FACTORS AFFECTING THE RETURN FOR MANAGEMENT
ON KANSAS FARMS

by

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INTRODUCTION

The farmer is continually attempting to coordinate the factors in his business in such a manner that it will be possible for him to realize the largest income over a long period of years. Farm management has been defined as "the problem of the individual farmer to so organize the various factors in his business, so adapt farm practice to his particular environment, and so dispose of his products as to yield him the greatest continuous profits."[1] If the farmer hopes to attain this goal it is necessary that he be familiar with the factors affecting his income. Certain factors affect income favorably while other factors affect it unfavorably. If the farmer is to secure the largest income over a period of years he must know how the various factors affect his business.

Factors which affect income vary from year to year. A factor which affects income favorably one year may affect it unfavorably the next year. If a factor is to be considered significant in determining income it should correlate either positively or negatively with income over a

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[1] Record of proceedings of the eighth annual meeting of the American Farm Management Association.

period of several years. Furthermore, data on which corre-
lation analyses are run for a period of several years
should come from the same area each year. This is import-
ant since the economic, biological, and physical factors
which are responsible for type of farming areas also are
responsible for variations in the method by which a factor
affects income in different areas.

The type of farming followed is an important item to
consider in attempting to determine the relation between
certain factors and income. A factor which consistently
has a favorable relation to income in one type of farming
may consistently have an unfavorable relation to income in
another type of farming. In other instances a factor may
be directly related to income in one type of farming while
under another type it may have no significant relationship.
This has made division by type of farming necessary in
addition to division by areas.

In calculating a correlation analysis of factors af-
fecting income for a period of several years it is essential
that the same factors be used each year. This is necessary
since the intercorrelation between the factors influences
the results materially. If different factors were used in
different years the variations from year to year would not

be comparable. Although different factors usually should be used for different areas and different types of farming, the same factors should be used when results from year to year are compared for a particular area or type.

The type of year is another factor which influences the relationship between certain factors and income. During prosperous years some factors have a favorable relationship with income while during years of depression the relationship may be unfavorable. Other factors may have an unfavorable relationship to income during prosperous years and a favorable relationship during years of depression.

Among the factors which were used for studying the relation to income for certain areas and types of farming in Kansas are the following:

Size Factors:

    1. Crop acres.

    2. Wheat production in bushels.

    3. Number of cows.

Efficiency Factors:

    1. Crop acres per man.

    2. Machinery investment per crop acre.

    3. Machinery cost per crop acre.

    4. Dairy receipts per cow.

5. Poultry receipts per hen.

6. Crop index.

Organization Factors:

1. Per cent of gross income from livestock.

2. Per cent of land in rotation in legumes.

3. Change in inventory.

Dependent Factor.

1. Operator's return for management.

A majority of these factors are self-explanatory and need no clarification. However, a few of the factors need to be explained. The factor "wheat production in bushels" refers to the total number of bushels of wheat produced on the farm during the year. It is, therefore, primarily a size factor. The factor "change in inventory" has been listed as an organization factor. It is influenced not only by organization but also by changes in price level. In some instances it is possible for a change in price to be responsible for a severe change in inventory without a change in the organization of the farm.

In attempting to determine the relationship between certain factors and income it is important that a satisfactory measure of income be used. There are various measures of income being used today. In measuring the relation of certain factors, a majority of which are

managerial in nature, to income an attempt should be made
to use the measure of income which will bear out the re-
lationship in the most satisfactory manner. Considering
the purpose of this study "operator's return for manage-
ment" was thought to be the most satisfactory measure since
it deducts income from all other sources except that re-
ceived for actual managerial ability.

PURPOSE OF STUDY

The purpose of this study is to determine what rela-
tion exists between the factors listed in the introduction
and the operator's return for management on Kansas farms.
If there is a direct relation consistently between a
certain factor and operator's return for management, the
farm operator can emphasize these factors.

If it is possible for the farm operator to determine
in advance certain practices which are profitable in a
majority of years it will give him a basis for planning his
future operations. At the present time planning for agri-
culture is being emphasized. Although a certain factor
does not affect income on each farm in the same manner it
is possible to determine which factors influence income on

a majority of the farms. By using such relationships as a basis it should be possible for the individual farmer and research workers in farm management to plan in a more satisfactory manner.

REVIEW OF LITERATURE

A large number of studies have been made on factors affecting income on farms in various parts of the United States. There are several methods of measuring the relationship between the factors and income. Among the methods frequently used for measuring the relationships are arraying the farms according to the number of factors in which they are above average, the cross tabulation method, and the correlation analysis method. The results secured by the above methods have in a majority of instances been similar.

Pond, Ranney, and Crickman (15) in a study of 766 Minnesota farms arrayed the farms according to the number of factors in which each farm was above average. The eight factors used as a basis for their study were: (a) Size of business, (b) choice of crops, (c) amount of livestock per 100 acres, (d) crop yields, (e) butterfat production per cow, (f) returns over feed cost from livestock

other than cows, (g) productive man work units per worker,
and (h) power, machinery and improvement expense per pro-
ductive man work unit. In their study farmers who were be-
low average in all eight factors made an average operator's
earning of $617 while those who were above average in all
eight factors made an average operator's labor earning of
$2965. The distribution between these two extremes was di-
rectly in proportion to the number of factors in which the
farm was above average. The groups which excelled in the
larger number of factors made the largest incomes while the
groups which were deficient in a large number of factors
were low in income. They make the following statement,
"Farmers who attain better than average accomplishments in
all or a majority of the organization and management factors
have a well balanced business which usually may be expected
to produce higher returns than can be obtained by farmers
who excel in only a small proportion of the eight factors,
even though they may be outstanding in some one phase of
their business."

The above study included records for the period 1928-
1932 inclusive. In making the study all the farms for the
total period were grouped together. Those farms that kept
a record for the four-year period were counted as one farm

each year. By using this method the farms that kept a re-
cord every year during the period were given a heavier
weighting than those farms which kept records for only one
year. However, the method has certain advantages since it
takes more than one year into consideration.

In a similar study published in 1920 Dixon and Haw-
thorne (5) made a rather extensive study of 4,244 farms in
12 different areas of the United States. They used size,
crop yields, returns from livestock, and efficiency in use
of labor as the factors affecting labor income. They found
a direct relation between the number of factors in which the
farm was above average and labor income in all 12 areas.

They recognize the fact that size of business can be
measured by several different methods. In this study they
did not use any one particular method for measuring size.
Instead, the farms were divided in size groups on the basis
of the method which indicated the size of the business best
for each area. In their study they divided the farms for
each area into three groups according to size. In each area
the small farms made the lowest labor income, the medium
sized farms made an average labor income, and the large
farms made the largest labor income.

In this study crop yields were an important factor in determining labor income. The farms with high crop yields made high labor incomes while those with low crop yields made low labor incomes. They believed this would hold true until yields considerably above average for the region were obtained.

In determining the effect of returns from livestock on labor income only farms where livestock was an important enterprise were used. These farms were grouped into three groups according to whether they showed poor, medium, or good production. The returns from livestock were measured by the quantity and value of product returned per animal. In each of the 12 areas the group of farms which showed poor returns was low in average labor income while the group which had good returns was high in average labor income.

The basis used for comparing efficiency in the use of labor was crop acres per man where the farms were of the same general type. Where farms varied in type they used the number of days of productive labor per man.

Warren (20) has stressed the importance of size to farm efficiency. He made a study of 586 farms operated by the owners in Tompkins county, New York. He found that a definite relationship exists between size of farm and labor

income. All the farms used in this study were family-sized
farms. He attributes this relationship to efficiency of
certain factors which are affected by size. In the study
he compared size to the efficient use of the following fac-
tors: Labor, horses, machinery, capital, and economics in
buying and selling. The important factor in making the
large farms pay better was the efficient use of man labor,
teams and machinery.

In a study of the organization and practices on dairy
farms in the Piedmont Plateau region of the Atlantic coast,
Ezekiel (8) used the multiple correlation method of analysis.
Records from 357 farms in Chester county, Pennsylvania for
the year 1923 were analyzed. The following factors were
used:

Size Factors:

    1. Number of cows.

    2. Acres in crops.

    3. Acres in pasture.

Efficiency Factors:

    4. Crop index.

    5. Labor index.

    6. Percentage of dairy feed purchased.

Organization Factors, dollars of receipts from:

7. Crops.

8. Dairy products or cattle.

9. Beef cattle.

10. Hogs.

11. Sheep.

12. Poultry.

The dependent factor used was operator's earnings. A multiple correlation of R = 0.843 was secured between the 12 factors and operator's earnings. The more important factors in determining operator's earnings as shown by the coefficients of determination were number of cows, acres in crops, receipts from crops, receipts from dairy herd, and receipts from poultry. The remaining factors were of negligible importance in determining operator's earnings.

The relationship between certain factors and income is not the same every year. Results from studies of the relationship of certain factors to income indicate that the type of year is important in determining the relationship which exists between a factor and income. Crickman (4) in a study of 231 farms in Warren county, Iowa, in 1921, attributes the unsatisfactory results to the unstable conditions in agriculture during that year. He used the

multiple correlation method of analysis. Fourteen factors were included in the study. A multiple correlation of R = 0.603 was secured. This indicates that the factors chosen were faulty for that particular year or that other factors not accounted for in the study affected income.

In a more recent study in Iowa, Hopkins (12) made a rather extensive study of efficiency factors and their relation to income. He used from 13 to 15 factors and estimated the income from the curves of relationship secured between the factors and income. After the estimated income was secured the estimates were correlated with the actual net income figures. The correlation secured between the estimated income and actual income was +.88 for 1929 and +.82 for 1930. On 144 farms in this study which kept a continuous record from 1927 to 1930 inclusive, the correlation of the estimated net incomes with the actual three-year averages gave a correlation coefficient of +.92. After making a study of the correlation of actual with estimated net income and management returns the following statement is made: "Thus we may say that the factors studied accounted for about 50 per cent of the variation in net income and about 40 per cent of the variation in the management return. The rest was caused by influences not reflected

adequately or not measured at all by these factors." The
fact that many difficulties are encountered in attempting
to measure the influence of certain factors on farm income
in quantitative terms was recognized.

Holmes (11) emphasizes the importance of maximum util-
ization of resources. In his book he discusses the law of
diminishing returns and the doctrine of comparative advan-
tage and their importance in agriculture. The importance
of the individual in farming is stressed. Holmes (11)
states, "As we go forward in this discussion we must keep
constantly in mind that the farmer's resources consist not
only of whatever of the technical factors — labor, land,
equipment, and raw materials — he may have, but also of
his available cash and credit, and most important of all,
his own capability as a business organizer and manager."
The discussion brings out the importance of the individual's
ability to coordinate the various factors in such a manner
that maximum utilization of resources is secured.

SCOPE OF STUDY

Farm Bureau-Farm and Home Management work was developed
in Kansas in 1931. In that year two associations were or-
ganized by the Extension Service of Kansas State College.

The Southern Association included a group of counties in East South Central Kansas. The Northern Association included a group of counties in East North Central Kansas. Each of these associations employs a field man who visits each farmer member from four to six times each year. The purpose of this field man is to assist in keeping the record, make a business analysis of the farm, and help to plan for its future development. Each member keeps a record of his farm business for each year. Thus, rather complete records are available for each association for the period 1931 to 1937 inclusive. These books have been summarized and analyzed by the Department of Agricultural Economics and much valuable research information has been secured.

Since 1931 two additional associations have been organized. The Southwest Association was organized in 1937 and the Northeast Kansas Association was organized in 1938. Records from these two associations were not included in the study as the analysis of the data commenced at too late a date for this study. Figure 1 shows the counties included in each of the four associations at the present time.

Records for the Northern and Southern Associations for the period 1933 to 1936 inclusive were used. The number of records included each year depended upon the number of

farmers who completed their farm account books.   Table 1
lists the number of records which were included in the
study for each association.

Table 1.   Number of records from the northern and southern
           associations which were included in the study for
           the period 1933-1936.

Year	Northern Association	Southern Association
1933	116	84
1934	126	80
1935	112	86
1936	98	95

The types of farming in these two associations vary
widely.   The more common types of farming in these associa-
tions are general, cash-grain, animal specialty, dairy, and
poultry.   As a general rule the farms in the Northern As-
sociation emphasize livestock while those in the Southern
Association rely upon cash grain to a larger extent to
furnish receipts.   The area covered by the Associations
gives a rather representative picture of Kansas agriculture.

METHOD OF PROCEDURE

The correlation method of analysis was used in this study. Scatter diagrams were prepared between the factors chosen and return for management to determine the relationships which existed, and exceptional deviations for individual farms. Where a particular farm varied widely from the line of regression for a certain factor the figures were checked for that farm to determine why the large deviation existed. This made it possible to eliminate farms which deviated widely due to reasons not pertaining to the farm business. These scatter diagrams were not used with the intentions of measuring relationships, but instead they were used to determine exceptional farms. Tolley and Mendum (16) state "The process of grouping and averaging, whether by the one-way or the two-way frequency table and scatter diagram, gives only a qualitative answer to the question of relationships between the variables. A quantitative measure of the degree of relationship is needed." The coefficient of correlation is one of the most practical methods available at present for giving a quantitative measure of the relationship between two factors.

Workers in farm management have frequently contended that a relationship exists between certain factors and farm income. Many factors which were related to income in certain studies have been listed in various publications. In this study certain size, efficiency, and organization factors on which data were available were chosen and correlated with return for management. The purpose was to determine what type of relationship exists on Kansas farms and how these relationships vary from year to year.

The same factors were used for each association each year. By using this method a considerable portion of the variation that might have been introduced by adding other factors or changing them from year to year was eliminated. Insofar as this variation was eliminated the relationships which existed between the variables from year to year should be on a comparable basis. If they are on a comparable basis it is possible to determine if the relationship is approximately the same or if it varies widely from one period to the next. Bennett (1) emphasizes the importance of this method when he states, "Two or three such analyses (using one year's data at a time, with the same variables each year, but not necessarily data from the same farms; and comparing the correlation coefficients so as to determine whether or not the same factors are significant each

year) ought to be undertaken in preference to many analyses of one year's data."

After the factors were chosen for each association the gross correlation between each pair of factors, the multiple correlation of all independent factors with the dependent factor, the straight line net regression of the dependent factor on each of the independent factors and the multiple regression equation were calculated. The equations and methods used in solving these equations to obtain the quantitative measures are explained thoroughly by Wallace and Snedecar (17) and Ezekiel (7).

The results obtained by using the above method were rather disappointing. Some element was present which was affecting the results. Several methods for improving the correlation between the variables were attempted. Finally the farms were divided according to type of farming. Pine (14) divided the farms in the Northern Association according to the type of farming followed. He used Elliott's (6) classification, with some modification in percentages, for his divisions. In this study the farms were classified in the same manner that Pine classified them in his study.

The factors selected for each type were chosen according to the relation which existed between the factor and a

particular type of farming. Only those factors which were thought to bear a relation to return for management under a certain type of farming were used. This made it possible to use certain factors for each type which could not be used satisfactorily for all farms together. The same equations and methods of solving these equations were used in this portion of the study as were used for all farms taken together.

The study by type was not completed for all four years or for all types of farms. Dairy type farms were studied in 1935 and cash-grain type farms were studied in 1935 and 1936. The correlation secured by using all farms during these years was poor in the Northern Association. By dividing them into types of farming the results were improved tremendously. It was not possible to work the correlation for each type of farming because of the limited number of records available. In a multiple correlation study size of sample is important when several variables are used. The number of cases used for each type in this study was small. Ezekiel's (7) formula was used to correct the results for the small number of cases in each sample. The results secured remained satisfactory after the correction was made.

LIMITATIONS OF STUDY

One of the important limitations encountered in the study was the limitation of the method used. The multiple correlation method of analysis has been criticized frequently when applied to farm-management data. The chief reason for the criticism is that most farm-management data are jointly related. If several factors which have causal relationships with each other or joint relationships with income are correlated with income, the results are influenced. Warren (21) states "In farm-management data, relatively few pairs of important factors fall into either of these groups. The writer has found only two cases in farm-management work which could be classed in either of these groups; that is, in which multiple linear or curvilinear correlation seemed to have been correctly used." In another portion of the same publication he states that it is practically impossible to find eight factors affecting income which do not have either a causal relationship with each other or a joint relationship with income.

In this study the factors used in many instances have causal relationships with each other and joint relationships

with income. Crop acres, crop acres per man, and wheat pro-
duction were used in the multiple correlation analysis of
the Southern Association. A study of Tables 14 to 17 in the
appendix reveals that these three factors are highly inter-
correlated. Several of the other factors are also inter-
correlated. The fact that causal relations with each other
or joint relations with income existed was not ignored.
However, it is believed that these interrelationships, al-
though they make interpretation of results more difficult,
do not detract from the value of the study to a large ex-
tent.

A second limitation encountered in the study was the
limitations in the available data. Although the records
kept were rather complete several valuable items of inform-
ation were omitted. The results secured probably would have
been more satisfactory if production and efficiency indexes
for beef cattle, hogs and sheep were available. In several
instances farms which deviated widely from the line of re-
gression were farms in which a high income was realized from
feeding operations. Another limitation was the fact that
there were not enough records available for each year to
give a satisfactory sample when the farms were divided by
type.

In some instances there were obvious errors in the
records kept. When such errors were detected the records
were eliminated or the errors corrected if possible. Inso-
far as these corrections were made the results were not
affected. However, if incorrect prices were used in the
inventory or if errors were made in summarizing the books
it is possible that they would not be detected. Such errors
can affect the return for management by a considerable
amount.

The above limitations probably affected the magnitude
of the results secured. However, the data which were in-
cluded should give a rather reliable basis for estimating
the effect these factors have on income. These limitations
are not so severe that they would change materially the re-
sults secured in the study.

DESCRIPTION OF ASSOCIATIONS

Much of the Northern Association is located in type-of-
farming area 6a. There are several counties adjacent to
type-of-farming area 6a located in area 8 and area 5 which
are included in this association. The general area covered
by the Northern Association is characterized by cash grain,

Table 2. Average percentage distribution of gross income for farms in the northern and southern associations for the period of years, 1933-1936.

Source of income	Northern Association				Southern Association			
	1933	1934	1935	1936	1933	1934	1935	1936
Dairy products	14.2	14.0	12.1	11.4	11.9	7.0	6.6	7.0
Cattle receipts	19.6	14.8	20.8	13.8	16.3	19.7	24.6	19.5
Hog receipts	18.4	15.7	19.3	18.7	10.5	6.8	11.8	11.3
Poultry receipts	10.8	12.8	13.5	11.9	6.5	5.1	6.2	5.6
Sheep receipts	2.3	1.9	1.3	2.0	2.7	4.0	3.7	1.3
Horse receipts	1.7	1.1	1.2	.9	3.5	1.3	1.1	.7
Total live-stock receipts	67.0	60.3	68.2	58.7	51.4	43.9	54.0	45.4
Crops sold	14.2	21.3	15.9	24.5	22.3	31.1	32.5	37.4
Inventory increase on crops and feeds	8.7	3.9	3.8	4.2	8.5	12.5	.9	3.5
Inventory increase on seeds and supplies	2.0	3.3	1.3	.7	4.0	1.6	.9	.2
Miscellaneous	8.1	11.2	10.8	11.9	13.8	10.9	11.7	13.5
Gross income	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

livestock, and general types of farming. Wheat production
is important in this area. Considerable acreages of corn
and sorghums are grown. Oats and alfalfa are other impor-
tant crops. Livestock are responsible for from 60 to 70
per cent of the receipts in this area. Cattle and hogs are
important livestock enterprises on farms in this associa-
tion. Receipts from these two enterprises account for 30
to 40 per cent of the total receipts. Dairying and poultry
also are important sources of income in this area.

In 1936 the farms in the Northern Association averaged
355 acres in size. Using average figures, 206 of the 355
acres were in crops. The remainder of the acreage was in
pasture, farmstead, waste, roads and fences.

The largest portion of the Southern Association is
located in type-of-farming area 6b. Several farms from
Cowley and Butler counties, located in area 5, are included.
The general area covered by this association is similar to
that covered by the Northern Association. The types of
farming which predominate are similar. There are a few
rather important differences. In the Southern Association
wheat is more important than in the Northern Association.
Crops are responsible for a larger percentage of the gross
income in the Southern Association. Livestock, although

important, does not account for as high a per cent of the receipts in the Southern Association as it does in the Northern Association. The dairy, hog, and poultry enterprises are relatively more important in the Northern Association than they are in the Southern Association. The beef cattle enterprise is more important in the Southern Association.

The average size of farm is larger in the Southern Association than in the Northern Association. In 1936 the average total acreage per farm in the Southern Association was 547 acres. The average crop acreage was 354 acres. Thus, from an acreage viewpoint, the farms in the Southern Association were considerably larger. The average gross receipts per farm in the Southern Association for the period 1933-1936 was $5,770 compared to an average of $3,943 for the Northern Association during the same period. By using practically all measures of size, the average farm business in the Southern Association is somewhat larger than in the Northern Association.

TYPES OF YEARS

There is a high degree of relationship between non-agricultural income and demand for farm commodities. When non-agricultural income is high the demand for farm commodities is good and prosperity usually exists on the farm. Figure 1 shows the indexes of non-agricultural income by months for the period studied. After reaching a low point in April, 1933 the index commenced going up and continued to do so throughout the period. The period of years included in the study is therefore one of increasing prices and increasing gross income. This combination usually is responsible for more prosperous conditions on the farm.

In the Northern Association the average gross income per farm increased each year until 1936 when it decreased somewhat. The average expense continued to increase throughout the period. This was responsible for rather erratic net income figures. In the Southern Association gross income increased continually throughout the period. However, expenses increased much more rapidly than gross receipts, and therefore, after the large average net income per farm in 1934 the net income has been decreasing each
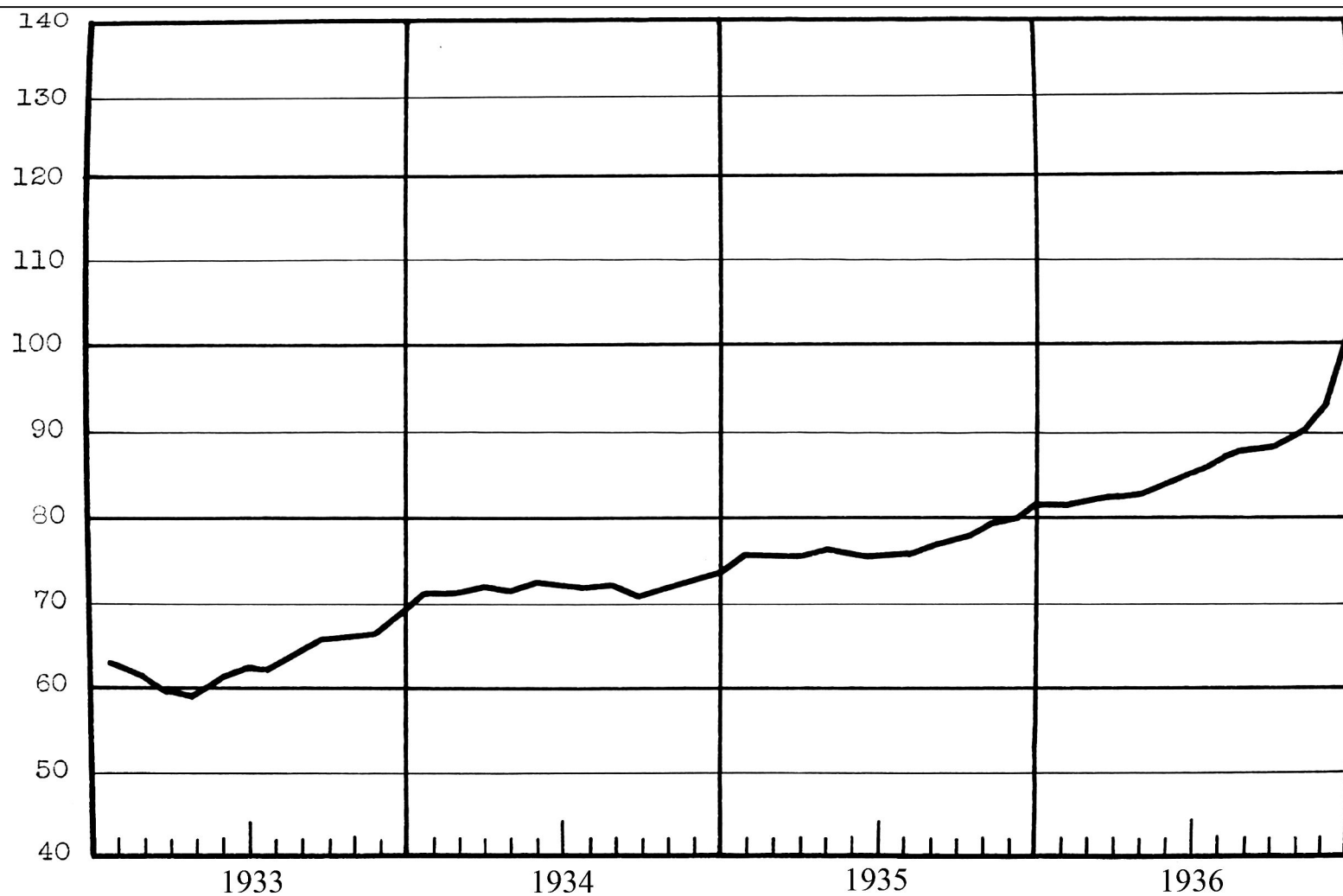
Fig. 1. Indexes of non-agricultural income, by months, adjusted for
seasonal variation, 1933-1936.

Table 3. Average gross income, expenses, and net income for the 1933-1936 period.

Year	Northern Association			Southern Association		
	Gross Income	Expenses	Net Income	Gross Income	Expenses	Net Income
1933	$2,870	$1,623	$1,247	$3,506	$2,214	$1,292
1934	3,452	2,487	965	5,925	2,994	2,931
1935	4,846	3,012	1,834	6,736	4,343	2,393
1936	4,605	3,143	1,462	6,916	4,703	2,213

year.

The drought years during this period were exceptionally
hazardous to farmers in the Northern Association. In 1934
the corn and feed crops were almost complete failures.
Prices for these commodities were high and maintaining the
normal amount of livestock on the farm was a difficult task.
During 1936 similar conditions existed; however, they were
not so severe. The Southern Association was not affected
so severely, as wheat which is the principal crop in this
area, matured each year before the drought became severe.

Although these years have been more prosperous than
the depression years of 1931 and 1932, efficiency was an
important factor in determining the success of the farm
during the period studied. Since expenses increased much
more rapidly than gross income it is essential that they
be kept at a minimum. Although the gross income of the farm
business increased each year the more than additional in-
crease in expenses decreased the farmers net income. Thus
it was a period of increasing prices and activity with
erratic net income figures.

RESULTS SECURED WHEN ALL FARMS WERE USED

Northern Association

The purpose of the correlation analysis in this study
was to determine the importance of certain factors in af-
fecting return for management on Kansas farms. The factors
which were thought to have a relation to return for manage-
ment on farms in the Northern Association were crop acres,
per cent of land in rotation in legumes, per cent of gross
income from livestock, dairy receipts per cow, poultry re-
ceipts per hen, crop acres per man, machinery investment
per crop acre, and machinery cost per crop acre.

Table 4 shows the relative importance of the different
factors in determining return for management, as indicated
by the coefficients of determination. The combined import-
ance of all factors in relation to the dependent factor was
highest in 1933. In the subsequent years the importance of
the factors in determining return for management decreased
each year until in 1936 all factors combined only accounted
for 7.76 per cent of a perfect correlation. The per cent of
gross income from livestock was the important factor in

Table 4. Relative importance of the different factors in determining return
for management as shown by the coefficients of determination.
Northern Association.

Factor	Per Cent			
	1933	1934	1935	1936
Crop acres	- 2.20	- .66	+ 5.20	+ 2.58
Per cent of land in rotation in legumes	+ 3.99	- .03	+ 3.74	- .03
Per cent of gross income from livestock	+35.86	+11.47	+ .01	+ 2.01
Dairy receipts per cow	+ 3.34	+ 1.63	+ .97	- .52
Poultry receipts per hen	+ .74	+ 6.68	+ 3.45	- .07
Crop acres per man	+ 3.07	+ .34	+ 5.26	+ .12
Machinery investment per crop acre	+ .16	+ .80	+ .21	+ 2.12
Machinery cost per crop acre	+ .21	+ 2.31	- .61	+ 1.55
Combined importance of all	45.17	22.54	18.23	7.76

determining the return for management in 1933 and 1934. In 1933 it was responsible for 78 per cent of the combined importance of all factors while in 1934 it was responsible for 50 per cent of the combined importance of all factors. If this factor were eliminated the multiple coefficients of correlation would be much lower than those shown. Other factors which were of some importance in determining the significance of the relationship in 1933 were per cent of land in rotation in legumes, dairy receipts per cow, and crop acres per man. The remaining factors were of practically no significance. In 1934 the important factors in addition to per cent of receipts from livestock were poultry receipts per hen, and machinery cost per crop acre. The remaining factors were of negligible importance. In 1935 four factors were of significant importance. Crop acres, per cent of gross income from livestock, poultry receipts per hen, and crop acres per man accounted for practically all of the relation in 1935. In 1936 none of the factors seemed to be of great importance. The relationships were disappointing every year. However, during 1936 none of the factors used seemed to be of any significant importance.

The multiple coefficient of correlation is the figure which quantitatively measures the relationship between the

various independent factors combined and the dependent factor. It is secured by extracting the square root of the combined importance of all independent factors as shown by the coefficients of determination. The eight factors combined gave a multiple coefficient of correlation with return for management of R = 0.672 for 1933, R = 0.475 for 1934, R = 0.427 for 1935, and R = 0.279 for 1936. The disappointing results secured in this portion of the study were probably due to the fact that all farms were combined regardless of type. Another important reason for the disappointing results is probably due to the type of years studied. The period from 1933 to 1936 in the Northern Association was one of crop failures and low prices. These unstable conditions usually are responsible for low relationships between certain of the independent factors and income.

The coefficients of determination give a measure of the importance of each factor in determining return for management, but they do not indicate if the relationship is positive or negative. In 1933 the coefficient of determination for per cent of receipts from livestock was high. It was responsible for 36 per cent of the relationship. This does not indicate if the return for management increased

or decreased with an increase in per cent of receipts from livestock. The net regression equations not only indicate if the relationship was negative or positive, but, they give a quantitative measure of the relationship. Table 5 shows the amount of increase or decrease in return for management per unit of increase in each of the factors. These figures give a definite means of calculating income on each of the farms used in the study. However, the incomes as estimated by these figures probably will not be accurate since the low correlations indicate a large standard error of estimate. In years when the correlations are high the estimates will be more nearly accurate.

There are several interesting relationships indicated in this table. Hodges (9) in a study on size of farm and the business cycle found that the relationship between size of farm and net farm income varied with different types of years. In years of drastic price declines between inventory periods an inverse relationship existed between size of farm and net income. In years of rising prices the relationship was positive. This variation in relationship also holds true when there is a low return for management on farms due to crop failures, or low prices. The average return for management per farm in the Northern Association

Table 5. Net regression of return for management on the factors used in the study as calculated from the net regression equations. Northern Association.

On the average, for each unit increase of:	Return for management showed an increase or decrease of			
	1933	1934	1935	1936
10 crop acres	$- 57.65	$- 13.49	$+ 25.09	$+ 16.22
3 per cent of land in rotation in legumes	+ 84.00	+ 12.60	+ 83.70	+ 1.05
10 per cent in per cent of gross income from livestock	-377.90	-216.70	+ 5.50	- 70.90
$10 increase in dairy receipts per cow	+ 96.90	+ 67.80	+ 20.90	+ 33.10
$1 increase in receipts per hen	+ 73.40	+336.80	+209.30	+ 44.50
10 crop acres per man	+180.02	+ 11.09	+ 56.59	+ 1.65
$1 in machinery investment per crop acre	+ 21.50	- 18.50	- 4.10	- 21.60
$1 in machinery cost per crop acre	+ 20.80	-107.10	+ 23.30	- 33.00

was $288.79 in 1933, $55.55 in 1934, $866.07 in 1935, and $423.47 in 1936. In 1933 and 1934 the relation between crop acres and return for management was negative. These were rather poor years in the Northern Association due to low prices and crop failures. In 1935 and 1936 the return for management on these farms was better. With these improved conditions the relation between these two factors changed from negative during 1933 and 1934 to positive during 1935 and 1936. Other factors which showed a positive relationship consistently throughout the period when calculated from the net regression equations were per cent of land in rotation in legumes, dairy receipts per cow, poultry receipts per hen and crop acres per man. The relationship between per cent of gross income from livestock and return for management was negative in three of the four years. This was due to the drought years which were responsible for high feed prices.

The gross correlation between each of the factors used in the study of the Northern Association is shown in Tables 18 to 21 in the appendix. By studying these tables carefully it is possible to visualize the causal relationships between the factors and the joint relationships of certain factors with return for management.

Southern Association

In a previous portion of this study the fact was mentioned that farms in the Southern Association differed from farms in the Northern Association. If differences in the organization of a farm exist it is necessary to use different factors in attempting to determine which factors affect income and what relationship exists. The factors which were thought to have a relationship to return for management in the Southern Association and on which data were available were used. These factors were crop acres, wheat production in bushels, crop acres per man, machinery investment per crop acre, machinery cost per crop acre, per cent of gross income from livestock, and per cent of land in rotation in legumes.

A study of Table 6 reveals that the measures of size are the factors which account for a large percentage of the correlation in practically every year in this association. Crop acres and wheat production in bushels are both factors which measure size. In each of the four years these two factors have been responsible for a considerable percentage of the correlation. In 1936 the coefficient of determination for crop acres was a — .1764. Thus, it was responsible

Table 6. Relative importance of the different factors in determining return for management as shown by the coefficients of determination. Southern Association.

Factor	Per Cent			
	1933	1934	1935	1936
Crop acres	1.48	11.39	10.10	-17.64
Wheat production in bushels	3.20	49.44	12.42	50.22
Crop acres per man	.94	-1.32	-1.87	11.21
Machinery investment per crop acre	2.19	- .43	- .58	- .54
Machinery cost per crop acre	.17	0	1.25	.01
Per cent of gross income from livestock	.93	-2.22	3.20	- .91
Per cent of land in rotation in legumes	1.44	-2.30	- .07	- 1.37
Combined importance of all	10.35	54.56	24.45	40.98

for detracting 17.64 per cent from the correlation for 1936.
In this year crop acres per man was a rather important fac-
tor in increasing the correlation. The remaining factors
were not of much significance in determining return for
management.

The multiple coefficient of correlation was also used
in the Southern Association to get a quantitative measure
of the relationship which existed. The seven factors used
in this association when combined gave a multiple coeffic-
ient of correlation with return for management of R = 0.322
for 1933, R = 0.739 for 1934, R = 0.494 for 1935, and
R = 0.640 for 1936. The coefficients of multiple correl-
ation in this association were more satisfactory than those
obtained in the Northern Association. One of the chief
reasons for this is that size of business is an important
factor in determining income in the Southern Association.
During the period studied wheat yields and prices of wheat
were exceptionally favorable in the area covered by this
association. Farms which had a large crop acreage with a
high production of wheat made good profits. The relation-
ship between these two factors and income was so strong that
they influenced the multiple correlation and gave more
favorable results.

Table 7 shows the amount of increase or decrease in return for management per unit of increase in each of the factors. The regression lines of the factors in this association have a lower standard error of estimate than do those in the Northern Association. Therefore they should be somewhat more reliable in estimating income.

The relationship between crop acres and return for management is similar to that found in the Northern Association. The average return for management per farm in the Southern Association was $141.67 in 1933, $1,697.50 in 1934, $1,143.02 in 1935, and $940 in 1936. The two poor years in this association were 1933 and 1936. In both of these years the relationship as shown by net regression was negative. In 1934 and 1935 when farmers in this area were generally more prosperous there was a positive relation as shown by the net regression equation.

This table indicates that wheat production should continue to be the major enterprise in this association. In each of the four years the farms which were high in wheat production tended to be high in return for management. Even in 1933 when prices were exceptionally low and when the net regression equation showed a negative relationship for every other factor the farms which were high in wheat

Table 7. Net regression of return for management on the factors used in the study as calculated from the net regression equations. Southern Association.

On the average, for each unit increase of:	Return for management showed an increase or decrease of:			
	1933	1934	1935	1936
10 crop acres	$-19.29	$ 18.97	$ 17.58	$-63.00
100 bushels of wheat	30.01	74.43	33.84	71.90
10 crop acres per man	-19.60	-83.19	-15.82	61.86
$1 in machinery investment per crop acre	-45.50	21.10	20.40	31.90
$1 in machinery cost per crop acre	-19.40	30.90	-97.20	41.30
10 per cent in per cent of gross income from livestock	-50.80	171.40	211.10	14.60
3 per cent of land in rotation in legumes	-39.96	102.90	15.18	30.60

production tended to show the highest return for management. Other factors which showed a positive relationship for the remainder of the period (1934-1936) were machinery investment per crop acre, per cent of gross income from livestock, and per cent of land in rotation in legumes. In this association per cent of gross income from livestock showed a much more favorable relationship than it did in the Northern Association. This is probably due to the fact that the largest percentage of receipts from livestock in the Southern Association are from beef cattle. The farms in the higher income group in this association have a higher per cent of their income from beef cattle than do the farms in the lower group. The per cent of gross income from the other types of livestock is lowest in the high income group and highest in the low income group.

Table 8 indicates that the beef cattle enterprise has a more favorable relation to net farm income than any of the other livestock enterprises. The fact that the beef cattle enterprise has a favorable relation to net farm income plus the fact that it accounts for a high percentage of the receipts is probably responsible for the favorable showing between per cent of gross income from livestock and return for management as shown by the net regression equation.

Table 8.   The average per cent of gross income from each
           type of livestock for the period 1933-1936.
           Southern Association.

Type of Livestock	High 25 per cent of farms in net farm income	Average for all farms	Low 25 per cent of farms in net farm income
Beef Cattle	23	21	20
Dairy Products	5	8	11
Hogs	7	10	15
Poultry	4	6	8

The gross correlations between each of the factors
used in the study of the Southern Association are shown in
Tables 14 to 17 in the appendix. These tables indicate the
causal relationships which exist between the factors and
the joint relationships of certain factors with income.

ANALYSIS BY TYPE OF FARMING

The results secured when all farms in each association
were grouped together proved disappointing. In most in-
stances the factors which did correlate with income had a

low correlation due to a large standard error of estimate. It was believed that a portion of the poor results secured could be attributed to the method used. Several studies were made in an effort to determine what was responsible for the disappointing relationships.

One of the first efforts made to improve the correlation was to calculate the estimated return for management for each farm from the regression equations and then determine the difference between the estimated figure and the actual figure. By doing this it was possible to determine on which farm the regression equation failed to give satisfactory results. The farms on which the estimates were in error by a large amount were studied individually to determine why the equations did not satisfactorily measure income. If the large error was due to some exceptional cause not accounted for in the study the farm was eliminated. After eliminating these farms the same factors were used and the regression equations and multiple coefficients of correlation were calculated for the remaining farms. The improvement secured by going through this procedure was negligible.

Evidently some other factor was responsible for the poor results. Pine (14) in his study of farms in the

Northern Association divided them by type of farms. It was
believed that the results could be improved to a consider-
able extent if the study were made according to type-of-
farming. The results secured by this method were excellent.
The multiple coefficients of correlation were improved con-
siderably by dividing the farms according to type-of-farming
and applying the factors which influenced that particular
type of farming to each type.

The chief limitation encountered in the study was the
small number of cases in each type of farming. In a few
of the years it was not possible to get a large enough
sample to analyze the farms by type. Cash-grain farms for
1935 and 1936, and dairy farms for 1935 were analyzed for
the Northern Association.

Cash-Grain Farms

The factors used in the analysis of cash-grain farms
were crop acres, crop acres per man, machinery cost per crop
acre, crop index, per cent of land in rotation in legumes,
and change in inventory. Table 9 shows the relative im-
portance of these factors in measuring income as shown by
the coefficients of determination.

Table 9. Relative importance of the different factors
in determining return for management as shown
by the coefficients of determination. Cash-
grain type. Northern Association.

Factor	Per Cent	
	1935	1936
Crop acres	17.73	16.45
Crop acres per man	32.29	10.42
Machinery cost per crop acre	3.42	15.27
Crop index	1.56	2.91
Per cent of land in rotation in legumes	.75	- 2.10
Change in inventory	24.59	6.57
Combined importance of all	80.34	49.52

Crop acres, crop acres per man, machinery cost per
crop acre, and change in inventory all bear important re-
lationships to return for management on cash-grain farms.
The crop index, and per cent of land in rotation in legumes
are not of much importance when the other factors are held
constant.

The quantitative measures as calculated from the net
regression equation are shown in Table 10. Considering

the factors used in the study the net regression for each
unit of increase in crop acres, crop acres per man, crop
index and change in inventory is positive. The net re-
gression for each unit increase in machinery cost per crop
acre is negative. The net regression for each unit increase
in per cent of land in rotation in legumes was negative in
1935 and positive in 1936.

Table 10.   Net regression of return for management on the
             factors used in the study as calculated from
             the net regression equations. Cash-grain type.
             Northern Association.

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On the average, for each unit increase of:	Return for management showed an increase of:	
	1935	1936
10 crop acres	$28.90	$34.51
10 crop acres per man	76.13	37.93
$1 in machinery cost per crop acre	-28.50	-148.00
10 points in crop index	22.20	23.70
3 per cent of land in rotation in legumes	-17.85	37.44
$100 change in inventory	38.53	36.98

The figures secured in Table 10 should be more accurate
in calculating income than those secured when all farms are

divided by type. Due to the small number of cases in each sample when the farms were divided by type it was necessary to correct R for this deficiency. The following formula of Ezekiel's (7) was used:

$$\overline{R} = \frac{n - m}{n - 1}$$

In 1935 the multiple coefficient of correlation before correcting for size of sample was R = 0.90. After applying the above formula it was $\overline{R}$ = 0.86. In 1936 a multiple coefficient of correlation of R = 0.70 was secured before correction for size of sample. After applying the formula it was $\overline{R}$ = 0.64. The higher multiple coefficients of correlation indicate that the standard error of estimate is smaller. Thus, the accuracy of the data is increased. Tables 12 and 22 show the gross correlation for each of the factors.

Dairy Farms

The factors used in the analysis of dairy farms in 1935 were number of dairy cows, dairy receipts per cow, crop acres, per cent of gross income from livestock, change in

inventory and per cent of land in rotation in legumes.

There are two factors which are responsible for practically all of the correlation. These two factors are dairy receipts per cow, and change in inventory. Per cent of land in rotation in legumes detracts from the combined importance of all factors as shown by the coefficients of determination.

Table 11. Relative importance of the different factors in determining return for management as shown by the coefficients of determination. Dairy type. Northern Association.

Factor	Per Cent
A. Number of cows	- 3.05
B. Dairy receipts per cow	52.32
C. Crop acres	1.67
D. Per cent of gross income from livestock	.65
E. Change in inventory	23.73
F. Per cent of land in rotation in legumes	- 8.06
Combined importance of all factors	67.26

The multiple coefficient of correlation secured is
R = 0.82 before correcting for size of sample. After cor-
recting for size of sample a correlation of $\overline{R}$ = 0.75 is
secured. Thus the estimates of return for management made
from the following regression equation should be rather re-
liable for 1935.

$$\overline{X} = -23.44A+11.13B-2.75C+2.23D+7.31E-22.22F-37.16$$

Number of cows, crop acres, and per cent of land in
rotation in legumes show negative net regression lines.
The remaining factors show positive net regression lines.
If the data are to be relied upon for estimating future re-
turn for management the data for several consecutive years
should be worked. Due to insufficient records it was not
possible to calculate the data on dairy farms over a period
of several years. The primary purpose of calculating these
farms for 1935 was to show that the results secured could
be improved if the data were divided according to type of
farming.

INTERPRETATION AND SIGNIFICANCE OF
GROSS CORRELATION TABLES

Cash-Grain Farms, Northern Association, 1935

The gross correlation between two variables measures
the relationship between these variables without attempting
to eliminate the effect of other factors. If other factors
are correlated with those being considered the gross co-
efficient may be affected. In Table 12 which shows the
gross correlations between each of the pairs of variables,
the gross correlation between machinery cost per crop acre
and return for management is -.6063. This would tend to
indicate that machinery cost per crop acre is an important
factor in determining return for management. In Table 9,
which shows the relative importance of machinery cost per
crop acre in measuring return for management as indicated
by the coefficient of determination, only 3.42 per cent of
the total is accounted for by this factor. Table 12 shows
that crop acres, crop acres per man, crop index, and change
in inventory have significant negative correlations with
machinery cost per crop acre. Furthermore it will be not-
iced that these same factors which correlate negatively with

Table 12. Coefficients of gross correlation between each pair of variables. Cash-grain farms. Northern Association, 1935.

Factor	Crop acres per man	Machinery cost per crop acre	Crop index	Per cent of land in rotation in legumes	Change in inventory	Return for management
Crop acres	.8029	-.2617	-.2874	-.3725	-.2324	.5915
Crop acres per man		-.3901	-.2982	-.4514	-.2577	.6295
Machinery cost per crop acre			-.1665	-.0301	-.4538	-.6063
Crop index				.2893	.6906	.2226
Per cent of land in rotation in legumes					.3298	-.1764
Change in inventory						.4297

machinery cost per crop acre correlate positively with return for management. Thus a good portion of the gross correlation between machinery cost per crop acre and return for management is due to the more efficient use of machinery on the large farms, the more efficient use of man labor with machinery, the better crop index on farms which use machinery efficiently and the relationship which exists between change in inventory and return for management. None of these relationships between these various factors and machinery cost per crop acre are eliminated in working the gross correlation between machinery cost per crop acre and return for management.

The influence on the final result, when the other factors are taken into consideration, is evident when the importance of machinery cost per crop acre as shown by the coefficients of determination is only 3.42 per cent. Therefore, in studying the relation between two variables they should be analyzed to determine if the relationship is due entirely to the correlation between the two variables or if some other relationships influence the results.

The most important factor in determining return for management on cash-grain farms for 1935 as shown by the coefficient of determination is crop acres per man. The

gross correlation between this factor and the dependent variable is .6295. It accounts for 32.29 per cent of the total multiple coefficient of correlation. Positive and negative gross correlations influence this result. There is a strong positive joint relationship between crop acres and crop acres per man. As crop acres increase there is a strong tendency for crop acres per man to increase. Offsetting this strong positive joint correlation are smaller negative joint correlations between machinery cost per crop acre, crop index, per cent of land in rotation in legumes, and change in inventory. The final effect is for these two groups of factors to counterbalance each other and crop acres per man remains an important factor when the other factors are held constant. Crop acres can be interpreted in the same manner that crop acres per man was interpreted. The same positive and negative joint relationships between crop acres and the other independent factors with the dependent factor exist as existed between crop acres per man and these factors. It is not possible to determine if crop acres is responsible for a high crop acreage per man or vice versa from the gross correlation tables.

Change in inventory was an important factor in determining return for management as shown by the coefficient of

determination. The gross correlation between change in inventory and return for management on cash-grain farms during 1935 is .4297. This is not an exceptionally significant gross correlation. However, the importance of this factor in determining return for management as shown by the coefficient of determination is 24.59 per cent. The relation between this factor and the dependent factor is more important than the gross correlation figure would indicate. This is due to certain intercorrelations which exist between the factors used. The gross correlation of crop acres, and crop acres per man, with return for management is rather high and positive, while the gross correlation between crop acres and crop acres per man with change in inventory is negative. The gross correlation between per cent of land in rotation in legumes and the dependent factor is negative, while the gross correlation between per cent of land in rotation in legumes and change in inventory is positive. These intercorrelations would tend to strengthen the gross correlation between change in inventory and return for management. However, none of these intercorrelations just mentioned are as significant as the factors which tend to decrease the gross correlation between the two factors being discussed. The high negative

gross correlation between machinery cost per crop acre and the dependent factor, combined with the rather high negative gross correlation between machinery cost per crop acre and change in inventory is an important factor in decreasing the gross correlation between change in inventory and return for management. Another intercorrelation which probably tends to decrease the correlation between these two factors is the positive gross correlation between crop index and the dependent factor combined with the positive correlation between crop index and change in inventory.

Dairy Farms, Northern Association, 1935

The factors used in studying dairy farms in the Northern Association during 1935 did not intercorrelate as badly as the factors used in the cash-grain study. Thus the gross correlations for the factors used on the dairy farms rank them in importance approximately the same as do the coefficients of determination as shown in Table 11. Table 13 shows that there are several significant intercorrelations which influence the results, however, in a majority of instances these intercorrelations tend to offset each other at least partially. The gross correlation between per cent

Table 13. Coefficients of gross correlation between each pair of variables. Dairy farms. Northern Association, 1935.

Factor	Dairy receipts per cow	Crop acres	Per cent of gross income from livestock	Change in inventory	Per cent of land in rotation in legumes	Return for management
Number of cows	.5561	.1924	.4103	-.0936	.2172	.1799
Dairy receipts per cow		-.0517	.3807	-.1992	.4566	.5795
Crop acres			-.1631	.1254	-.6354	-.0674
Per cent of gross income from livestock				-.1684	.3368	.1536
Change in inventory					.0356	.3921
Per cent of land in rotation in legumes						.2682

of land in rotation in legumes and pay for management is r = 0.268 on the dairy type farms. This correlation tends to be decreased by the slight negative correlation r = -0.067 of crop acres with pay for management combined with the significant negative correlation r = -0.635 between crop acres and per cent of land in rotation in legumes. The remaining independent factors have significant positive correlations with pay for management and all of them show positive correlations with per cent of land in rotation in legumes. This makes it difficult to distribute the effects of this intercorrelation to any one of the factors. However, a good portion of it can be distributed to per cent of land in rotation in legumes since the positive effects are strong enough to counterbalance the negative effects mentioned above and result in a positive correlation of r = 0.268 between per cent of land in rotation in legumes and return for management.

The most significant gross correlation between the in-dependent factors and the dependent factor exists between dairy receipts per cow and return for management. Dairy receipts per cow also is the most important factor in de-termining the multiple coefficient of correlation as shown by the coefficient of determination in Table 11. There are

several rather significant intercorrelations which influence the gross correlation between these two factors. The significant intercorrelations which influence the result between these two factors as shown by Table 13 are a correlation of r = 0.556 between dairy receipts per cow and number of cows, a correlation of r = 0.41 between per cent of gross income from livestock and number of cows, a correlation of r = 0.381 between per cent of gross income from livestock and dairy receipts per cow, a correlation of r = 0.217 between per cent of land in rotation in legumes and number of cows, and a correlation of r = 0.457 between per cent of land in rotation in legumes and dairy receipts per cow. All these correlations are positive correlations. The correlations between these factors and the dependent factor are also positive. Thus it is not possible to attribute any of the intercorrelation to a specific factor. However, it appears as if the larger portion of effect these intercorrelations have on the gross correlation can be attributed to dairy receipts per cow since it is by far the most important if measured by either the gross correlation or coefficient of determination.

SUMMARY AND CONCLUSIONS

The primary objective of the farmer as a manager of the farm business is to secure the largest income over a period of years. It is the task of the research worker to assist the farmer in accomplishing this objective. The research worker should attempt to find out by what methods it is possible for the farmer to increase his income and at the same time conserve his labor, capital, and natural resources.

Various methods of approaching this problem have been attempted by research workers. The general method followed by farm management specialists has been to study the relationship between certain size, efficiency, and organization factors and farm income. If either a favorable or unfavorable relationship exists it is possible either to recommend or disapprove the practice which is being studied.

Many studies have been made in which farm management workers have chosen certain factors which influence farm profits. Warren (20) has made rather extensive studies on farms in New York in which he showed that certain factors have a direct effect upon income. Ezekiel (8) found similar

results in studies conducted in Pennsylvania. More recent studies have been made by Hopkins (12) in Iowa.

The purpose of this study is to analyze records which have been kept by Farm Bureau-Farm and Home Management Association members to determine the relation that exists between certain factors and return for management on Kansas farms. An attempt has been made to analyze the records thoroughly for a period of four consecutive years to determine if the relationships which exist are consistent or if they tend to vary from year to year. If a certain factor correlates with income consistently throughout a period of years it is more important in estimating income than if it varies from year to year. By analyzing records for a period of years it is also possible to determine what effect the different types of years have on any relationships which exist.

The records were analyzed and studied by two general methods. The first approach to the study was to group all farms in each association together and analyze them regardless of type. The second method of approach was to divide the farms in the Northern Association by type and analyze them by the different types of farming. The multiple correlation method of analysis was used.

In the Northern Association the factors which were correlated with income were crop acres, per cent of land in rotation in legumes, per cent of gross income from livestock, dairy receipts per cow, poultry receipts per hen, crop acres per man, machinery investment per crop acre, and machinery cost per crop acre. The results secured were disappointing. The multiple coefficients of correlation for the different years were insignificant. The gross correlations between the various independent factors and the dependent factor were low. The net regression equations did not accurately estimate income.

The only factor of significant importance during the entire period in measuring income was per cent of gross income from livestock. This was an important factor due to the drought and the resultant high feed prices. Farms which depended on livestock for a considerable portion of their gross income made less money than did those farms which secured only a small portion of their gross income from livestock. With a return to normal conditions this relationship probably will be reversed.

The unsatisfactory results secured were probably due to two causes. The period of years studied has been rather unstable. Many conditions which are not normal have been in

existence during the period from 1933 to 1936. A second cause for the unsatisfactory results is due to the different types of farming which are found in this association. Certain of the factors used correlate positively with income on one type of farm and negatively on another type of farm. When they are grouped together the correlation which exists by a definite type of farming is cancelled by another type of farming.

In the Southern Association the factors correlated with return for management were crop acres, wheat production in bushels, crop acres per man, machinery investment per crop acre, machinery cost per crop acre, per cent of gross income from livestock, and per cent of land in rotation in legumes. The results secured in this association were more satisfactory than those secured in the Northern Association. This is due to the fact that the dominant type of farming in the Southern Association is cash-grain farming. Many of the variables used are factors which particularly have an influence on cash-grain farms.

The important factors in measuring income in the Southern Association as shown by the study are crop acres, wheat production in bushels, and crop acres per man. Two of these factors are size factors while the third factor is an

efficiency factor. Thus, size appears to be the dominant factor in measuring income on farms in the Southern Association.

In both associations the degree of prosperity, as measured by net farm income, was an important item in determining what relationship existed between certain factors and return for management. In both associations in prosperous years there was a favorable positive relation between crop acres and return for management. In years which were not prosperous the relation between crop acres and return for management was negligible or negative.

In the Southern Association there was a favorable relation between per cent of gross income from livestock and return for management as shown by the net regression equation. In the Northern Association the relationship between these same factors was negative in three of the four years, while in the remaining year there was practically no relation. One reason for this difference in the two associations is the fact that a large percentage of the livestock receipts in the Southern Association are from beef cattle. The beef cattle enterprise had a more favorable relation to income in this association than the other livestock enterprises. The farms which were high in income tended to have

a higher per cent of their receipts from beef cattle than did the farms which were low in income. The tendency of all other livestock enterprises was in the opposite direction.

Due to the unsatisfactory results secured when all farms in each association were grouped together an effort was made to determine why the existing relationships were so poor. In studying the data from different types of farms in each association it was discovered that a variable may have a different relationship on one type of farm than on another type. This opposing relationship on different types of farms causes poor correlations when all types are grouped together.

To eliminate this inconsistency the farms were divided according to type of farming followed. Two different types of farms were studied in the Northern Association. The cash-grain type was analyzed for the years 1935 and 1936, while the dairy type was analyzed for 1935. The results secured when the farms were divided by type were improved significantly. Due to the fact that the samples were small it was necessary to correct the multiple coefficient of correlation for size of sample. Ezekiel's (7) formula was used to make the correction.

The factors used on the cash-grain type were crop acres, crop acres per man, machinery cost per crop acre, crop index, per cent of land in rotation in legumes, and change in inventory. In figuring the net regression between each factor and return for management all independent factors are held constant except the factor being measured. By doing this it is possible to minimize the effect of interrelationships between the independent factors. The net regression for each unit of increase in crop acres, crop acres per man, crop index and change in inventory is positive. For each unit increase in machinery cost per crop acre the net regression is negative. For each unit increase in per cent of land in rotation in legumes the net regression was negative in 1935 and positive in 1936. The multiple coefficient of correlation, corrected for size of sample, when all factors were used was $\overline{R} = 0.86$ in 1935 and $\overline{R} = 0.64$ in 1936.

The factors used in the analysis of dairy farms in 1935 were number of dairy cows, dairy receipts per cow, crop acres, per cent of gross income from livestock, change in inventory, and per cent of land in rotation in legumes. Dairy receipts per cow and change in inventory are responsible for practically all of the correlation. Dairy

receipts per cow is especially important as this one factor is responsible for 52 per cent of the correlation. Per cent of land in rotation in legumes detracts from the combined importance of all factors as shown by the coefficient of determination. The multiple coefficient of correlation secured after correcting for size of sample was $\overline{R} = 0.75$.

The relationships existing between the independent factors and the dependent factor as shown by the line of net regression are as follows: Number of cows, crop acres, and per cent of land in rotation in legumes show negative net regression lines. The remaining factors show positive net regression lines.

In order to thoroughly understand the various relationships which exist it is necessary to trace the interrelationships among independent factors as well as the effect of each independent factor upon return for management. If these interrelationships can be traced it is possible to clarify the net effect of each factor. An attempt was made to interpret the gross correlation tables on the cash-grain and dairy type farms in the Northern Association with the intentions of clarifying the relationships which exist.

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APPENDIX

Table 14.   Coefficients of gross correlation between each pair of variables.   Southern Association, 1933.

Factor	Wheat production in bushels	Crop acres per man	Machinery investment per crop acre	Machinery cost per crop acre	Per cent of gross income from livestock	Per cent of land in rotation in legumes	Return for management
Crop acres	.5960	.7642	-.2869	.0371	-.2369	-.4662	-.0637
Wheat production in bushels		.5199	-.2030	-.0220	-.3574	-.4216	.1425
Crop acres per man			-.0281	-.0269	-.2000	-.4778	-.0881
Machinery investment per crop acre				.1471	-.0819	.3332	-.1541
Machinery cost per crop acre					-.0410	.1026	-.0661
Per cent of gross income from livestock						.1792	-.1032
Per cent of land in rotation in legumes							-.1206

Table 15. Coefficients of gross correlation between each pair of variables. Southern Association, 1934.

Factor	Wheat production in bushels	Crop acres per man	Machinery investment per crop acre	Machinery cost per crop acre	Per cent of gross income from livestock	Per cent of land in rotation in legumes	Return for management
Crop acres	.7443	.7575	-.3037	-.2381	-.2621	-.3584	.5798
Wheat production in bushels		.6460	-.2161	-.1090	-.4336	-.4372	.6806
Crop acres per man			-.3311	-.3301	-.4355	-.4944	.3928
Machinery investment per crop acre				.3405	-.0072	.2560	-.1108
Machinery cost per crop acre					.1400	.2794	.0021
Per cent of gross income from livestock						.2443	-.1261
Per cent of land in rotation in legumes							-.1217

Table 16. Coefficients of gross correlation between each pair of variables. Southern Association, 1935.

Factor	Wheat production in bushels	Crop acres per man	Machinery investment per crop acre	Machinery cost per crop acre	Per cent of gross income from livestock	Per cent of land in rotation in legumes	Return for management
Crop acres	.8162	.7551	-.2967	-.1736	-.3448	-.3135	.3819
Wheat production in bushels		.7283	-.1616	-.0464	-.5016	-.3618	.3402
Crop acres per man			-.2397	-.2556	-.4967	-.4408	.2224
Machinery investment per crop acre				.3334	-.0484	-.0223	-.1289
Machinery cost per crop acre					.1030	.2058	-.1045
Per cent of gross income from livestock						.4531	.0976
Per cent of land in rotation in legumes							-.0183

Table 17.　Coefficients of gross correlation between each pair of variables.　Southern Association, 1936.

Factor	Wheat production in bushels	Crop acres per man	Machinery investment per crop acre	Machinery cost per crop acre	Per cent of gross income from livestock	Per cent of land in rotation in legumes	Return for management
Crop acres	.8398	.6846	-.3207	-.2356	-.4738	-.3906	.2369
Wheat production in bushels		.6485	-.3029	-.1665	-.6392	-.4360	.5018
Crop acres per man			-.3098	-.3379	-.6142	-.4916	.3636
Machinery investment per crop acre				.4655	.1309	.0917	-.0790
Machinery cost per crop acre					.1372	.2408	.0023
Per cent of gross income from livestock						.3881	-.4123
Per cent of land in rotation in legumes							-.2033

Table 18. Coefficients of gross correlation between each pair of variables, Northern Association, 1933.

Factor	Per cent of land in rotation in legumes	Per cent of gross income from livestock	Dairy receipts per cow	Poultry receipts per hen	Crop acres per man	Machinery investment per crop acre	Machinery cost per crop acre	Return for management
Crop acres	-.1916	-.2040	-.0091	-.0033	.7214	-.1688	-.3054	.0311
Per cent of land in rotation in legumes		.1916	-.0247	.0008	-.2647	.0426	.0518	.1040
Per cent of gross income from livestock			.1122	.1071	.2163	.1204	.0653	-.4060
Dairy receipts per cow				.0678	-.1695	.2056	.3509	.1039
Poultry receipts per hen					.1246	.0037	.0195	.1122
Crop acres per man						-.2384	-.3758	.0332
Machinery investment per crop acre							.6602	.0142
Machinery cost per crop acre								.0571

Table 19. Coefficients of gross correlation between each pair of variables, Northern Association, 1934.

Factor	Per cent of land in rotation in legumes	Per cent of gross income from livestock	Dairy receipts per cow	Poultry receipts per hen	Crop acres per man	Machinery investment per crop acre	Machinery cost per crop acre	Return for management
Crop acres	-.2792	-.3364	-.0843	-.0390	.6065	-.2268	-.3172	.0592
Per cent of land in rotation in legumes		.2668	.1315	.0806	-.1543	.0491	.1584	-.0084
Per cent of gross income from livestock			.1579	.0443	-.2569	.1225	.2116	-.3187
Dairy receipts per cow				-.0312	-.2051	.2781	.2175	.0836
Poultry receipts per hen					-.0713	.0961	.1414	.2370
Crop acres per man						-.2852	-.3545	.0745
Machinery investment per crop acre							.6682	-.1149
Machinery cost per crop acre								-.1594

Table 20. Coefficients of gross correlation between each pair of variables, Northern Association, 1935.

Factor	Per cent of land in rotation in legumes	Per cent of gross income from livestock	Dairy receipts per cow	Poultry receipts per hen	Crop acres per man	Machinery investment per crop acre	Machinery cost per crop acre	Return for management
Crop acres	-.2432	-.2770	-.0977	-.0559	.6877	-.2718	-.2851	.2674
Per cent of land in rotation in legumes		.3750	.2620	.1628	-.3518	.0369	.0323	.1587
Per cent of gross income from livestock			.1612	.2508	-.3991	.0773	.1683	.0148
Dairy receipts per cow				.1386	-.1429	.3039	.2342	.1210
Poultry receipts per hen					-.1524	-.0193	.1208	.1917
Crop acres per man						-.4020	-.3906	.2288
Machinery investment per crop acre							.5354	-.1102
Machinery cost per crop acre								-.1334

Table 21.   Coefficients of gross correlation between each pair of variables, Northern Association, 1936.

Factor	Per cent of land in rotation in legumes	Per cent of gross income from livestock	Dairy receipts per cow	Poultry receipts per hen	Crop acres per man	Machinery investment per crop acre	Machinery cost per crop acre	Return for management
Crop acres	-.3767	-.4685	-.8879	-.2402	.6666	-.2680	-.3772	.1888
Per cent of land in rotation in legumes		.2951	-.2223	-.1769	-.5766	.0467	.0952	-.1112
Per cent of gross income from livestock			-.7644	-.0593	-.6972	.0400	.0936	-.2158
Dairy receipts per cow				-.7504	-.9255	.1728	.5669	-.1004
Poultry receipts per hen					-.3776	-.0769	-.0578	-.0170
Crop acres per man						-.3691	-.5201	.1818
Machinery investment per crop acre							.6047	-.1958
Machinery cost per crop acre								-.1854

Table 22. Coefficients of gross correlation between each pair of variables, cash-grain farms, 1936.

Factor	Crop acres per man	Machinery cost per crop acre	Crop index	Per cent of land in rotation in legumes	Change in inventory	Return for management
Crop acres	.7085	-.2698	-.0490	-.3483	-.1050	.4912
Crop acres per man		-.4608	-.1400	-.3454	-.0328	.5288
Machinery cost per crop acre			.0182	.2118	-.0449	-.4818
Crop index				-.3449	.6441	.1992
Per cent of land in rotation in legumes					.0092	-.1893
Change in inventory						.2997