WHY FARM EARNINGS VARY

FOUR DETERMINING FACTORS

1. Adequate Size
2. Wise Selection of Enterprise
3. High Rates of Production
4. Efficient Methods

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CONTENTS

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5M—6 45

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ANYONE who has studied the earnings of a group of farmers over a period of years is impressed with the wide variation from year to year, but even more with the variation among different farmers within a given year. This latter variation is commonly observed among farms of similar type even within the same county or community. Some of these variations in earnings are due to factors, such as price and weather, which are outside the farmer's control. Others are due to management factors which are more or less within his control. It is the purpose of this study to analyze the effect of some of these management factors on the earnings of a group of dairy farmers in southeastern Minnesota and to determine the extent to which they point the way to more profitable farming.

Source of Data

This is the second study of management factors covering largely the same group of farms. In the previous study[1] farm records for a five-year period (1928-32) were used. In this study the same records have been used and in addition records for the same or similar farms for an additional five years (1933-37) have been included in the analysis. The farmers supplying these records are members of the Southeastern Minnesota Farm Management Service.[2] A total of 1,462 farm year records were distributed as follows in 10 counties:

Goodhue	256	Waseca	179
Freeborn	245	Le Sueur	56
Steele	240	Mower	45
Rice	205	Olmsted	32
Dodge	193	Dakota	11

Since a description of the type of records and also of the agriculture of the area was presented in the previous study, it will not be repeated.

Description of Farms Studied

Only farms on which dairying was a major enterprise were selected for this study. However, once a farm was selected, it was retained, even though other lines of production might supplant dairying as a major source of income. There were relatively few shifts of this kind. For the 10-year period 31 per cent of the gross cash income was from the sale of dairy products and 13 per cent from the sale of cattle. The cattle sold were largely of dairy breeding. Hog sales contributed 21 per cent of the income, poultry and egg sales 12 per cent, crop sales 11 per cent,

[1] Pond, G. A., Ranney, W. P., and Crickman, C. W. Factors causing variations in earnings among dairy farmers in southeastern Minnesota. Minn. Agr. Expt. Sta. Bul. 314. 1934.

[2] The author wishes to acknowledge his indebtedness to the farmers who cooperated in this study and especially to R. C. Bevan who served as fieldman during most of the 10 years. He also wishes to thank his collaborators in the previous publication, W. P. Ranney, formerly of the Division of Agricultural Economics, and C. W. Crickman, of the Bureau of Agricultural Economics, U. S. Department of Agriculture, who prepared the data and made the tabulations for this study.

Table 1. Total Acres and Tillable Acres per Farm and Percentage Distribution of the Use of Land on Farms Studied and on All Farms in the Same Counties, 1928-1937

	Farms studied	All farms in same counties
Total acres per farm	196	144
Tillable acres per farm	146	94
Per cent tillable land	75	65
Percentage distribution of land use		
Small grain	31	30
Cultivated crops	23	20
Tame hay	11	10
Wild hay	3	5
Tillable pasture	10	5
Nontillable pasture	13	21
Other	9	9
Total	100	100

Table 2. Number of Livestock per 100 Acres on Farms Studied Compared with Average Numbers in Same Counties, 1928-1937

	Horses and mules	Milk cows	Other cattle	Hogs	Sheep	Poultry
Farms studied	3.3	9.3	10.1	21.7	6.7	132
All farms in same counties*	3.2	8.4	6.4	17.0	2.4	86

* Data from Minnesota Annual Crop and Livestock Statistics, except poultry figures which are taken from the United States Census for the years 1930 and 1935 and weighted by the number of records in each county.

Table 3. Average Yields of Crops on Farms Studied and on All Farms in Same Counties, 1928-1937

Crops	Farms studied	All farms in 10 counties*	Relation of yield on farms studied to all farms
	——Bushels——		
Corn	43.2	37.0	117
Oats	42.5	36.0	118
Barley	28.5	26.3	108
Winter wheat	20.5	18.5	111
Spring wheat	17.7	15.5	114
Rye	16.4	17.2	95
Flax	9.0	9.6	94

* Data from Minnesota Annual Crop and Livestock Statistics, weighted according to the number of records from each county.

and miscellaneous sources 12 per cent.

Some comparisons between the organization and production of these farms and that of all farms in the counties in which they are located are shown in tables 1, 2, and 3. The farms studied are more than one-third larger, and a larger proportion of the acreage is tillable. The cropping systems for both groups are quite similar except as modified in line with differences in the proportion of tillable land. The farms studied carry more livestock per 100 acres, but the distribution by classes is quite similar. The yields of most crops are materially higher on the farms studied than the averages of the counties in which they are located. This increased crop production is one factor making it possible to carry more livestock per 100 acres.

Variations in Earnings

Year-to-year Variations

The average farm income, farm expense, and operator's labor earnings per farm for each of the 10 years of this study are shown in table 4.[3] Income is much more variable from year to year than is expense. It varied from 147 per cent of the average of the period in 1936 to 58 per cent of that average in 1932. The extreme variation in expense was from 122 per cent of the average in 1937 to 66 per cent in 1933. Two very important factors causing variations in income and earnings from year to year are weather and prices of farm products. It is difficult to sum up weather in any one index, but it affects income primarily through crop yields. The years 1931, 1934, and 1936 were characterized by hot, dry summers, and the crop indexes, based on the average yields for the 10-year period as 100,

[3] "Operator's labor earnings" is used throughout this study as the measure of farmer's earnings. For an explanation of the method of computing this and other technical measures or factors used, the reader is referred to the Appendix of Minn. Agr. Expt. Sta. Bul. 314 (see footnote [1]).

Table 4. Average Farm Income, Farm Expense, and Operator's Labor Earnings per Farm, 1928-1937

Year	Total farm income	Total farm expense	Operator's labor earnings
1928	$5,166	$3,906	$1,260
1929	6,202	4,369	1,833
1930	4,753	4,542	211
1931	4,031	4,681	—650
1932	2,949	3,746	—797
1933	3,634	2,676	958
1934	5,016	3,199	1,817
1935	5,358	4,022	1,336
1936	7,504	4,616	2,888
1937	6,393	4,960	1,433
Average	$5,101	$4,072	$1,029

were 87, 62, and 82 respectively. Crop indexes for the other years were all above 100 with 1932 the highest at 119, and 1929 and 1935 close behind with indexes of 116 and 114.

The average prices received by these farmers for livestock and livestock products each of the 10 years are shown in table 5. Complete information on prices of cattle, sheep, and poultry was not available from the farmers' records but was supplied from the reports of the Agricultural Marketing Service.[4] An index of prices for each year has also been computed.

The average price of the principal feed crops for each of the 10 years is presented in table 6. These prices apply to both sales and purchases, as some farmers sell feed crops and others buy them, and any individual may sell them one year and buy them another. Crop sales also include wheat, flax, seed corn, peas and corn for canning, sugar beets, potatoes, and truck crops. Because of the diversity in quantity and quality of the crops sold, no attempt has been made to construct either an index of crop prices or a combined index of crop and livestock prices. Sales of crops make up only 11 per cent of the gross cash income, and their omission from the price index does not detract greatly from its usefulness for this study.

Price affects changes in earnings from year to year in two ways. With a drop in prices from one year to another there will be a drop in cash income, and therefore in earnings, if the same quantity and quality of products are sold. If, in addition, prices continue to decline during the year, there will be an inventory loss (assuming the same physical inventories at the beginning and end of the year) that will further depress earnings. On the other hand, prices may rise rapidly during the closing months of the year, and although the average price received for products sold during the year is less than that of the previous year, there may be an inventory gain that more than offsets the loss of income due to lower price. This occurred in 1933. The index of prices received in 1933 was actually lower than in 1932. However, prices were still declining during 1932 but had risen materially during the closing months of 1933. As a result of this difference in inventory trends, the earnings in 1933 are substantially greater in spite of a lower average price level. If this dual effect of price on earnings is considered, a large part of the differences in average earnings from year to year can be explained on the grounds of prices and crop yields.

The data in table 4 indicate the variation from year to year in the average earnings of all farmers included in the study. There was, however, some change each year in the farmers included in the study. In order to compare the same identical men over the 10-year period, 17 farmers who keep records each year have been selected. Figure 1 shows the relative rank in earnings of each of these men for each of the 10 years, and also their rank on the basis of their average earnings for the period.

[4] Now the Division of Agricultural Statistics, Bureau of Agricultural Economics, U. S. Department of Agriculture.

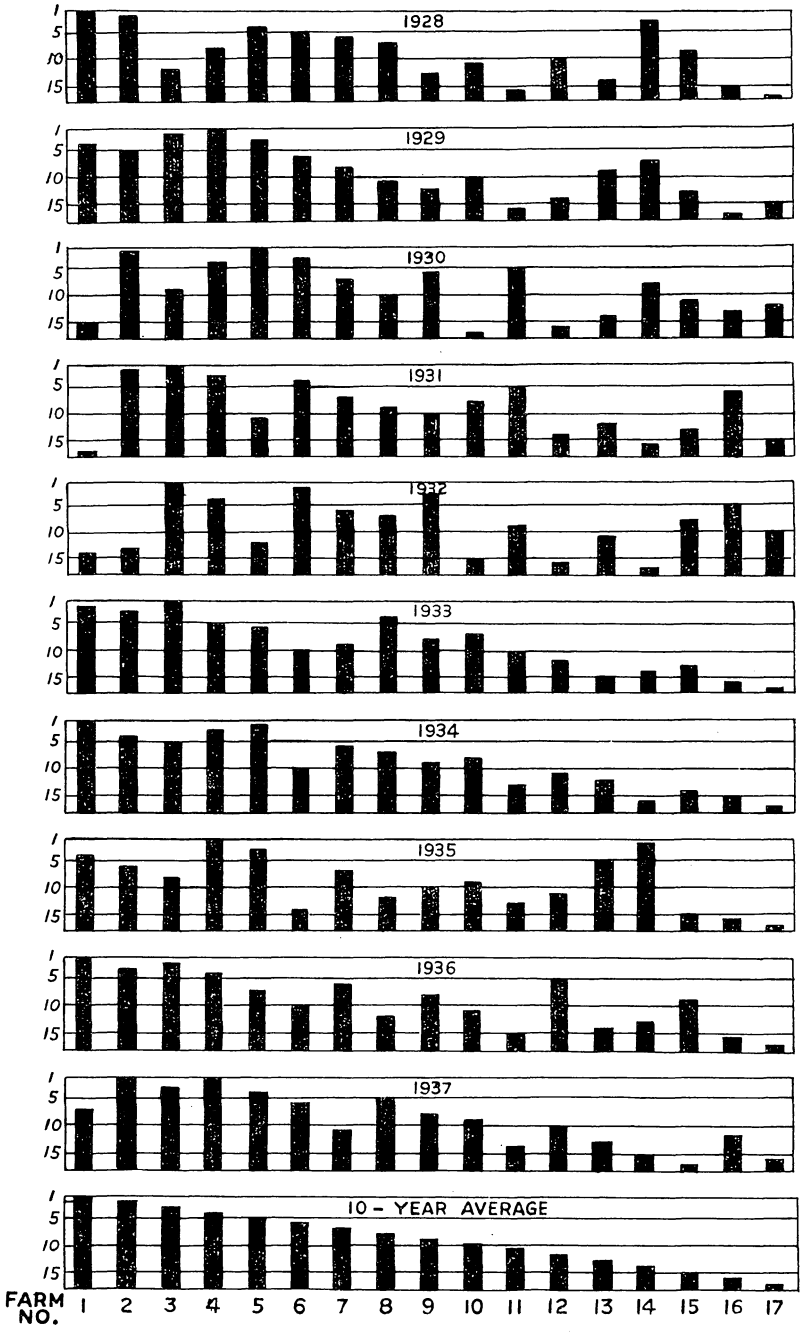


FIG. 1. Ranked array of average operator's labor earnings for 17 farmers for 10 years and the individual rank of each farmer each year, 1928-1937

Each bar represents the relative rank in earnings of a particular farmer. The average rank for the 10-year period for each farmer is shown at the bottom of the diagram and ranking of that farmer for each individual year directly above in a vertical line.

Table 5. Average Prices Received by Farmers for Livestock and Livestock Products and Index of Prices by Years, 1928-1937

Year	Cattle† 100 lb.	Hogs* 100 lb.	Sheep and lambs† 100 lb.	Poultry† pound	Butter-fat* pound	Wool* pound	Eggs* dozen	Weighted index‡ of prices
1928	$9.07	$8.23	$11.53	$0.18	$0.53	$0.42	$0.27	140
1929	9.19	9.60	10.99	.18	.50	.30	.28	142
1930	7.53	8.94	7.27	.14	.40	.18	.22	118
1931	5.22	5.33	5.40	.13	.29	.13	.16	82
1932	4.05	3.18	4.39	.08	.22	.08	.13	59
1933	3.53	3.42	4.98	.07	.22	.23	.12	58
1934	3.88	4.01	5.76	.09	.28	.19	.15	70
1935	6.37	8.73	7.56	.14	.33	.20	.22	106
1936	6.21	9.26	7.96	.12	.37	.29	.20	111
1937	7.27	9.47	8.47	.14	.39	.32	.19	117
Average	$6.23	$7.02	$ 7.43	$0.13	$0.35	$0.23	$0.19	100

* Average prices received by farmers included in study.

† Average state farm prices as reported by Agricultural Marketing Service.

‡ Weighted by average annual production.

The operator of farm No. 1 had the highest average earnings of the 17 for the 10-year period. However, his earnings were highest of the group only three years. In 1931 he had the lowest earnings, and in 1930 and 1932 he was well down in the range. Difference in price from year to year was the principal cause of the year-to-year variations in earnings. In 1931 low crop yields were a contributing factor and to a lesser extent in 1935 and 1937. Farm No. 1 was the largest of this group and hence price changes from year to year resulted in greater absolute changes in earnings than occurred in the case of smaller farms. This effect of size on earnings will be more fully discussed in a later section. The greatest change from year to year in the earnings of the operator of farm 1 was $9,865 and the average change from year to year for the period was $4,623. The greatest change from year to year in the average earnings of all farms included in this study was $1,755 and the average change was $1,034.

The operator of farm 2 had relatively high earnings nine of the ten years. Low crop yields in 1932 resulted in decreased earnings that year. Low yields resulted in lower earnings in 1928 for the operators of farms 3 and 4. Changes in prices or changes in crop yield serve to explain not only much of the difference in average earnings for the entire group but also the variations in relative ranking of the 10-year

Table 6. Average Farm Price of Principal Feeds by Years, 1928-1937

Year	Shelled corn	Barley	Oats	Bran	Oil meal	Alfalfa
	Bu.	Bu.	Bu.	100 lbs.	100 lbs.	Ton
1928	$0.66	$0.67	$0.49	$1.80	$2.90	$15.00
1929	.73	.52	.40	1.60	3.05	14.50
1930	.64	.42	.31	1.40	2.75	13.09
1931	.46	.37	.24	.90	1.85	13.00
1932	.36	.29	.19	.68	1.48	10.00
1933	.27	.35	.19	.77	1.60	7.50
1934	.52	.65	.36	1.15	2.13	12.00
1935	.64	.58	.32	1.23	1.88	13.00
1936	.72	.60	.30	1.28	2.13	8.00
1937	.78	.60	.35	1.45	2.13	11.00
Average	$0.58	$0.51	$0.32	$1.23	$2.19	$11.71

record farms. There was a considerable range in the rank in earnings of these 17 farmers from year to year. However, some farms were fairly consistently in the high earnings group and others just as consistently in the low group. The operator of farm 2 was below sixth place only once in the 10-year period and the operator of farm 4 ranked among the first four in seven years out of ten, and the operator of farm 5 six years out of ten. On the other hand, the operator of farm 17 was lowest in rank of earnings five years out of ten and was never higher than tenth place.

Farm-to-farm Variations

The variation in earnings among farmers in a given year is much greater than that between the average earnings of the whole group from year to year. The highest, average, and lowest earnings for each year are shown in table 7. The range between the high and low figures varied from $4,835 to $11,936. This range is also presented graphically in figure 2. The average year-to-year variation of average earnings for the entire group was $1,034, but the average range between the high and low earnings for each of the 10 years was $7,578, or more than seven times as great.

It has already been pointed out that weather (as reflected in crop yields) and prices are major factors causing variations in farmers' earnings from year to year. Market prices do not vary widely between different parts of an area as small as 10 counties within a given year. Any variation in prices received for a given product among farmers in this area is likely to reflect differences in the quality of the product, in time of marketing, or in salesmanship rather than any marked difference in price levels in different parts of the area. Differences in prices received by different farmers in so far as they are due to differences in the quality of the product, the time of marketing, or the salesmanship of the farmer represent the result of management. This type of price variation should be differentiated from changes in the price level from year to year which are almost if not wholly beyond the control of the individual farmer. He may have the foresight to adjust his production so as to gain most or lose least as the result of these price changes but he can do little to eliminate them.

Table 7. Average, Highest, and Lowest Operators' Labor Earnings and Range of Earnings, 1928-1937

Year	Highest	Average	Lowest	Range
1928	$4,314	$1,260	$—1,042	$5,356
1929	5,898	1,833	— 722	6,620
1930	2,950	211	—2,222	5,172
1931	2,287	—650	—4,052	6,339
1932	2,595	—797	—2,240	4,835
1933	6,430	958	— 609	7,039
1934	7,001	1,817	— 55	7,056
1935	8,968	1,336	— 728	9,696
1936	11,978	2,888	251	11,727
1937	9,570	1,433	—2,366	11,936
Average	$6,199	$1,029	$—1,379	$7,578

Weather, on the other hand, varies materially within a year among different parts of an area of this size. A study of temperature records shows little variation among the four weather reporting stations in these counties. However, precipitation was far from uniform. In 1930 there was an excess of 6.16 inches of rainfall during the growing season (April to August, inclusive) at Waseca, an excess of 3.32 inches at Albert Lea, and deficits of .69 inches and 4.68 inches at Zumbrota and Faribault, respectively. In 1928 all four stations reported excess rainfall for the growing season, and in 1931, 1933, 1934, and 1937 all reported deficit rainfall. During the other five years some stations reported an excess and others a deficit within the same year. In 1936 Waseca reported 25.31 inches of rainfall from April to August inclusive, and Faribault only 20 miles away reported 11.55 inches—less than one-half

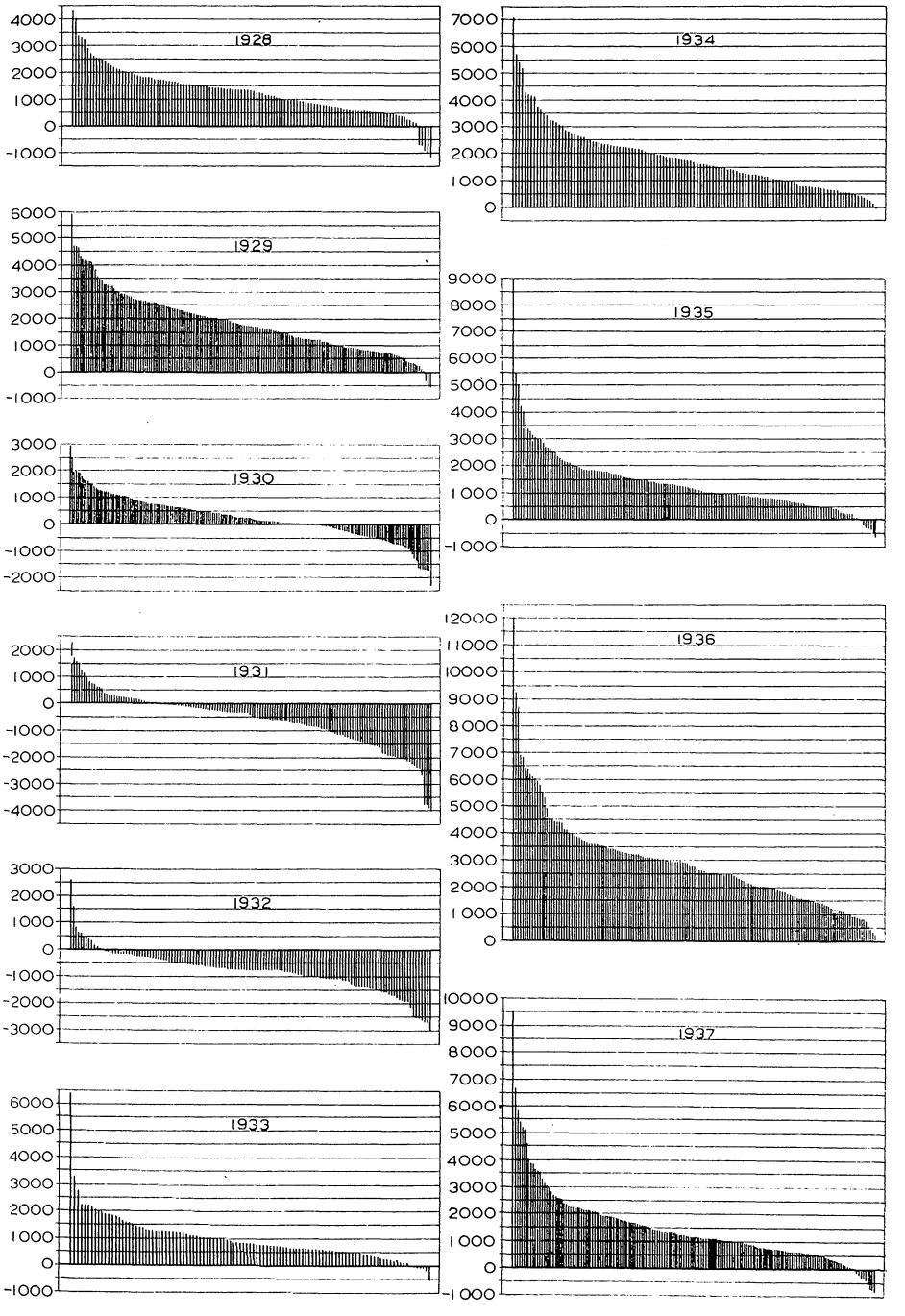


FIG. 2. Range in operator's labor earnings by years, 1928-1937

Each line in each section of this chart represents the earnings of one farmer for one year. The earnings of any individual are shown for each year for which records are available, and are placed in the chart according to the actual earnings of that year. No individual's earnings appear in the same vertical line each year, as was the case in figure 1.

as much. Hail storms are another feature of weather that affect only a small portion of the area in any one year, but may do serious damage on the few farms affected.

In addition to weather, other factors cause material variations in earnings among farmers within a given year. Disease and insect damage may cut the production of some farms severely and not affect others at all. Unlike weather, disease and insect damage may be prevented to some extent by spraying, sanitation, inoculation, and other practices. It is difficult to distinguish clearly between factors causing variation in earnings that are within the farmer's control and those that are due to factors which he can neither control nor predict with any considerable degree of accuracy. It is the purpose of the following section to determine some of the management factors more or less within the control of the farmer that may be used in analyzing the operations of a given farm business and in pointing out their effect in contributing to or limiting earnings.

Management Factors and Their Relation to Earnings

Eight management factors have been selected for use in this study: (1) size of business, (2) choice of crops, (3) intensity of livestock production, (4) crop yields, (5) butterfat production per cow, (6) returns over feed from livestock other than cows, (7) labor efficiency, and (8) power, machinery, and building expense per work unit. Since the records cover a 10-year period characterized by wide fluctuations in prices, it is desirable to use factors that can be measured in physical terms in order to avoid confusing the effect of price changes with the effect of changes in the factors. All of the factors mentioned are measurable in physical terms except (6) and (8). These have been reduced to an index basis to avoid reflecting the effect of changes in prices. There is considerable interrelationship among the eight factors, as well as between each factor and earnings. In some cases these relationships are constant from year to year, and in others they vary with the price level or some other factor in the situation. For convenience in discussion these factors have been grouped under the following headings: (1) size, (2) organization or selection of enterprises, (3) production or yield, and (4) efficiency in production.

SIZE OF BUSINESS

Size of business may be measured in various ways. Physical measures commonly used include total acres, crop acres, numbers of livestock units, number of workers employed, and productive man work units. Measures of area such as acres are very satisfactory where farms are uniform in type and in the quality and utilization of land. Numbers of livestock reflect only one aspect of the farm business, and number of workers is unsatisfactory because of the variation in skill and capacity among different workers. Both total acres and total productive man work units are used in this study as measures of size, but in general the

Table 8. Average Adjusted Operator's Labor Earnings on Farms Classified According to Productive Man Work Units, 1928-1937

Productive man work units		Number farms	Adjusted operator's labor earnings*
Group	Average		
349 and less	296	65	$ 921
350- 499	434	249	1,101
500- 649	581	429	1,481
650- 799	721	308	1,733
800- 949	868	165	2,213
950-1,099	1,020	100	2,491
1,100 and more	1,395	146	2,977

* All operator's earnings data have been reduced to a 1928-1929 basis in order that the figures for each of the 10 years may be combined. This adjustment serves to eliminate differences in earnings due to differences in price level among different years.

Table 9. Average Adjusted Operator's Labor Earnings on Farms Classified According to Acres in Farm, 1928-1937

Acres in farm		Number farms	Adjusted operator's labor earnings
Group	Average		
89 and less	74	105	$1,133
90-139	115	232	1,494
140-189	161	456	1,530
190-239	209	298	1,886
240-289	252	184	2,058
290-339	314	104	2,300
340 and more	439	83	2,520

latter, since it combines both crop and livestock and reflects differences in intensity, has proved more satisfactory and is given preference.

The relationship of size of business to earnings is shown in tables 8 and 9. Whether size of business is measured by acres or work units, the operator's labor earnings increase steadily with increases in size, but the relationship is more pronounced in case of work units. This relationship is, however, not constant from year to year. The data in table 10 indicate that in only 7 of the 10 years were earnings positively correlated with size of business. In 1931 and 1932 this relationship was reversed, and in 1930 there was little relationship if size is measured by work units, and a negative one if it is measured by acres.

Some explanation as to why, in general, earnings increase with increased size of business is indicated in table 11. The larger farms have a large advantage in labor efficiency (productive man work units per worker) as well as less expense for power, machinery, and buildings. The farms with the larger businesses were more heavily stocked (animal units per 100 acres), but the production of the dairy cows was slightly lower—largely because of the larger proportion of dual-purpose cattle on these farms and the fact that normally their production is below that of the specialized dairy breeds. No significant difference in the other management factors occurred among the different size groups. The chief advantage in size as far as these factors are concerned appears to be in the greater efficiency that is possible in the use of labor, power, machinery, and buildings.

Size is a very important factor affecting the farmer's earnings. Although in general earnings increase with size of business, this increase is neither regular nor sure. The data in table 10 indicate that in periods of low or rapidly declining prices, the large farm is at a disadvantage. When prices or other conditions are so unfavorable that there is a loss on each unit of goods produced, the larger the business, the greater the loss. Even with normal prices size must be accompanied

Table 10. Average Adjusted Operator's Labor Earnings on Farms Classified According to Productive Man Work Units and Acres in Farm, 1928-1937

Year	Productive man work units			Acres in farm		
	499 and less	500-799	800 and over	139 and less	140-239	240 and over
1928	$ 837	$1,277	$2,256	$1,213	$1,152	$1,771
1929	1,274	1,884	2,809	1,522	1,928	2,113
1930	182	245	173	356	293	—164
1931	—237	—659	—842	— 76	—606	—1,179
1932	—527	—748	—1,013	—310	—706	—1,310
1933	443	792	1,446	645	827	1,396
1934	701	1,575	2,624	1,047	1,645	2,640
1935	650	1,228	2,091	1,025	1,210	1,860
1936	1,280	2,506	4,135	1,793	2,602	4,157
1937	664	1,190	2,106	970	1,304	1,929
Average	$ 527	$ 929	$1,579	$ 819	$ 965	$1,321

Table 11. Relation of Productive Man Work Units to Other Management Factors

Productive man work units		Total acres	Index of crop selection	Animal units per 100 acres	Index of crop yields	Pounds butter-fat per cow	Index of returns over feed*	P.M.W.U. per man	Index of power, mach., bldg. exp.
Group	Average								
349 and less	296	94	36.9	18.3	93	244	51	228	118
350- 499	434	124	35.5	19.5	98	249	48	279	106
500- 649	581	165	35.7	19.3	99	237	49	310	99
650- 799	721	201	36.3	19.9	101	238	49	344	97
800- 949	868	237	37.7	20.4	102	239	50	369	99
950-1,099	1,020	250	37.6	21.7	102	235	51	392	95
1,100 and more	1,395	353	39.5	21.2	100	233	47	406	96

* From livestock other than cows.

with reasonably good management if it is to prove advantageous. This is indicated in table 12. The operators of large farm businesses of low quality actually had lower earnings than the operators of small farms with a low quality of business. However, with a high quality of management exercised on both groups of farms, the operators of the large businesses had distinctly higher earnings.

A large size of business does not in itself insure large earnings. It merely affords the opportunity for securing them. The element of risk is greater in that unfavorable prices are more disastrous to the large business than to the small. A good quality of management is essential if losses are to be avoided even in normal times. The farmer with ability and capacity as a manager can make more money with the large farm business, but the operator limited in ability and capacity is likely to find a moderate size of business safer and more profitable.

Table 12. Relationship of Size of Business and Quality to Earnings

Size of business	Low quality*		High quality†	
	Number farms	Earnings	Number farms	Earnings
Below average	65	$993	45	$2,060
Above average	30	787	55	3,268

* Poor selection of crops, low crop yields, and low livestock efficiency.

† Good selection of crops, high crop yields, and high livestock efficiency.

ORGANIZATION

The wise selection of crops and livestock and their combination into a well-balanced farm organization are important factors influencing the farmer's earnings. Natural and economic conditions within an area are such that certain crops and certain kinds of livestock contribute more to the net income of the farm than do others. The resources of the individual farmer also affect the wisdom of the choice for a particular farm, but they do not lend themselves to classification and measurement as do these more general considerations. The index of crop selection used in this study is based on the fact that certain crops contribute more to the income of the farmer in proportion to the expenses involved than do others. The larger the proportion of the cropland devoted to the higher return crops, the higher is the crop index. No attempt was made to construct a comparable index of livestock selection, since conditions on the individual farm are more important in determining the best choice of livestock than is the case with crops. In addition these farms were originally selected as dairy farms, and the range in livestock choice is not as wide as if a random sample had been taken. The organization factor selected for livestock is the number of livestock per 100 acres of land. This is a measure of intensity of livestock production and is therefore listed as an organization factor.

Choice of Crops

The relationship of crop selection to earnings for the 10-year period is shown in table 13. The same relationship for each of the 10 years is shown in table 14. The degree of relationship varied somewhat from year to year, but each year the earnings increased or the losses decreased with increases in the crop index. Crop yields and crop prices vary widely from year to year. A crop may produce a larger quantity of feed or a larger cash value than another in one year, and a much smaller quantity or value another year. However, over a period of years certain crops have a definite advantage. The cropping systems on most of these farms are sufficiently diversified so that the unfavorable position of a given crop in a particular year does not seriously disturb the index. Some of the crops classed as "high return crops" can be grown on practically every farm. Others like alfalfa may involve additional expense for liming on some soils, and even with lime may not be as sure a crop. Others such as sugar beets or canning crops require the availability of special markets or special processing facilities.

The relationship of crop selection to the other management factors is shown in table 15. A better choice of crops increases the size of business because more crops are produced from a given acreage and are available for sale or feed. The increase in crop production due to wise selection makes it possible to keep more livestock. Crop yields increase with an increase in the index of crop selection, since the crops rated high in the index are those that yield most in the area and that combine with

Table 13. Average Adjusted Operator's Labor Earnings on Farms Classified According to Index of Crop Selection, 1928-1937

Index of crop selection		Number farms	Adjusted operator's labor earnings
Group	Average		
19 and less	16.3	41	$1,188
20-25	23.2	122	1,423
26-31	28.7	256	1,527
32-37	34.5	391	1,581
38-43	40.5	348	1,880
44-49	45.9	185	2,043
50 and more	55.4	119	2,425

Table 14. Average Adjusted Operator's Labor Earnings on Farms Classified According to Index of Crop Selection, 1928-1937

Year	Adjusted operator's labor earnings		
	31 and less	32-43	44 and over
1928	$1,142	$1,358	$1,647
1929	1,533	1,963	2,699
1930	18	267	759
1931	— 892	—588	21
1932	—1,007	—843	—214
1933	855	831	1,249
1934	1,452	1,847	2,473
1935	708	1,238	1,681
1936	2,608	2,640	3,253
1937	1,042	1,470	1,575
Average	$ 746	$1,018	$1,514

Table 15. Relation of Index of Crop Selection to Other Management Factors

Index of crop selection		Total P.M.W.U.	Total acres	Animal units per 100 acres	Index of crop yields	Pounds butter-fat per cow	Index of return over feed*	P.M.W.U. per man	Index of power, mach., bldg. exp.
Group	Average								
19 and less	16.3	586	176	18.2	84	236	47	308	96
20-25	23.2	698	207	18.9	93	226	49	335	99
26-31	28.7	727	210	18.8	95	237	48	337	99
32-37	34.5	680	190	19.5	99	239	48	325	99
38-43	40.5	705	187	20.5	103	243	51	327	100
44-49	45.9	791	200	20.3	103	250	50	328	103
50 and more	55.4	791	191	22.7	111	235	49	346	104

* From livestock other than cows.

other crops to maintain or increase soil productivity. The greater quantity of crop production resulting from the selection of high return crops enables the farm operator to use his labor, power, machinery, and buildings more productively.

Intensity of Livestock Production

The measure of livestock organization, for reasons already suggested, is primarily a measure of livestock intensity rather than an index of selection of the type used as in the case of crops. The number of livestock per 100 acres measures the relative importance of livestock in the farm business. The relationship of this factor to earnings is shown in table 16 for the 10-year period, and in table 17 for each individual year. Earnings increased with increasing intensity of livestock production up to 26 head per 100 acres. Beyond that there was little change. In seven of the ten years, earnings increased with the intensity of livestock production, but no definite relationship was evident the other three years. Any advantage generally associated with more livestock per 100 acres was offset in 1932 by the larger size of business on the farms with more livestock. Since the average income that year was insufficient to meet expenses, the larger the business the greater the disadvantage. The situation in 1934 and 1936 was different. Both of these were drouth years characterized by low crop yields. The farmer with a large amount of livestock per 100 acres had to resort to large feed purchases, and feed was relatively high in price because of the short crop.

The relationship of livestock intensity to other management factors is shown in table 18. More livestock per 100 acres results in a larger size of business on the same acreage. The heavily stocked farms show a somewhat better cropping system and distinctly higher crop yields. To a certain extent, high livestock production is made possible by the selection of those crops producing more and better feed per acre. Livestock provide a market for some of these desirable crops, such as legumes, which are a factor in the higher crop yields. A large amount of livestock contributes directly to higher crop yields through the larger amount of manure that is available. The more intensively stocked farms show greater dairy production and greater feeding efficiency. The more skillful livestock producers are more likely to stock their farms heavily. Labor, power, machinery, and buildings are more fully

Table 16. Average Adjusted Operator's Labor Earnings on Farms Classified According to Animal Units of Productive Livestock per 100 Acres, 1928-1937

Animal units of productive livestock per 100 acres		Number farms	Adjusted operator's labor earnings
Group	Average		
9.9 and less	7.9	35	$1,093
10.0-13.9	12.5	172	1,589
14.0-17.9	16.1	371	1,639
18.0-21.9	19.8	423	1,661
22.0-25.9	23.7	256	2,004
26.0-29.9	27.5	116	1,951
30.0 and more	34.5	89	2,142

Table 17. Average Adjusted Operator's Labor Earnings on Farms Classified According to Number of Productive Animal Units per 100 Acres, 1928-1937

Year	Number of productive animal units per 100 acres		
	13.9 and less	14-21.9	22.0 and over
1928	$ 637	$1,289	$1,535
1929	1,447	1,717	2,408
1930	— 70	151	494
1931	—1,017	—759	—501
1932	— 759	—929	—610
1933	685	896	1,128
1934	2,319	1,683	1,911
1935	1,129	1,259	1,718
1936	3,043	2,777	3,028
1937	1,217	1,362	1,709
Average	$ 863	$ 945	$1,282

Table 18. Relation of Number of Animal Units per 100 Acres to Other Management Factors

Animal units per 100 acres		Total P.M.W.U.	Total acres	Index of crop selection	Index of crop yields	Pounds butter-fat per cow	Index of return over feed*	P.M.W.U. per man	Index of power, mach., bldg. exp.
Group	Average								
9.9 and less	7.9	540	263	34.5	87	223	47	267	132
10.0-13.9	12.5	680	246	36.5	90	230	46	307	106
14.0-17.9	16.1	711	220	35.1	95	229	47	325	100
18.0-21.9	19.8	680	184	36.1	101	240	50	324	100
22.0-25.9	23.7	786	171	36.9	104	248	52	357	94
26.0-29.9	27.5	765	161	38.6	106	253	51	347	98
30.0 and more	34.5	787	135	42.8	114	261	53	349	95

* From livestock other than cows.

utilized on the more intensive livestock farms. Livestock may, by harvesting crops, reduce the labor on those crops below what it would otherwise be.

The relationship among the prices of farm products was relatively favorable to livestock during most of the period covered by this study. This tended to increase the advantage of intensive livestock production. There are, however, several factors that represent more or less permanent advantages to fairly intensive livestock production in this area. The importance of livestock as a market for crops best adapted to the area and their contribution to soil productivity should be mentioned. Livestock also provide fuller employment for farm labor than is possible with crops alone, and they supplement crops effectively, not only in the use of labor, but also in the use of power, machinery, and buildings.

RATE OF PRODUCTION

The rate of production is an important factor affecting the farmer's earnings. Crop yields during any given year may be determined largely by weather conditions. Over a period of years, however, management practices of the operator have an important bearing on crop yields. Livestock production, since it is affected less directly by weather, reflects the managerial ability of the operator more directly and perhaps more fully.

Crop Yields

The measure of crop yields used in this analysis is the crop index. This expresses the relationship of the yields of all crops on a given farm, weighted by the acreage of each, to the average yield of the same crops on all farms included in the study. An index of 100 indicates yields just equal to the average of the group. An index figure of 115 would indicate yields 15 per cent above the average, and an index of 90, yields 10 per cent below the average. The relationship of crop yields to earnings for the 10-year period is shown in table 19 and for each of the individual years in table 20. The relationship between crop yields and earnings is consistent and positive throughout the period.

The relation of crop index to the other management factors is shown in table 21. Although the farmers with

Table 19. Average Adjusted Operator's Labor Earnings on Farms Classified According to Index of Crop Yields, 1928-1937

Index of crop yields		Number farms	Adjusted operator's labor earnings
Group	Average		
62 and less	56	34	$1,203
63- 77	72	150	1,308
78- 92	86	355	1,470
93-107	100	445	1,739
108-122	115	317	1,993
123-137	129	116	2,302
138 and more	145	45	2,681

Table 20. Average Operator's Labor Earnings on Farms Classified According to Index of Crop Yields, 1928-1937

Year	Index of crop yields		
	92 and less	93-107	108 and over
1928	$ 843	$1,353	$1,680
1929	1,433	1,881	2,223
1930	32	159	488
1931	—931	—677	301
1932	—890	—872	—598
1933	852	757	1,239
1934	1,428	1,807	2,293
1935	825	1,621	1,647
1936	2,528	2,737	3,405
1937	1,036	1,464	1,837
Average	$ 716	$1,023	$1,452

high yields had smaller farms in terms of acres, they had more livestock per acre so that there was little difference in size of business associated with crop yields. The relationship between crop selection and crop yields has already been pointed out. More livestock is maintained on farms with high yields, and butterfat production per cow and feeding efficiency for other livestock are also high. Labor was used with about the same efficiency in all the crop yield groups, but power, machinery, and buildings were more effectively utilized on the higher-yielding farms. Higher crop yields mean more feed from a given area, and when accompanied with a better crop selection that improves the quality of feed, more livestock can be maintained and more efficient production is effected. The advantage of high crop yields may be partly or entirely offset if these high yields are obtained at the expense of increased production costs. If high crop yields are the result of better selection of crops, the use of the best adapted varieties, careful selection and treatment of seed, skill and timeliness in performing the operations, and similar factors that add little if anything to the expenses of production, then they make their maximum contribution to earnings. If, on the other hand, they are the result of large increases in labor and fertilizer, the increased costs involved may more than offset all other advantages. High yields contribute to earnings only within the limits suggested.

Butterfat Production

The amount of butterfat produced per cow is a measure of dairy production fairly comparable to the yield of crops. The relationship between butterfat production and earnings for the 10-year period is shown in table 22, and for each individual year in table 23. As might be expected on farms with nearly one third of the gross cash income coming from the sales of dairy products, earnings increase steadily with increased production per cow. The difference, however, was less between the higher production groups. Adjusted earnings increased $650 as production per cow increased from 136 to 250 pounds, but only $403 as it increased

Table 21. Relation of Index of Crop Yields to Other Management Factors

Crop index Group	Average	Total P.M.W.U.	Total acres	Index of crop selection	Animal units per 100 acres	Pounds butter-fat per cow	Index of return over feed*	P.M.W.U. per man	Index of power, mach., bldg. exp.
62 and less	56.1	766	225	30.2	17.5	227	47	327	94
63- 77	71.7	756	225	32.3	17.2	220	47	337	94
78- 92	86.2	667	199	34.6	18.1	231	48	328	99
93-107	100.1	723	196	37.1	20.0	241	49	331	101
108-122	114.7	707	178	38.6	21.2	253	49	323	101
123-137	128.9	771	187	40.7	23.0	249	50	341	105
138 and more	145.2	792	176	41.4	26.0	248	55	339	103

* From livestock other than cows.

Table 22. Average Adjusted Operator's Labor Earnings on Farms Classified According to Pounds of Butterfat per Cow, 1928-1937

Pounds of butterfat per cow		Number farms	Adjusted operator's labor earnings
Group	Average		
149 and less	136	46	$1,102
150-189	174	191	1,519
190-229	210	390	1,670
230-269	250	449	1,752
270-309	287	279	1,987
310-349	326	80	2,009
350 and more	371	27	2,155

Table 23. Average Operator's Labor Earnings on Farms Classified According to Butterfat Production per Cow, 1928-1937

Year	Pounds butterfat per cow		
	189 and less	190-269	270 and over
1928	$ 792	$1,349	$1,337
1929	955	1,766	2,226
1930	— 43	1,139	549
1931	—1,253	—560	—526
1932	— 927	—825	—647
1933	758	904	1,181
1934	1,664	1,792	2,041
1935	1,095	1,276	1,853
1936	2,651	2,763	3,269
1937	1,150	1,408	1,823
Average	$ 684	$1,101	$1,311

from 250 to 371 pounds. In the tabulation of average earnings in table 23, the increase in earnings from the low to the median production group was $417 and from the median to the high group $210. The difference in production between the low and median group was 64 pounds, and between the median and high group, 70 pounds.

The relationship between butterfat production per cow and other management factors is shown in table 24. The size of business as well as the acreage of the farm is less on those farms in the higher production group. Higher crop yields, more livestock per 100 acres, lower labor efficiency, and a higher index of power, machinery, and building cost on the farms with high production indicate that these farms were organized on a more intensive basis. It is significant that those farmers who secured high production from their cows were also efficient in handling their other livestock.

The advantage in high production per cow is quite analogous to the advantage of high crop yields. As long as the increase is due to better selection and breeding, more ample and better-balanced rations, economical production of feed and forage crops, and better management methods generally, it is likely to contribute materially to higher earnings. If, however, the high production is obtained at the expense of more than proportionately higher costs, earnings will be adversely affected.

EFFICIENCY IN PRODUCTION

The management factors considered thus far affect earnings primarily through their effect on income. Earnings may be increased either by in-

Table 24. Relation of Butterfat Production per Cow to Other Management Factors

Pounds butterfat per cow		Total P.M.W.U.	Total acres	Index of crop selection	Animal units per 100 acres	Index of crop yields	Index of return over feed*	P.M.W.U. per man	Index of power, mach., bldg. exp.
Group	Average								
149 and less	136	735	211	38.6	18.2	91	18.2	344	97
150-189	174	755	228	35.4	17.7	94	17.7	342	98
190-229	210	724	200	36.5	19.6	97	19.6	341	96
230-269	250	697	191	36.6	19.9	101	19.9	328	101
270-309	287	738	183	36.3	21.2	104	21.2	322	105
310-349	326	642	172	39.4	21.5	102	21.5	300	106
350 and more	371	619	139	38.9	24.1	109	24.1	285	102

* From livestock other than cows.

Table 25. Average Adjusted Operator's Labor Earnings on Farms Classified According to Index of Return over Feed Cost from Livestock Other Than Cows, 1928-1937

Index of return over feed cost from livestock other than cows		Number farms	Adjusted operator's labor earnings
Group	Average		
24 and less	16.9	55	$1,196
25-34	29.9	151	1,365
35-44	39.9	336	1,590
45-54	49.4	424	1,759
55-64	58.8	311	1,994
65-74	68.8	124	1,997
75 and more	83.4	61	2,176

Table 26. Average Operator's Labor Earnings on Farms Classified According to Index of Returns over Feed Cost from Livestock Other Than Cows, 1928-1937

Year	Index of return over feed costs from livestock other than cows		
	34 and less	35-54	55 and over
1928	$ 451	$1,265	$1,483
1929	1,226	1,814	2,634
1930	— 275	128	750
1931	—1,113	—786	374
1932	— 873	—825	—723
1933	878	977	974
1934	1,610	1,709	2,130
1935	1,032	1,211	1,559
1936	2,005	2,566	3,210
1937	1,031	1,500	1,732
Average	$ 597	$ 956	$1,412

creasing income or by decreasing expense. The factors considered under efficiency deal with the control of expense. They are measured in terms of ratio of income or of size units to expense.

Feeding Efficiency

The measure of feeding efficiency selected is the return over feed from all productive livestock other than cows. Cows are not included, since the return over feed from them is closely associated with butterfat production, and this factor and its relationship to earnings have already been considered. In order to eliminate the effect of price changes from year to year, the return over feed is expressed as an index rather than in monetary terms. The relationship of feeding efficiency to adjusted earnings for the 10-year period is shown in table 25, and for each individual year in table 26. Earnings increased consistently with increases in feeding efficiency. This was true each of the 10 years.

The relationship of feeding efficiency to other management factors is shown in table 27. The farms on which the feed was used most effectively were somewhat below the average of the entire group in size of business and in acres. Neither crop selection nor crop yields showed any marked association with the level of feeding efficiency. The amount of livestock per 100 acres was higher on the farms using feed to best advantage. The same amount of feed

Table 27. Relationship of Index Return over Feed from Livestock Other Than Cows to Other Management Factors

Index of return over feed to livestock other than cows		Total P.M.W.U.	Total acres	Index of crop selection	Animal units per 100 acres	Index of crop yields	Pounds butter-fat per cow	P.M.W.U. per man	Index of power, mach., bldg. exp.
Group	Average								
24 and less	17	775	200	36.3	17.6	95	231	318	100
25-34	30	731	202	36.2	19.1	99	225	315	102
35-44	40	733	209	36.0	18.9	98	232	335	99
45-54	49	701	193	36.6	20.3	100	242	329	99
55-64	59	712	189	37.4	20.6	101	242	338	99
65-74	69	700	180	36.7	20.9	101	255	335	102
75 and more	83	698	176	36.5	21.0	100	260	312	101

would support more livestock production if used to optimum advantage. Apparently more economical feeding does not involve more labor, power, machinery, or building expense. In so far as more growth or production can be secured from a given quantity of feed by paying more attention to the quality of the animals, by supplying feed of ample quantity and quality, and by following good livestock management practices generally, it contributes regularly and consistently to the farmer's earnings.

Labor Efficiency

Labor efficiency is measured in terms of the number of work units per worker. It is a measure of output or accomplishment in terms of acres of crops and numbers of livestock. The data presented in table 11 indicate a marked relationship between size of business and labor efficiency. To eliminate this effect of size, the number of work units per worker has been reduced to an index basis by dividing each individual item by the average of the size group in which it falls. The relationship of this index of labor efficiency to earnings is shown in table 28 for the 10-year period. The actual number of work units per worker for each size group is also shown. There is some increase in earnings with increases in the labor efficiency index, but it is not as great or as regular as in the case of most of the other factors. The relationship for each of the 10 years is shown in table 29. Every year the farmers who used their labor most productively had the highest earnings.

The relationship of labor efficiency to the other management factors is shown in table 30. Size has been held fairly constant by the method of computing the index as already described. There seems to be little marked relationship between labor efficiency and crop selection, crop yields, intensity of livestock production, or feeding efficiency. The most striking fact brought out is the substantial decrease in the expense for power, machinery, and buildings as labor accomplishment increases. If the output of labor per man

Table 29. Average Operator's Labor Earnings on Farms Classified According to Index of Productive Man Work Units per Worker, 1928-1937

Year	Index of productive man work units per worker		
	84 and less	85-114	115 and over
1928	$ 718	$1,459	$1,559
1929	1,307	1,998	2,160
1930	— 256	252	605
1931	—1,029	—631	434
1932	— 800	—879	—593
1933	875	967	1,006
1934	1,655	1,706	2,350
1935	1,386	1,270	1,518
1936	2,837	2,892	2,947
1937	1,027	1,392	1,950
Average	$ 772	$1,043	$1,394

Table 28. Average Adjusted Operator's Labor Earnings on Farms Classified According to Index of Productive Man Work Units per Worker, 1928-1937

Index of productive man work units per worker		Work units per worker	Number farms	Adjusted operator's labor earnings
Group	Average			
74 and less	66	216	126	$1,304
75- 84	80	265	205	1,527
85- 94	90	297	323	1,296
95-104	99	332	299	1,877
105-114	109	362	184	1,897
115-124	119	395	147	2,036
125 and more	140	457	178	1,965

Table 30. Relationship of Labor Efficiency to Other Management Factors

Index of man work units per worker		Total work units	Total acres	Index of crop selection	Animal units per 100 acres	Index of crop yields	Butter-fat per cow	Feeding efficiency	Index of power, mach., bldg. exp.
Group	Average								
74 and less	66	627	195	36.4	17.7	102	250	48	113
75- 84	80	673	190	35.6	19.1	99	242	47	101
85- 94	90	686	194	37.3	19.4	99	240	48	103
95-104	99	738	201	36.7	20.0	100	245	50	101
105-114	109	742	193	36.5	20.4	102	240	50	100
115-124	119	808	200	36.8	21.9	99	231	52	93
125 and more	140	746	192	36.5	20.8	97	223	48	88

can be increased, the output of power and machinery is likewise increased, and unit costs decline.

Power, Machinery, and Building Expense per Work Unit

Approximately one third of the total cash farm expenditures on these farms for the 10-year period was for the purchase, construction, operation, and repair of power, machinery, and buildings. The expense for these items per unit of work accomplished is used as a measure of economy in their use. The relationship of earnings to power, machinery, and building costs per work unit is shown in table 31. Unlike the previous relationships discussed, this is a negative one. As the index of expense decreases, the earnings increase fairly regularly.

The effect of increased economy in the use of power, machinery, and buildings on earnings each individual year is shown in table 32. During 7 of the 10 years, the highest earnings were associated with the lowest expense per work unit. There is, however, very definite evidence of limitations beyond which lower expense for power, buildings, and machinery results in lower earnings. The increase in earnings was much greater between the high and median cost group than between the median and low cost group. The average indexes for these three groups were 144, 99, and 64 respectively. Apparently high expense for these items is a definite disadvantage, but there is a point beyond which they cannot be reduced without sacrificing some other economy such as labor.

Table 31. Average Adjusted Operator's Labor Earnings on Farms Classified According to Index of Power, Machinery, and Building Expense, 1928-1937

Index of power, machinery, and building expense		Number farms	Adjusted operator's labor earnings
Group	Average		
138 and more	158	133	$1,064
123-137	129	132	1,515
108-122	114	252	1,562
93-107	100	347	1,868
78- 92	85	302	1,856
63- 77	71	194	2,032
62 and less	51	102	2,102

Table 32. Average Operator's Labor Earnings on Farms Classified According to Index of Power, Machinery, and Building Expense per Productive Man Work Unit, 1928-1937

Year	Index of power, machinery, and building expense per P.M.W.U.		
	123 and over	78-122	77 and less
1928	$ 760	$1,267	$1,625
1929	1,210	1,963	1,813
1930	— 53	180	613
1931	—1,208	—716	— 13
1932	—1,007	—844	—439
1933	760	920	1,294
1934	1,934	1,842	1,637
1935	835	1,438	1,529
1936	1,974	3,185	2,947
1937	763	1,454	1,964
Average	$ 597	$1,069	$1,297

Another fact brought out in this connection is that reducing expense for power, machinery, and buildings below that of the median group is much less advantageous from the standpoint of earnings in years when price conditions favor high earnings. In the three years of highest earnings, 1929, 1934, and 1936, the earnings of the groups with the lowest expense per work unit for power, machinery, and buildings were lower than those of the median expense group. In the years of lowest earnings, 1930, 1931, and 1932, the group with the lowest expense showed earnings $514 higher than the median expense group. This seems to indicate that the control of expense for power, machinery, and buildings is more important in years of unfavorable prices. When prices are high, earnings are apparently increased more by expanding production than by the close control of expenses—especially if such expense control tends to curtail income. On the other hand, in years of unfavorable prices that definitely limit income, the control of expense is relatively more important.

The relationship of the index of power, machinery, and building expense to the other management factors is shown in table 33. There is a definite negative relationship between this index and both size of business and labor efficiency. Since power and machinery to a certain extent displace labor, one might expect a positive relation between these factors. Size of business accounts in part for the negative relation. It seems likely also that those farmers who keep down power, machinery, and building expense also make a special effort to plan the effective use of labor. The lower crop yields and lower butterfat production suggest less intensive operation of the farms with the low cost index and a material saving of labor.

CUMULATIVE RELATIONSHIP OF MANAGEMENT FACTORS

The relationship to earnings of each of the eight management factors considered in this study has already been discussed. In every case high accomplishment in any individual factor was associated with relatively high earnings. An association between the several factors was also pointed out. A good selection of crops and high crop yields are closely associated with each other and also with the amount of livestock maintained on the farm. High accomplishment in one factor may also be associated with high accomplishment in another because the farmer who makes a wise selection of crops may also follow other good practices that result in high crop yields, efficient use of feed and labor, and a high level of livestock production. It is impossible to measure accurately the specific increase in earnings that results from a given increase in accomplishment in any one

Table 33. Relation of Index of Power, Machinery, and Building Expense per Work Unit to Other Management Factors

Index of power, machinery, and building expense per work unit		Total work units	Total acres	Index of crop selection	Animal units per 100 acres	Index of crop yields	Butterfat per cow	Feeding efficiency	Labor efficiency
Group	Average								
138 and more	158	601	189	37.2	18.1	102	245	50	288
123-137	129	706	208	38.8	19.2	102	245	48	311
108-122	114	691	201	36.0	18.9	100	249	50	321
93-107	100	722	196	36.8	20.3	101	241	49	330
78- 92	85	733	192	36.0	20.4	100	234	48	342
63- 77	71	763	193	36.2	20.8	97	232	50	351
62 and less	51	782	184	36.4	20.7	93	222	49	359

of these factors. It is, however, possible to point out the general cumulative effect of excellence in several factors just as was done in the case of the individual factors.

The extent to which farmers who excelled in a majority or all of the management factors also excelled in earnings is shown in figure 3. All farms were divided into groups according to the number of factors in which the operator was above the average of the entire 1,462 farmers. There were 26 cases in which less than average accomplishment was recorded for each of the eight factors. At the other extreme there were 20 cases in which better than average accomplishment was recorded for each factor. Earnings increase steadily as the number of factors in which the operator excels increases. This seems to indicate that each factor has a definite independent effect on earnings even though the effect does not lend itself to exact measurement.

In setting up figure 3, any accomplishment above average was listed as a factor in which the operator excelled whether the accomplishment was just barely above average or whether it was in the upper 10 per cent. Accomplishment above average was used because it was a convenient, easily understood measure, and does not imply the assumption that attaining a rating above average in each factor should be the objective of each farmer. Rather, the objective should be as high an accomplishment as possible in each factor. Conditions vary widely among different farms. Excellence in one factor may be attained more easily on one farm than on another. The farmer who raises his accomplishment to a very high level in certain factors over which he has control may gain much more, even though some other factors are still below average, than if he tried to raise all factors above average. In other words, it is the combined effect of all factors that determines earnings. With some factors sufficiently far above average to offset those below, the earnings will be just as high as though all factors were at the average level. Since all of these management factors are not equally within the control of any individual farm operator, the farm manager will find his efforts most amply rewarded if they are exerted toward increased

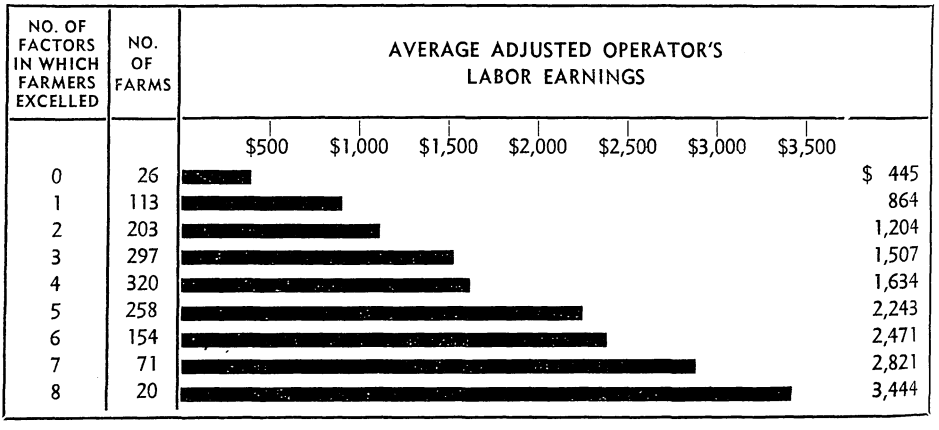


FIG. 3. Average operator's labor earnings on farms grouped according to number of management factors in which the farmer was above average

The eight factors used as a basis for this chart were (1) size of business, (2) choice of crops, (3) amount of livestock per 100 acres, (4) crop yields, (5) butterfat production per cow, (6) feeding efficiency, (7) labor efficiency, and (8) power, machinery, and building expense per work unit.

accomplishment in those factors over which he has the most effective control. The farmer's earnings are determined by the sum of the accomplishment in all the factors rather than by the number in which better than average performance is registered.[5]

Factor Analysis and the Thermometer Chart

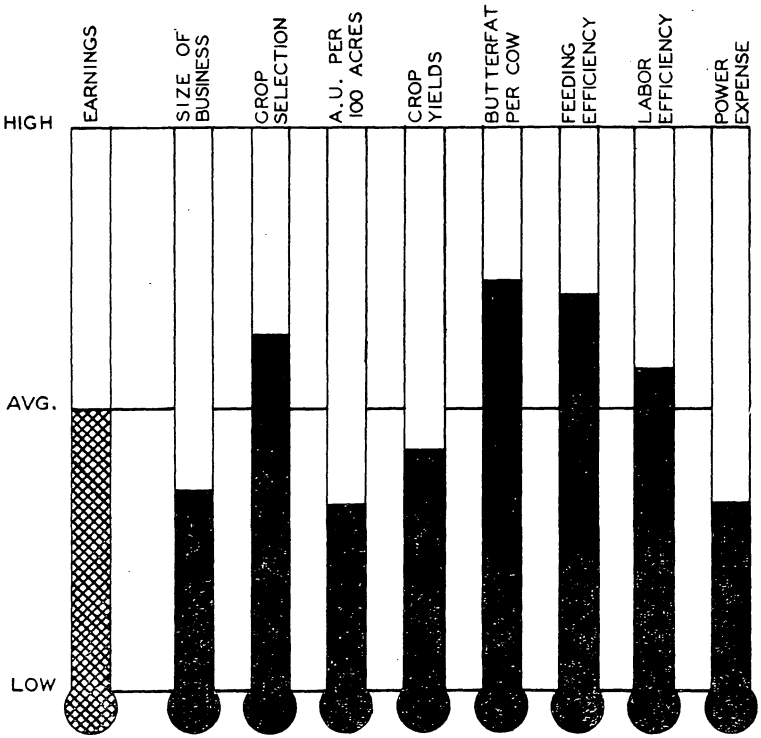
This study thus far has dealt with the application of the factor analysis to groups of farms. It can also be applied to the individual farm business, but the interpretation must be carefully made. For any given year there may be irregularities in the individual farm business owing to individual and personal factors affecting management and earnings as well as peculiar interrelationships between the factors that are largely offsetting in large groups. A valuable graphic device for illustrating the effect of the different factors on the earnings of an individual farmer is the thermometer chart. This method has been developed and adapted in the interpretation of individual farm records in cooperative farm management services. It is a very useful extension device within the limitations suggested above, and is particularly adapted to the presentation of the factor analysis of farm records to individual farmers.

An illustration of a thermometer chart is presented in figure 4. In the first thermometer or bar is shown the earnings for the year. In the succeeding thermometers are shown the eight factors that have been discussed in the previous section. The heavy black line just above the bulb of the thermometer represents the lowest rating of any farm in the group studied for each factor. The heavy black line at the top represents the highest rating of any farm in each factor and the line midway between these represents the average rating of the group. The figures for a given farm are then shown by shading each bar up to a height that represents the rating of this farm in each factor relative to the high, low, and average rating for the entire group. This makes it possible to see at a glance the earnings of this farm relative to the group and also the relative ranking in each of the eight factors.

The operator of the farm represented in figure 4 had a relatively small business, fewer than the average number of units of livestock per 100 acres, low crop yields, and relatively high expense per unit for power, machinery, and buildings. His accomplishment in these factors was below the average of the group. On the other hand, he had a good selection of crops, showed good results from his livestock operations as indicated by higher than average butterfat production per cow and high feeding efficiency, and used his labor efficiently. The advantage in earnings that would be expected to result from the factors above average is almost exactly offset by the depression of earnings owing to the low factors, since the earnings are exactly the average of the group. In fact, if the heights of the shaded portions of the factor bars were added and divided by eight (the number of factors), the quotient would be almost exactly the height of the shading in the earnings column. The relation of the earnings of this farmer to those of the entire group is the resultant of his relative rankings in these eight factors.

The operation of the farm for which the factor analysis is presented in figure 5 was low in each of the eight factors. He ranked lowest of the entire group in crop selection and in no factor did his ranking approach the average of the group. His earnings were in the lower 5 per cent in the range of earnings. In figure 6 is shown a thermometer chart for a farmer whose

[5] See Engene, S. A. New light on factor analysis. Jour. Farm Econ. 25:477-486. 1943.



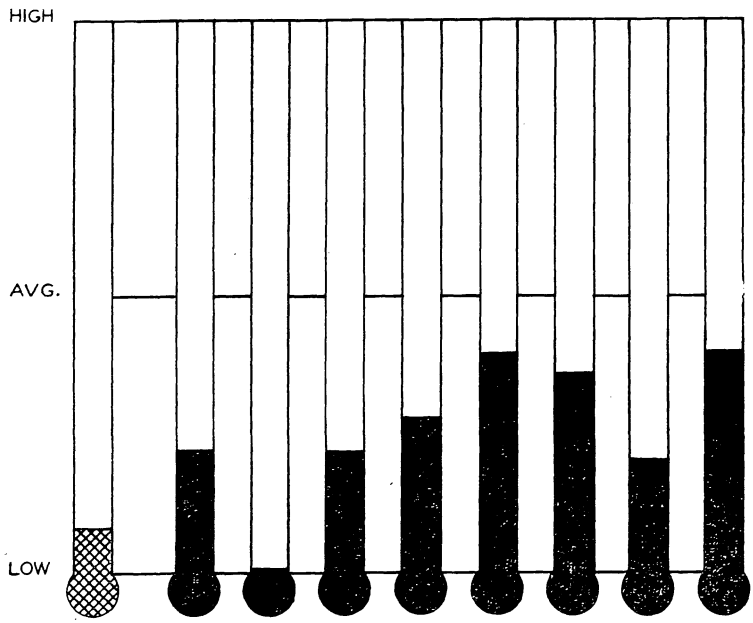
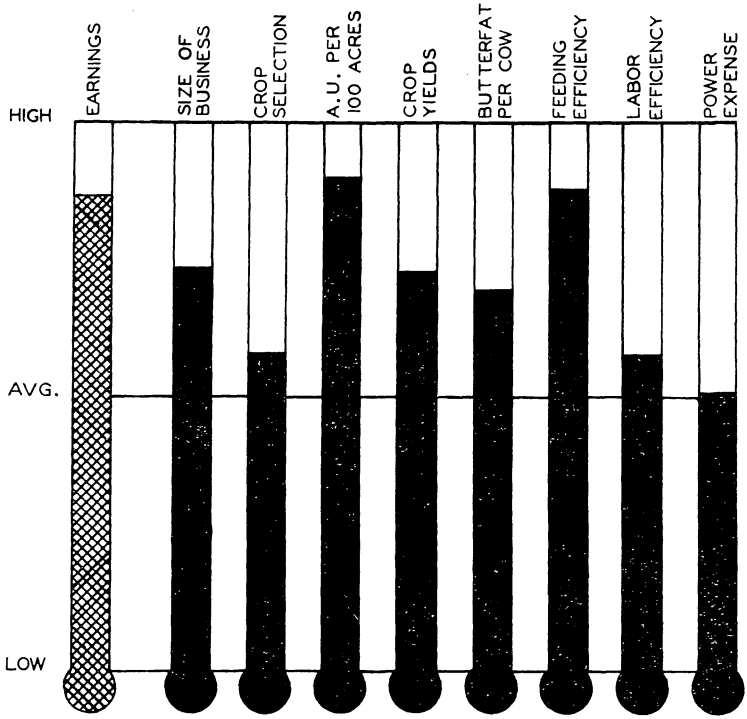


FIG. 4 (Above). Thermometer chart for a farm with average earnings

FIG. 5 (Below). Thermometer chart for a farm with low earnings



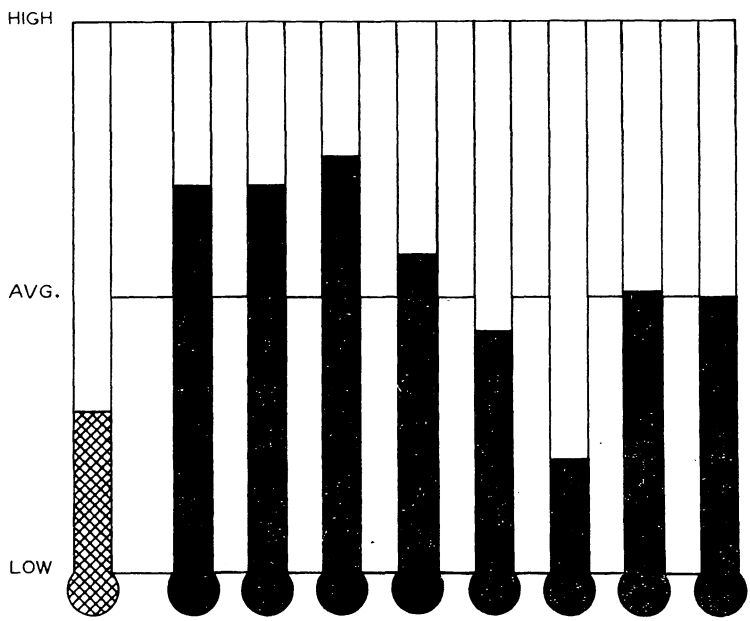


FIG. 6 (Above). Thermometer chart for a farm with high earnings

FIG. 7 (Below). Thermometer chart showing earnings influenced by relationship between factors as well as by factor ratings

rankings in each of the factors was above the group average and whose earnings were also high. These two charts, figures 5 and 6, illustrate another point of some significance in this type of analysis. When a farmer ranks uniformly high in all of the factors, there is a cumulative effect that results in earnings somewhat higher than one would expect from the ranking of the several factors. Likewise, when all of the factors are low, the earnings are depressed more than proportionate to the factor ranking.

The data for the farm presented in figure 7 illustrate the importance of a careful study of these thermometer charts before drawing conclusions as to the cause of high or low earnings. In this case the farmer rated well above average in four factors, about average in two, and below average in only two. A purely mechanical analysis based on the assumption that each factor had an equal and independent effect on earnings might lead to the superficial conclusion that the earnings of this farmer would be about average. Actually his earnings were much below average. This farmer had a large business, a good selection of crops, somewhat better than average crop yields, a large amount of livestock per 100 acres, used his labor with average efficiency, and had only moderate expense for power, machinery, and buildings. On the other hand, his butterfat production was below average and his feeding efficiency very low. This unsatisfactory showing with livestock actually cancelled out the advantage that would ordinarily result from a high ranking in size of business and in crop selection and crop yields. His large size of business is largely due to the large amount of livestock he maintained but because of the unfavorable showing of this livestock, size becomes a liability instead of an asset as discussed in a previous section. The advantage of good crop choice and good yields are sacrificed when these crops are fed to unprofitable livestock. This interrelationship between factors must be carefully observed and studied before drawing conclusions as to the combined effect of these factors on the earnings of a particular farmer.

The thermometer chart may be used to present the progress or retrogression in factor ratings of an individual farmer over a period of time and the changes in earnings that result. This is illustrated in figure 8. When this farmer started to keep records in 1931 he had a relatively low rating in all of the factors. Only one factor, animal units of livestock per 100 acres, was above the average of the group and this was really a disadvantage from the standpoint of earnings since his butterfat production and feeding efficiency were low. Increasing unproductive livestock contributes nothing to earnings.

In the five years following receipt of his report showing his low ratings in the factors as indicated by the 1931 figures in figure 8, this farmer succeeded in increasing his relative rating in seven of the eight factors. In some, such as crop selection and butterfat per cow, the change has been relatively large even though he still does not rank high in these factors. He has less livestock units per 100 acres than in 1931 but his returns are greater because of increased production and feeding efficiency. He is keeping less livestock but feeding them better. For example, he has increased the total digestible nutrients per cow from 3,647 to 5,011, and the percentage of protein in the ration from 9.9 to 13.4. There was a distinct gain in feeding efficiency for all classes of livestock. Management methods are important factors in livestock returns, and the analysis of the records pointed out both the needs for improvement and the methods by which they could be accomplished. In spite of the fact that the soil on this farm was distinctly lower in natural productivity than that of most farms in the group with which it was com-

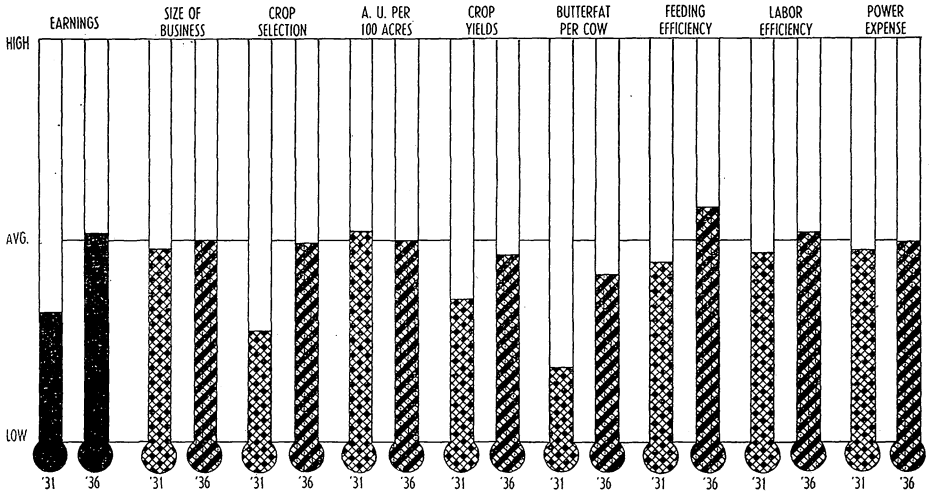


FIG. 8. Thermometer chart showing increase in earnings resulting from improved factor ratings

pared, a material increase in relative crop yields was achieved. The increase in earnings from 1931 to 1936, on the basis of the 1936 price level, was $1,216. In other words, the improvement in the organization and operation of the farm as indicated by the improved ratings in the factors studied accounted for a major part, if not all, of this increase of over $1,200 in earnings for the year. An observation of a large number of farm records over a period of years reveals similar increases in financial returns resulting from improved management as measured by these management factors. The thermometer chart is a very useful device in bringing to the farmer's attention the elements of strength and weakness in his farm business.

Usefulness and Limitations of Factor Analysis

This study indicates a close relationship between management factors and the farmer's earnings. The particular factors used in this study apply specifically to farms of a fairly homogeneous type located in a limited area within the state. These particular measures as computed for this study might have little significance if used for farms of a different type in a different area. The general principle, however, is of wide application. The factors of size, organization, production, and efficiency are important determinants of financial success in any area and with any type of farming. The specific method of measuring these factors may vary widely among different areas or states. A good choice of crops in one area may be very different from that in another. Butterfat production per cow is significant only on dairy farms, and feeding efficiency may be of no consequence on crop sale farms. The particular method of measuring any one of these general factors must be selected to fit the farms for which it is to be used. This limits the application of any one set of factor measurements to a particular area and often a particular type of farm. The more diverse as to type and environment a group of farms to which the factor analysis is applied may be, the less significant will be the relationship between any specific factors and earnings. This type of analysis can be used for almost any area or type of farm so long as the factors are measured in a way significant for the particular farms on which they are to be used.

The results of this study furnish a sound basis for advocating the importance of management factors as a determinant of earnings. They should be distinctly valuable to the extension worker. The principles that apply on the farms studied are as significant for other farmers operating under similar conditions. However, the individual farmer will be much easier to interest in the principles of good farm management if he has records of his own farm business so that he may compare his factor rating with that of other farmers. To get the most help he should be a member of a cooperative farm management service under whose direction comparable accounts are organized, supervised, and summarized for a group of farmers operating under similar conditions. However, where such service is not available, the individual who is keeping his own records may compute many of these management factors for his farm to check his progress from year to year. He may also find in the results of farm management service records or research projects in other areas standards which may be useful as a guide in checking his accomplishment.

To know that he is low in any management factor and that earnings suffer as a result is not of any particular service to a farmer unless he can and will do something about it. Where he has farm records he may be able to trace down the particular factor that accounts for his low rating. This is especially true if he is a member of a farm management service and has the records of other farmers for comparison and the technical advice of the supervisor or fieldman. The agronomist or the animal husbandman may be able also to point to improved methods and practices. The primary service of the factor analysis is to point out the factors that limit earnings. Once these are brought clearly to his attention, the alert progressive farmer will not waste much time in learning and using specific practices or methods that will overcome these limitations.

In applying the results of a factor analysis to an individual farm business, the limitations that are peculiar to that business must be recognized. It is seldom that the rating on all factors can be improved or even that an attempt should be made to do so. The farmer with land of relatively low natural productivity must expect low crop yields. This may be a permanent handicap about which he can do little. The major attention should be given to improving factors within his control. Earnings will often be increased more by increases in the factors which are easily controlled, even though these be already high, than by increases in the ratings in other management factors which are now low, but which cannot be increased without great effort and expense.

The thermometer chart is a very useful device for focusing the farmer's attention on opportunities for improving his management practices. However, it should not be interpreted as a simple method of forecasting earnings on the basis of factor ratings. This would only be possible if all factors were mutually independent and each exerted practically the same effect on earnings as the others. Unfortunately, with a business as complicated and variable as farming, it is difficult to devise factors with these qualifications. The relative importance of the different factors and their interrelations on a given farm must be carefully weighed in interpreting the thermometer chart for that farm. The factor analysis and the thermometer chart, after all, must be considered as aids in forming sound judgment as to management practices for a given farm rather than as mechanical or mathematical processes that point directly to the practices or improvements needed.