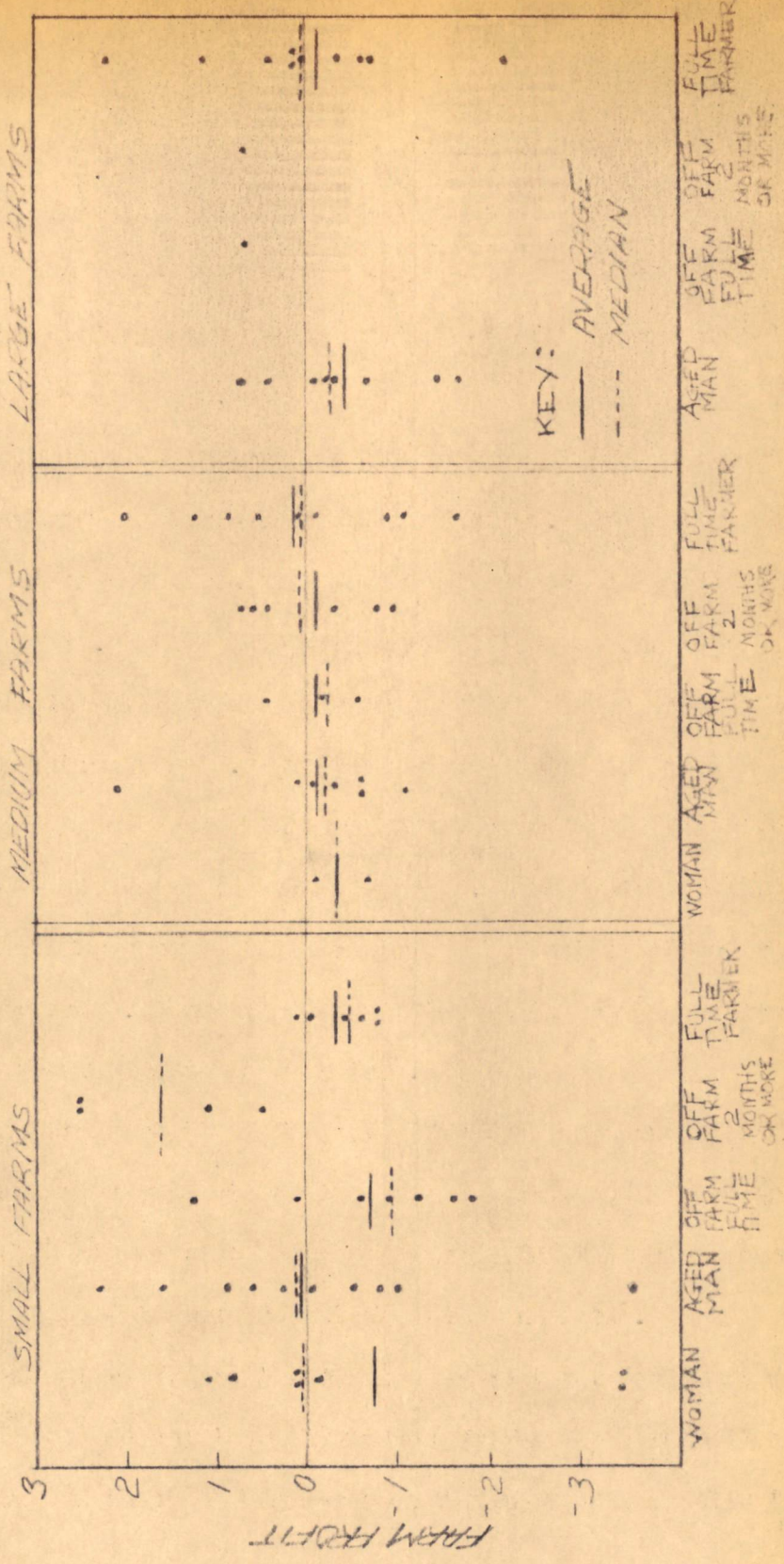
There were only two operators in the large group other than full time farmers and aged men.

Only in the small farms did the characteristic of the operator seem to be related to farm profit (see chart 6). The noticeable difference here was between part-time workers and those with full time employment off the farm. Both median and average incomes for these farmers working part-time off the farm were considerably above that of any other groups (more than \$1.50 return per dollar of interest charge above the next lower group after returns were adjusted for size of labor force available on individual farms). The median profit of operators of small farms that had full time employment off the farm was the lowest of any group. The average profit of this group was about the same as the average of women operators.

The average profit of full time farmers was about average of all farms. There was a wide dispersion in the medium and large farms. The profits of full time farmers on small farms were in a close concentration and averaged less than the profits of all small farms.

The operators of small farms that worked off farm part time during the slack season had considerably higher profits than full time operators. This could be due to either one or a combination of the following:

CHART 6 - PROFIT, 82 FARMS GREENEVILLE, TENNESSEE AREA,
 APRIL 1, 1949 TO MARCH 31, 1950 BY SIZE OF FARM AND CHARACTERISTICS
 OF OPERATOR.



(1) The full time farmer was charged for full time employment, and if receipts were equal, profits would be greater for the one that had off farm employment.

(2) The off farm worker has an additional source of income, and may have alternative full time employment if his farm should be a failure. With this additional security, he may be in a different position with respect to management decisions.

(3) He may be a more able manager due to his outside contacts.

(4) Natural inherent ability may prevent some farmers from obtaining alternative employment.

If either of the first three suggestions caused the difference in incomes, a field of endeavor is suggested to assist these small operators in training for and/or finding outside employment. If the latter suggestion is true, his problem is, at least in part, a social problem as well as or more than an agricultural or economic problem.

That aged men and women operators compared favorably with able bodied men indicates that, under the conditions of this study, agriculture is playing a useful social and economic role in providing retirement opportunities for those who desire to continue limited productivity. In view of the growing population in this group further studies concerning aged men and women may be justified.

In the analysis that follows, different groups were plotted separately according to the characteristics of the operator. There was

no apparent differences in the relationship of profits to organization factors classified according to the characteristics of operator.

Relation of Investment to Income

The relation of investment to income is shown in chart 7. Income ranged from approximately nothing to about five times the interest charge, but the upper limit was somewhat higher in proportion for the smaller farms than the larger farms. In the small farms a definite concentration was noted around a ratio of income to interest charge of 3:1. This ratio was reduced as farms became larger; the concentration for the largest farms was about 1:1. The ratio of receipts to interest charge was about the same at the lower limit of all size groups. The fact that the ratio was greater at both the point of concentration and at the upper limit in the small farm group than in the other groups indicates that the smaller farms made more efficient use of their capital than the larger farms.⁷

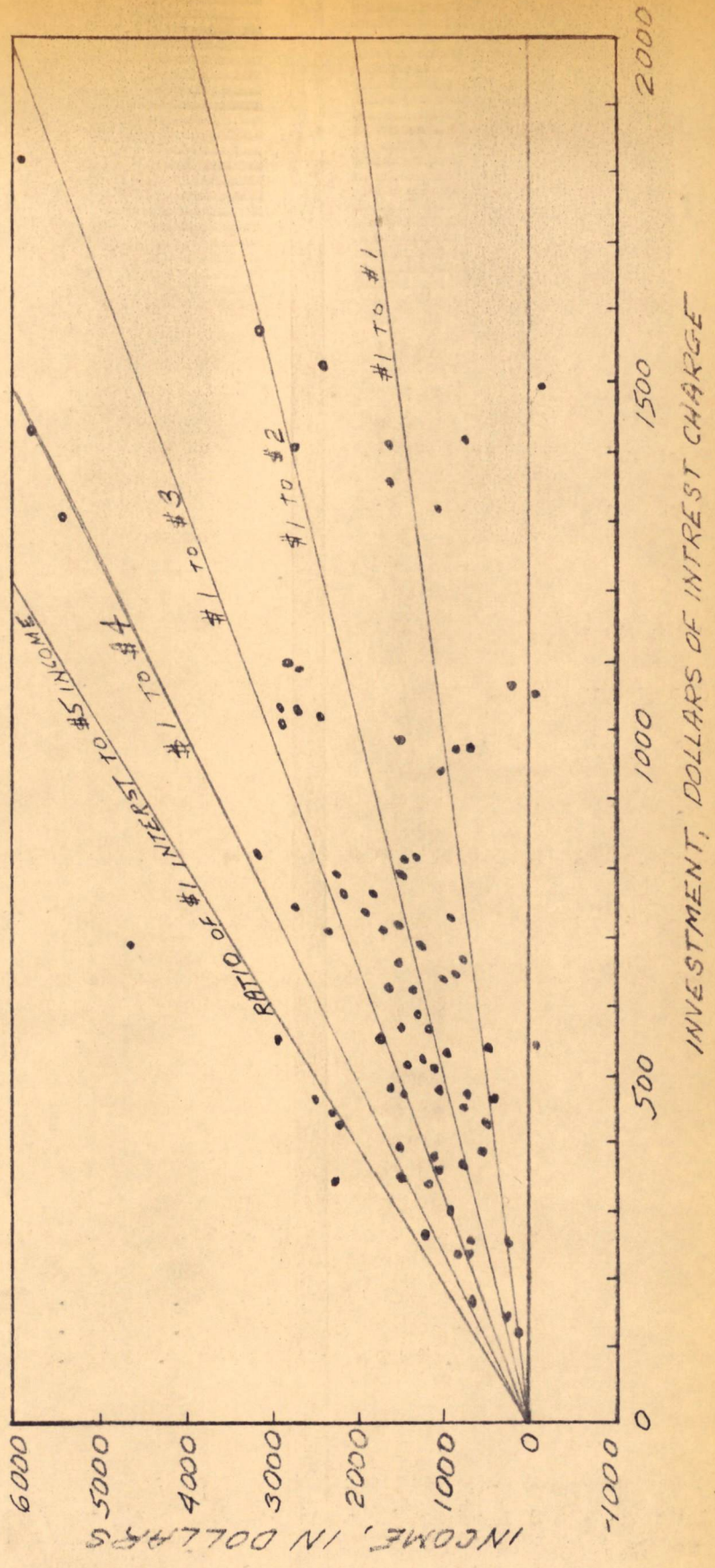
Labor Intensity

Man work units (MWU) required per acre of cropland ranged

from 2.6 to 15.0 among small farms;
from 3.5 to 14.3 among medium farms; and
from 3.6 to 8.1 among large farms.

⁷The function of capital may possibly be more of a limiter of possible returns rather than a determiner of central tendency as is assumed in most research work. The use of a "limiting factor" or "ceiling" concept may give a clearer picture of the role of management in causing or preventing maximum profits.

CHART 7. THE RELATION OF INCOME (RETURNS TO UNPAID FAMILY LABOR, INVESTMENT AND MANAGEMENT) TO SIZE OF INVESTMENT (DOLLARS OF INTEREST CHARGE), 82 FARMS GREENEVILLE, TENNESSEE AREA, APRIL 1, 1949 TO MARCH 31, 1950.



Dispersion was fairly even on large farms. Medium farms were dispersed fairly even above 6 MWU per acre and major concentration was from 3.5 to 6.0 MWU per acre of cropland. The small farms were similar in distribution to medium farms except that major concentration was from 2.6 to 10.0 MWU per acre and the upper limit was 15 MWU per acre of cropland.

A cross sectional analysis relating profits to labor intensity revealed no significant relationship between the two variables. An examination of individual cases of the more intensive medium and large farms showed that dairy and livestock farms were more profitable than crop farms. In the small group intensive crop farms were more profitable than intensive livestock and dairy farms. These facts are of importance to farmers in the various groups who are in the process of intensifying their operations.

CHAPTER IV

COMBINATION OF ENTERPRISES

Dairy and Livestock Specialization and Intensity

Large farms -- Dairy specialization as measured by the percentage of gross receipts that were from milk¹ ranged from 5.8 to 25.6 with an average of 14 (see chart 8).

Estimates of profits on large farms are as follows:

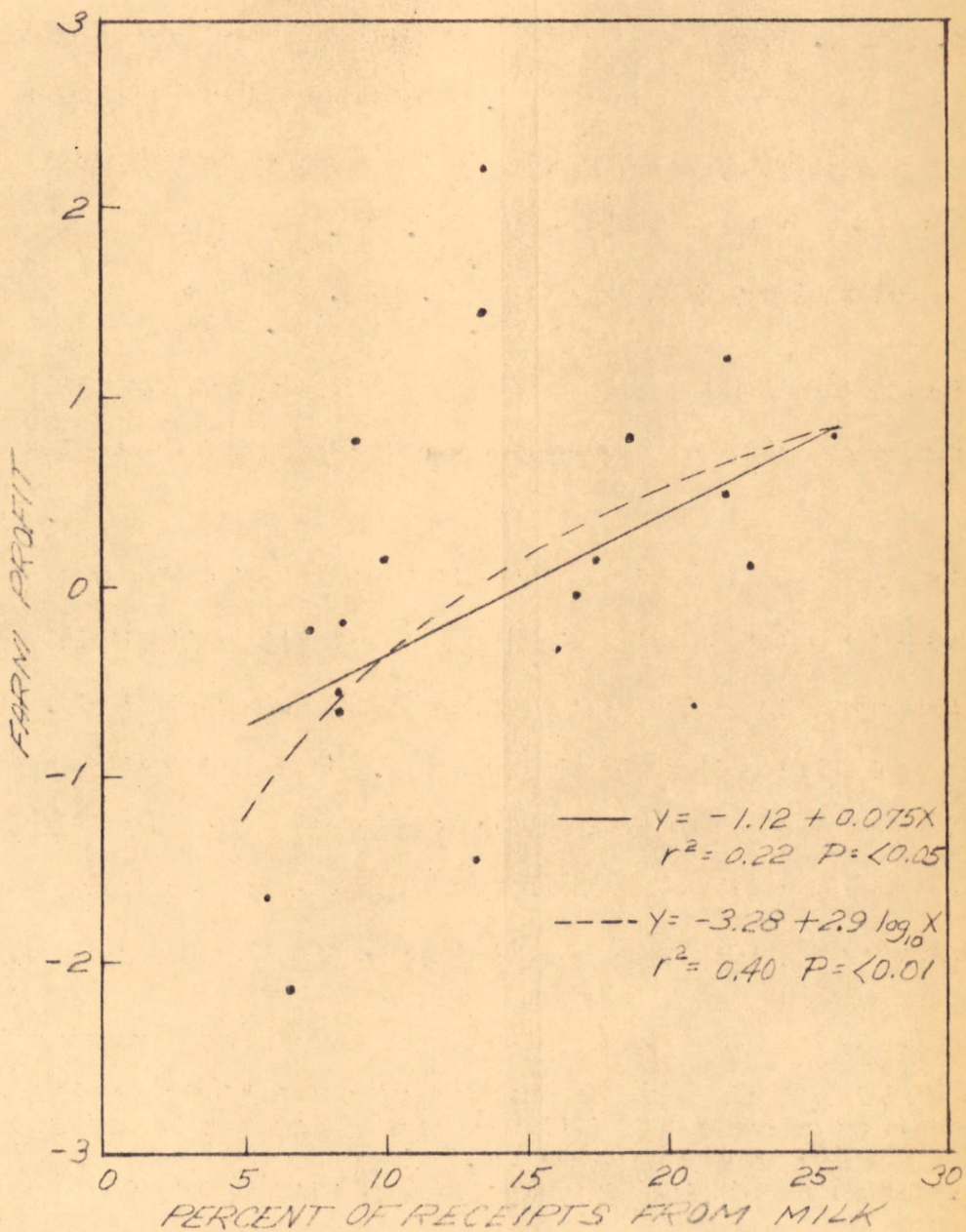
$$\begin{aligned} \text{Profit} &= -1.12 + .0745 (\text{percent of receipts from milk}) \\ & \quad (r^2 = .22 \quad P = < .05) \\ \text{and Profit} &= -3.28 + 2.90 (\text{log percent of receipts from milk}) \\ & \quad (r^2 = .40 \quad P = < .01) \end{aligned}$$

Both measures relating profits to dairy specialization indicate that an increase in the percentage of receipts from milk increases profits.

That some point of specialization may be reached beyond which further specialization will not be accompanied with additional increases in profits, is indicated by the logarithmic estimation being more reliable than the arithmetic equation. The logarithmic estimation being more reliable than the arithmetic equation also demonstrates that the amount of increase in profits corresponding with an absolute increase in specialization decreases as the farm becomes more specialized, even within the

¹"Percent of total receipts that were from milk" is influenced by the number of cows and by the productivity of the cows as compared with that of the other enterprises. Hence the measure reflects specialization of the use of all the farm resources including management.

CHART 8 - RELATION OF PROFIT TO DAIRY SPECIALIZATION (percent of receipts from milk), 20 LARGE FARMS GREENEVILLE, TENNESSEE AREA, APRIL 31, 1949 TO MARCH 31, 1950.



range of the sample. Neither the regression lines nor the distribution of cases around those lines indicates that the maximum increase in profits by dairy specialization has been reached by farms in the sample.

There was a wide range among the large farms in the amount of livestock kept.² On the basis of Morrison's standards the average amount of livestock on these farms would have consumed 857 pounds of T.D.N. per acre. The range was from 210 to 1590 pounds of T.D.N. per acre.

Profits varied directly with livestock intensity (see chart 9) as indicated by the following estimations:

$$\begin{aligned} \text{Profit} &= -1.03 + .116 (\text{hundred pounds of TDN required per} \\ &\quad (r^2 = .24 \quad P = < .05) \quad \text{acre}) \\ \text{and Profit} &= -1.57 + 1.78 (\text{log hundred pounds of TDN required} \\ &\quad (r^2 = .57 \quad P = < .01) \quad \text{per acre}) \end{aligned}$$

When the influence of dairy specialization and intensity were considered simultaneously the following influence upon profits was found:

When: X_1 = Profit,
 X_2 = percent of receipts from milk, and
 X_3 = hundred pounds of TDN required per acre:

$$\text{Then: } X_1 = -1.54 + .05X_2 + 8.6X_3$$

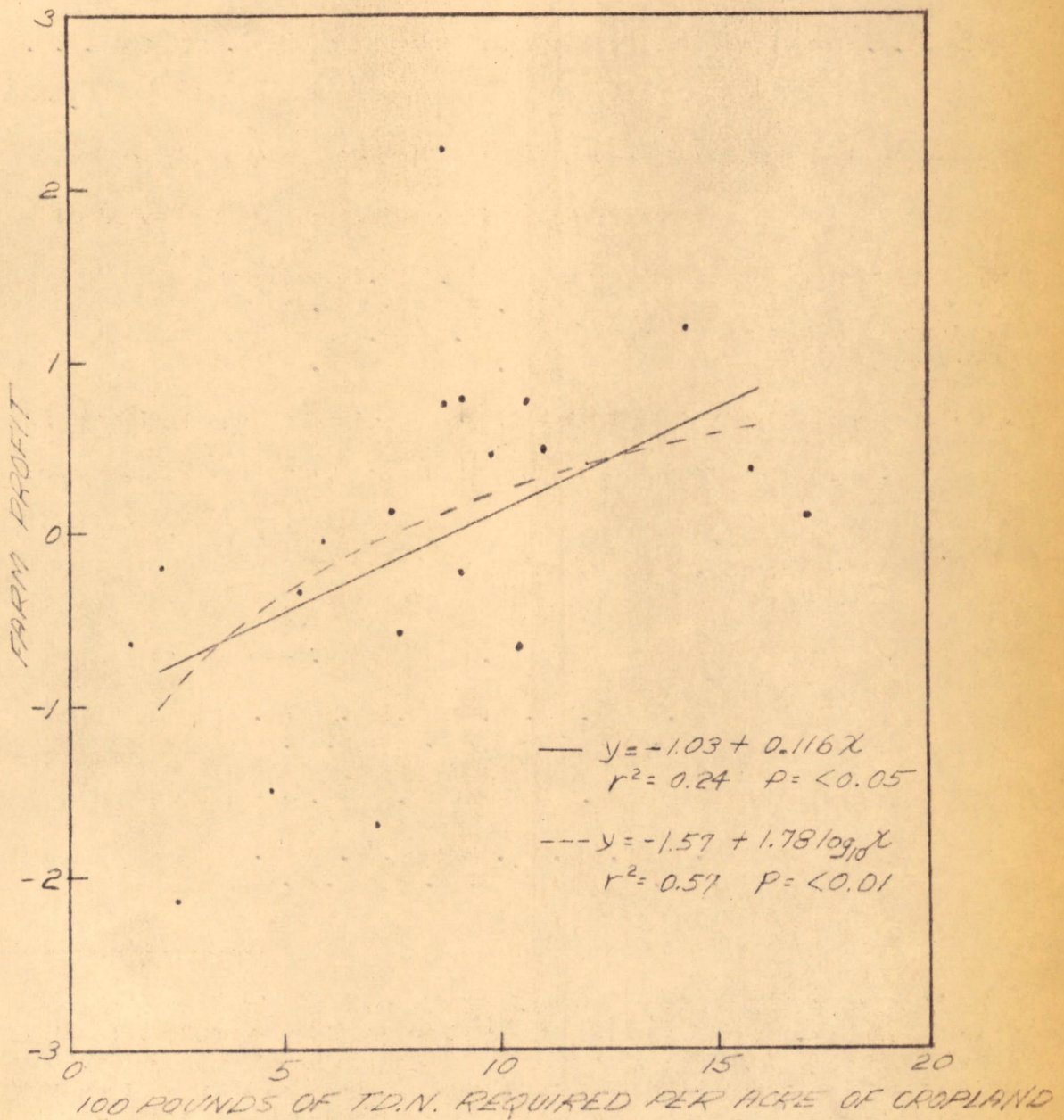
$$(R^2_{1.23} = .333, P = < .05, S_{1.23} = .84 \\ B_2 = .35, B_3 = .38, \text{ and } r^2_{23} = .15),$$

$$\text{and } X_1 = -4.37 + 2.85 \log X_2 + 1.34 \log X_3$$

$$(R^2_{1.23} = .64, P = < .001, S_{1.23} = .55 \\ B_2 = .52, B_3 = .45, \text{ and } r^2_{23} = .05).$$

²"Amount of livestock kept" is intended to reflect productivity of the livestock as well as numbers and kind of animals. This "Amount of livestock kept" was measured by the amount of total digestible units that would have been consumed by the livestock on the farm with its 1949 production rates, if that livestock had consumed total digestible nutrients according to Morrison's standards, and is stated as "hundred pounds of T.D.N. required per acre".

CHART 9- RELATION OF PROFIT TO LIVESTOCK INTENSITY (100 pounds of T.D.N. required per acre of cropland), 20 LARGE FARMS GREENEVILLE, TENNESSEE AREA, APRIL 1, 1949 TO MARCH 31, 1950.



Both equations indicate that under the conditions in the area when the sample was drawn (1) the dairy enterprise is more profitable than the average of other enterprises on these farms, (2) intensive livestock (primarily dairy) operations are more profitable than extensive operations, and (3) that it will be profitable to expand the dairy enterprise by either more intensive total livestock operations or by substitution of dairy for other enterprises on an equal percent of receipts basis (see chart 10).

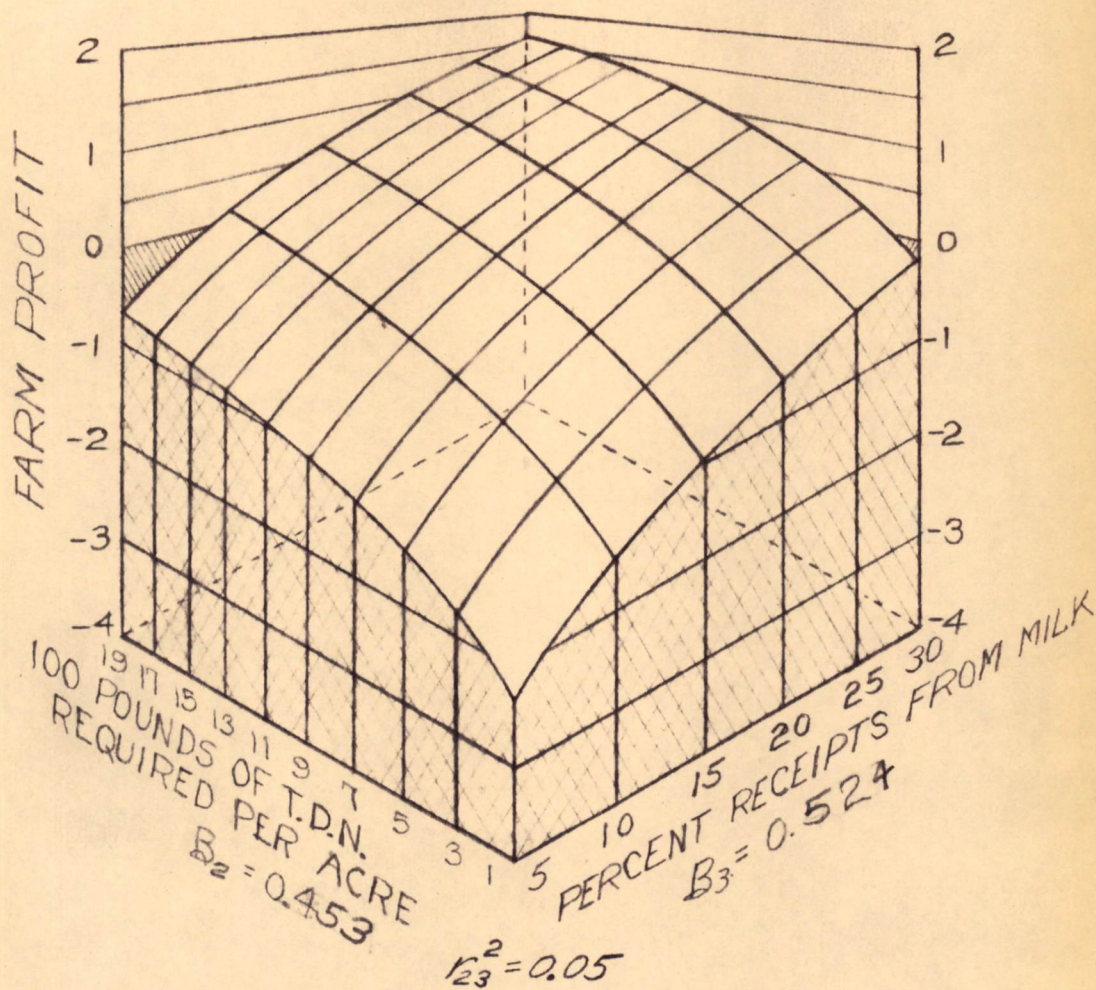
The logarithmic equation having a higher coefficient of determination and probability and a lower error of estimate, indicates that some point (beyond the limit of the sample) may be reached when further specialization and intensification may not be profitable.

Medium farms -- The range in percent of receipts from milk in medium farms was 6.4 to 31.5. Profits were about average for the farms with lowest receipts from milk, tended to decrease to about fifteen percent and to increase again as specialization increased; however, this relationship was not statistically significant by graphic approximation or linear least squares.

Since dairy and other livestock have some similar physical and economic characteristics and are considerably substitutable and competitive, an analysis was also made of the percent of receipts from all livestock.

The relationship of profits to percent of receipts from livestock was determined by graphic approximation according to chart 11. It indicates that profits were slightly above average (+.02) at 22 percent

CHART 10 - THE RELATIONSHIP OF LIVESTOCK INTENSITY (100 Pounds of Total Digestible Nutrients Required per Acre) AND DAIRY SPECIALIZATION (Percent of Receipts from Milk) TO FARM PROFIT, TWENTY LARGE FARMS NOLICHUCKY RIVER VALLEY, GREENE COUNTY, TENNESSEE, APRIL 1, 1949 TO MARCH 31, 1950.



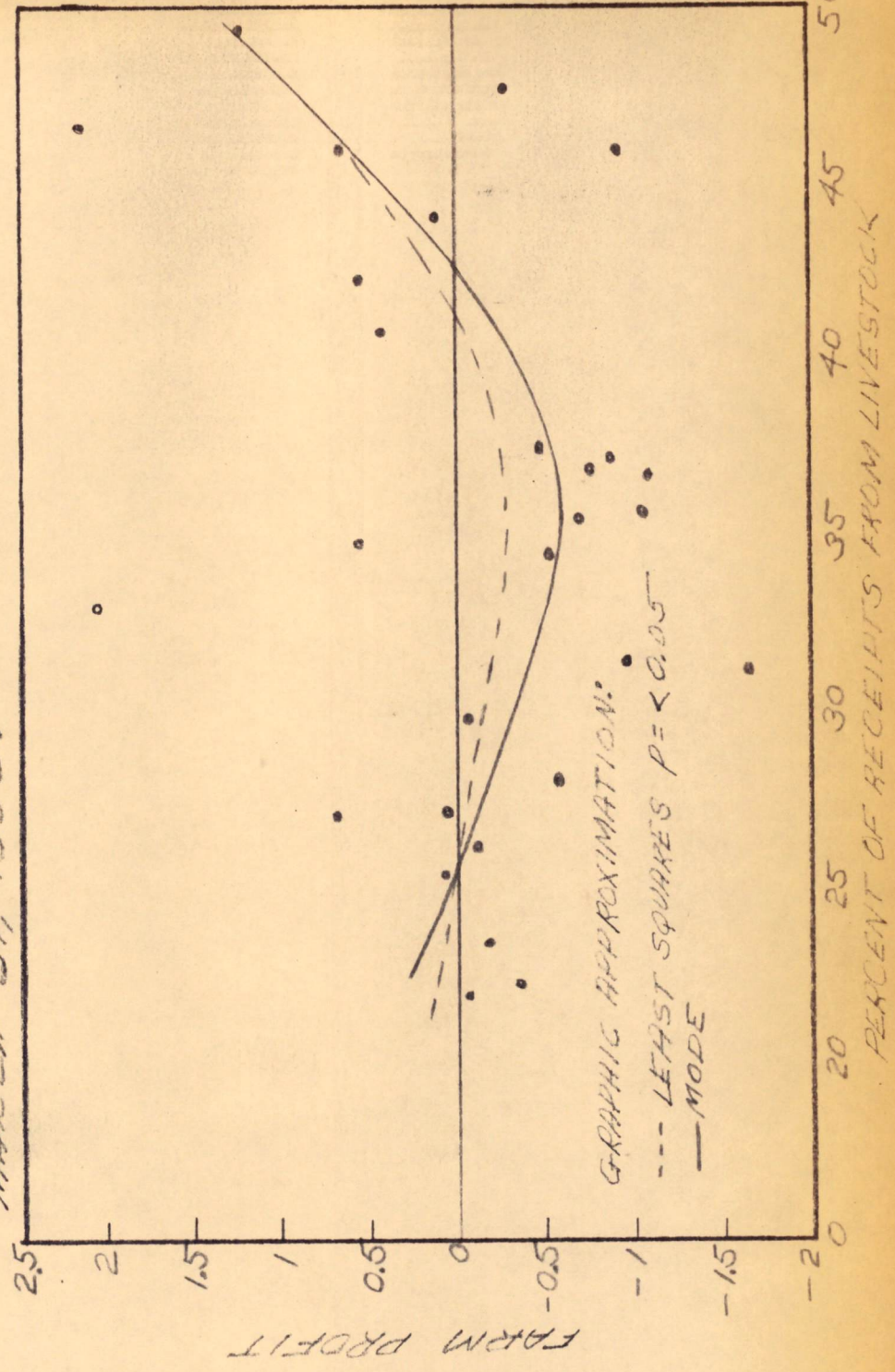
FARM PROFIT = $-4.37 + 2.85(\log_{10}$ percent of receipts from milk) + $1.34(\log_{10}$ 100 pounds of T.D.N. required per acre).

$$R_{1,23}^2 = 0.638$$

$$P = < 0.001$$

$$S_{1,23} = 0.55$$

CHART II. RELATION OF PROFIT TO LIVESTOCK
 SPECIALIZATION (PER CENT OF RECEIPTS FROM
 LIVESTOCK) 28 MEDIUM SIZED FARMS,
 GREENEVILLE, TENNESSEE AREA, APRIL 1, 1948 TO
 MARCH 31, 1950.



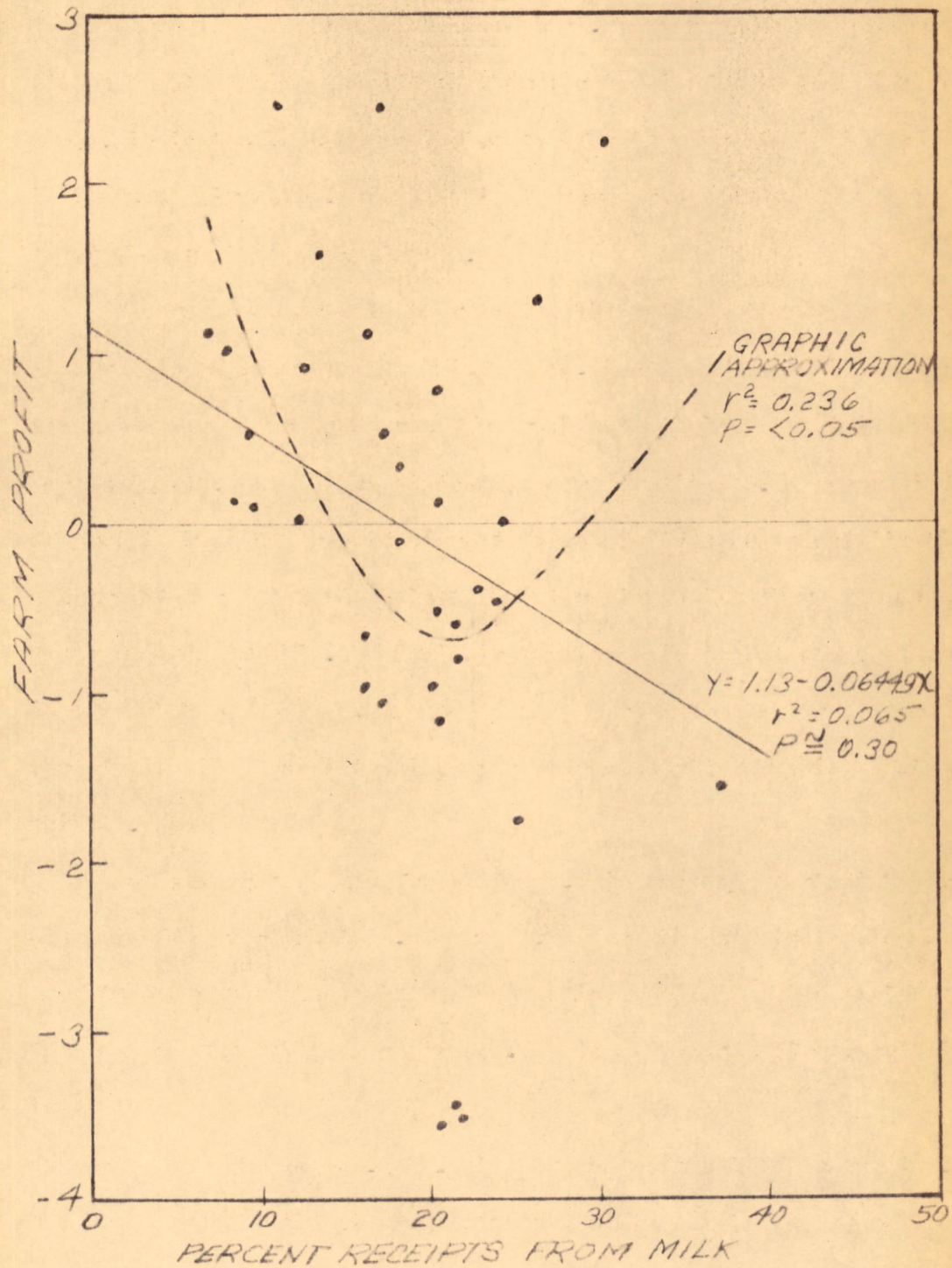
of receipts from livestock and decreased slightly to $-.03$ at about 36 percent of receipts from livestock, and increased rapidly to about $+1.40$ at 50 percent of receipts from livestock. The concentration of cases, although not meeting the least squares criteria for testing for significance, indicated that the relationship for the more typical farms were in the same direction, but definitely more pronounced than the least squares approximation indicated.

There is apparently no relationship between livestock intensity and profits as indicated by this sample. When means of high and low intensity farms were compared for profitability the high intensity farms were slightly, but not significantly more profitable. When residuals of profit from the graphic approximation of livestock specialization and profit were plotted against livestock intensity there was even less apparent relationship. This indicates that within the range of farms in the sample (280 to 3,130 pounds of TDN required per acre) farmers can vary their livestock intensity without necessarily changing their profitability.

Small farms ranged from 7 to 37.8 in percent of receipts from milk with an average of 18.4 percent. There is some indication that profits decrease with an increase in dairy specialization at least up to about 25 percent (see chart 12). A least squares linear relation indicated:

Profit = $1.13 - .064$ (percent of receipts from milk),
but had a probability of only about seven chances in ten of being a

CHART 12- THE RELATIONSHIP OF PERCENT OF RECEIPTS FROM MILK TO PROFIT, 34 SMALL FARMS, GREENEVILLE, TENNESSEE AREA, APRIL 1, 1949 TO MARCH 31, 1950.



better estimate of profit than the average profit on all small farms. A graphic approximation indicated that profits were about +1.9 at 6.0 percent of receipts from milk, fell to about -.7 at about 21.0 percent, and increased again to about +1.0 at about 38.0 percent of receipts from milk. (Although this graphic approximation was significant at the .05 level, i.e., had such a large error of estimate that it is not considered too reliable.)

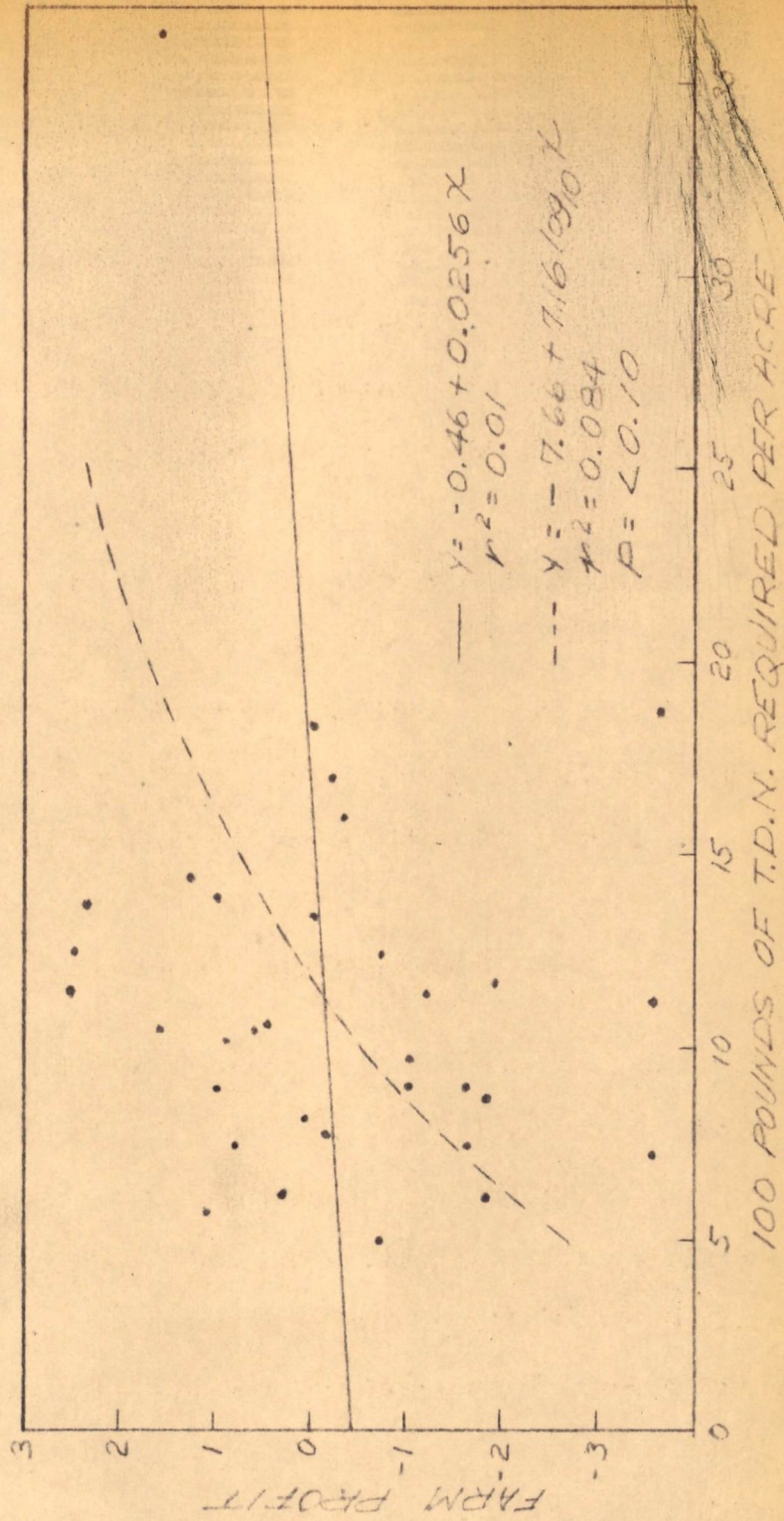
Livestock intensity on small farms ranged from 510 to 3820 pounds of TDN required per acre to meet the feed requirements of livestock kept and livestock products produced, with an average of 1223 pounds of TDN required per acre. The farms with the highest livestock population per acre had somewhat higher profits (see chart 13).

Size of Dairy Enterprise

The actual size of the dairy herd has received much discussion in recent years by extension workers, and there has been a trend toward larger herds. In the past two decades milk production has increased 20 billion pounds in the United States, yet the number of farms selling milk has declined.³ Among the farms selling milk in Greene County the value of dairy products sold per farm increased 64 percent from 1940

³John L. Wilson, "Fewer Herds, More Milk," The Agricultural Situation (Washington, D. C.: U. S. Department of Agriculture, October 1950), Vol. 30, No. 10.

CHART 13. RELATION OF PROFIT TO LIVESTOCK INTENSITY
 (100 POUNDS OF T.D.N. REQUIRED PER ACRE) 34 SMALL
 FARMS, GREENEVILLE, TENNESSEE AREA, APRIL 1, 1949 TO
 MARCH 31, 1950.



to 1945.⁴

Farms were classified on the basis of number of dairy cows to determine if there was any relationship between the size of herd and profit.⁵ The small farms showed no relationship between the size of herd and farm profit. The following relationships were found between number of milk cows and profits on large and medium sized farms:

On large farms Profits = $-.86 + .07$ (number of cows milked)
($r^2 = .15$ $P = < .10$)

On medium sized farms Profits = $-.83 + .119$ (number of cows milked)
($r^2 = .08$ $P = < .05$)

Chances are greater than five (but less than 10) percent that profits are not directly associated with the number of cows milked on the medium and large farms. Since the number of cows is only one factor⁶ determining the size of dairy enterprise it is not surprising that there is a low coefficient of determination and probability. It

⁴United States Department of Commerce, U. S. Census of Agriculture, 1945. The value of products was adjusted with index of prices of all commodities.

⁵Other factors affecting size of dairy enterprise are amount of feed, labor, etc. per cow, quality of cows and equipment buildings, etc., that add to cost per cow and influence output of milk per cow. For a discussion of the influence of expanding the dairy enterprise by these methods on profits see an unpublished manuscript by the author "Input-Output Relations of the Dairy Cow" on file with both the Department of Economics and the Department of Agricultural Economics and Rural Sociology, University of Tennessee, Knoxville, Tennessee.

⁶A classification of this type is valid since the profit measure is one of efficiency and not one of absolute income determined by the farm size.

does give some indication that large herds are more profitable than small herds.

In both size groups the distribution was similar to that of percent of receipts from milk as related to profits for the respective size groups. The concentration was linear throughout for the large farms. On the medium sized farms a concentration tended to begin at 0 profits and 3 cows, reduce to about $-.5$ profits at about 6 cows and rise linearly to $+1.0$ profits at about 13 cows.

Size of Tobacco Enterprise

The relationship of acres of tobacco to farm profits on small farms (see chart 14) is indicated by:

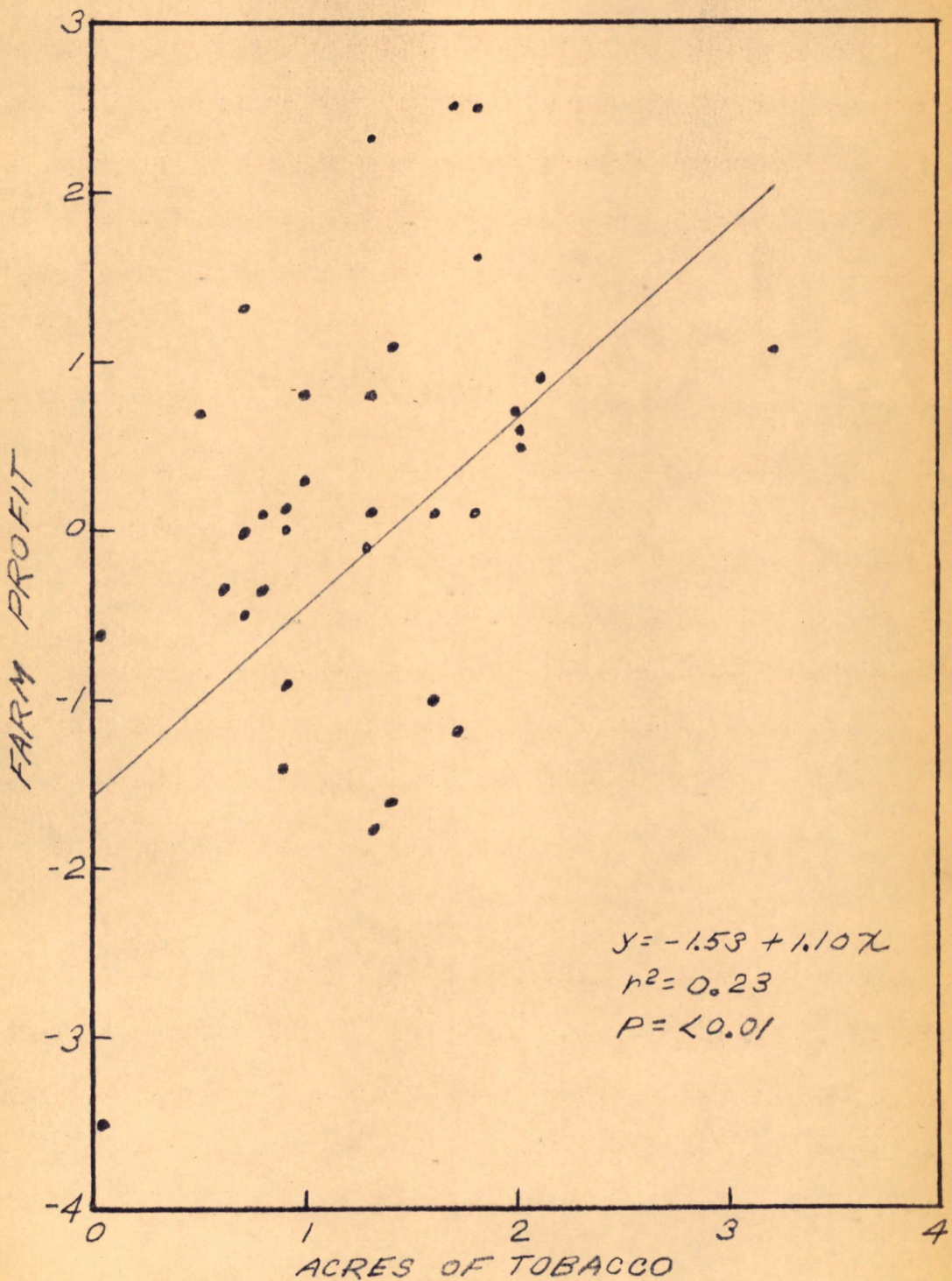
$$\begin{aligned} \text{Profits} &= -1.53 + 1.095X \\ (r^2 &= .226 \quad P = < .01), \end{aligned}$$

but there was no apparent relationship between tobacco acreage and profit in the medium and large farms. Tobacco acreage and number of dairy cows appeared to be independent in all size groups.

Pasture Use

Reliable empirical evidence necessary to evaluate the place of pastures in the farming program is very limited compared to the statements and action on the subject based only on suppositions or on unreliable or inaccurate evidence. This is not a criticism of workers who have hobbled on the crutches of logic and limited information, but to

CHART 14. RELATION OF PROFIT TO SIZE OF TOBACCO ENTERPRISE, 34 SMALL FARMS GREENEVILLE, TENNESSEE AREA, APRIL 1, 1949 TO MARCH 31, 1950.



explain why it is so and to report another unsuccessful approach to the problem.

The limiting factor in a pasture study is the difficulty of measuring the pasturage. Due to the extreme variation in quality and amount of feed obtained from pasture, no measure of pasture yield is known that is completely satisfactory for a farm management study. This is further complicated by the irregularity of the fields and heterogeneity of the soils that are, and should be, utilized as pasture.

An attempt was made to relate the percent of total digestible nutrients used that were received from pasture to farm profits. The total digestible nutrients required to maintain all animals and produce the products reported for the entire farm was computed. The amount of total digestible nutrients required that was furnished by supplemental feeding was determined and related to farm profit. The serious limitation of the approach is that all errors in enumeration and computation of livestock kept, their sizes, growth, products produced, and the amount and quality of feed fed accumulate within this computation. Another limitation is that feeding standards are not based on farm conditions, but this error should be about equal for all farms and should not seriously affect conclusions if this is considered during interpretation of the data.

On the large farms the percent of nutrients fed by supplemental feeding ranged from 10 to 130.⁷ On large farms:

$$\text{Profit} = .59 - .0078 \left(\begin{array}{l} \text{percent of total digestible nutrients} \\ \text{furnished by supplemental feeding} \end{array} \right)$$
$$(r^2 = .25 \quad P = < .05).$$

This gives some additional evidence that profits are directly associated with pasture use.

On medium and small farms no significant relationship was found between pasture use and farm profits.

If this measure of pasture use is to be used in other studies it is suggested that more accurate observation be made than can be obtained on a one visit survey.

⁷That some farms had a value greater than 100 is probably due to feeding standards not being based on farm conditions, but possibly due to error. Also, it could and probably does indicate a low feeding efficiency on some farms.

CHAPTER V

PROPOSED ADJUSTMENTS

Large and Medium Sized Farms

The findings of this study indicate that most large and medium sized farms can probably increase their monetary returns by expanding their livestock (primarily dairy) enterprises.

If monetary returns are increased by the method suggested, it will necessarily require the use of additional labor. In general this labor is available on the farms. Making this adjustment will only mean that the present labor force will be utilized rather than being absorbed in inefficiency or leisure as at present.

Livestock enterprises are in general supplementary and complimentary to crops. If crops and livestock are used together in proper proportion they will provide full time year around employment. They are supplementary in labor requirements in regards to either seasonal, time of day, or short weather fluctuations. Livestock and crops are complimentary as crops furnish feed for livestock, and livestock furnish manure for crops. The primary competition between livestock and crops is for capital.

The quality of land on practically all farms does not permit continuous cultivated crop production, which indicates that a roughage consuming enterprise (dairy or beef) should be considered. Dairy and

beef are largely competitive and/or substitutable in the farming program, except for labor requirements. It appears then that dairying will be most adaptable to farms with surplus labor, and beef to the farms with limited labor.

Expansion of the dairy or other livestock enterprises obviously will require additional capital. This study does not furnish sufficient evidence to determine the source of capital that should be used. The additional capital that will be needed is small compared to the total investment.

Small Farms


Small farms evidently would increase their monetary returns if they would increase their size of operation, especially by expansion of the tobacco enterprise. The tobacco enterprise is limited by government control programs, and in order to expand this enterprise action must be directed through government officials.

Farm profit on the small (but apparently not the medium and large farms) is directly associated with the acres in tobacco. These farms have a surplus of labor, and this surplus labor can profitably be utilized in tobacco production. As these same farmers increased their dairy enterprise, their profits decreased; probably because they did not have enough capital to operate a dairy enterprise efficiently. Dairying and other livestock enterprises require considerably more capital to employ a man than does tobacco and these operators do not have enough capital to make their expansion with dairying.

Economic Effect of Adjustments to Dairying

If all farmers in the area attempted to make the adjustments suggested, probably none of them would get the results indicated. The immediate effects would be an increase in the price of labor (after the expansion reached the point that the normal movement of labor to industry was interrupted or farmers began bidding for additional labor) and the advantages of intensification would be offset by increased labor cost. The amount of milk produced would probably influence the price of milk very little as the company presently handling the milk has national and international markets, and other companies are competing with it in both purchase of milk and sale of products. If the amount of milk produced is increased, marketing costs per unit of milk will undoubtedly decrease.

If these adjustments are made immediately, there will probably be a local rise in costs of production in the short-run. These costs will return to the same relative position, or to a lower position, when soil fertility and crop yields get full benefit of the increased livestock, and when local shortages of equipment, cattle, and other capital goods are alleviated.

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BIBLIOGRAPHY

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APPENDIX



Appendix A

SELECTED CHARACTERISTICS OF 82 OWNER OPERATED FARMS, GREENEVILLE,
TENNESSEE AREA, APRIL 1, 1949 TO MARCH 31, 1950, BY
SIZE OF FARM

(Average per Farm)

Characteristic and Unit	Size of Farm ^a		
	Small	Medium	Large
Number	34	28	20
Total acres	31.9	66.8	118.7
Cropland, acres	26.4	53.2	86.1
Tobacco, acres	1.3	2.2	2.9
Other crops, acres	25.2	51.1	83.2
Rotation pasture, acres	11.9	22.6	35.5
Other pasture, acres	3.0	8.1	20.4
Milk cows, number	4.1	6.9	11.9
Other cattle, Animal Units ^b	1.5	3.2	12.3
Other livestock, Animal Units ^b	1.2	2.2	2.7
Real estate, value dollars	6,587	12,450	20,050
Equipment, value dollars	421	1,027	2,817
Livestock, value dollars	880	1,686	3,404
Interest charge, dollars ^c	391	743	1,286
Total labor required, man work units	153	302	467
Family labor, men ^d	.65	1.08	1.18
Wages of croppers, percent of receipts	10.6	11.3	14.1
Income, ^e dollars	736	1,731	2,556
Returns to management and labor, dollars	345	988	1,270
Returns to management, dollars	-390	-235	-64

a. Based on investment.

b. Based on feed requirements to maintain one milk cow or 2,628 pounds of total digestible nutrients.

c. 4.5 percent of real estate and 5.0 percent for other investment.

d. Able bodied man equivalent.

e. Returns to labor, capital and management.