# The Uses of Efficiency Factors in Analysis of Farm



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In interpreting data obtained from farm accounts, frequent use is made of financial ratios, and of rates of input per unit of labor, land, or capital employed in the farm business. These so-called farm efficiency factors are designed to give the farm operator an approximate measurement of his success in organizing and managing those elements of the farm business which are, to some degree, under his control.

Efficiency factors or operating ratios are also useful to the extension worker in farm management. This specialist, as he discusses applications of farm organization and management principles, often feels a need for some means of making a rapid preliminary appraisal of the farmer's performance in the recent past.

This calls for a systematic examination of all important branches of the business. It therefore requires a comprehensive list of the ratios or factors mentioned. The analysis should be sufficiently thoroughgoing to uncover any serious failure of organization or management. After these weaknesses are discovered the farmer and the extension worker will need to combine their technical knowledge and economic principles to plan for improvement. In other words the efficiency factors provide a means of discovering points of weakness, but they do not provide nor dictate any particular method for their correction.

The efficiency factors are seldom exact measures of variation in returns per unit of any pure economic factor of production. Nor do they often show the exact effect of any single change in management without an admixture from other influences. This fact results from a corresponding heterogeneity in the factors of production themselves, from the almost infinite mutations of techniques of operation from farm to farm, and from the universal fact of variation in mental acuteness, inertia and aptitudes of the farm operator himself.

Efficiency factors, or financial and operating ratios have been used for years in other industries than agriculture. In recent years their use has been increasing and has become common in the analysis of farm records in some states. Unfortunately little thought has been given to a careful analysis of the efficiency factors themselves. Thus such factors as the rate of turnover on capital, returns per hundred dollars of feed consumed, and

1 Project No. 1 of the Iowa Agricultural Experiment Station.

the acres of crops handled per man have been treated as though increases in their values were to be desired without limit. The ordinary worker in extension or in research has fully realized that spreading labor too thinly over a large area of land, or concentrating attention on a small number of livestock in order to obtain an extremely high rate of return on feed either encounters diminishing returns or is accompanied by a lack of attention to other phases of the farm business. But there has been but little definite information as to just where the point of diminishing returns was located for a given factor and under a given set of conditions.

It is the purpose of this study to attempt an appraisal of some of the principal efficiency factors in use or available from the simpler forms of farm records. It is desired to discover as accurately as the nature of the data permits the relationships which exist between these factors and net farm income and farm profit as well as concomitant variations in other efficiency factors or in related phases of the farm business. The conclusions must be limited to the physical and economic conditions existing in Iowa in the recent past and to the sizes and types of farm organizations common in this state.

Every research worker and teacher who has come in contact with the realities of farm operation realizes that many simplifications which are possible and often necessary in the discussion of the classroom become impossible on an actual farm. The farmer must operate his business in terms of concrete goods and often in terms of narrowly limited combinations of concrete goods.

For the benefit of the practical farmer an effort must be made to devise a group of ratios or efficiency factors comprehending the more important controllable influences on farm returns. These factors must be expressed in terms of those natural units in which the complexes of farm production elements are associated in actual farm operation.

As a basis for this study data were drawn from 323 Iowa farm business records for 1927, 430 for 1928, 610 for 1929 and 690 for 1930, or a total of 2,053 records in all. These records were kept under the supervision of the Iowa Agricultural Extension Service and represent simple forms of single entry farm account books. The records for 1930 came from 56 counties distributed over all the type-of-farming areas of the state.

## SCOPE OF THE STUDY

Over 20 efficiency factors were examined during the course of the study. Several of these were rejected as lacking significance, or because they seemed to duplicate influences which were expressed more satisfactorily by other factors. Three were studied

only insofar as their gross or uncorrected relationship to other factors were concerned. Two factors, the net income and the rate of turnover, were examined only in their relationship to the profit or return on management. Fourteen other factors were examined in their gross relationship to other factors and in their net relationship to net income and return on management.

The list of factors used in the final analysis, and their average values are shown in table I.

TABLE I. FARM EFFICIENCY FACTORS. AVERAGES FOR GROUPS OF IOWA FARMS, 1927-1930

| Year | Records kept 3 consecutive years | 1927 | 1928 | 1929 | 1930 |
|---|---|---|---|---|---|
| Number records studied | 144 | 328 | 430 | 610 | 690 |
| **Financial factors and ratios** | | | | | |
| 1. Net farm income | $3008 | $ — | $ — | $3721 | $1678 |
| 2. Net farm income after interest payments | $2734 | $1952 | $2068 | $3293 | $1322 |
| 3. Management return | $ 336 | $–160* | $ 458 | $ 600 | $–1224* |
| 4. Gross income per $100 invested | $ 15.68 | $ 13.50 | $ 17.00 | $ 16.50 | $ 12.40 |
| 5. Percent total expense to total income | 50 | 54 | 47 | 48 | 73 |
| 6. Percent investment in working capital | 19 | — | — | 20 | 21 |
| **Factors related to the cropping system** | | | | | |
| 7. Total acres in farm | 198 | — | — | 206 | 215 |
| 8. Acres corn | 62 | 65 | 71 | 72 | 78 |
| 9. Yield of corn, bu. | 44 | 39 | 49 | 47 | 42 |
| 10. Value of crops per acre | — | — | — | $ 25.50 | $ 20.80 |
| **Factors related to the livestock system** | | | | | |
| 11. No. litters spring pigs | 12 | 14 | 12 | 13.3 | 13.2 |
| 12. No. litters fall pigs | 4.4 | — | — | 4.6 | 4.8 |
| 13. Hog income per sow | $ 149 | — | — | $ 167 | $ 135 |
| 14. No. steers fed | 12 | — | — | 13 | 17 |
| 15. Beef income per head | $ 26 | — | — | $ 25 | $ 10 |
| 16. Dairy income per cow | $ 101 | — | — | $ 100 | $ 88 |
| 17. Livestock income per $100 of feed | $ 150 | $ 140 | $ 135 | $ 152 | $ 116 |
| **Factors related to efficiency in use of cost elements** | | | | | |
| 18. Months labor used | 22 | 23 | 22 | 23 | 22 |
| 19. Crop acres per man | 79 | 71 | 82 | 88 | 92 |
| 20. Livestock income per man | — | — | — | $2660 | $2032 |

* Deficit.

Many of these factors were interrelated. Therefore the methods of curvilinear correlation were used to ascertain net relationships between the factors and net income or management returns.[2]

Each year's records were studied independently, except that in the preliminary analysis of the 1928 and 1929 records, the curves of net relationship of the preceding year were used as the first approximation to the relationship for the year in question. In this way preliminary work of determining rectilinear

[2] Ezekiel, Mordecai. Methods of correlation analysis. John Wiley and Sons, New York. 1930.

correlation and regression was avoided. This was well justified by the results. The close correspondence of the final curves of relationship to the ones discovered for the earlier years indicated a high degree of stability of the relationships found, at least during years of relatively stable economic conditions. For the year 1930 it was thought that the seriously unsettled price conditions might well upset some of the relationships obtained for the three earlier years. Consequently the 1930 records were analyzed quite independently of the earlier records.

*In this and in other studies concerned with data from a large number of farm records, it should be remembered that differences in income represent variations between farms and not relationships of income to the factors in question on the same farm.* It is hoped that the relationships discussed in this bulletin may be suggestive of the consequences to be expected from indicated variations in organization or management of a specific farm. But it should not be forgotten that each farm included in this study differs from its neighbors to some degree in its physical makeup or economic environment, and more important, that each farm was under the management of an individual man whose mental acuteness, aptitudes, experience and preferences differed from those of every other man in the group.

The averages for the factors studied are shown in table I. These figures give an idea of the performance of farms slightly more productive than the ordinary farm. They may, therefore, be used as standards under Iowa conditions.

## THE TYPES OF FARMS STUDIED

In the earlier stages of the study it was thought that relationships between factors under examination and the income and profit might differ as between different areas of the state. Therefore the records from the five principal type-of-farming areas were examined separately. Inconclusive and contradictory tendencies soon began to show up. Many of these seemed due to the presence of farms in each area which were ordinarily regarded as typical of some other area. Therefore, it was decided to group farms with regard to type of the individual farm rather than the general area in which it was found.

It was necessary to use the relative importance of different sources of income as the basis of classification. More satisfactory classification might have been possible had there been a complete record of the disposition of crops raised. But feed records were available only on a small number of farms on which detailed records were kept in Webster County. The classification is, of course, largely arbitrary. On most of these farms the hog enterprise was the most important source of income. Thus the farms classified as cattle-raising farms generally produced a consider-

able number of hogs, but also raised enough cattle for the sale of beef to amount to 25 or more percent of the gross income.

In brief, the scheme of classification was as follows:

1. Hog farms—those receiving over 50 percent of their gross income from sale or increase in inventory of hogs.
2. Commercial feeding farms—those receiving over 25 percent of their gross income from beef sale or increase, and feeding at least 20 head of purchased cattle.
3. Cattle-raising farms—receiving over 25 percent of their gross income from the sale of home-raised cattle.
4. Dairy farms—over 25 percent of gross income from dairy products.
5. Cash crop farms—over 40 percent of gross income from crop sales.
6. Mixed or general purpose farms—those on which there was no single outstanding source of income.

Table II gives the distribution of the different types of farms among the records obtained in 1929 and 1930. Table III shows the principal characteristics of the types.

When differences in organization and operation of the types of farms just described are considered, it will be realized that the significance of a given amount of variation in some efficiency factors will differ widely as between types. Thus a maximum rate of returns from dairy cows is highly important for the dairy type of farm with a large number of cows, but means relatively little on a commercial feeding farm or a cash grain farm where there are only two or three milk cows. Likewise a large acreage of crops per man means much more to the cash grain farmer with a large crop acreage and a small labor supply than to a dairy farmer with a smaller crop acreage and with a dairy enterprise to provide other work. There are other factors whose variation seems to have about the same significance for each of the different types. We shall need to return to the question of type from time to time throughout the rest of the discussion.

## NET FARM INCOME AS RELATED TO MANAGEMENT RETURNS

In fig. 1 is shown the relationship between the net farm income and the management returns.[3] For all the farms included

[3] Net income comprises the returns left after deducting all actual out-of-pocket expenses, including expenses accrued but unpaid. This sum represents the remuneration which the farmer receives for his labor and that of unpaid members of his family, and for the land and capital he is using. It is the amount the farmer has with which to pay interest on any borrowed funds he may be using and for his living.

In the records studied a "net income" figure had been computed the same as the above but minus any payments of interest on funds borrowed. This was found unsatisfactory for the purposes of the present study because certain types of farms tended to be more in debt than others and because the farms operated by owners frequently had large outlays deducted for interest payments on land mortgages, while such items did not occur in the income statements of tenant farms. Consequently net income was recomputed for the farms studied for 1929 and 1930. In fig. 1 the curve shown for 1927 and 1928 gives the relationship between the old net income figure, from which interest payments had been deducted, and the profit.

The management return or profit is obtained by subtracting from the net income payments for interest, an allowance at current rates for interest on the farmer's own investment, and wages for his own labor and that of the members of his family. The management return is an index of success in the management of the farm,

TABLE II. TYPES OF FARMS STUDIED, 1929-1930 RECORDS COMBINED

| | Northeastern Dairy area | | Eastern Meat Producing area | | Western Meat Producing area | | North Central Cash Grain area | | Southern Pasture area | | Entire state | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent |
| Hog farms | 27 | 14 | 102 | 32 | 45 | 43 | 157 | 30 | 46 | 31 | 377 | 29 |
| Commercial feeders | 5 | 2 | 37 | 12 | 17 | 16 | 37 | 7 | 13 | 9 | 109 | 8 |
| Cattle raising | 8 | 3 | 10 | 3 | 2 | 2 | 17 | 3 | 15 | 10 | 52 | 4 |
| Dairy farms | 82 | 41 | 55 | 17 | 7 | 7 | 56 | 11 | 22 | 16 | 222 | 17 |
| Cash grain farms | 9 | 4 | 39 | 12 | 6 | 6 | 93 | 18 | 5 | 3 | 152 | 12 |
| General purpose | 72 | 36 | 77 | 24 | 27 | 26 | 167 | 31 | 46 | 31 | 389 | 30 |
| Total | 203 | 100 | 320 | 100 | 104 | 100 | 527 | 100 | 147 | 100 | 1301 | 100 |

TABLE III. VARIATIONS BETWEEN TYPES OF FARMS
(Averages for 1929-30, except where otherwise noted)

| | 1 Hog farms | 2 Commercial feeder | 3 Cattle raising | 4 Dairy farms | 5 Cash grain farms | 6 General purpose |
|---|---|---|---|---|---|---|
| No. records 1929 | 126 | 61 | 26 | 89 | 68 | 240 |
| No. records 1930 | 251 | 48 | 25 | 140 | 76 | 150 |
| Total acres | 217 | 294 | 272 | 174 | 220 | 192 |
| Acres corn | 80 | 107 | 80 | 55 | 90 | 67 |
| No. spring litters | 18.1 | 19.0 | 13.4 | 8.8 | 8.6 | 11.2 |
| No. fall litters | 7.0 | 6.1 | 4.6 | 3.1 | 2.4 | 3.8 |
| No. steers fed | 15.3 | 76.4 | 17.4 | 4.6 | 5.2 | 8.6 |
| Hog income per sow | $ 168 | $ 165 | $ 142 | $ 133 | $ 124 | $ 149 |
| Beef income per head of all cattle | $ 13 | $ 32 | $ 34 | $ 11 | $ 15 | $ 19 |
| Dairy income per cow | $ 85 | $ 97 | $ 93 | $ 120 | $ 80 | $ 89 |
| Percent invested in working capital | 21.8 | 24.0 | 22.9 | 21.5 | 15.5 | 19.4 |
| Percent expense to income, 1929 | 51.3 | 58.5 | 48.0 | 46.8 | 39.9 | 45.1 |
| Percent expense to income, 1930 | 79.4 | 85.2 | 76.0 | 73.9 | 56.1 | 65.2 |
| Months labor used | 22.8 | 29.1 | 25.3 | 21.8 | 21.0 | 21.0 |
| Crop acres per man | 89 | 94 | 93 | 77 | 111 | 90 |
| Livestock income per man, 1929 | $3213 | $4121 | $2650 | $2408 | $1746 | $2352 |
| Livestock income per man, 1930 | $2418 | $2921 | $2384 | $1816 | $1120 | $1715 |
| Corrected net income, 1929 | $3680 | $5710 | $3650 | $2810 | $4060 | $3250 |
| Corrected net income, 1930 | $1604 | $1721 | $1760 | $1473 | $2160 | $1823 |
| Management return, 1929 | $ 586 | $1124 | $ 523 | $ 337 | $ 744 | $ 564 |
| Management return, 1930 | $-1414 | $-2013 | $-1328 | $-1181 | $-685 | $-953 |

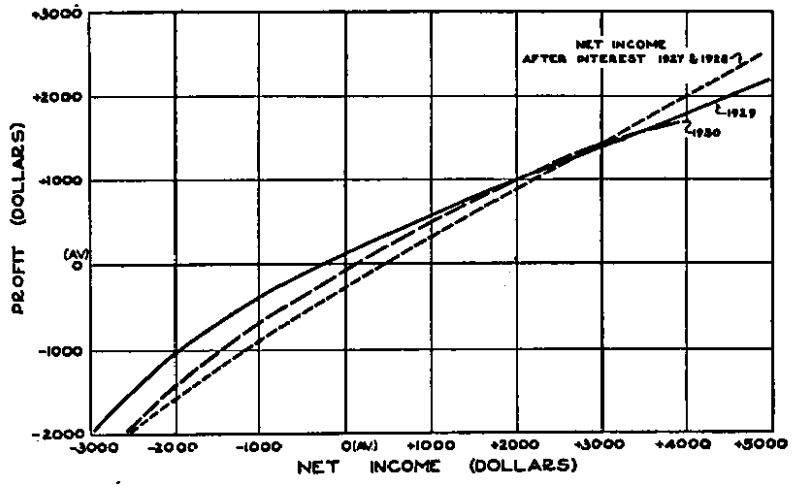


Fig. 1. Relationship between net farm income and profit or management returns.

in the study in any particular year the profit or management return was found to increase in a line which was slightly convex upwards.

According to the curve from the 1929 records, the farmer whose net income was $1,000 less than average received a management return that was about $950 less than average. Above this point an increase of $1,000 in the net income was accompanied by an increase of about $650 in the management return. As the net income increased the profit rose more slowly. Thus an increase in net income from $1,000 to $2,000 above the average was accompanied by an increase of only $400 in the management return.

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while the net income is a measurement of the net return from the business regardless of the size of the operator's input in labor, land or capital.

The following summary of an income statement may serve to make the relationship between the net income and the management return clearer. It should also help in arriving at an understanding of the method used in arriving at the various elements of income and expense. Throughout the discussion the terms management return and profit are used interchangeably.

*Income Statement Summary*

| *Receipts*: | | *Expenses*: | |
|---|---|---|---|
| Total livestock sales | $2021 | Total operating expenses | $1484 |
| Total crop sales | 2880 | Total fixed expenses | 435 |
| Miscellaneous receipts | 50 | Depreciation, working assets | 180 |
| Food and fuel used by household | 247 | Depreciation, fixed assets | 161 |
| Incr. in current assets | 1347 | | |
| | | Total expense | $2260 |
| Gross income | $6545 | Net farm income | 4285 |
| | | | $6545 |

*Distribution of Net Income*

| | | |
|---|---|---|
| Labor, operator and family | $ 950 | |
| Interest on owned capital | 2020 | |
| Total allowances | | $2970 |
| Management return (or profit) | | 1315 |
| | | $4285 |

It will be noticed in fig. 1 that the curves do not express absolute figures but deviations from the averages of the respective series. It was decided to follow this practice throughout the study in order to facilitate the analysis. It was found that a deviation in an independent series varied in its significance according to its deviation from the means of the series. Thus a variation in the yield of corn from 40 to 50 bushels has a different significance for the operation of the business depending on whether the average or typical yield for the year in question is 30 or 60 bushels. This method is followed with each of the factors analyzed. Further, for simplicity, the relationships discovered were combined or averaged graphically whenever possible in order to show more stable relationships and to simplify the graphs. This, of course, was not done in cases where the factors could not be put on a strictly comparable basis for each of the years concerned, or where the relationships differed significantly from year to year, as between 1929 and 1930 in a number of cases.

## FINANCIAL FACTORS AND RATIOS

Besides the net income in its relationship to the management return, three other financial factors were studied in their relationship to farm profits and two in relationship to the net income. The income per $100 invested was studied in its relationship to profits. The percentage which expense is to the income, and the percentage of total capital invested in working capital were examined in their relationship both to net income and management returns. The purely financial ratios such as these three seemed, in general, to have a straight line relationship to net income or profit over the greater part of their range. At the extremes, curvilinear relationships showed up. On the other hand, the factors representing physical variations in production, such as the number of acres of corn or acres of crops handled per man, had, typically, a curvilinear relationship to the net income or profit over their entire course. This was generally explainable as some sort of a manifestation of the law of diminishing returns.

### THE INCOME PER $100 INVESTED[4]

This factor, commonly referred to as the rate of turnover on the capital invested, shows, in fig. 2, an almost straight line in

[4] In this section there are two closely related and interwoven discussions. The first, which may be regarded as the main line of investigation, is concerned with the relationships of the independent variables to net farm income and management returns. The other or secondary interest, is concerned with cross relationships between the independent variables. In order to distinguish between these two lines of thought and to simplify the presentation for the reader who is interested only in the principal results, it was decided to use two different typographic arrangements. Consequently the discussions of cross relationships are set in smaller type than those of relationships to net income and management returns. In this way the reader will be able to follow through the relationships to farm returns without being distracted by the cross relationships. When a question of relationships between independents does arise he will find the discussion in the smaller print contiguous to the primary line of discussion.

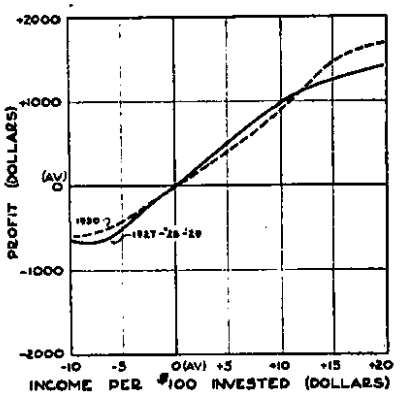


Fig. 2. Income per $100 invested as related to profit.

its relationship to the management return. At first there seems to be an initial stage of increasing returns. After this the profit rises with the rate of turnover in an almost straight line until the income amounts, for the first three years of the study, to about $25 per $100 invested (i.e., about $10 more than average). After this the curve turns downward, probably because of an increasing difficulty of getting a still greater gross income from a limited amount of capital.

In Table IV is shown the variation in the other financial factors with the rate of turnover. It will be noticed that since the rate of income in 1930 was materially less than in the three earlier years, the entire distribution was shifted toward the lower values. As the rate of turnover increased the percentage which expense is to income, declines at first, but at a diminishing rate. Finally when highest rates of turnover are reached the percentage of expense tends to stand still or rise. It is interesting to notice that higher percentages of working capital are closely associated with the greater rates of turnover. Also there is a close relationship between the receipts from livestock and the rate of turnover.

## PERCENTAGE EXPENSE TO INCOME

The percentage which the total expense is to total income is one of the simpler and more significant financial ratios obtainable directly from the figures of the income statement. Figure 3

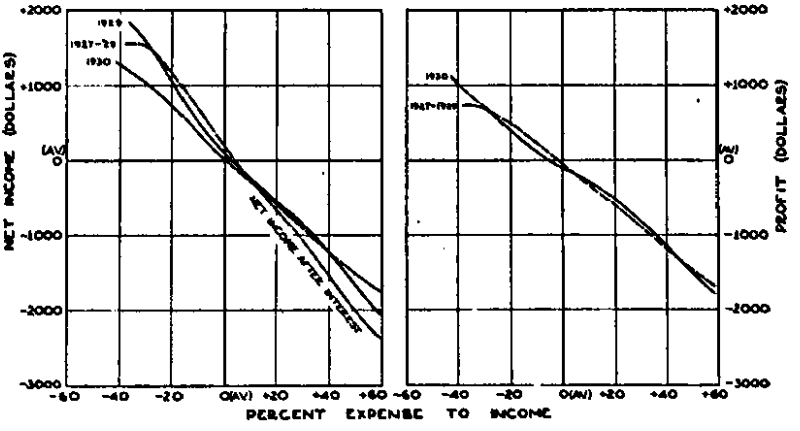


Fig. 3. Percentage expense to income as related to net income and profit.

TABLE IV. VARIATION IN INCOME PER $100 INVESTED AND RELATED FACTORS
(Rate of Turnover)

| Income per $100 invested | No. records | | Percent expense to income | | Percent invested in working capital | | Livestock income per man | |
|---|---|---|---|---|---|---|---|---|
| | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 |
| $ 3 — $ 5 | — | 15 | — | 130 | — | 19 | — | $ 760 |
| 6 — 10 | 42 | 244 | 67 | 84 | 15 | 19 | $1895 | 1596 |
| 11 — 15 | 241 | 384 | 49 | 65 | 18 | 21 | 2314 | 2131 |
| 16 — 20 | 224 | 113 | 44 | 65 | 20 | 25 | 2829 | 2596 |
| 21 — 25 | 80 | 26 | 47 | 57 | 23 | 24 | 3313 | 2496 |
| 26 — 30 | 13 | 7 | 49 | 67 | 26 | 27 | 3392 | 4171 |
| 31 — 35 | 6 | 3 | 38 | 57 | 28 | 29 | 2983 | 4693 |
| 36 — 45 | 4 | — | 50 | — | 32 | — | 5725 | — |

shows that the relationship of this ratio to the net income and the management return is, in general, a straight line. As the percentage of expense rises the net returns fall. The net return, however, falls less rapidly than net return after payment of interest, since interest payments have already been deducted in arriving at the latter figure. This forces the heavily indebted farm to show a high outlay per dollar of income.

In 1930 the net income ran smaller on nearly all farms than in the earlier years of the study. Among these smaller absolute figures there was naturally a smaller absolute variation from group to group. But the variation was generally as great in proportion to the average net income as in other years. Thus between two farms, one with a percentage of expense 30 points below and the other 30 points above average for the year, there was a difference in net income of $2,700 in 1929 as compared with $1,900 in 1930. But the average net income was $3,721 in 1929 and only $1,678 in 1930.

TABLE V. PERCENTAGE EXPENSE TO INCOME

| Percent expense to income (mid-value of group) | No. records | | Percent invested in working capital | | Income per $100 invested | | Return per $100 feed | |
|---|---|---|---|---|---|---|---|---|
| | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 |
| 10 | 8 | — | 17 | — | $20 | $— | $ — | $174 |
| 20 | 64 | 5 | 18 | 17 | 17 | 15 | 175 | 88 |
| 30 | 154 | 23 | 19 | 18 | 17 | 14 | 159 | 151 |
| 40 | 155 | 77 | 20 | 19 | 17 | 15 | 156 | 156 |
| 50 | 98 | 100 | 20 | 20 | 16 | 14 | 148 | 129 |
| 60 | 59 | 102 | 21 | 20 | 16 | 13 | 138 | 115 |
| 70 | 38 | 118 | 21 | 22 | 17 | 13 | 135 | 118 |
| 80 | 18 | 77 | 19 | 22 | 12 | 12 | 106 | 103 |
| 90 | 6 | 57 | 20 | 23 | 12 | 12 | 100 | 106 |
| 100 | 7 | 56 | 29 | 22 | 13 | 10 | 91 | 97 |
| 110—120 | 3 | 39 | 16 | 22 | 13 | 10 | 128 | 86 |
| 130—140 | — | 20 | — | 23 | — | 9 | — | 80 |

Table V shows that there is a close inverse relationship between the percentage of expense to income and the rate of turnover, and that there is a fairly close direct relationship between percentage of expense and the proportion of the capital invested in working assets. There is also a close inverse relationship between the returns per hundred dollars of feed and the percentage of outlay. The percentage of expense may be higher on one farm than another either because the expense is greater or because the income is lower. The percentage expense to income is a highly valuable summary figure. But no one ratio is sufficient. A more complete story may be obtained by the use of several factors or ratios together, each of which deals either with the volume of production or with the rate of expense of a limited part of the business.

## PERCENTAGE INVESTED IN WORKING CAPITAL

It is commonly believed that the investment in livestock and equipment, which is turned over more rapidly than investment in land or buildings, is also more closely associated to the net income and the management return. The investment in working

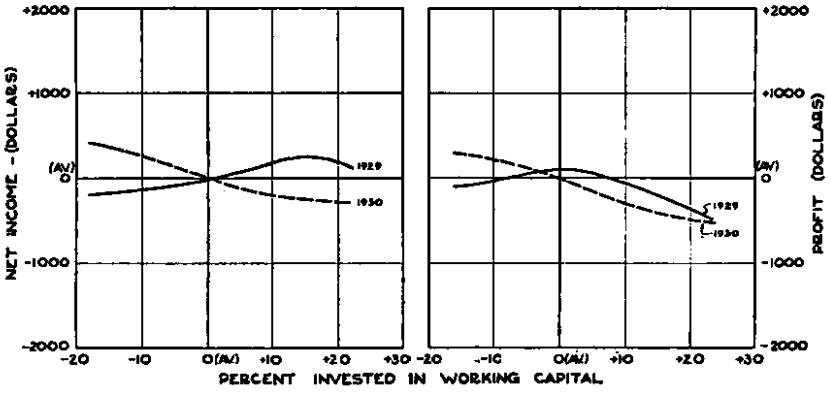


Fig. 4. Percentage invested in working capital as related to net income and profit.

capital on the farms studied averaged 20 percent of the total investment in 1929 and 21 percent in 1930. Figure 4 shows that as the working capital increased in the 1929 records, the amount of net income rose gradually until between 30 and 35 percent (10 to 15 percent more than average) was in working capital and after this point showed a tendency to decline. In the 1930 records, however, increases in the proportion in working capital were accompanied by declines in the net income. The 1929 relationship seems more likely to be the normal one. 1930 was a year of declining prices and the greater the amount of livestock and crops on hand the greater was the loss on their values between the beginning of the year and the time they were sold or inventoried again.

TABLE VI. PERCENTAGE INVESTED IN WORKING CAPITAL AS RELATED TO OTHER FACTORS

| Percent working capital | No. records 1929 and 1930 combined | Livestock increase per man | | Income per $100 invested | | Percent expense to income | | Crop acres per man Av. 1929 and 1930 |
|---|---|---|---|---|---|---|---|---|
| | | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 | |
| 1— 5 | 3 | $1900 | $1800 | $12 | $18 | 74 | 65 | 90 |
| 6—10 | 36 | 2348 | 1276 | 14 | 12 | 39 | 71 | 102 |
| 11—15 | 210 | 2093 | 1390 | 14 | 10 | 48 | 63 | 96 |
| 16—20 | 408 | 2553 | 1874 | 16 | 11 | 45 | 72 | 93 |
| 21—25 | 417 | 2877 | 2238 | 18 | 12 | 48 | 73 | 88 |
| 26—30 | 153 | 3385 | 2307 | 19 | 14 | 54 | 77 | 84 |
| 31—35 | 48 | 2780 | 2527 | 22 | 16 | 53 | 78 | 72 |
| 36—40 | 23 | 3789 | 2671 | 24 | 18 | 65 | 97 | 73 |
| 41—45 | 2 | 5300 | 3500 | 34 | 20 | 49 | 49 | 75 |
| 46—55 | 1 | — | 6000 | — | 35 | — | 90 | 100 |

There is a close relationship between the percentage invested in working capital and the rate of turnover as is shown in table VI. From the group with 10 percent in working capital to the one with 40 percent the rate of turnover nearly doubled in 1929 and increased by 50 percent in 1930. This is accompanied by, or rather takes the form of a greater

income per man from livestock. The greater part of this increased income is a result of keeping a greater number of livestock, but there is also a tendency for the income to increase per cow or per steer.

At the same time that the livestock income increases there is a tendency for the acres of crops handled per man to decline. This simply indicates that there is a tendency for the farms with the highest investment in livestock and equipment to fall among the livestock types and for the crop farms to require a relatively small working capital. The same table shows that as the percentage in working capital rises the percentage expense to income also tends to increase. The short lived equipment generally has a higher rate of upkeep, and livestock enterprises generally require a greater current expenditure per dollar of receipts than do crop enterprises.

## FACTORS RELATED TO THE CROPPING SYSTEM

The farm enterprises may be divided into two groups, one of which is related directly to production of crops and the other to the conversion of these crops into livestock products. In the general analysis of the farm business we need to raise three questions regarding each of these two groups of enterprises; First as to the size of the cropping system or the livestock system, second as to its yield or rate of productivity, and third a question which we touch on only incidentally in this bulletin, as to the relative sizes or combinations of enterprises.

### TOTAL ACRES IN THE FARM

The total number of acres in the farm is thought of as an indication of the size of the business and particularly as a measurement of the size of the cropping system.

When the cross relationships with the other factors are removed, the relationship between the acres per farm and the net income and profit is found to assume the form of a flat curve as shown in fig. 5. The net income increases with total acreage up to about 400 acres (200 acres more than average). After this point the curve turns downward as the farmer's managerial

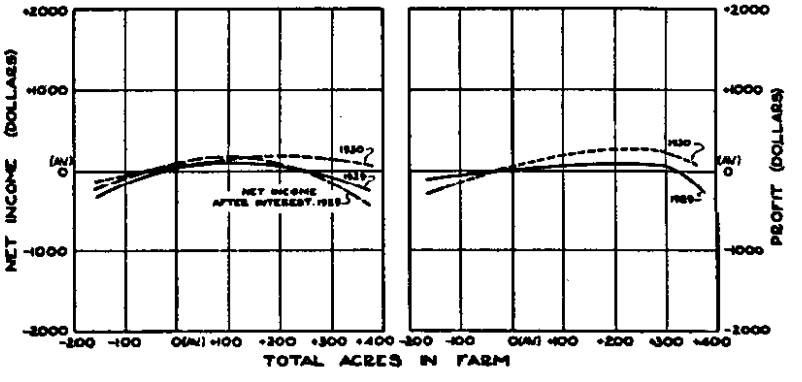


Fig. 5. Total acres in farm as related to net income and profit.

ability is (generally) spread over an area greater than he can handle effectively with the present equipment and under the present forms of farm organization. It will be noticed that the net income after the payment of interest drops off more rapidly than net income before interest payments.

Figure 5 shows that the curves of profits follow the same general course as those for net income but do not turn downward quite so soon. This may be because the largest farms run more towards the extensive crop type. As the livestock types appear less often in the larger acreage groups, average net income declines partly because of more extensive farming and partly because of lower efficiency on larger areas of land. A pronounced tendency to a decline in the managerial return sets in at about 500 acres on all types of farms.

Table VII indicates that the type of the farm changes to some degree with increase in total acreage. In the first place the acres in corn increase closely in proportion to the total acres, and approximate one-third of the total acreage on these farms. The numbers of litters of pigs, both spring and fall, also follow the numbers of acres, and more closely the acres in corn until the farms average about 400 acres. After this point but little further increase occurs in the number of spring litters, and the number of fall litters actually declines. It is at about this point that the number of steers fed per farm begins to increase much more rapidly than before, and the farms tend to change more definitely to the steer-feeding type rather than to the hog-farm or general farming type.

As the farms become larger the rate of turnover on the capital invested tends to become smaller. The larger farms tend to specialize more largely in the direction of crop production and convert smaller percentages of crops into livestock products. At the same time they seem to give relatively less attention to livestock. Consequently the returns per hundred dollars of feed decline as the farms become larger. The increase in size of farm brings with it the possibility of a man handling a larger acreage of crops. This advantage seems to reach its maximum on farms of about 300 acres. On the farms of 296 to 335 acres, an average of 108 acres of crops are handled per 12 months of labor. Beyond this point there was practically no further change.

## ACRES IN CORN

In fig. 6 is shown the relationship of the acreage in corn to the net income and the management return. For 1929 and the earlier years, net income rises until the corn reaches about 140 acres (70 acres more than average). After this point there seems to be but little change in the net income, but the management return continues to rise until nearly 200 acres of corn are raised. In 1930, with a poor corn crop, the acreage in corn made less difference in the net income and appeared to make practically no difference in the management return.

Since the larger-sized machines used in growing the corn crop function best on rather level land, we may expect that the acreage of corn which would return the greatest net income or profit would be smaller on rough land than in the smoother areas. To

TABLE VII. TOTAL ACRES IN FARM

| Total acres | No. records 1929 and 1930 combined | Acres corn | Av. no. spring litters | Av. no. fall litters | Livestock increase per man | No. steers fed | Income per $100 invested | Returns per $100 feed | Percent expense to income | Months labor | Crop acres per man |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 56— 95 | 88 | 30 | 7.1 | 3.4 | $2234 | 2 | $17 | $157 | 58 | 15 | 55 |
| 96—135 | 184 | 42 | 7.7 | 2.9 | 2035 | 2 | 14 | 127 | 57 | 16 | 74 |
| 136—175 | 351 | 59 | 11.3 | 3.8 | 2262 | 8 | 14 | 139 | 58 | 19 | 88 |
| 176—215 | 170 | 69 | 12.0 | 4.8 | 2321 | 16 | 15 | 134 | 60 | 22 | 88 |
| 216—255 | 176 | 86 | 14.9 | 4.5 | 2285 | 20 | 13 | 124 | 66 | 25 | 99 |
| 256—295 | 112 | 100 | 17.2 | 6.1 | 2438 | 21 | 14 | 125 | 61 | 28 | 100 |
| 296—335 | 103 | 122 | 17.5 | 6.4 | 2620 | 29 | 14 | 124 | 60 | 29 | 108 |
| 336—375 | 35 | 115 | 18.3 | 8.1 | 2549 | 25 | 13 | 126 | 66 | 28 | 108 |
| 376—415 | 30 | 125 | 23.8 | 8.3 | 2850 | 28 | 14 | 109 | 77 | 31 | 114 |
| 416—515 | 28 | 146 | 28.5 | 10.8 | 2943 | 51 | 14 | 116 | 83 | 38 | 109 |
| 516—615 | 16 | 172 | 29.0 | 9.8 | 2812 | 72 | 12 | 111 | 84 | 46 | 104 |
| 616—715 | 7 | 249 | 29.0 | 3.9 | 2857 | 107 | 13 | 120 | 57 | 42 | 146 |



TABLE VIII. ACRES IN CORN

| Acres corn | No. records 1929 and 1930 combined | Number spring litters | Number fall litters | Months labor | Crop acres per man | Livestock income per man | Number steers fed | Returns per $100 feed | Beef income per head |
|---|---|---|---|---|---|---|---|---|---|
| 15 & under | 8 | 1 | 1 | 17 | 44 | $1400 | 0 | $160 | $19 |
| 16— 35 | 161 | 6 | 3 | 17 | 62 | 2052 | 3 | 149 | 16 |
| 36— 55 | 287 | 10 | 4 | 18 | 79 | 2168 | 5 | 138 | 15 |
| 56— 75 | 331 | 12 | 5 | 21 | 91 | 2344 | 13 | 133 | 17 |
| 76— 95 | 183 | 15 | 5 | 24 | 96 | 2423 | 16 | 130 | 17 |
| 96—105 | 141 | 18 | 6 | 27 | 103 | 2550 | 23 | 123 | 19 |
| 106—135 | 87 | 20 | 5 | 29 | 109 | 2431 | 27 | 124 | 21 |
| 136—155 | 41 | 22 | 6 | 31 | 113 | 2517 | 30 | 122 | 18 |
| 156—175 | 22 | 22 | 6 | 30 | 115 | 2791 | 55 | 115 | 20 |
| 176—195 | 13 | 24 | 11 | 31 | 128 | 3092 | 69 | 105 | 24 |
| 196 & above | 25 | 28 | 11 | 43 | 138 | 2720 | 64 | 116 | 22 |

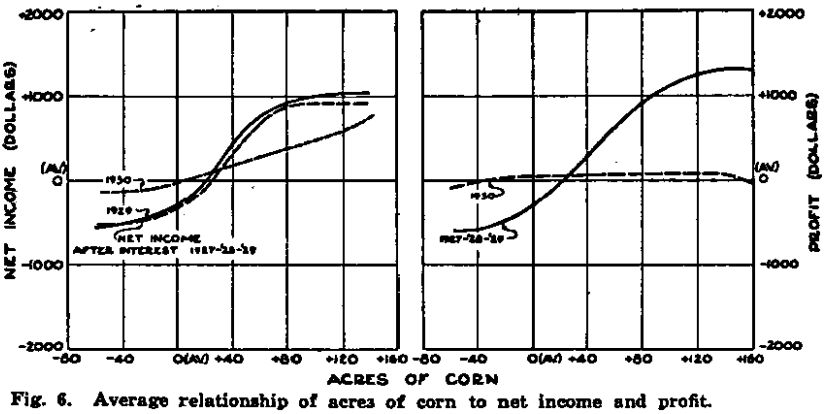


Fig. 6. Average relationship of acres of corn to net income and profit.

test out this assumption the 1929 records obtained from the more level north central Iowa area were separated from those for the rest of the state, and separate curves were obtained for the two areas. The results are shown in fig. 7. For the areas of the state where the land is more rolling the net income began to decline after the corn acreage reached about 140. For the north central section the net income continued to rise to 180 acres and then declined parallel to the curve for the other areas. The management return ceased to rise at about 160 acres of corn for the rougher areas and continued to rise to about 200 acres in the smoother north central area.

Table VIII shows the gross changes which occur along with variations in the acreage of corn. As more corn is raised the number of litters of pigs increases along with it but at the declining rate. At the same time the number of steers fed increases more rapidly, again demonstrating the tendency for the type of farm to change with an increased acreage.

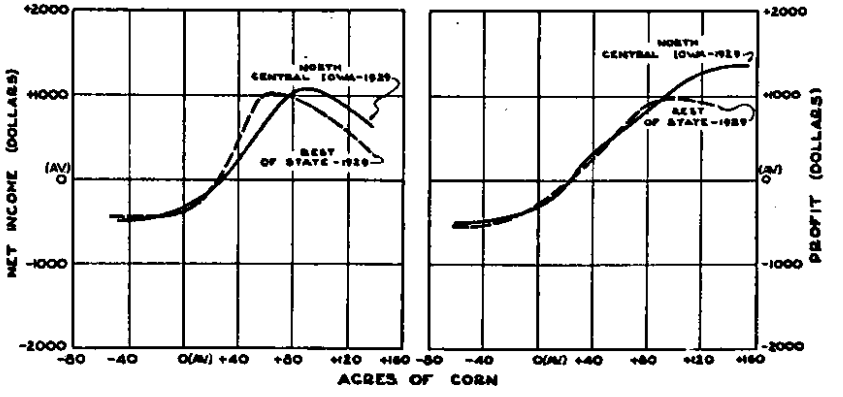


Fig. 7. Acres of corn as related to net income and profit contrasting relationship in north central Iowa with rest of state.

On the larger farms there is a tendency for the beef income per head to be larger than on the smaller farms. This seems to be explained partly by the fact that a larger proportion of the cattle on the large corn farms are steers for feeding as compared with the general purpose type of cattle on smaller farms. At the same time the returns per $100 of feed fed tends to decline as the total number of hogs and steers increases and makes it more difficult to utilize the feed to the best possible advantage.

Corn is the crop requiring the greatest amount of labor per acre of any of the more common Iowa crops. Therefore we would expect the number of months of labor to increase in direct proportion to the acreage of corn. Of course these records do not show separately the amount of labor used during the crop season as compared with that in the winter time, and to that extent the variation shown in table VIII is inconclusive. Nevertheless, as the farm becomes larger the number of months of labor used increases at a diminishing rate.

## YIELD OF CORN—VALUE OF CROPS PER ACRE

As a measure of the productivity of the cropping system the yield per acre of corn was selected as the most simple and significant figure directly available.

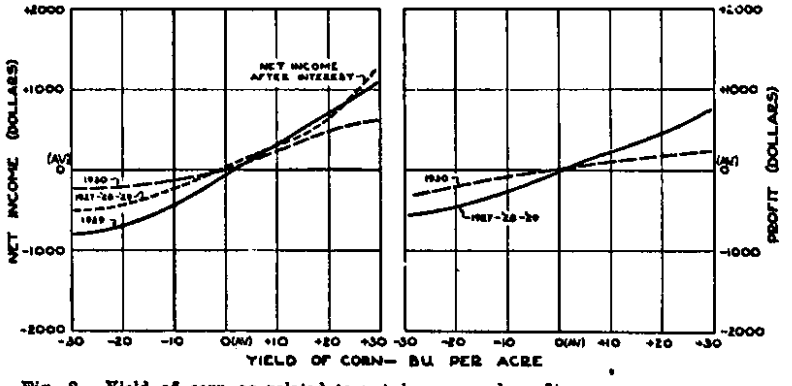


Fig. 8. Yield of corn as related to net income and profit.

In fig. 8 is shown the relationship of the yield of corn to the net farm income and to the management return. With higher yields the net income before payment of interest rises more rapidly than net income after interest, and this increases more rapidly than the management return. In 1930, with its lower prices, the variation in corn yields made less difference in income and profits than in the earlier years.

It should be noticed that the relationship between corn yield and the management returns does not indicate that a point of diminishing returns has been reached among the records studied. It should be remembered, however, in this connection that the variations in corn yield here come only to a small degree from any corresponding variations in input of cost factors within the

years studied. Very few of the farms studied used commercial fertilizers. The differences in yield come either from variations in the rainfall from section to section or else from differences in the soil management program of the various farm operators as these programs—or lack of programs—have been followed for years past.

As an alternative to the yield of corn we might use the average value of crops per acre in the rotation as an index of the cropping system. Some experiments were carried on with this factor while analyzing the 1929 records. But as a general thing less satisfactory results were obtained.

Table IX shows how some of the other closely related factors change with variations in the yield of corn. It should be remembered that 1930 was a year of serious drouth in most parts of Iowa and consequently that a given yield, for instance 50 bushels per acre, represents relatively a better crop in 1930 than in 1929. Nevertheless, the closely parallel variations in the related factors in table IX show the relationships to be fairly stable.

As the yield of corn increased a smaller acreage of crops was handled per man, suggesting that a larger amount of labor was required to obtain the greater yield as well as to handle the greater amount of corn harvested. At the same time greater income from higher yields resulted in lower percentages of expense to income and a higher rate of return on the capital invested. Also the availability of a greater amount of feed led to the production of more livestock or livestock products and consequently to a greater livestock increase per man. For 1929 this was accompanied by decreasing returns per hundred dollars of feed fed. But with the smaller amounts of feed available in 1930, this tendency did not appear.

## FACTORS RELATED TO THE LIVESTOCK SYSTEM

On the majority of Iowa farms the greater part of the income comes directly from the sale of livestock or livestock products. The variations in size of livestock enterprises and differences in efficiency with which these enterprises are handled were found to be among the most important influences on the net income and on the management returns. In the selection of efficiency factors it was decided to use the number of litters of spring pigs, and the number of litters of fall pigs to measure the size of the hog enterprise. The income per year per sow was selected as a measure of the rate of production in the absence of figures on the pounds of gain per litter or per sow. On the beef enterprise the number of head of cattle fed and the beef income per head of all cattle were selected. On the dairy enterprise the productivity of the cows was represented by the dairy income per milk cow. In addition to these factors the feeding efficiency of the farmer on all his livestock enterprises is represented by the in-

come from livestock per hundred dollars of feed consumed by livestock enterprises other than horses.

Before the analysis had gone far it was observed that some of these factors vary somewhat in their significance, depending on the type of farm. Thus a high dairy income per milk cow is more closely related to income on a dairy farm where there is a large number of cows than on a steer-feeding farm. In the latter case there are likely to be only a few milk cows. The income from them is trivial in comparison with that from the sale of beef cattle, and the close attention necessary to obtain a large production per cow would be likely to cost more in neglect of the feeding steers than it gains in dairy products. Similar considerations need to be kept in mind as we examine several other factors.

## NUMBER LITTERS OF SPRING PIGS

In fig. 9 is shown the relationship of the number of spring litters to the net income and to the management return. In 1929 and the earlier years net income rose until there were about 35 litters, (i.e., 20 to 25 more than the average number of litters). After this point it tended to decline as the larger number of pigs received less efficient care. It should be remembered that these curves refer to the relationship between the efficiency factor and income under the conditions on the average farms of the group. On farms where the most modern methods and equipment are used and where, at the same time, the management is more than ordinarily efficient, it seems likely that the point of diminishing returns would occur with a large number of litters.

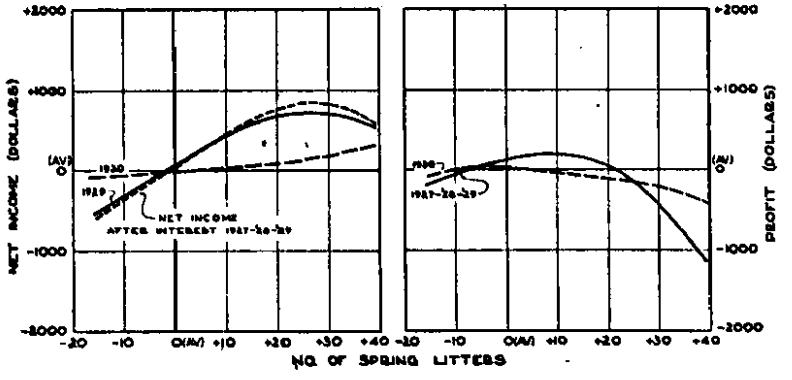


Fig. 9. Average relationship of number of litters of spring pigs to net income and profit.

## TABLE IX. YIELD OF CORN

| Yield of corn | No. records | | Crop acres per man | | Income per $100 invested | | Percent expense to income | | Livestock increase per man | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 |
| 12—17 | 1 | 2 | 80 | 70 | $14 | $19 | 56 | 65 | $1600 | $2300 |
| 18—22 | 6 | 9 | 100 | 69 | 16 | 14 | 51 | 83 | 2117 | 1811 |
| 23—27 | 11 | 29 | 96 | 94 | 18 | 13 | 62 | 72 | 1727 | 1679 |
| 28—32 | 40 | 71 | 89 | 94 | 16 | 11 | 50 | 19 | 2250 | 1832 |
| 33—37 | 38 | 105 | 91 | 97 | 15 | 11 | 51 | 78 | 2224 | 1770 |
| 38—42 | 96 | 159 | 89 | 95 | 16 | 12 | 47 | 72 | 2356 | 2089 |
| 43—47 | 103 | 121 | 96 | 93 | 16 | 12 | 47 | 78 | 2602 | 2038 |
| 48—52 | 152 | 101 | 86 | 91 | 17 | 13 | 47 | 70 | 2710 | 2134 |
| 53—57 | 68 | 55 | 84 | 87 | 17 | 14 | 45 | 63 | 3075 | 2284 |
| 58—62 | 54 | 20 | 78 | 83 | 18 | 13 | 46 | 71 | 3015 | 2555 |
| 63—67 | 21 | 9 | 81 | 68 | 18 | 15 | 54 | 60 | 3200 | 2767 |
| 68—72 | 8 | 5 | 87 | 66 | 18 | 12 | 53 | 66 | 3925 | 2440 |
| 73—77 | 4 | 4 | 67 | 78 | 17 | 18 | 39 | 65 | 3875 | 3900 |



## TABLE X. NUMBER LITTERS SPRING PIGS

| No. spring litters | No. records 1929 and 1930 combined | No. fall litters | Months labor | Livestock increase per man | | No. steers fed | Returns per $100 feed | | Hog income per sow | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1929 | 1930 | | 1929 | 1930 | 1929 | 1930 |
| 0 | 44 | 5 | 20 | $2427 | $1761 | 15 | $165 | $125 | $ — | $ — |
| 1— 5 | 160 | 2 | 19 | 1828 | 1838 | 4 | 165 | 118 | 185 | 158 |
| 6—10 | 415 | 4 | 20 | 2380 | 1809 | 9 | 162 | 116 | 169 | 142 |
| 11—15 | 291 | 5 | 22 | 2648 | 2048 | 12 | 150 | 114 | 155 | 139 |
| 16—20 | 171 | 6 | 25 | 2899 | 2456 | 22 | 139 | 117 | 159 | 144 |
| 21—25 | 90 | 6 | 28 | 3521 | 2300 | 31 | 136 | 110 | 171 | 129 |
| 26—30 | 56 | 6 | 29 | 3439 | 2876 | 33 | 144 | 111 | 180 | 116 |
| 31—35 | 32 | 6 | 29 | 3819 | 2694 | 25 | 151 | 120 | 161 | 124 |
| 36—40 | 19 | 7 | 31 | 4083 | 3287 | 53 | 130 | 126 | 143 | 147 |
| Above 40 | 21 | 10 | 39 | 4578 | 3083 | 58 | 118 | 108 | 173 | 204 |

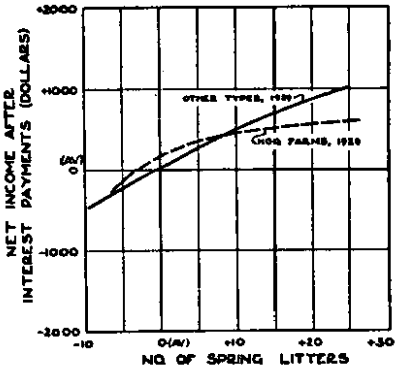


Fig. 10. Number of spring litters as related to net income, contrasting hog farms with other types.

In 1930 with hogs maintaining their prices relatively better than most other farm products for the first part of the year, the farms with a large number of hogs showed slightly greater net incomes than those with few hogs, but the difference was not so marked as in 1929.

The management return in 1929 and the two earlier years rose gradually with the number of pigs until there were between 25 and 30 litters (about 15 more litters than average). After this point the curve turned downward and reflected clearly the diminishing efficiency with which the larger herds of hogs were handled.

With some livestock enterprises part of the feed is composed of low grade or unmarketable crop products. As the size of the livestock enterprise increases beyond a certain point on a given farm, it becomes necessary to purchase feeds in addition to those raised. The purchased feeds are generally of marketable grades. Thus the larger the livestock enterprise becomes the smaller the proportion of low grade feed. This is likely to mean a smaller margin of returns above the value of feed.

Figure 10 shows that the net income after interest payments rose less rapidly after about 20 litters on the specialized hog farms than on the more diversified farms with corresponding numbers of hogs. In other words the net income rose at a more nearly constant rate when the increase in the number of hogs was accompanied by simultaneous increases in the size of the other farm enterprises. The variations in management returns, however, differed but little as between hog farms and other types.

As the number of litters of spring pigs increases from 5 to 15, the number of fall litters increases from an average of 2 to an average of 6 per farm, as shown in table X. Above this point, although there is a wide variation from farm to farm, there is no general increase in the number of fall litters until the spring litters exceed 35. In other words, on the farms studied there was a tendency for the fall pigs to decline in relative importance as the number of spring litters increased.

With an increase in the size of the hog enterprise the livestock income per man also rose, increasing from an average of $1,828 on farms with 1 to 5 litters in 1929 to $4,083 on farms with 36 to 40 spring litters. A large part of this increase, however, was from the feeding of a large number of steers which rose from an average of 4 to 53 head per farm. Even though the livestock income per man increased with the number of hogs raised, the income per sow tended to decline as the number of

litters per farm increased. That is to say the livestock income per man rose much less than the number of pigs. Another manifestation of declining returns from a larger number of litters is seen in the fact that the returns per $100 of feed were smaller where there were larger hog enterprises.

## NUMBER LITTERS OF FALL PIGS

Figure 11 shows that the net farm income increases as more fall litters are raised up to about 20 fall litters in 1929 and to about 15 in 1930 (that is, to about 15 and 10 litters, respectively, above average). After these points there appeared a clearly defined tendency for the income to decline as the larger number of fall pigs received less careful attention or exceeded the number that could be handled to advantage with available equipment or with available feed supplies. Sometimes, also, the larger amount of time required by hogs began to cause some lack of attention to other enterprises.

The divergence of the curves of regression or relationship as between different types of farms which was mentioned in discussing the spring pigs is more marked here, as is shown in fig. 12. Few farms other than hog farms raised more than 12 or 15 litters of fall pigs. The net income on the hog farms, which presumably were better equipped to care for the pigs, increased until about 20 litters were raised. Beyond this point the diminishing returns mentioned in the previous paragraph set in. On the dairy farms there seemed to be a greater benefit from a small number of fall pigs than on the other types because of the opportunity to utilize skimmilk. There were no records, however, from dairy farms with more than about a dozen litters. On the other types of farms additional fall litters beyond 7 or 8 seemed to add very little to the net income.

The management return was affected much less than the net income. On the dairy farms, in 1929, the farms with five fall

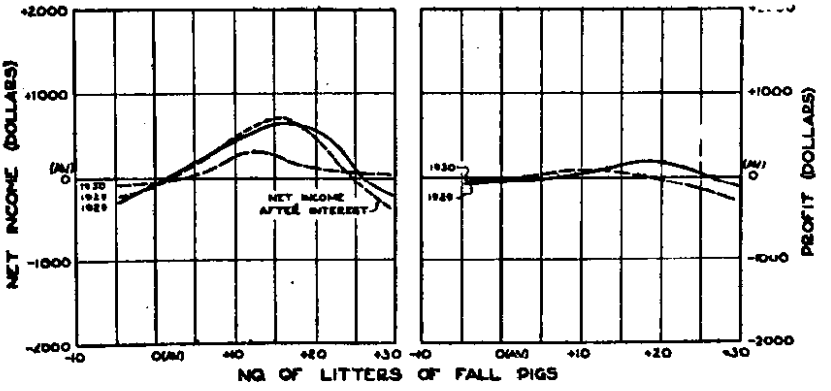


Fig. 11. Average relationship of number litters of fall pigs to net income and profit.

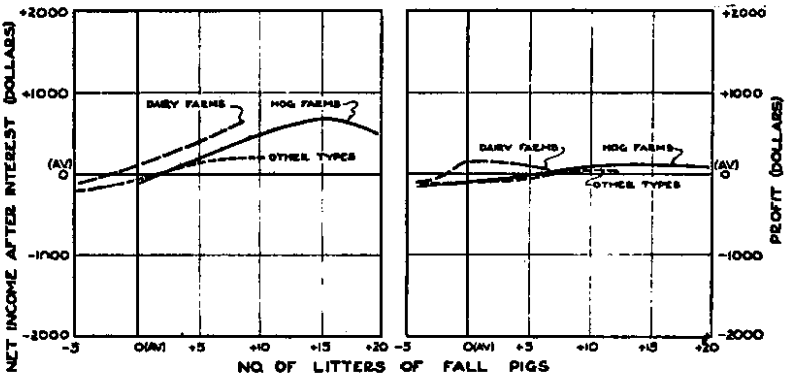


Fig. 12. Relationship of number litters of fall pigs to net income and profit, by types of farms.

litters made management returns about $250 greater than the dairy farms with no fall litters. The dairy farms with 10 fall litters showed profits about $150 less than those with 5. On the hog farms management returns increased about $200 from no fall litters to 20. On other types the change was at a smaller rate than this.

In table XI we find that increases in the number of fall litters are closely associated with corresponding increases in the number of spring pigs. Between 5 and 30 fall litters there is an increase in the amount of labor used of about 10 months. There was also an increase in the number of steers fed from 10 to 28, and partly as a result, there was an increase in the livestock income per man, which amounted to about $2,000 in 1929 and to $1,500 in 1930.

The increase in the number of fall litters generally indicated that a larger proportion of the sows were being bred for two litters per year. Consequently the hog income per sow increased somewhat with the larger number of pigs. At the same time where a larger number of litters was raised there was generally a smaller return per $100 of feed fed. This was much more marked in 1929 than in 1930.

## THE HOG INCOME PER SOW

The income per sow is frequently referred to as an index of the profitableness of the hog enterprise. Table XII and fig. 13, however, show that the returns of the farm change much less than the returns per sow would indicate. A large income per sow is generally due to a large production of marketable hogs per sow.

This larger production may be obtained by raising more pigs per litter and getting a greater rate of gain on them. In this case a larger net income and profit may be expected. Or it may result from breeding the sows for two litters per year instead of one. In this case, there may be a neglect of other enterprises in order to take care of the fall pigs, or the gains may cost more

## TABLE XI. NUMBER LITTERS FALL PIGS

| No. fall litters | No. records 1929 and 1930 combined | No. spring litters | Months labor | Livestock increase per man | | No. steers fed | Returns per $100 feed | | Hog income per sow | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1929 | 1930 | | 1929 | 1930 | 1929 | 1930 |
| 0 | 494 | 14 | 22 | $2488 | $1801 | 14 | $162 | $113 | $158 | $111 |
| 1— 5 | 348 | 10 | 21 | 2315 | 1836 | 10 | 158 | 119 | 167 | 144 |
| 6—10 | 283 | 13 | 23 | 2760 | 2262 | 15 | 150 | 115 | 175 | 153 |
| 11—15 | 114 | 18 | 27 | 3405 | 2457 | 25 | 140 | 120 | 175 | 155 |
| 16—20 | 36 | 22 | 27 | 3807 | 2882 | 39 | 144 | 115 | 198 | 154 |
| 21—25 | 11 | 21 | 30 | 4560 | 3050 | 38 | 120 | 117 | 178 | 156 |
| 26—30 | 8 | 25 | 31 | 4375 | 3550 | 28 | 153 | 135 | 175 | 172 |
| 31—50 | 7 | 7 | 28 | 4250 | 3750 | 76 | 128 | 103 | 162 | 143 |



## TABLE XII. HOG INCOME PER SOW

| Hog income per sow | No. records | | Livestock increase per man | | Income per $100 invested | | Return per $100 feed | | Income per cow | Beef income per head | Percent expense to income | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 | | | 1929 | 1930 |
| 0 | — | 28 | $ — | $1675 | $ — | $18 | $ — | $127 | $101 | $18 | — | 69 |
| $ 1— 55 | 9 | 24 | 2411 | 1063 | 14 | 8 | 132 | 80 | 89 | 8 | 64 | 110 |
| 56—105 | 84 | 165 | 2111 | 1647 | 15 | 11 | 139 | 108 | 86 | 15 | 51 | 75 |
| 106—155 | 202 | 251 | 2435 | 2096 | 16 | 12 | 153 | 118 | 91 | 16 | 46 | 71 |
| 156—205 | 168 | 132 | 2900 | 2307 | 17 | 14 | 154 | 121 | 98 | 20 | 48 | 67 |
| 206—255 | 85 | 58 | 2959 | 2595 | 17 | 14 | 150 | 125 | 100 | 20 | 47 | 74 |
| 256—305 | 34 | 26 | 3065 | 2450 | 19 | 15 | 164 | 116 | 95 | 18 | 42 | 72 |
| Above 305 | 27 | 7 | 3207 | 2257 | 20 | 15 | 159 | 119 | 109 | 28 | 52 | 86 |

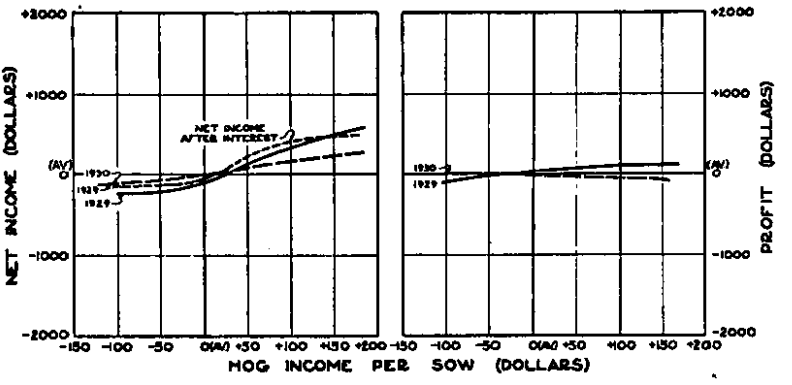


Fig. 13. Hog income per sow as related to net income and profit.

because a larger part of the growth of the pig occurs during the winter when more labor is needed and when there is no possibility of producing cheap gains on pasture. When the greater income per sow is obtained by the production of two litters, therefore, the increase in net income and profit may be small or entirely absent.

In fig. 13 we see that the net income increased with the income per sow, at least up to $200 per sow or about $40 more than average. In 1930 the rate of increase was smaller but after the point of diminishing net return was reached, the decline in returns was also smaller than in 1929. From average income per sow to $100 greater than average the management return on the farm increased about $150 in 1929.

In table XII it is shown that as the income per sow increases up to about $200 the livestock income per man and the returns per $100 of feed both increase. But after this point is reached no appreciable change takes place in these factors. The percentage of expense to income, however, continues to fall, and the rate of turnover of the invested capital continues to rise until the hog income amounts to $250 to $300 per sow.

## NUMBER OF BEEF CATTLE FED

Slightly over half the farms on which records were obtained sold no more than five head of cattle and, consequently, can hardly be regarded as having a beef enterprise worth consideration. Out of the records obtained only 8 in 1929 and 18 in 1930 fed over 125 head. Thus we may say that for the purpose of our present discussion, the beef enterprise varied between 5 and 125 steers.

Figure 14 shows that the farms feeding 90 steers more than the average, or slightly over 100 head in all, in 1929 had net incomes about $1,000 greater than the average net income. After

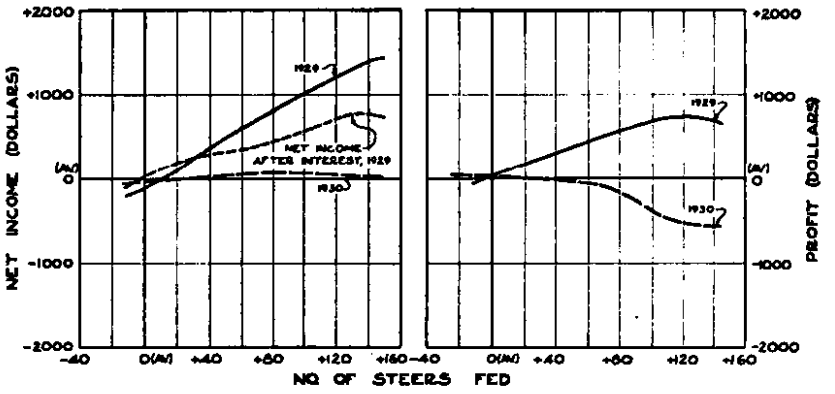


Fig. 14. Number of steers fed as related to net income and profit.

the payment of interest on funds borrowed the remaining net income was about $500 greater than average. In 1930, with relatively unfavorable price relationships, the corresponding difference in net income amounted to less than $200. In the management returns on the same farms in 1929 the men feeding 100 steers in all showed profits about $600 greater than the average, while in 1930 their profits were $300 less than average.

In 1929 the curve of regression suggested that the net income before interest was paid began to decline after about 160 head of steers, while the net income after interest payments declined after about 140 head. The profit, on the other hand, turned downward after the enterprise reached about 130 head in 1929 and after 80 head in 1930.

As the size of the beef enterprise increased, the number of hogs tended to increase with it but at a slower rate as shown in table XIII. On the farms feeding over 125 steers the number of litters of pigs actually declined as attention of the operator was centered on cattle feeding as a specialty and to the exclusion of other enterprises.

With the growth of cattle feeding, the amount of labor used on the farm followed a trend much like that of the size of the hog enterprise, except that the farms feeding over 125 steers used many more months of labor than the smaller ones. Both the livestock income per man and the rate of turnover on the capital invested increased almost in a straight line with the size of the beef enterprise. The returns per $100 of feed, however, declined rapidly as the number of steers fed increased from 5 to 30 or 40 head. After this the decline continued but at a slower rate. The hog income per sow showed a tendency to rise as more steers were fed and the pigs were used more and more to follow the cattle. Another change occurred in the financial ratios as the size of the feeding enterprise grew. The more steers bought to feed, the higher became the percentage of expense to income until on the largest feeding farms it was nearly half again as high as where the smallest number of steers was fed.

TABLE XIII. NUMBER OF STEERS FED

| No. steers fed | No. records 1929 and 1930 combined | Beef income per head | | Litters | | Months labor | Livestock income per man | | Income per $100 invested | | Return per $100 feed | | Percent expense to income | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1929 | 1930 | Spring | Fall | | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 |
| 0— 5 | 704 | $28 | $ 7 | 11 | 4 | 20 | $2265 | $1787 | $16 | $12 | $158 | $122 | 45 | 69 |
| 6— 25 | 378 | 27 | 11 | 14 | 5 | 24 | 2763 | 1905 | 17 | 12 | 149 | 111 | 47 | 73 |
| 26— 45 | 86 | 27 | 16 | 18 | 7 | 25 | 3261 | 2471 | 16 | 12 | 136 | 104 | 53 | 81 |
| 46— 65 | 56 | 27 | 16 | 20 | 7 | 27 | 3938 | 2626 | 17 | 12 | 135 | 103 | 52 | 82 |
| 66— 85 | 31 | 30 | 18 | 23 | 7 | 28 | 3775 | 2995 | 15 | 16 | 134 | 119 | 58 | 72 |
| 86—125 | 25 | 42 | 19 | 24 | 11 | 28 | 5568 | 3435 | 20 | 15 | 124 | 99 | 67 | 88 |
| 126 & up | 26 | 29 | 20 | 21 | 7 | 36 | 4938 | 3906 | 23 | 16 | 126 | 103 | 68 | 88 |

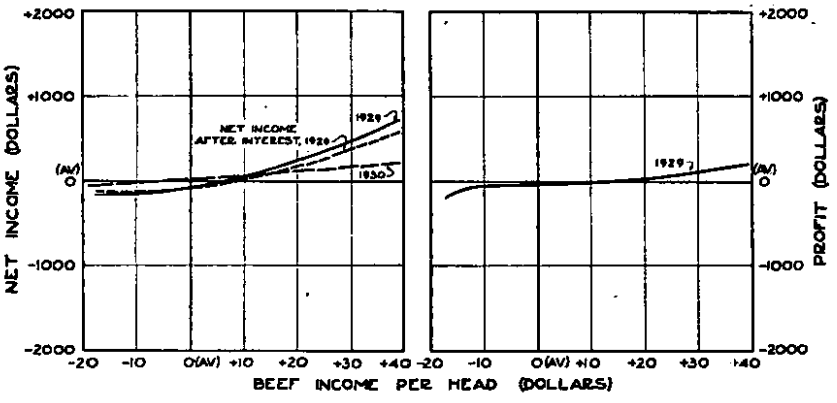


Fig. 15. Beef income per head as related to net income and profit.

## BEEF INCOME PER HEAD

Figure 15 suggests the increasing costs of obtaining a higher beef income per head of cattle. In 1929 on farms which received an average beef income $30 per head greater than average, the net income was only about $500 greater than average. After the payment of interest charges it was only about $350 greater, and profit was only about $100 greater than average. In 1929 there was no perceptible difference in management returns as between the farms with a beef income per head $10 less than average and those where it was $15 greater than average, but outside these limits this factor caused some variation in the profits.

In 1930, with unfavorable price relationships, there was a much smaller change in the net income with variations in the beef income per head. In the profit there was no apparent change that could be attributed to this factor. In other words, in 1930 the higher rates of income from beef on some farms were completely absorbed in the feed and other expenses required in obtaining them.

As the income from sales of beef per head of all the cattle on the farm increases, we find in table XIV that an increase occurs in the

TABLE XIV. BEEF INCOME PER HEAD

| Beef income per head | No. records | | Livestock increase per man | | Income per $100 invested | | Return per $100 feed | |
|---|---|---|---|---|---|---|---|---|
| | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 |
| —$30—$16 | — | 16 | $ — | $1300 | $ — | $12 | $ — | $113 |
| — 15— 1 | — | 81 | — | 1599 | — | 11 | — | 109 |
| 0+ 14 | 137 | 316 | 2349 | 1813 | 16 | 12 | 151 | 115 |
| 15+ 29 | 263 | 223 | 2457 | 2366 | 17 | 13 | 152 | 116 |
| 30+ 44 | 163 | 46 | 3000 | 2789 | 17 | 14 | 152 | 123 |
| 45+ 59 | 35 | 7 | 3429 | 2886 | 16 | 17 | 154 | 167 |
| 60+ 74 | 12 | 2 | 3758 | 2650 | 19 | 15 | 142 | 210 |

rate of turnover on the capital invested in the farm, in the livestock income per man, and in the income per $100 of feed. Each of these related factors, however, increases with the beef income per head at a diminishing rate. The beef income and the hog income per sow increase together. It seems likely that the farmers who are better than average feeders of cattle are also generally good feeders of hogs. Another reason was suggested in the last section. That is, beef income per head increases with the number of steers fed, and as more steers are fed the hogs are used more and more to clean up after the steers. The "pick up" by hogs following cattle may make up some deficiencies in the hogs' ration.

## DAIRY INCOME PER COW

In order to obtain high income per cow it is necessary to give close attention to the dairy. Where the dairy enterprise is a relatively minor source of income, close attention is likely to result in some neglect of other enterprises and a corresponding loss of income for the business as a whole. For 1929, table XV suggests that, for the group of farms as a whole, about $130 was as high a rate of income per cow as was likely to be profitable. For other years with different relative prices for dairy products as compared with alternative farm products, the point of maximum advantage might be expected to be somewhat different.

Figure 16 shows that the point of maximum advantage for this factor is higher on specialized dairy farms than on farms of other types. Thus on dairy farms the net income after interest payments continued to rise until the dairy income amounted to about $160 per cow, or $60 above the average for the 610 farms. The profit continued to rise until the dairy income was between $180 and $200 per cow. On farms of other types, however, changes in the dairy income made very little difference up to $120 or $140 per cow. After this point both net farm income and the management return began to decline. The fact that the decline sets in at a point about $40 per cow lower on

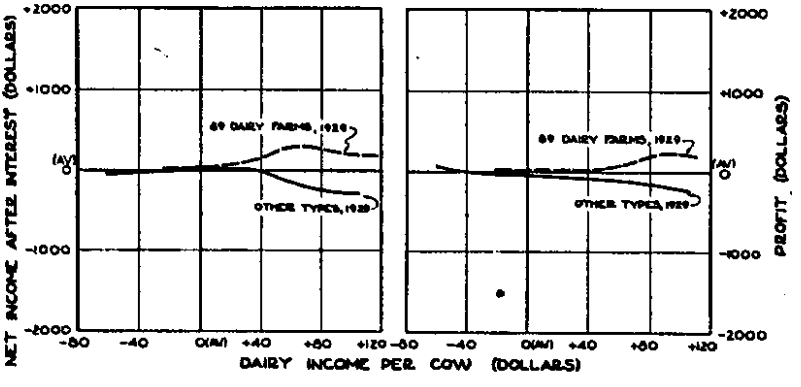


Fig. 16. Dairy income per cow as related to net income and profit.

other types than on dairy farms seems more highly significant than the absolute difference in net income or management return at any given point. The more important a given enterprise is, relative to the rest of the farm, the farther it will pay to concentrate attention on its management. The smaller the enterprise the sooner we encounter the point of diminishing returns as we give it more managerial attention, with a consequent reduction in the care to other sections of the business.

In table XV it is shown that, in 1929, the livestock income per man tended to rise with the dairy income per milk cow until it amounted to about $135 per cow, but no further. The returns per $100 of feed and the hog income per sow also followed a similar course. They seemed to rise until the dairy income per cow was between $120 and $140 per cow and then tended to turn downward as a still larger income was obtained from the dairy herd. The same tendency shows up again in the income per hundred dollars invested.

### LIVESTOCK INCOME PER $100 OF FEED

The income from productive livestock per $100 of feed consumed by income-yielding livestock is a significant measure of managerial and feeding efficiency. This is influenced both by the selection of the ration and also by the judgment of the farmer in selecting his stock. With hogs the feed generally constitutes about 75 percent of the total expense chargeable to the enterprise. With fattening steers it is from 75 to 85 percent. With dairy cows, where more care is required per cow, the feed comprises 50 to 60 percent. But if we take together all the livestock enterprises on the farms which we have been studying, the feed will amount to something like 75 percent of the total expenses on livestock. Therefore, an income of about $130 may be considered as necessary for each $100 of feed before the combined enterprises can be regarded as breaking even on all the cost elements used.

Figure 17 shows that for 1929 the net income of the farms studied rose until the returns per $100 of feed amounted to about $200 (about $60 more than average). After this point the net income as well as the management returns from the farm tended to remain constant or to decline. The net income after deduction of interest charges also increased with higher returns from feed. On this curve the decline set in at about $160 per $100 of feed for the years 1927, 1928 and 1929.

In 1930 the livestock income per $100 of feed averaged $116, which was $30 to $40 lower than in the earlier years. This differed considerably from farm to farm with the time of year when the farmer sold the greater part of his livestock crop. As between farms in 1930 the net income and the management return varied less with the returns from feed than in the earlier and more favorable years. Indications were that the point of

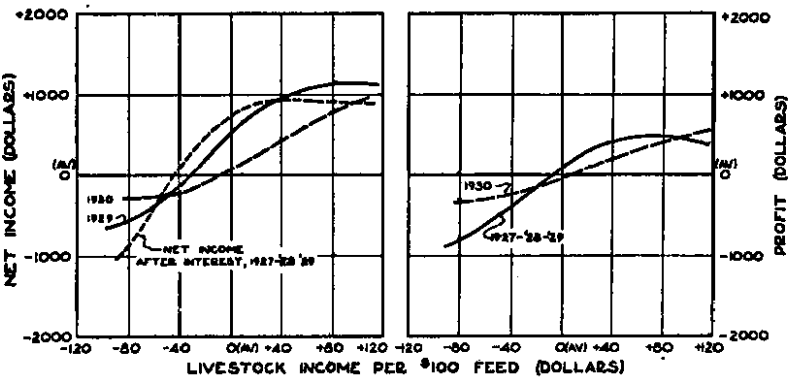


Fig. 17. Livestock income per $100 of feed as related to net income and profit.

maximum advantage for 1930 was probably at about $200 per $100 of feed, or about $80 greater than the average, as compared with $60 greater than average in the three earlier years.

At first thought one might expect that the net income and management returns would increase practically in a straight line with returns from feed. Why do they not do so? The explanation seems to be that higher expenses in other directions are necessary to get the highest possible returns from a given livestock enterprise. With the same feed consumption a higher total return may be obtained by more care and labor. The highest production per unit of feed is commonly obtained from high grade and more expensive stock. This stock requires a greater investment, on which the interest charge is greater than on mediocre stock. In several different directions, greater rates of return from livestock require intensification in that particular enterprise. This makes it more difficult for the farmer to handle as large a business. Thus the gain in efficiency is likely to be offset by a loss in size of enterprise. In each enterprise there is a point where it is profitable to stop intensifying in order to get the most advantageous balance between efficiency and size of the particular enterprise as well as between it and the rest of the farm.

It may be true that the point of optimum returns per $100 of feed varies somewhat as between different livestock enterprises, and it would seem likely to vary as between different feed and livestock price ratios. Unfortunately the data at hand did not permit a separate examination of returns on feed from different enterprises. An examination, however, was made of the curves of relationship as between different types of farms represented in the 1929 records. On the hog, beef, dairy, crop and diversified farms the points at which the curves turned downwards

## TABLE XV. DAIRY INCOME PER COW

| Dairy income per cow | No. records | | Livestock increase per man | | Return per $100 feed | | Hog income per sow | | Income per $100 invested | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 |
| $ 6— 25 | 2 | 7 | $3000 | $1514 | $145 | $ 97 | $185 | $100 | $ 15 | $ 8 |
| 26— 45 | 28 | 37 | 1971 | 1997 | 115 | 101 | 136 | 147 | 14 | 12 |
| 46— 65 | 71 | 123 | 2334 | 1825 | 145 | 110 | 159 | 121 | 16 | 12 |
| 66— 85 | 119 | 198 | 2680 | 1941 | 149 | 115 | 166 | 132 | 16 | 12 |
| 86—105 | 140 | 139 | 2598 | 1940 | 149 | 114 | 163 | 138 | 16 | 12 |
| 106—125 | 105 | 89 | 2978 | 2204 | 160 | 118 | 182 | 144 | 18 | 13 |
| 126—145 | 76 | 56 | 2799 | 2452 | 165 | 134 | 179 | 144 | 18 | 14 |
| 146—165 | 33 | 15 | 2879 | 2727 | 152 | 129 | 166 | 144 | 18 | 15 |
| 166—185 | 15 | 6 | 2718 | 2550 | 166 | 130 | 178 | 117 | 18 | 14 |
| 186—205 | 9 | 7 | 2744 | 2614 | 162 | 106 | 144 | 121 | 16 | 14 |
| 206 and above | 7 | 8 | 8048 | 2488 | 173 | 188 | 159 | 117 | 17 | 18 |



## TABLE XVI. RETURNS PER $100 OF FEED

| Returns per $100 feed | No. records | | Income per $100 invested | Percent expense to income | Crop acres per man | Livestock income per man | | Hog income per sow | | Dairy income per cow | | Beef income per head | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1929 | 1930 | | | | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 |
| $ 0— 45 | — | 10 | $ 7 | 116 | 108 | $ — | $ 660 | $ — | $ 72 | $ — | $ 59 | $ — | $ 2 |
| 46— 65 | — | 30 | 9 | 110 | 88 | — | 1097 | — | 102 | — | 81 | — | 1 |
| 66— 85 | 13 | 89 | 10 | 86 | 100 | 2369 | 1682 | 149 | 127 | 55 | 81 | 17 | 7 |
| 86—105 | 52 | 147 | 12 | 75 | 95 | 2267 | 2052 | 142 | 135 | 88 | 84 | 19 | 11 |
| 106—125 | 103 | 195 | 14 | 64 | 93 | 2752 | 2250 | 157 | 141 | 92 | 86 | 27 | 11 |
| 126—145 | 144 | 104 | 15 | 55 | 87 | 2924 | 2156 | 171 | 136 | 97 | 94 | 26 | 10 |
| 146—165 | 103 | 54 | 16 | 47 | 85 | 2517 | 2148 | 176 | 141 | 110 | 88 | 25 | 13 |
| 166—185 | 78 | 26 | 18 | 45 | 85 | 2642 | 2488 | 179 | 168 | 113 | 110 | 27 | 14 |
| 186—205 | 56 | 9 | 19 | 43 | 81 | 2705 | 1867 | 176 | 143 | 109 | 97 | 27 | 9 |
| 206—225 | 26 | 10 | 19 | 41 | 84 | 2750 | 1640 | 194 | 115 | 117 | 80 | 21 | 8 |
| 226—245 | 12 | 6 | 19 | 47 | 78 | 2575 | 2033 | 182 | 125 | 122 | 168 | 26 | 7 |
| 246 & up | 21 | 9 | 19 | 38 | 91 | 2319 | 2589 | 181 | 112 | 106 | 138 | 20 | 21 |

varied by only a few dollars. The principal difference between types of farms was that the curves showing variations in net income and the management returns rose more steeply on the steer feeding farms than on the other types. This may be explained by the two facts that, a larger proportion of total income generally comes from the sale of livestock on these than on the other types, and that in this year there was a rather favorable price relationship between the prices of corn and of beef cattle.

Table XVI shows that as the returns per $100 of feed increased, the rate of turnover on capital increased, and the percentage of expense to income declined. Changes in these factors, however, became small after the returns amounted to about $200 per $100 of feed. The same is true of the acres of crops handled per man, which declined as the returns on feeds rose to about $200.

The total livestock income per man increased with the returns on feed until this was somewhere between $150 and $200 and thereafter showed no definite trend. Hog income per sow and dairy income per cow showed some tendency to rise with the higher returns per $100 of feed, but not as clear a trend as might be expected. The beef income per head, of all cattle, however, rose sharply from the lowest to medium rates of return on feed, thereafter remained at about the same level for a time and then declined again.

## EFFICIENCY IN USE OF COST ELEMENTS

To achieve a high net return the farmer needs to give attention to economy in the use of the cost elements as well as to get the greatest possible returns from the income-yielding enterprises. Among the cost elements we find the effective use of labor to be, generally, the most important consideration. The supply of labor on most farms is likely to be rather narrowly limited. Hence the great amount of attention given to the means of accomplishing as much as possible with it by the aid of labor-saving layout of fields and buildings and by the use of relatively large power and equipment outfits.

As a measure of the effectiveness with which the labor was employed, it was decided to use the acres of crops raised per 12 months of labor. This factor was found to be affected by the intensiveness with which labor was applied to the crop or livestock enterprises as well as by the efficiency with which it was used. It was therefore unsatisfactory as a measure of efficiency of labor alone. This is one of the many cases where two measures of performance might be more satisfactory than one alone. Nevertheless, definite and important relationships were found between this factor and the net income and profit, showing that even as an expression of a mixture of two sets of influences this factor may be well worth using.

An examination was made of the expense per acre for crop equipment, as a measure of the economy with which the needed

machinery is provided. But in spite of the large amount of attention and discussion given to economy in capital invested in equipment, this was found to be of relatively small importance as an influence on the farm's returns. Also it did not represent a single homogeneous influence.

## MONTHS OF LABOR USED ON THE FARM

It is shown in fig. 18 that net income increased with the amount of labor used, as between farms. This held true until 20 to 25 months labor more than average was used. Since the average was 22 or 23 months this means that net income increased up to about 45 months. After this point there seemed to be but little change, although there was some tendency for income to decline after this point.

In the earlier years of the study there was but little change in management returns as between farms using different amounts of labor until about 30 months were reached. After this point a definite tendency to smaller returns appeared. In other words the wages of the additional labor more than consumed any increases in value of the farm output. There was, in some areas and in some years, a suggestion that the management returns tend to reach a low point at between 27 and 30 months of labor, to recover between this and 35 months and to decline again at 36 or 37 months. The farms using 27 to 30 months of labor are those which employ one man the year round in addition to the 12 months of the operator's labor plus 3 or 4 months of family labor, but which are not large enough to need additional help in the busy seasons. Consequently the available labor is likely to be only partly utilized during several slack months. Likewise the farms using 36 or 37 months of labor are generally the ones which employ two men the year round but no supplementary labor in the busy seasons.

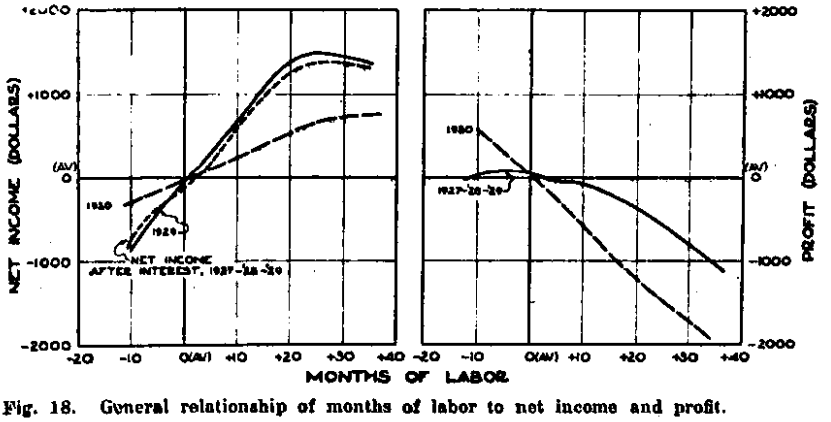


Fig. 18. General relationship of months of labor to net income and profit.

In 1930 with unfavorable prices and poor crop yields, the net income increased less with added months of labor than in the earlier years of the study. Also the management return declined more rapidly, and the decline was continuous from the start instead of setting in after the average amount of labor was reached.

Table XVII shows that as more labor was used the acreage in corn and the number of litters of pigs raised increased almost in a straight line. This was true for all types of farms combined, but as we shall see later the relationship varied somewhat as between different types. The number of steers fed increased somewhat more rapidly as more and more labor was used and as we changed to larger farms where there was a tendency towards more cattle feeding relative to other enterprises.

Labor is generally recognized as the cost element which requires the greatest application of managerial attention. Thus the amount of labor available on a farm which is being operated under a given technique and with a given managerial ability may be assumed to determine pretty definitely the aggregate size of the productive enterprises. Naturally the size of a specific enterprise, such as corn or hogs, will vary with the labor in a different ratio depending on the number and size of the other enterprises present. Consequently we expect a closer relationship between months of labor and size of a given enterprise on farms of the same type.

In fig. 19 are shown the general curves of gross relationship between months of labor and acreage in corn, and between months of labor and litters of pigs by types of farms. For this part of the study the records for 1929 and 1930 were combined, since there was but little change in the physical organization of the farms from year to year and the larger number of records helped to smooth out those fluctuations in the curves which were due to chance variation within small groups of farms.

TABLE XVII. MONTHS LABOR

| Months labor | No. records 1929 and 1930 combined | Corn acres | Spring litters | Fall litters | No. steers fed |
|---|---|---|---|---|---|
| 10 or under | 8 | 27 | 2 | 3 | — |
| 11—15 | 273 | 49 | 9 | 3 | 4 |
| 16—20 | 341 | 56 | 10 | 4 | 8 |
| 21—25 | 297 | 83 | 14 | 5 | 19 |
| 26—30 | 203 | 92 | 16 | 6 | 18 |
| 31—35 | 87 | 105 | 20 | 5 | 24 |
| 36—40 | 58 | 117 | 24 | 6 | 38 |
| 41—45 | 16 | 136 | 20 | 7 | 48 |
| 46—50 | 11 | 136 | 17 | 7 | 75 |
| 51 and over | 12 | 184 | 29 | 9 | 90 |

The acreage in corn and the number of litters of spring pigs both showed a tendency to rise in almost straight lines as the amount of labor used on the farm was increased. The corn acreage increased at an increasing rate until the total labor amounted to about 25 months. After this the rate of increase in corn acreage slowed down. The number of litters of pigs did not exhibit any clear tendency to change in the rate of rise.

As between types of farms there were some clear differences in the rate of increase in the size of these two outstanding enterprises. Of course, the more a farm is specialized, the closer the relationship between months of labor and size of the major enterprise. Thus the rate

of increase in the acreage of corn was greatest on the cash grain farms, next greatest on the diversified farms, and was least on the dairy farms. The rate of increase in number of litters of pigs was greatest on hog farms and least on cash grain farms.

The general tendencies shown in fig. 19 are clear between groups of farms using different amounts of labor. But within each group there was a wide variation, as is shown in fig. 20 for the group of diversified farms. Within some of the subgroups of farms using about the same amount of labor, the maximum range in the acres of corn or of litters of pigs is almost as wide as the entire range for this type of farm. The distribution for other types of farms was very similar to that shown in fig. 20 for the diversified farms.

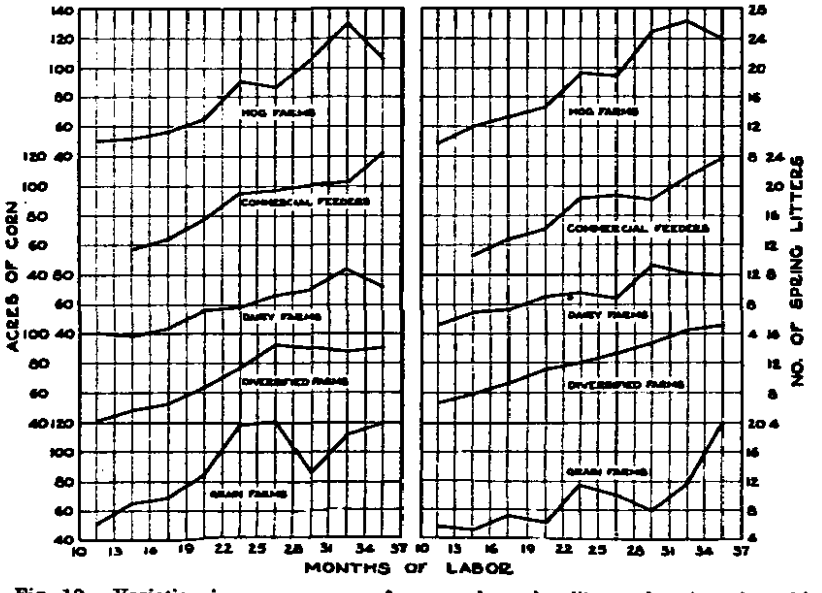


Fig. 19. Variation in average acres of corn and number litters of spring pigs with months of labor.

## CROP ACRES PER MAN

The number of acres of crops handled per man-year (i.e., 12 months of labor) is an inverse measure of the intensiveness of the business; that is, of the relative proportion of labor to land. It is also influenced by the effectiveness with which labor is used. It therefore represents a composite of two influences rather than one.

In fig. 21 is shown the relationship of acreage of crops per man to net income and farm profit. In general net income increased almost in a straight line with acres of crops per man.

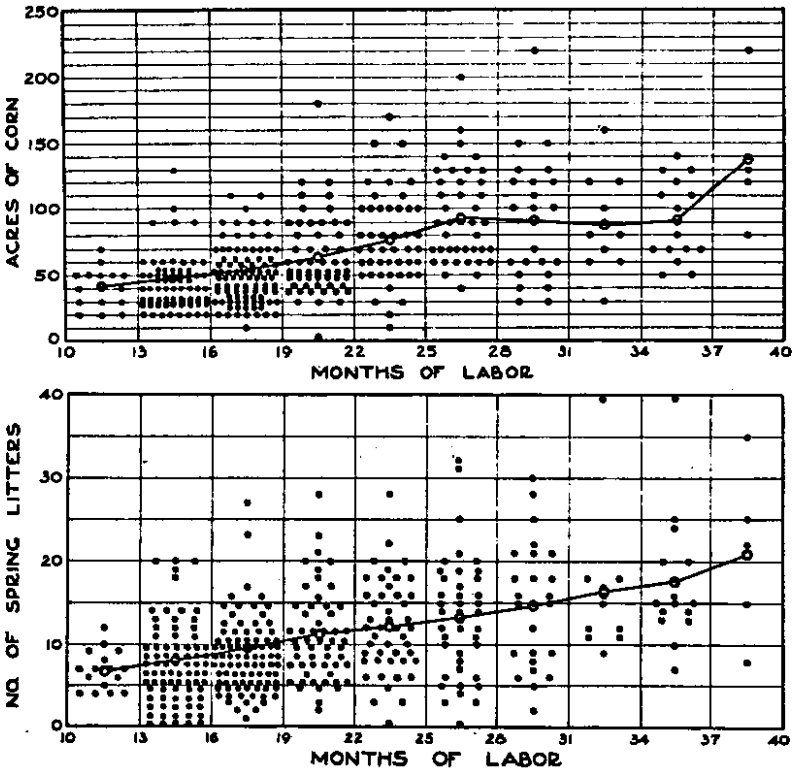


Fig. 20. Scatter diagrams showing variation in acres of corn and in litters of spring pigs with months of labor.

Net income after payment of interest charges increased more rapidly up to between 60 and 70 acres than beyond this point. There is probably but little difference in the interest charges per acre on large as compared with small farms, but the farm that is being operated more extensively yields a smaller total return per acre and consequently the interest takes a larger proportion of the gross income.

The profit or management return for the earlier years, as shown in fig. 21, rose until about 100 acres of crops (10 to 20 acres more than average) were being handled per man and thereafter tended to decline. In 1930 greater losses were encountered, because of falling prices and a partial crop failure, on those farms where most effort had been invested per acre in an attempt to get a high yield.

It was thought that the rates of returns from labor might vary as between the more extensive types of farms and those where a larger proportion of the effort was spent on the elabora-

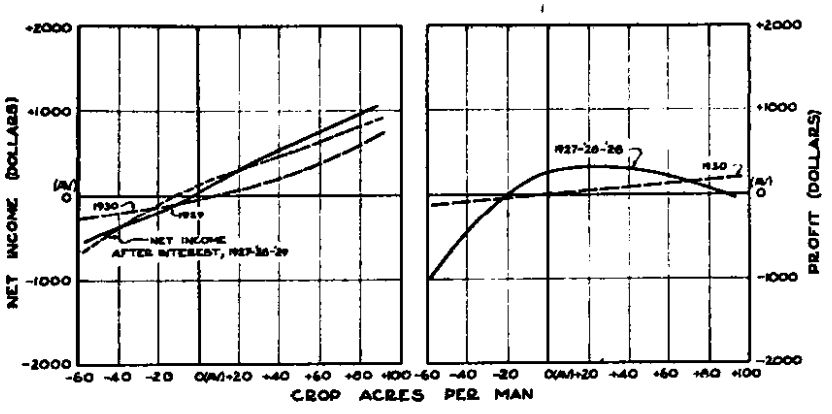


Fig. 21. General relationship of crop acres per man to net income and profit.

tion of crops into livestock products. Consequently the farms were divided into two groups, one containing the diversified farms and those getting the greater part of their income from crop sales and the others the livestock types—hog farms, commercial cattle feeding, cattle raising and dairying. The results are shown in fig. 22.

There is relatively little difference in the curves of net returns or profits as between the two types of farms until about 100 acres of crops are being raised per 12 months of labor. After this point the difference is clearly marked. The returns declined rather sharply as the land farmed per man rose above 100 acres on the livestock types of farms. On the crop farms the net returns continued to rise, at least up to 170 acres per man. The profits, however, began to decline after approximately 140 acres.

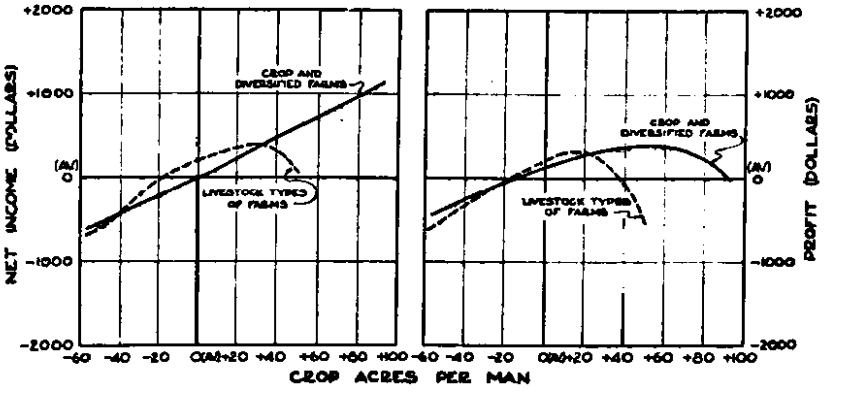


Fig. 22. Crop acres as related to net income and profit, crop and livestock farms contrasted.

It is shown in table XVIII that, as the acreage of crops handled per man increased, there was a tendency for the livestock income per man to rise also. But, on the other hand, with an increase in the total acreage and in the livestock at the same time, there was a strong tendency for the work to be more superficial in nature. Consequently we find that with the increase in acres of crops raised per man, there was a tendency to lower yields of corn. Also the rate of turnover on capital invested declined from $17 per $100 on farms where 50 acres of crops were raised per man to $12 where 200 or more acres were raised. At the same time the returns from livestock per $100 of feed declined from about $150 to $107.

## LIVESTOCK INCREASE PER MAN

The gross income from livestock per 12 months of labor was examined as one measure of the effectiveness with which labor is used and as an indication of the emphasis placed on livestock production. It was not used as an independent factor in the multiple correlation study because it would largely have duplicated influences already covered jointly by factors representing amount of labor used, hog income per sow, beef income per head and dairy income per cow. Table XIX gives some idea of the gross relationships between the livestock income per man and four of the other factors.

As the attempt was made to produce more and more livestock per man the percentage of expense to income at first declined. But as the livestock income per man rose beyond $4,000 in 1929, and above $3,500 in 1930, the percentage of expense again became less favorable—reflecting the difficulty of handling larger and larger livestock enterprises with the same amount of labor.

The rate of turnover, or income per $100 invested tended to rise with the livestock income per man. A larger investment in livestock was generally necessary to a larger livestock income per man. Also the turnover of capital is rapid on the investment in livestock. Therefore, we find a fairly close relationship between livestock income and rate of turnover.

It might be expected that the production of more income per man from livestock would imply a reduction in the size of the crop enterprises. But the two sets of enterprises are very closely associated. If more livestock are to be raised it is necessary to produce more feed crops for them. A relatively small proportion of the farms bought large amounts of feed. Thus the size of livestock enterprises was generally an indication of labor efficiency which carried over into other branches of the business as well. Thus the acreage of crops increased along with the income per man from livestock except on a small number of specialized livestock farms where the effort was actually centered on livestock at the expense of the crops.

The returns per $100 of feed increased along with the livestock income until this amounted to about $4,000 per man. Beyond this point the fluctuation in returns from feed was rather erratic, partly because of the small number of cases in each class in table XIX. There appears, however, to be a rather clear tendency for livestock returns higher than $4,000 per man to be accompanied by a decline in the returns from feed. Again the effort to spread labor over too large an enterprise is accompanied by a loss of efficiency.

## TABLE XVIII. CROP ACRES PER MAN

| Crop acres per man | No. records 1929 and 1930 combined | Acres corn | Yield corn | Income per $100 invested | Return per $100 feed | No. spring litters | No. fall litters | Months labor | Livestock income per man | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 1929 | 1930 |
| 16 — 35 | 16 | 24 | 45 | $17 | $154 | 4 | 1 | 26 | $1450 | $1350 |
| 36 — 55 | 111 | 44 | 46 | 17 | 146 | 11 | 4 | 23 | 2424 | 1698 |
| 56 — 75 | 293 | 58 | 47 | 16 | 139 | 12 | 5 | 23 | 2723 | 2089 |
| 76 — 95 | 381 | 71 | 44 | 14 | 131 | 14 | 5 | 23 | 2693 | 2009 |
| 96 — 115 | 257 | 84 | 44 | 13 | 129 | 15 | 4 | 21 | 2725 | 2114 |
| 116 — 135 | 160 | 101 | 43 | 13 | 124 | 14 | 4 | 22 | 2669 | 1833 |
| 136 — 155 | 50 | 114 | 41 | 13 | 132 | 15 | 7 | 22 | 2570 | 2533 |
| 156 — 195 | 25 | 141 | 42 | 13 | 118 | 17 | 6 | 23 | 2933 | 2519 |
| 196 — 296 | 8 | 180 | 41 | 12 | 107 | 19 | 10 | 23 | 3150 | 3250 |



## TABLE XIX. LIVESTOCK INCREASE PER MAN

| Livestock increase per man | No. records | | Percent expense to income | | Income per $100 invested | | Crop acres per man | Return per $100 feed | |
|---|---|---|---|---|---|---|---|---|---|
| | 1929 | 1930 | 1929 | 1930 | 1929 | 1930 | | 1929 | 1930 |
| $ 60 — 550 | — | 16 | — | 84 | $ — | $ 10 | 78 | $ — | $ 68 |
| 560 — 1050 | 19 | 50 | 51 | 82 | 14 | 10 | 78 | 143 | 97 |
| 1060 — 1550 | 66 | 139 | 46 | 75 | 15 | 11 | 89 | 145 | 113 |
| 1560 — 2050 | 117 | 164 | 50 | 71 | 15 | 12 | 87 | 152 | 120 |
| 2060 — 2550 | 132 | 135 | 46 | 70 | 16 | 13 | 90 | 154 | 119 |
| 2560 — 3050 | 102 | 64 | 45 | 67 | 17 | 14 | 93 | 155 | 124 |
| 3060 — 3550 | 66 | 33 | 48 | 66 | 17 | 16 | 90 | 151 | 135 |
| 3560 — 4050 | 44 | 30 | 48 | 69 | 20 | 17 | 89 | 162 | 128 |
| 4060 — 4550 | 20 | 9 | 47 | 72 | 18 | 19 | 93 | 143 | 154 |
| 4560 — 5050 | 13 | 10 | 63 | 86 | 18 | 16 | 107 | 131 | 105 |
| 5060 — 6050 | 20 | 9 | 59 | 79 | 21 | 21 | 103 | 145 | 119 |
| Above 6050 | 11 | 1 | 52 | 100 | 23 | 26 | 93 | 153 | 100 |

## RESULTS FOR INDIVIDUAL YEARS COMPARED WITH THREE-YEAR AVERAGES

Will the relationships just discussed hold good for averages of two or more years? For each individual farm the values of many of the efficiency factors vary widely from year to year, as do the net income and the management return. This results from changes in relative prices, in the general price level, and in seasonal influences which affect crop yields. If we average together the values for a given efficiency factor for a particular farm for 2 or more years, the result is more typical than for any one year. A series of such averages might give us a picture very different from the list of factors from one single year.

There were 144 farms on which records were available for each of the 3 years, 1927, 1928 and 1929. Starting with the curves already developed, estimates of the 3-year average net incomes and management returns were made for each of these farms. Next the curves were corrected to fit the data more closely. Some of the comparisons afforded by this study are shown in tables XX and XXI.

TABLE XX. STANDARD DEVIATIONS FOR 1929 COMPARED WITH STANDARD DEVIATIONS OF 3-YEAR AVERAGES BY FARMS

| | 1929 | 3-year av. 1927-1929 |
|---|---|---|
| No. farms | 610 | 144 |
| Net farm income | $1970 | $1422 |
| Management return | 1334 | 939 |
| Gross income per $100 invested | $ 4.95 | $ 4.12 |
| Percent total expense to income | 17.2 | 14.9 |
| Percent investment in working capital | 5.9 | 4.3 |
| Total acres in farm | 101 | 92.2 |
| Acres corn | 42 | 31 |
| Yield corn, bushel | 10.8 | 9.2 |
| No. litters spring pigs | 9.8 | 9.4 |
| No. litters fall pigs | 5.5 | 4.9 |
| Hog income per sow | $ 67.74 | $ 52.42 |
| No. steers fed | 26 | 17 |
| Beef income per head | $ 13.63 | $ 9.31 |
| Dairy income per cow | 39.20 | 28.10 |
| Livestock income per $100 feed | 44.85 | 26.04 |
| Months labor used | 9.2 | 6.7 |
| Crop acres per man | 29 | 22 |

It was found that the 3-year averages by farms varied less widely than the corresponding figures for any individual year. In other words, many of the extreme variations were largely cancelled out in the averaging process. Table XX shows that the standard deviation for net income for 1929 was $1,970, while for the 3-year average it was only $1,422. The 1929 standard deviation for management returns was $1,334, while for the 3-year average it was $939. The standard deviation for corn yield was 10.8 bushels for 1929, as compared with 9.2 bushels for the

TABLE XXI. STEEPNESS OF CURVES BASED ON 3-YEAR AVERAGES COMPARED WITH 1929 CURVES

| | Assumed change in independent variables (a) | Associated change in dependent variable | | | |
|---|---|---|---|---|---|
| | | Net income | | Management return | |
| | | 1929 | 3-yr. av. | 1929 | 3-yr. av. |
| Gross income per $100 invested | From $10 to $20 | — | — | +$1050 | +$1050 |
| Percent total expense to income | From 33% to $67 | —$1325 | —$1150 | — 750 | — 700 |
| Percent investment in working capital | From 8% to 25% | + 150 | + 240 | + 100 | + 200 |
| Total acres in farm | From 100 to 300 acres | + 275 | + 250 | + 100 | + 125 |
| Acres corn | From 20 to 100 acres, Cash Grain Area | + 750 | + 750 | + 1075 | + 1075 |
| | From 20 to 100, rest of state | + 800 | + 550 | + 1100 | + 1050 |
| Yield corn | From 30 to 50 bu. per acre | + 825 | + 725 | + 525 | + 525 |
| No. litters spring pigs | From 5 to 25 litters | + 750 | + 600 | + 175 | + 75 |
| No. litters fall pigs | From 2 to 12 litters | + 425 | + 225 | + 100 | + 100 |
| Hog income per sow | From $80 to $200 per sow | + 350 | + 250 | + 125 | + 200 |
| No. steers fed | From 10 to 60 steers | + 650 | + 550 | + 325 | + 375 |
| Beef income per head | From $12 to $40 per head | + 325 | + 225 | — | — |
| Dairy income per cow | From $100 to $180 per cow, dairy types | + 275 | + 325 | + 225 | + 300 |
| | From $60 to $140 per cow, other types | + 50 | + 75 | — 50 | 0 |
| Livestock income per $100 feed | From $100 to $200 per $100 feed | + 1350 | + 1325 | + 500 | + 225 |
| Month labor used | From 14 to 32 months | + 1275 | + 1175 | — 125 | — 175 |
| Crop acres per man | From 50 to 110 acres, crop and mixed types | + 675 | + 550 | + 500 | + 400 |
| | From 50 to 110 acres livestock types | + 550 | + 475 | + 425 | + 500 |

(a) The changes in the independent variables assumed were approximately equal to changes from one standard deviation below to one standard deviation above the mean in the 1929 figures.

3-year averages. Similar reductions occurred in standard deviations of other factors. Only the total acres in the farm and the number of spring and fall litters failed to show reductions in their standard deviations of over 10 percent. The typical reduction was between 20 and 25 percent.

Table XXI gives some idea of the degree to which the functional curves between the independent variables, on the one hand, and the net income and profit on the other shifted from the studies based on individual years to that based on 3-year averages. In general, the curves related to net income tended to become somewhat less steep, while those related to management return showed only slight changes in slope and no pronounced tendency to become steeper or flatter as a group.

The percentage invested in working capital showed somewhat steeper curves than in the 1-year studies, but still remained one of the minor influences. The curves for the percentage of expense to income, the number of litters of spring pigs, and the crop acres handled per man became less steep both in their relationships to net income and to management returns. The curves for number of litters of fall pigs, hog income per sow, beef income per head, and the number of months of labor became less steep for net income but remained the same or became slightly steeper for management returns. Other factors showed no appreciable changes except possibly at the extremities where the small numbers of cases made the results inconclusive.

In no case did the general conformation of the curves change. With most of the factors, curves based on individual years could have been used to estimate 3-year average returns, or curves based on 3-year averages could have been used to estimate returns for an individual year without serious error. In other words, the relationships discovered appear to be highly stable, at least during periods when price levels or price relationships are not undergoing unusual fluctuations.

## VARIATIONS IN MANAGERIAL ABILITY AND INTERPRETATION OF EFFICIENCY FACTORS

Differences in managerial ability seem to cause a wider variation in farm returns than any other individual factor. This statement is made a priori, for there is no unquestionable method by which the ability of the manager may be measured excepting the farm returns themselves. In the course of this study the question of influence of the manager's capacity and efficiency was raised repeatedly. How often does an unsatisfactory value in an efficiency factor represent an opportunity which has been overlooked and how often does it simply indicate that the farmer in question is unable to do better because of limitations within himself? Or to put the problem in a slightly different way, if

a farmer of an inferior grade of managerial ability spends the necessary effort to attain what would be a satisfactory value of an efficiency factor for a good farmer, will his curve of income rise as would that of the good farmer under the same condition? Conceivably the same change in returns per hundred dollars of feed or in the acres of crops handled per man might mean different things for the income of the poor manager and the good manager.

To obtain an answer to this question, however, it is necessary to have some sort of a measurement of managerial ability of the different managers which is independent of the returns. In this case it was not possible to apply psychological tests to the farmers concerned nor to use any measurements other than those already in the records. It was thought, however, that the relationship between the size of business and the rate of returns might give an indication of the ability of the farmers without being too greatly influenced by the size of the net income or the profit figure.

The index of managerial ability which was adopted for this experiment was obtained by taking a geometric average of an index of size of business and an index of efficiency.[5] The basic assumption is that net returns depend both on size of business and on efficiency with which it is operated and that a man of given ability will operate at a rate of efficiency which varies inversely with the size of his business. Thus if a manager whose operating efficiency is represented by an index of 1.20 of the average efficiency is found on a farm of the average size we would expect him to earn a return to management greater than average by about 20 percent. If a farmer operates a farm 1.30 the average size but at an efficiency of only 80 percent the average efficiency, we would expect his management returns to be about 1.04 the average management returns.

On the other hand, if we find a farmer operating a farm of 1.30 the average size and obtaining a management return of only 1.04 the average, we might conclude that his efficiency was only 1.04 divided by 1.30 or 80 percent of average efficiency.

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5 For this statistical experiment there were available only the data in the records. Therefore it was decided to use the relative of the percentage of expense to income, i.e., the percentage of expense for the specific farm divided by the average percentage of the entire group of farms, as the index of economic efficiency. As a measure of size of the business an arbitrary index was obtained by averaging together the relatives of acreage in the farm, amount of labor used and number of livestock.

Thus a farm with 258 acres had 120 percent of the average acreage. If it used 29.5 months of labor in the course of the year, this amounted to 130 percent of the average amount of labor. If it had only 90 percent of the average number of livestock, its index of size would be the average of 120, 130 and 90 or 113.

The index of number of livestock was obtained by adding together the number of head of cows, plus the number of steers fed out, plus the number of litters of pigs, plus the number of ewes divided by seven. This number of livestock roughly corresponds to the more common measure of "animal units."

The index of managerial ability was now obtained by multiplying the index of size by the index of efficiency and extracting the square root. In other words the final index was a geometric average of the size and the efficiency.

Of course the measurement of managerial ability obtained by averaging the index of size with the index of efficiency must be recognized as only approximate. This is especially true in this case since only one year's data were included in the experiment. The total income received, which affects the measure of efficiency, is largely affected by abnormalities of weather and of price as well as by the actual efficiency of the farmer.

For our present purpose it was not necessary that the index adopted provide us with an accurate measure of managerial ability, but merely that it give us a figure other than the management return which appears to be definitely related to the managerial ability.

TABLE XXII. INDEX OF MANAGERIAL ABILITY 1929 RECORDS

| Management index | No. records | Crop acres per man | Yield corn | Return per $100 feed | Livestock increase per man | Hog income per sow |
|---|---|---|---|---|---|---|
| Up to .49 | 2 | 60 | 44 | $115 | $3150 | $155 |
| .50— .59 | 12 | 65 | 43 | 140 | 1767 | 144 |
| .60— .69 | 47 | 73 | 44 | 149 | 2296 | 161 |
| .70— .79 | 76 | 77 | 46 | 147 | 2234 | 160 |
| .80— .89 | 103 | 84 | 45 | 151 | 2432 | 162 |
| .90— .99 | 105 | 85 | 48 | 150 | 2610 | 167 |
| 1.00—1.09 | 92 | 97 | 46 | 164 | 2809 | 164 |
| 1.10—1.19 | 70 | 95 | 49 | 152 | 3037 | 179 |
| 1.20—1.29 | 45 | 97 | 49 | 142 | 3122 | 179 |
| 1.30—1.39 | 28 | 99 | 55 | 156 | 3152 | 165 |
| 1.40—1.49 | 14 | 99 | 54 | 134 | 3436 | 204 |
| 1.50—1.59 | 11 | 102 | 54 | 164 | 2891 | 150 |
| 1.60 & up | 10 | 102 | 47 | 178 | 2870 | 197 |

Table XXII shows that several of the more outstanding efficiency factors with which we have been dealing are definitely associated with the index of managerial ability. The crop acres per man and the yield of corn both rise with the management index. The livestock income per man rises with the management index except that the farmers with the highest management indexes seem not to have specialized in livestock production to such a great extent as the ones with moderately high management indexes. The returns per hundred dollars of feed and the hog income per sow increase along with the management index but in a less regular manner.

In order to see whether the same curves of relationship hold good for the various grades of managers, the 610 records for 1929 were divided into three groups on the basis of the index of managerial ability. Separate curves of relationship to net income and profit were then developed for each of the efficiency factors which had shown any significant relationship to the returns. Three of the more important of the resulting sets of curves are shown in figs. 23 to 25.

Figures 24 and 25 are fairly typical of the results of this section of the study as regards those factors related to size of busi-

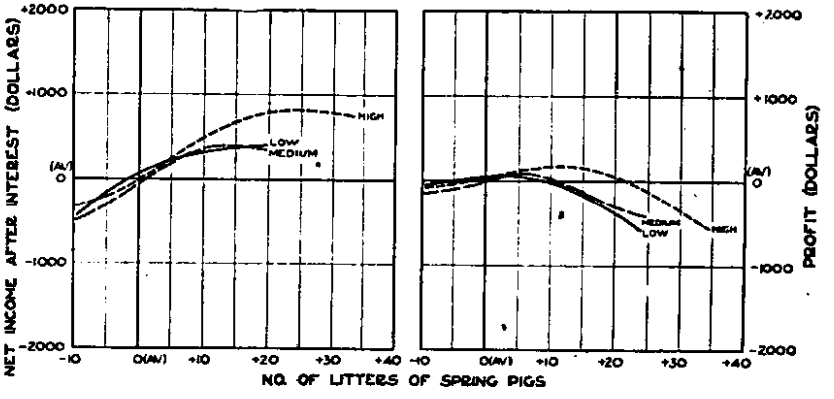


Fig. 23. Relationship of number litters of spring pigs to net income and profit by grades of managers.

ness. Figure 23 shows that as the number of litters of spring pigs is increased the net income and the profit rise at about the same rate up to about 18 or 19 litters (6 more than average) regardless of whether the farms are operated by high, medium or low rating managers. After this point, however, the returns on the farms operated by high rating managers increase at a definitely greater rate than on the farms operated by the medium or low rating managers. As between the medium and low rating men there seems to be no definite variation in the trends of returns.

In the case of the amount of labor used on the farm in the course of the year, the net income to high-grade managers rises more rapidly with increased amounts of labor from the start. With added months of labor the profit tends to decline after about 20 months of labor in each group, but among the high rating managers the rate of decline is decidedly less than with the medium or low rating groups. With this factor the differences in trends of returns vary more uniformly from low to medium, and then to high rating management groups.

These differences in trends between management groups are fairly typical of most of the other factors related to the size of business. The total acres in the farm, and acres of corn show differences in trends very similar to those in fig. 23. The trends of returns on number of fall litters and number of steers fed are more similar to fig. 24.

The classification of farms on the basis of the index of management brought to light another noteworthy variation between groups on some of the factors. There is a tendency for the highest values of some factors to be reached only in the group with highest management rating. Thus the largest acreages of corn occurred only on farms operated by high rating managers.

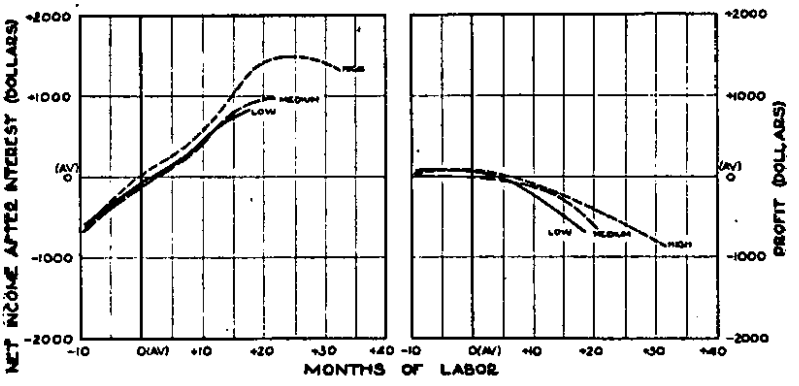


Fig. 24. Relationship of months of labor to net income and profit by grades of managers.

None of the low rating managers fed more than 40 head of steers, and only one of the medium rating managers fed more than 80 head. The same is true of some other factors. The highest rates of turnover were obtained only by high rating managers. Only 5 of the 400 low or medium rating men had a turnover rate in excess of $30 per $100 invested, while seven of the 200 high rating men had turnover rates in excess of this figure.

The occurrence of a large proportion of farms of large size in the higher management rating groups may be explained partly by the method used in construction of the management index. But this hardly explains why there should be no farms at all with medium to large cattle feeding enterprises and hardly any with a large corn acreage in the low management groups. Neither does it explain the scarcity of high rates of turnover on the low management rating farms.

It seems likely that there is a fairly close correlation between the managerial ability of the farmer and the size of the farm business which he finally builds up for himself. Therefore it may be said that the general group of factors used here, the management index, and the size of business are, to a large degree, measures of different aspects of the same thing.

Among the factors related to efficiency of operation, the livestock income per $100 of feed and the crop acres per man exhibit tendencies similar to those shown in figs. 23 and 24. The curves for the low, medium and high rating groups as classified on livestock income per $100 of feed are shown in fig. 25. With the low group there is less variation in net income with changes in livestock income per $100 of feed than with the medium or high groups. Larger returns on the feed are associated with greater increases in profit on the high rating farms than on farms of lower management ratings.

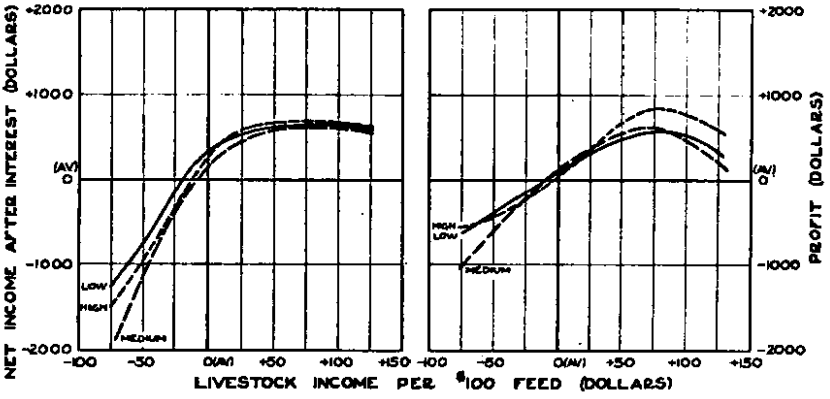


Fig. 25. Relationship of livestock returns per $100 of feed to net income and profit by grades of managers.

The conclusion to this section of the study is that the curves of relationship between most of the size and efficiency factors, on the one side, and the net income and profit on the other vary but little with the management rating as long as the efficiency factor is near its mean value. But on some factors, particularly those related to size of business, differences in trend often appear as the higher values of the efficiency factor are approached. The curves of profit turn downward sooner on the low or medium management rating groups than in the high rating group.

In several cases the operation of the principle of diminishing returns has been clearly exemplified. In this section it has been shown that with some factors the point of diminishing returns differs between farms operated by managers with different ratings of managerial ability. Even though the device used to measure managerial ability is not highly accurate, this general statement appears to be substantiated by the results of the study.

The research or extension worker who is attempting to use factors indicative of size or efficiency as a basis of recommendations to individual farmers appears to be on safe ground as long as the values of these factors are near their means. But as extreme values are approached, more and more care is needed in interpretation. In the first place a point of diminishing returns ultimately appears, and in the second place this point differs as between entrepreneurs of varying ability.

## AGGREGATE RELATIONSHIP OF FACTORS TO FARM RETURNS

Table XXIII shows the correlation between the various forms of farm returns and the estimates of the same made from the curves of relationship which we have discussed. When the actual net income figures were correlated with the estimates, a coeffi-

cient of +.88 obtained for 1929 and +.82 for 1930. The standard error of estimate was 43 percent as great as the standard deviation in 1929 and 54 percent as great in 1930. That is, the standard deviation of net income for 1929 was reduced by 57 percent and for 1930 by 46 percent. On the 144 farms which kept records continuously from 1927 to the end of 1929, the correlation of the estimated net incomes with the actual 3-year averages gave a correlation coefficient of +.92 and reduced the standard deviation by 62 percent.

The correlation of actual and estimated net income after interest payments yielded coefficients for the 4 years of +.85, +.83, +.90 and +.87. The reductions in the standard deviations amounted to 46, 44, 57 and 51 percent, respectively. The correlation coefficients between actual and estimated management returns varied from +.80 to +.84, and the reduction in the standard deviations was between 40 and 42 percent.

TABLE XXIII. CORRELATION OF ACTUAL WITH ESTIMATED NET INCOME AND PROFIT

| Year | Number factors in study* | Net income | | Net income after interest payments | | Management returns | |
|---|---|---|---|---|---|---|---|
| | | Cor. coef. | Percent reduction in $\sigma$ | Cor. coef. | Percent reduction in $\sigma$ | Cor. coef. | Percent reduction in $\sigma$ |
| 3 yr. av. | 13 | +.92 | 62 | — | — | +.81 | 39 |
| 1927 | 13 | — | — | +.85 | 46 | +.84 | 40 |
| 1928 | 13 | — | — | +.83 | 44 | +.82 | 42 |
| 1929 | 15 | +.88 | 57 | +.90 | 57 | +.80 | 40 |
| 1930 | 14 | +.82 | 46 | +.87 | 51 | +.81 | 40 |

* Including the factor, income per $100 invested, which was correlated to the management return but not to the net income figures.

Thus we may say that the factors studied accounted for about 50 percent of the variation in net income and about 40 percent 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 difficulty of representing some of the influences on farm returns in adequate quantitative terms has already been touched upon. We have here a very different problem from the qualitative theoretical analysis of the classroom.

In addition to those influences which are recognizable in a qualitative way but not exactly measurable, there are others which operate on a few farms but not on all. Peculiar soil or topography or the presence of unusual farm enterprises are examples. There are also many influences to which all farms are subject but which operate only at very irregular intervals. Hailstorms, periodic insect pests or outbreaks of plant or animal diseases are examples of this. The effects of sharp rises or falls in prices are somewhat similar in that they affect differently or-

ganized farms in different ways. When we consider the number and importance of these influences the fact that we have accounted for about 50 percent of the variation in net income for individual years and over 60 percent on the 3-year averages seems an accomplishment of some importance.

## TO WHAT USE CAN THESE RELATIONSHIPS BE PUT?

There are two somewhat different applications to which such curves of relationship as have been developed in this study can be put. One pertains to their use by extension workers in comparing individual farms with others or with averages of groups of farms. The other is related to the possible use of the curves by the individual farmers or by extension men in measuring the progress of individual farms from year to year. These may both be combined under the question: just what do the "Efficiency Factors" indicate and within what limits are their ordinary interpretations valid? Thus, it has been generally assumed that larger acreages of corn were associated with larger net farm incomes. This study suggests that net income tends to increase with the acreage in corn only up to about 130 acres in the rougher parts of the state and 160 acres in the smoother areas, and that above these acreages net income tends to decline. Even more specific, fig. 7 shows that in the more level sections the net income increased on an average between $150 and $175 per added 10 acres of corn between 70 and 150 acres. With this information we are in a position to evaluate the influences studied in a much more specific way.

Table XXIV contains information of the type necessary for each of the two applications just mentioned. It gives averages for the efficiency factors for the state for 1928 and 1929 and also data for one particular farm which we shall call Mr. Jones' farm. Let us suppose that an extension worker in farm management is assisting Mr. Jones in the analysis of his record for 1929. How can he make use of the information in these curves in advising Mr. Jones of opportunities which he may exploit further and in warning him against undesirable tendencies?

The net income of this farm was about $400 smaller than for the average, while the profit was nearly $600 greater. The farm was a diversified one, located in the level cash grain area. An examination of the efficiency factors for this farm in comparison with the average for the group of farms shows a gross income per $100 invested of $19.09 as compared with an average of $16.50 and a percentage of expenses to income of only 38 as compared with an average of 48. These are both to be regarded as favorable deviations from the average. The curves of relationship between these factors and the management return indicate that the former should result in a profit about $300 greater than

TABLE XXIV. COMPARISON OF 1928 AND 1929 EFFICIENCY FACTORS

| | Mr. Jones' farm | | Average | |
|---|---|---|---|---|
| | 1929 | 1928 | 1929 | 1928 |
| **Financial factors:** | | | | |
| Net farm income (plus int. payment) | $3321 | $3152 | $3721 | $2460* |
| Management return | $1185 | $1163 | $ 600 | $ 458 |
| Gross income per $100 invested | $ 19.09 | $ 17.23 | $ 16.50 | $ 17.00 |
| Percent total expense to total income | 38 | 42 | 48 | 47 |
| Percent invested in working capital | 18 | 16 | 20 | 20* |
| **The crop system:** | | | | |
| Acres in farm | 149 | 149 | 206 | 205* |
| Acres in corn | 70 | 72 | 72 | 71 |
| Yield of corn, bushel | 43 | 49 | 47 | 49 |
| Value of crops per acre | $ 24 | $ 27 | $ 25.50 | $ 27.00* |
| **The livestock system:** | | | | |
| Livestock income per $100 feed | $ 169 | $ 135 | $ 152 | $ 135 |
| No. litters spring pigs | 9 | 12 | 13.3 | 12.0 |
| No. litters fall pigs | 8 | 4 | 4.6 | 4.2* |
| Hog income per sow | $ 218 | $ 133 | $ 167 | $ 145* |
| No. cattle fed | 4 | 6 | 13 | 14* |
| Beef income per head | $ 14 | $ 12 | $ 25 | $ 24 |
| Dairy income per cow | $ 75 | $ 60 | $ 100 | $ 94* |
| **Use of labor:** | | | | |
| Months labor used | 12 | 14 | 23 | 22 |
| Crop acres per man | 128 | 111 | 88 | 82 |
| Livestock income per man | $3041 | $2140 | $2660 | $2480* |

* Approximately

average and the latter in a profit about $250 greater than average on a farm otherwise like the average.

An examination of some aspects of the crop system of course suggests that the smaller total acreage might be expected to reduce both the net income and the profit. Since Mr. Jones' performance in general is satisfactory he might well consider the possibilities of increasing his income by renting or buying some additional land, if he can obtain the labor to work it, but the yield of corn was 4 bushels smaller than average and this occurred in an area which usually obtains high yields of corn. The smaller acreage and yields of corn would lead us to expect, from the curves, a reduction in profits of $200 to $250 below the average. It should be pointed out to Mr. Jones that he has an opportunity to increase his profits by attempting to increase his yields.

The next step is to examine the livestock system. The outcome of the whole livestock system is reflected in the total income from livestock per $100 of feed. This factor is $17 greater than average which should result in an increase of profit of about $200. The size of the hog enterprise as measured by spring and fall litters combined is about the same as average, but the fact that the sows were bred for two litters resulted in a much larger income per sow, which should increase the profit by about $50. In the cattle enterprise we find there were only a few head sold. The beef income per head of cattle on the farm was only $14 as compared with an average of $25 and the dairy income per cow was $75 as compared with an average of $100. The combined effects of these deviations, according to the curves, is a reduction in the profit of about $150. Mr. Jones should give some attention to the performance of his cattle and should either reduce the enterprise to a few cows to yield dairy products for the home or else should improve his methods and perhaps his stock.

Finally we come to the use of labor. Mr. Jones used only 12 months of labor, that is, only his own work in handling this farm. He handled 128 acres of crops. According to the curve of relationship between the acres of crops per man and the profit, this should have resulted in an increase in his profits of about $200. The curve also suggests that the profit generally begins to decline when the crop acreage per man is pushed beyond this point.

The extension worker is able in this manner to criticize the farm operation in some detail and to appraise approximately the effects of good or poor practices on farm income. In the example used it happened that the factors which were examined accounted for just about $600 greater profit than average in all and that this was the amount by which the profit on this farm exceeded the average profit on the whole group of farms for this

year. In cases where there is a wide difference between the actual and the estimated returns, a further investigation should be made of the practices followed in order to discover the reasons.

USE OF THE CURVES IN MEASURING YEAR-TO-YEAR PROGRESS

Now let us suppose Mr. Jones to be studying over his own records in an effort to measure his progress as compared with the preceding year. In the first place he notices that his net income was about $200 greater than in 1928, but his profit was almost exactly the same. Evidently the greater net income was offset by an equal amount of added family labor or required the use of more capital. The nature of this expense will be shown by a comparison of the income statements for the two years. The percentage which the expense was to the gross income was actually reduced and the percentage invested in working capital was increased. Thus the business is in a more liquid state and the turnover has been greater, but less of the income has remained in the hands of the manager as profit after allowing for the value of his own labor and the use of his own capital. He therefore needs to examine the direction in which his efforts have been applied.

As we go through the list of efficiency factors we find that he has hired less labor and has handled more acres of crops himself. The acreage of crops in 1929 was about the maximum consistent with increasing returns, therefore it would be well for Mr. Jones to consider whether under the peculiar conditions of his farm he may have gone too far in this direction. This is perhaps the chief value of an understanding of the curvilinear relationships as contrasted with the simpler rectilinear concept of efficiency factors according to which any increase in the acreage of crops handled per man would be interpreted as desirable. Here we have an indication of a danger point as the value of the factor approaches extremely high figures. The lower yield of corn and the lower value of crops per acre than in 1928 lends some weight to the idea of excessive "efficiency" in this direction. Mr. Jones seems to have retrogressed in this respect and should give attention to his methods to see if more care in some directions might not yield greater returns.

In the livestock enterprises Mr. Jones seems to have made progress of a more substantial sort. Hogs are the most important livestock enterprise in this farm. By raising two litters per sow per year the income per sow has been increased much more than the increase in the average—which is of course influenced by price levels. The income per litter has also increased about 15 percent, and this is approximately explained by the changes in price. Getting two litters per sow per year, however, seems likely to have resulted in some economy. The slight improve-

ment in the beef income per head has not been of much benefit because of the small number of cattle raised. Some improvement has been made in the returns from dairy products per cow, but as with the beef income, Mr. Jones still has a long way to go before the cattle will be very profitable.

Of course Mr. Jones needs to study all other information available to him on the results of the methods he is using. This other information may be obtained from his balance sheets, his income statements, his records of yields on other crops, records of rates of production by cattle or poultry, and of rates of gains on fattening stock. All of this information will need to be studied carefully in the light of the specific methods which have been used. The farmer's memory and his general knowledge will have to be drawn on to a large degree in this process. Further, in adopting what seem to be desirable changes, the budgeting method will need to be used in order to appraise the probable effects of a contemplated change on other parts of the business, and to compare the probable results of alternative practices or organizations.

Thus the use of the efficiency factors, and particularly of the curvilinear relationships between these and the farm returns, forms only a small part of the process of analysis of the farm business. It is, however, a very useful part in that it permits a rapid survey of probable sources of satisfactory or unsatisfactory returns and directs attention to the particular enterprises which are likely to be in greatest need of improvement. And, of course, the advantage of the curves over the rectilinear interpretation of efficiency factors is in that they permit a more exact evaluation of the forces at work and indicate points of overemphasis as well as of underemphasis.