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The Operators' Cost of
Producing Some Field Crops in
Central Missouri

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COLUMBIA, MISSOURI

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INTRODUCTION

In the late fall and early winter of 1944-45, two areas in Central Missouri were selected for an investigation of the cost of producing field crops common to the region. Fifty survey records were secured in each region. The two areas selected were:

(1) A Missouri River valley area south of Carrollton in Carroll County. This area extended up and down the river about 15 miles and was of varying width but averaged about 4 miles. The entire area is above the flood land along the river. The soil is mostly of the Wabash silty clay loam and Buckner loam types, with spots of Wabash clay loam. All the soil is extremely fertile and high in organic matter and lime. The Wabash clay spots are very dark, rather heavy and hard to work. They are frequently referred to by local people as "black soils." On the surveyed farms these spots were generally kept in permanent pasture, if their location on the farm was such that they were handy for pasture. In some localities outside the surveyed area, this "black soil" predominates and is used extensively for the production of wheat.

(2) The other area selected was an upland area across the river from Area 1, but back from the river away from the river hill section. The area was about 20 miles long, extending from Higginville, in Lafayette County, about 5 miles into the west side of Saline County. Thirty-seven records were taken in Lafayette County and thirteen in Saline County. The average width of the area was 5 or 6 miles, lying north of an east-west line through Higginville. The soil is of the type known as the Marshall silt loam, which is one of the best upland soils in the State. It is dark in color, well drained, easily worked, high in organic matter and generally well supplied with lime and other mineral nutrients, although some of the soil is benefited by moderate applications of lime and mineral fertilizers.

Erosion is no problem in the Carroll County area, but the area in Lafayette and Saline Counties is rolling and erosion is beginning to be quite a problem. Several of the surveyed farms had part or all

of their cultivated fields terraced. Hereafter these two areas will be referred to as the Carroll area and the Lafayette-Saline area.

In this publication the *operators' cost* is defined as the sum of all costs customarily borne by the tenant as distinguished from the landlord. Although *operators' cost*, as thus defined, is almost synonymous with *tenants' cost*, the latter implies that the entire sample of records was composed of tenants' records whereas both samples were composed of both tenants and owners. *The operators' cost per unit of production* was obtained by dividing the operators' per acre cost by the customary tenants' share of the crop.

Factors Studied in the Survey

To compute the operators' cost of crop production, information had to be obtained on the amount and cost of man labor, hours and cost of power used (horse or tractor), the cost of machinery, and its allocation to the various productive enterprises, the amount and cost of seed and seed treatment, fertilizers, twine, and cost of special machine hire such as threshing, baling, corn picking, etc. The proportionate part of these costs, furnished by the operator and the landlord, and the division of the crop between the two parties, had also to be ascertained. The rental agreement, either oral or written, between the tenant and the landlord was obtained from renters and in the case of owners, the operator was questioned regarding the rental practices prevailing in the community.

Forms to be filled in by a representative of the College of Agriculture in a personal interview were prepared to obtain the needed information from fairly accurate estimates by the operator. For instance, instead of asking how many hours of man labor and hours of horse or tractor use were required to produce an acre of corn, the operator was asked what operations (plowing, disking, etc.) were done, how many times each operation was performed, approximately how many acres were covered per 10-hour day for each operation, and the number of men, horses or tractors involved in the operations. In this manner difficult inquiries were broken down into easier questions which led to fairly accurate estimates.

The Crop Pattern

The crop pattern in the two areas differed, in some respects, quite significantly. Since Table 1 shows the average farm in the Lafayette-Saline area to be 41.6 acres or 15.4 per cent smaller than in the Carroll area, the same crop pattern would require each crop to be reduced by 15.4 per cent. Instead of such a uniform reduction there was a larger acreage of alfalfa, pasture and miscellaneous crops and slightly more

in the homestead. Corn, red clover, soybeans and wheat showed more than the required reduction, while oats was reduced only slightly. Although no data were obtained on livestock, except work stock, a great deal more livestock was observed in the Lafayette-Saline area than in the Carroll area. Many of the Carroll county farms were

TABLE 1. - AVERAGE LAND USE PATTERN PER FARM

| Crops | Carroll Area | | | Lafayette-Saline Area | | |
|--------------------|----------------|-------|-----------------|-----------------------|-------|-----------------|
| | No. Farms with | Acres | Percent of Area | No. Farms with | Acres | Percent of Area |
| Alfalfa | 20 | 5.1 | 1.9 | 36 | 8.0 | 3.5 |
| Corn | 50 | 86.1 | 31.9 | 50 | 68.4 | 29.9 |
| Oats | 44 | 26.0 | 9.6 | 45 | 24.2 | 10.6 |
| Red Clover (alone) | 30 | 12.8 | 4.7 | 17 | 5.4 | 2.3 |
| Soybeans | 25 | 10.9 | 4.0 | 3 | 0.7 | 0.3 |
| Wheat | 49 | 68.7 | 25.5 | 39 | 22.8 | 10.0 |
| Pasture | 50 | 39.7 | 14.7 | 50 | 69.4 | 30.4 |
| Homestead | 50 | 3.5 | 1.3 | 50 | 4.1 | 1.8 |
| Miscell. Crops | 21 | 7.0 | 2.6 | 36 | 16.2 | 7.1 |
| Waste | 39 | 10.3 | 3.8 | 41 | 9.3 | 4.1 |
| Total acres | 50 | 270.1 | 100.0 | 50 | 228.5 | 100.0 |

largely cash grain farms. This accounts for the fact that the Lafayette-Saline farms had more than twice the percentage of total farm in pasture than did the Carroll farms. Another significant difference in the two areas was the greater dependence on alfalfa and less on red clover by the Lafayette-Saline operators. The Carroll operators have no trouble growing either red clover or alfalfa. Red clover, however, fits into their crop rotations much better and gives them all the legume hay they need. More trouble is experienced in the Lafayette-Saline area in getting stands of clover and alfalfa without extra soil conditioning and preparation. The operators therefore concentrate this extra expense on smaller areas and use the higher yielding alfalfa rather than red clover.

No description of the crop patterns would be complete without some comment on the double cropping practice of using clover and lespedeza sown in small grains, i. e. wheat and oats. Table 2 shows the extent to which this is done in the two areas. In the Carroll area about 40 per cent of the wheat is used as a nurse crop for red clover and lespedeza in approximately equal percentages, whereas over 61 per cent of the oats is used as a nurse crop, practically all of it for lespedeza. In the Lafayette-Saline area, a larger percentage (46.5) of the wheat is used as a nurse crop, but over three times as much for lespedeza as for clover. Approximately the same proportion of the oats is utilized for a nurse crop as in the Carroll area, but all of it is for lespedeza. The bottom part of the table presents the data from the standpoint of the legume. In the Lafayette-Saline area, no clover

was seeded with oats and only about four per cent in the Carroll area. In contrast, about 65 per cent and 54 per cent of the lespedeza was seeded in oats in the Lafayette-Saline and Carroll areas respectively.

TABLE 2. - USE OF WHEAT AND OATS AS NURSE OR COMPANION CROPS FOR RED CLOVER AND LESPEDEZA

| Crop | Carroll Area | | Lafayette-Saline Area | |
|----------------------|--------------|---------|-----------------------|---------|
| | Acres | Percent | Acres | Percent |
| Wheat alone | 2062 1/2 | 60.1 | 594 1/2 | 53.5 |
| Wheat with clover | 712 | 20.7 | 125 | 11.3 |
| Wheat with lespedeza | 658 1/2 | 19.2 | 391 1/2 | 35.2 |
| Total | 3433 | 100.0 | 1111 | 100.0 |
| Oats alone | 504 | 38.8 | 477 | 40.1 |
| Oats with clover | 29 | 2.2 | 0 | -- |
| Oats with lespedeza | 768 | 59.0 | 713 | 59.9 |
| Total | 1301 | 100.0 | 1190 | 100.0 |
| Clover with wheat | 712 | 96.1 | 125 | 100.0 |
| Clover with oats | 29 | 3.9 | 0 | -- |
| Total | 741 | 100.0 | 125 | 100.0 |
| Lespedeza with wheat | 658 1/2 | 46.2 | 391 1/2 | 35.4 |
| Lespedeza with oats | 768 | 53.8 | 713 | 64.6 |
| Total | 1426 1/2 | 100.0 | 1104 1/2 | 100.0 |

Land Tenure

No distinction was made between tenants and owners, nor was there any effort made to obtain equal numbers of the two classes of operators. Under such conditions it is assumed that the different tenure groups were represented in the samples in about the same proportions as actually existed in the areas. The difference between the two areas was very significant. There were 14 owners in the Carroll area and 26 in the Lafayette-Saline area, while the number of

TABLE 3. - LAND TENURE

| | Carroll Area | | Lafayette-Saline Area | |
|------------|--------------|---------|-----------------------|---------|
| | Number | Percent | Number | Percent |
| Owner | 14 | 28.0 | 26 | 52.0 |
| Part-owner | 7 | 14.0 | 7 | 14.0 |
| Renter | 29 | 58.0 | 17 | 34.0 |
| Total | 50 | 100.0 | 50 | 100.0 |

renters was 29 and 17 respectively. There were seven part-owners in each area. This followed the familiar tenure pattern, tenancy being highly correlated with high values and grain farming. While no attempt was made to record land price data, casual inquiries disclosed the fact that land prices were higher in the Carroll area than in the

Lafayette-Saline area, and the greater degree of grain farming in the Carroll area has already been mentioned. A very interesting feature of the tenancy in the Carroll area was disclosed quite accidentally through conversation with the tenants. The length of tenure was much longer than is common in such regions. Several of the tenants had been on the same farm more than five years, and three had rented the same farm more than 25 years. One tenant had rented the same farm from three generations of the owner family.

Rate of Doing Field Operations

One of the most important factors of the cost of production is the rate of doing the various operations involved. Obviously the total

TABLE 4. - AVERAGE RATE OF DOING VARIOUS ONE-MAN OPERATIONS¹

| Operation | Power used | Carroll Area | | | Lafayette-Saline Area | | |
|-----------------------------------|-------------------|--------------|-----------------------|------------------|-----------------------|-----------------------|------------------|
| | | No. Farms | Acres per 10-hour day | Minutes per acre | No. Farms | Acres per 10-hour day | Minutes per acre |
| Cultipacking | 2 horses | | | | 5 | 13.1 | 46 |
| | 2-14" tractor | 6 | 27.4 | 22 | 9 | 23.0 | 26 |
| Cultivating corn (1st time) | 2 horses | | | | 29 | 5.25 | 114 |
| | 2-14" tractor | 38 | 14.3 | 42 | 24 | 13.2 | 45 |
| | 2-16" tractor | 7 | 16.3 | 37 | | | |
| Cultivating corn (2nd time) | 2 horses | | | | 26 | 6.83 | 88 |
| | 2-14" tractor | 38 | 20.4 | 29 | 27 | 18.4 | 33 |
| | 2-16" tractor | 7 | 24.3 | 25 | | | |
| Cultivating corn (after 2nd time) | 2 horses | | | | 22 | 7.52 | 80 |
| | 2-14" tractor | 39 | 25.8 | 23 | 26 | 23.0 | 26 |
| | 2-16" tractor | 7 | 34.3 | 17 | | | |
| Cutting corn stalks | 2-14" tractor | 14 | 27.1 | 22 | 5 | 33.0 | 18 |
| Cutting grain (binder) | 4 horses | | | | 8 | 13.1 | 46 |
| Disking (single disk lapped) | 4 horses | | | | 6 | 7.17 | 84 |
| | 2-14" tractor | | | | 12 | 19.3 | 31 |
| Disking (tandem disc) | 2-14" tractor | 31 | 24.2 | 25 | 18 | 22.3 | 27 |
| | 2-16" tractor | 5 | 39.5 | 15 | | | |
| Drilling grain | 2 horses | | | | 6 | 10.3 | 58 |
| | 3 horses | | | | 7 | 14.4 | 42 |
| | 4 horses | | | | 24 | 14.4 | 42 |
| | 2-14" tractor | 31 | 28.4 | 21 | 11 | 23.8 | 25 |
| | 2-16" tractor | 5 | 47.0 | 13 | | | |
| Harrowing | 4 horses | | | | 22 | 17.5 | 34 |
| | 2-14" tractor | 33 | 45.3 | 13 | 24 | 40.2 | 15 |
| | 2-16" tractor | 6 | 65.0 | 9 | | | |
| Husking corn (standing stalk) | hand ² | 12 | 1.56 | 385 | 41 | 1.50 | 400 |
| Mowing | 2 horses | 9 | 9.11 | 66 | 32 | 9.52 | 63 |
| | 2-14" tractor | 17 | 20.6 | 29 | 6 | 21.0 | 29 |
| Planting corn | 2 horses | 22 | 13.1 | 46 | 42 | 12.2 | 49 |
| | 2-14" tractor | 18 | 20.6 | 29 | 6 | 23.0 | 26 |
| | 3 horses | | | | 7 | 2.57 | 233 |
| Plowing (breaking) | 2-14" tractor | 33 | 8.20 | 73 | 32 | 7.91 | 76 |
| | 2-16" tractor | 8 | 10.2 | 59 | | | |
| | 3-14" tractor | 5 | 11.4 | 53 | | | |
| Raking (side delivery) | 2 horses | | | | 11 | 14.2 | 42 |
| | 2-14" tractor | 9 | 22.8 | 26 | | | |
| Raking (sulky) | 2 horses | | | | 17 | 15.0 | 40 |
| | 2-14" tractor | 7 | 18.1 | 33 | | | |
| Rotary hoeing | 2-14" tractor | 9 | 42.4 | 14 | | | |
| Shocking grain | hand | 8 | 9.88 | 61 | 39 | 10.4 | 58 |
| Sowing lespedeza (hand seeder) | hand | 15 | 26.4 | 23 | 28 | 23.1 | 26 |
| Sowing oats (endgate seeder) | 2 horses | | | | 5 | 26.0 | 23 |

¹ Unweighted mean.

² Team and wagon to haul.

time units of man labor used depends on the number of operations, the number of men used on these operations and the speed with which they are performed. The limiting factor in one man's production is his own time, and America leads the world in the efficient utilization of man labor. This applies to agriculture as well as to other industries. Larger power units and correspondingly larger machines enable the present-day American farmer to accomplish much more than his predecessor of only a few years ago. Tables 4 and 5 give the unweighted averages of the operator's estimates of the number of acres they covered per 10-hour day. These were estimates on operations they actually performed using the power shown in the table. Data were also obtained regarding the width of the implement used, but since there was a very high degree of correlation between the power used and the width of the implement, not much additional information would have been obtained by classifying the data on this factor. Tractor power was classified according to the number and size of plows pulled.

The rate of doing field operations naturally varies a great deal from one operator to another. This probably introduces more error in the averages than the inaccuracy of the estimates. The larger any group, the smaller the error of the average becomes. In no case were fewer than five estimates used.

The two areas were compared in regard to speed of field operations. This can best be done in Table 4, all the operations of which were performed by one man. There were 16 instances where the power unit was identical and in eleven of these, more acres were covered in a 10-hour day in the Carroll area than in the Lafayette-Saline area. The soil is probably some heavier in the Carroll area but offsetting this disadvantage the fields in the Lafayette-Saline area are a little smaller, more irregular and some are terraced. If there were really no difference in the speed of the operation in the two areas, the probability that one would excel the other 11 times out of 16 operations is about 0.11. That is, such an "apparent" advantage would show up about 11 times out of 100 times by chance alone and therefore the difference in favor of the Carroll area can hardly be regarded as significant. The most interesting comparison of the two areas which shows up in Table 4 is the greater use of horse power in the Lafayette-Saline area. There were only three field operations (husking corn, planting corn and mowing) in the Carroll county area done with horses on enough farms to give a sample of five, while there were 17 samples of horse power units on the Lafayette-Saline farms. In fact, in the Lafayette-Saline county area Table 4 shows

TABLE 5. - AVERAGE RATE OF DOING VARIOUS CREW OPERATIONS

| Operation | Carroll Area | | | | | | Lafayette-Saline Area | | | | | |
|------------------------------------|--------------|-------------------------------|-----------------------|----------------|-----------------------|--------------------|-----------------------|-------------------------------|-----------------------|---------------------|-----------------------|--------------------|
| | No. farms | Av. ¹ men per crew | Per Crew | | Per Man | | No. farms | Av. ¹ men per crew | Per Crew | | Per Man | |
| | | | Acres per 10-hour day | Hours per acre | Acres per 10-hour day | Man hours per acre | | | Acres per 10-hour day | Crew hours per acre | Acres per 10-hour day | Man hours per acre |
| Combining lespedeza | 38 | 1.95 | 15.26 | 0.66 | 7.83 | 1.28 | 14 | 1.57 | 10.51 | 0.93 | 6.82 | 1.47 |
| Combining oats and wheat | 46 | 2.26 | 17.22 | 0.58 | 7.62 | 1.31 | 17 | 1.82 | 12.56 | 0.80 | 6.90 | 1.45 |
| Combining soybeans | 22 | 2.14 | 14.59 | 0.69 | 6.82 | 1.47 | | | | | | |
| Cutting grain (tractor) | 8 | 2.00 | 18.18 | 0.55 | 9.09 | 1.10 | 28 | 2.00 | 16.07 | 0.62 | 8.04 | 1.24 |
| Picking corn (picker) ² | 44 | 2.90 | 12.56 | 0.80 | 4.33 | 2.31 | 7 | 2.37 | 7.06 | 1.42 | 2.98 | 3.36 |
| Put up hay (loose) | 7 | 4.00 | 9.86 | 1.01 | 2.46 | 4.07 | 29 | 3.45 | 8.21 | 1.22 | 2.38 | 4.20 |
| Put up hay (Pick-up baler) | 29 | 8.72 | 16.52 | 0.61 | 1.89 | 5.29 | 18 | 9.07 | 22.36 | 0.45 | 2.47 | 4.05 |
| Put up hay (Stationary baler) | | | | | | | 5 | 7.40 | 7.50 | 1.33 | 1.01 | 9.90 |
| Threshing oats | | | | | | | 10 | 17.00 | 57.10 | 0.18 | 3.36 | 2.98 |
| Threshing wheat | | | | | | | 8 | 16.38 | 32.88 | 0.30 | 2.01 | 4.98 |

¹ Unweighted averages.

² All the pickers in the Lafayette-Saline area were 1-row pickers while in the Carroll area they were 2-row pickers.

that for more than half the field operations horses were used more frequently than tractor power. The use of horse power on the Carroll farms will be referred to again later.

Table 5 shows the rate of doing certain crew operations (operation requiring more than one man). These data are not as reliable or usable as those in Table 4 because of the variations in the size of the crew, and the number of horses and tractors. According to the data in both areas, there is little advantage in using a pick-up baler to put up hay as compared to putting it up loose, provided it is to be fed on the farm and there is plenty of barn space.

TIME REQUIREMENT OF DIFFERENT CROPS

The time required to produce different crops in the two areas is shown in Table 6. - The difference in the man labor requirement for producing corn husked by hand and corn husked with a picker and also between small grain cut and threshed and that harvested with a combine is very significant. The difference in both areas is almost entirely due to the method of harvesting. Husking with a corn picker requires more tractor labor but much less horse labor because tractors displace horses to a large extent in the harvest operation. However, in the small grains, the data in the two areas seem to be contradictory in so far as tractor labor is concerned. Combining seems to increase the tractor hours in the Carroll area but decrease it in the Lafayette-Saline area. In both areas binders are pulled almost exclusively by tractors. The apparent contradiction is probably explained by the fact that tractors and trailers are used more extensively in the Carroll area to haul the grain away from the machine.

TABLE 6. - LABOR USED IN PRODUCING AN ACRE OF VARIOUS CROPS

| Crop | Carroll Area | | | Lafayette-Saline Area | | |
|--------------------------|--------------|---------------|-------------|-----------------------|---------------|-------------|
| | Man hours | Tractor hours | Horse hours | Man hours | Tractor hours | Horse hours |
| Corn - husked by hand | 12.57 | 4.31 | 16.77 | 14.33 | 3.76 | 21.87 |
| Corn - husked by picker | 7.44 | 6.34 | .75 | 8.37 | 6.67 | 2.23 |
| Lespedeza seed | 2.07 | 1.23 | .46 | 2.19 | 1.11 | .74 |
| Oats - combined | 2.99 | 2.59 | .38 | 3.75 | 1.98 | 5.55 |
| Oats - cut and threshed | 6.89 | 2.93 | 3.60 | 7.27 | 1.77 | 6.64 |
| Soybeans - combined | 6.74 | 5.33 | 1.23 | | | |
| Wheat - combined | 3.83 | 3.50 | .37 | 4.55 | 3.09 | 4.04 |
| Wheat - cut and threshed | 9.49 | 3.72 | 4.64 | 10.01 | 2.78 | 11.06 |

The difference between the two areas in the labor requirements for producing crops by the same method of harvesting is also very marked. The greater use of horse labor in the Lafayette-Saline area shows up in more hours of man labor in every instance. In only one instance (corn, husked with a picker) is the tractor labor as high in

the Lafayette-Saline area as in the Carroll area. This was caused by the 1-row pickers in the Lafayette-Saline area in contrast to the 2-row pickers in the Carroll area.

Per Hour Cost of Man Labor

The cost of man labor per hour was determined by the wages paid hired hands. Most of the operators had hired some labor during the year. Some of them had regular hired hands while some had used hired labor only during harvest and for corn picking. Where a dwelling house, garden, cow, and other perquisites were furnished the

TABLE 7. - PER HOUR WAGES PAID FOR MAN LABOR¹

| Item | Carroll Area | | Lafayette-Saline Area | |
|----------------------|--------------|---------|-----------------------|---------|
| | Regular | Harvest | Regular | Harvest |
| Highest | 50.0¢ | 75.0 | 45.0 | 70.0 |
| Lowest | 30.0 | 40.0 | 25.0 | 45.0 |
| Average ¹ | 37.7 | 56.6 | 35.3 | 54.1 |

1. Unweighted

estimated value of these was included in the wages paid. The value of these perquisites varied more from farm to farm than the cash wages paid. The time of the operator was counted at the same rate as that of the hired hand. Table 7 gives the high, the low, and the average wages paid in the two areas, for regular and for harvest hands. Wages were about 2½¢ per hour higher in the Carroll area than in the Lafayette-Saline area.

Horse Labor Cost¹

The cost of horse labor is an important factor in the cost of producing farm crops, although not so important as formerly because it seems that the horse as a source of farm power is being slowly but inexorably replaced by the tractor and truck. Of the 50 surveyed farm operators in the Carroll county area, 29 owned and used 83 horses. This was an average of 2.86 head per "horse farm." There were no horses used on the other 21 farms except that one of the 21 swapped work with a neighbor and got his corn planted with horses. On five of the 29 "horse-farms" horses were not used for field work. Most of the horseless-farm operators admitted that there were some operations which could be done as efficiently, or perhaps more efficiently, with horses than with tractors or trucks, but that there wasn't enough of such work to justify keeping a team for these few jobs. Perhaps

¹Includes both horses and mules.

in some cases there was a natural reluctance on the part of the operator or his sons to spend a little more time on the job or on feeding, grooming, and harnessing the horses at a time of the year when farm work is not ordinarily very pressing. There were only two horseless farms in the Lafayette-Saline area. There were 188 horses on the other 48 farms in this area for an average of 3.92 per farm. The writer is of the opinion that the horseless farm era, if such is a picture of the future, has been greatly accelerated by the war and the consequent shortage of man labor. Such a change will naturally occur first in areas best suited to tractor operations such as the Carroll area. One of the results of this rapid change is reflected in the lower prices of horses in the Carroll area as compared to prices in the Lafayette-Saline area. The average age of work stock in the Carroll area was only a little over one year more, but the average price was almost \$27.00 lower.

One of the immediate effects of the first coming of the tractor into the corn belt, some thirty years ago, was a drastic lowering of the average hours of labor per horse. There were many farm oper-

TABLE 8. - THE COST OF HORSE LABOR¹

| Cost items | Carroll Area | | | Lafayette-Saline Area | | |
|----------------------------------|--|--------|-----------------|--|--------|-----------------|
| | 29 farms 83 horses | | Cost | 48 farms 188 horses | | Cost |
| | Av. age of horses: 10.4 yrs. Av. value of horses: \$76.01 | | | Av. age of horses: 9.2 yrs. Av. value of horses: \$102.72 | | |
| | Quantity | Price | | Quantity | Price | |
| Feed | | | | | | |
| Corn | 12.7 bu. | \$1.01 | \$12.83 | 29.1 bu. | \$1.00 | \$29.10 |
| Oats | 19.3 bu. | 0.73 | 14.09 | 22.4 bu. | 0.74 | 16.58 |
| Hay | 2.18 T | 14.43 | 31.46 | 2.36 T | 15.09 | 35.61 |
| Pasture (head month) | 5.57 mo. | 1.59 | <u>8.86</u> | 3.50 mo. | 1.42 | <u>4.97</u> |
| Total feed cost | | | \$67.24 | | | \$86.26 |
| Man labor | 35.2 hrs. | 37.5¢ | 13.20 | 30.8 hrs. | 35.2¢ | 10.84 |
| Interest, taxes, insurance | | | 5.56 | | | 7.29 |
| Net depreciation ² | | | <u>3.47</u> | | | <u>1.62</u> |
| Total cost per head | | | \$89.47 | | | \$106.01 |
| Crop labor per horse | | | 231 hrs. | | | 448 hrs. |
| Other labor per horse | | | <u>416 hrs.</u> | | | <u>491 hrs.</u> |
| Total labor per horse | | | 647 hrs. | | | 939 hrs. |
| Cost per horse hour ³ | | | 13.8¢ | | | 11.3¢ |

¹ Weighted averages.

² Some of the younger stock were appreciating.

³ Does not include barn charge which is a cost to the landlord.

ations these first tractors could not do, so that practically the same number of horses had to be retained to perform the non-tractor operations, such as corn cultivation. Later, tractor improvements and greater versatility on the part of the operator resulted in a better adjustment of the number of horses to the many, but lighter, operations

still performed by horses on most farms so that the hours of labor per horse rose again to something approaching the pre-tractor level. In spite of the low crop labor per horse in the Carroll area, the average of 647 hours per horse is probably as high as the state average, although it lacks almost 300 of reaching the Lafayette-Saline average of 939 hours.

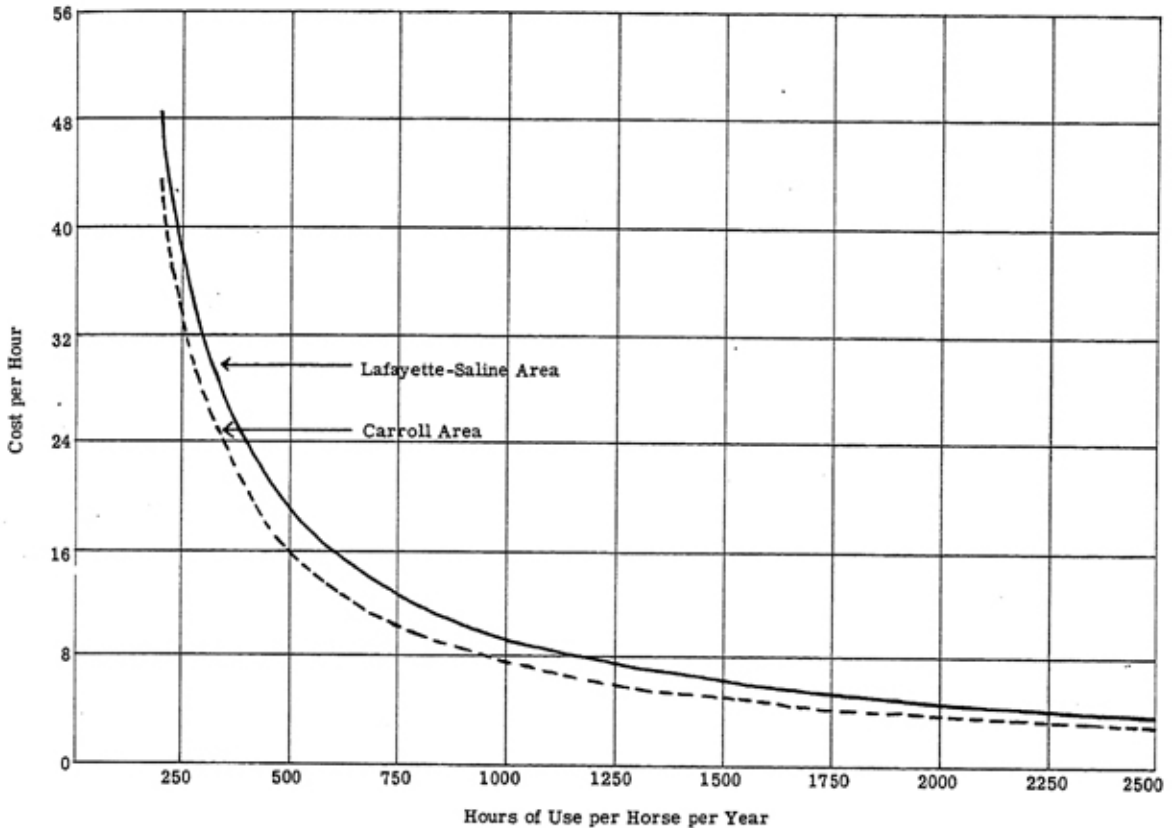


Fig. 1. Relationship Between Hours of Use and Cost of Horse Labor per Hour.

The annual cost per head was \$16.54 higher in the Lafayette-Saline area than in the Carroll area. Slightly more than this difference is accounted for by the higher feed requirements to do the extra and assumedly heavier field work while other costs were slightly lower.

The effect of the annual hours of use per horse on the cost per hour is shown in Figure 1. Interest, taxes and depreciation amount to the same regardless of the amount of use made of the horse. There is some reduction in the feed requirement and care with less use, but many farmers feed and care for their horses practically the same regardless of whether they are working or not. The net result is that there is a very sharp decrease in cost per hour proportional to any given increase in use, a 100 per cent increase in use resulting in

about 50 per cent decrease in cost per hour. Although the average cost per hour was lower in the Lafayette-Saline area than in the Carroll area (11.3¢ compared to 13.8¢), Figure 1 shows that for any given amount of use the cost in the Carroll area was lower than in the Lafayette-Saline area. The lower average cost in the latter area resulted from a greater average use while the higher cost for any given amount of use probably resulted from higher priced horses and the heavier field work required of them.

Tractor Power

Tractors were owned and used on all the Carroll area farms, and on 45 of the 50 Lafayette-Saline area farms. It would have been interesting to compute the cost of production on the tractor and non-tractor farms separately, but the five non-tractor farms would not have been a sufficiently large sample to have had much significance. The present age and estimated probable life of the tractors differed very little between the two areas. The difference in present value (\$25.98) was probably significant and represents a greater original investment in 2-16" and 3-14" bottom tractors in the Carroll area. It was almost impossible to arrive at any definite cost for different size tractors because the numbers in some size classes were not sufficient

TABLE 9. - THE COST OF TRACTOR USE¹

| Item | Carroll Area | Lafayette-Saline Area |
|----------------------------|--------------|-----------------------|
| Farms using tractors | 50 | 45 |
| Tractors | 70 | 50 |
| Present age | 5.1 yrs. | 4.9 yrs. |
| Probable life | 8.4 yrs. | 8.8 yrs. |
| Present value | \$673.14 | \$647.16 |
| Gas, oil and grease cost | \$228.11 | \$188.74 |
| Cash repair cost | 57.98 | 42.23 |
| Home labor on repair | 1.96 | .44 |
| Interest, taxes, insurance | 47.12 | 44.50 |
| Depreciation | 93.11 | 81.05 |
| Total cost | \$428.28 | \$356.96 |
| Crop use | 603.3 hrs. | 436.3 hrs. |
| Non-crop and custom work | 102.1 hrs. | 110.3 hrs. |
| Total use | 705.4 hrs. | 546.6 hrs. |
| Cost per hour use | 60.7¢ | 63.5¢ |

¹ Weighted average

to furnish adequate samples and also because where different size tractors were owned by one operator (the usual case where more than one tractor was owned) no cost records had been kept on separate tractors. For the same reason, although many of the operators had accurate total cost records or could give a good estimate of their "filling

station" costs, very few of them could give a good break-down of the total into gas, oil and grease. The "home labor on repair" item is suspiciously low. It is almost impossible to believe that so many of the operators spent no time repairing their own tractors but most of them said that they were so busy with their crops that their time

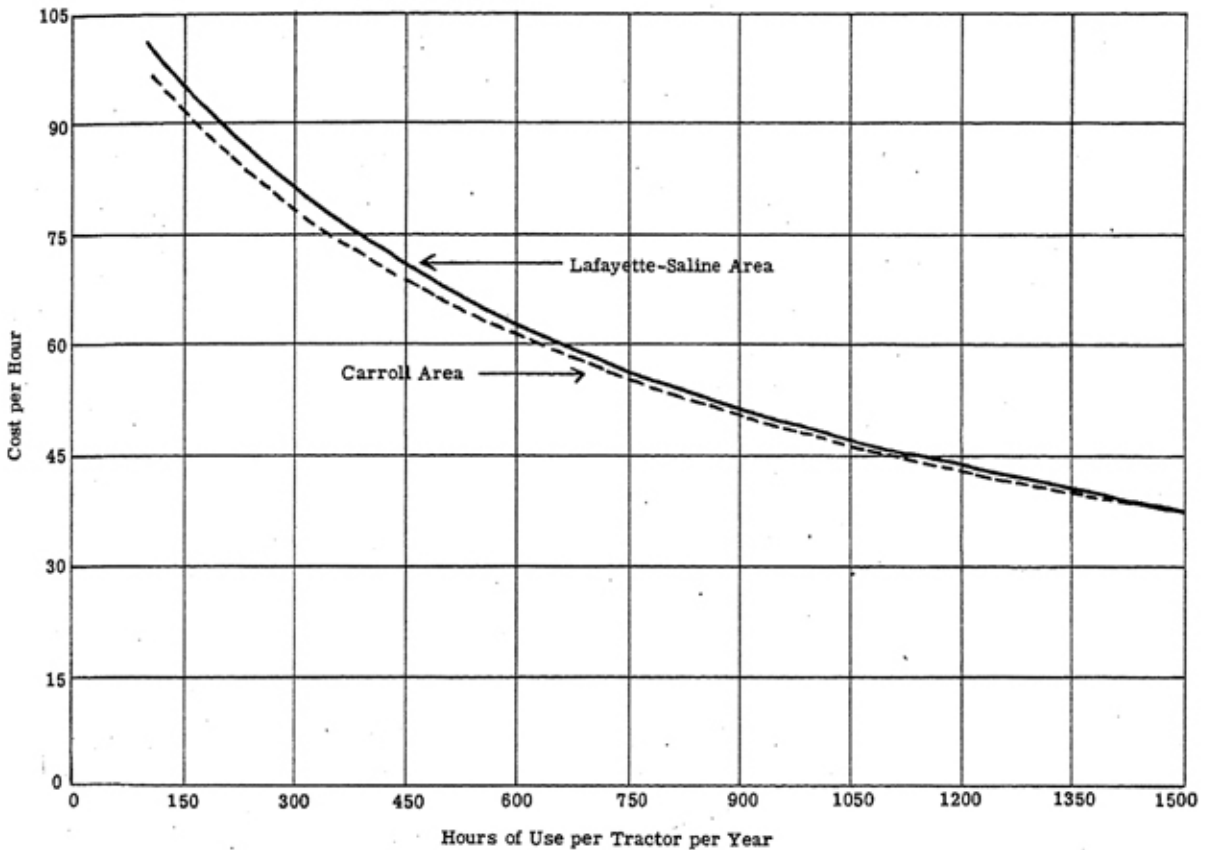


Fig. 2. Relationship Between Hours of Use and Cost of Tractor Labor per Hour.

was better spent driving their tractors to town for repairs. It is strongly suspected that most of them did spend considerable time in servicing and making minor adjustments and repairs on their tractors but that such time was considered as part of the field operations, resulting in a slight lowering of the area covered per day. The higher total cost on the Carroll county farms resulted from larger tractors and more use, but the higher total cost was more than off-set by the extra use, resulting in about 4.6¢ lower average per hour cost.

The effect of annual use on cost per hour (Figure 2) gives the same type of curve as the horse use—cost per hour relationship shown in Figure 1, but the slope of the curve is not nearly so sharp. Although interest, taxes, and, to some extent, depreciation is accruing during the time when the tractor is not being used, the larger items of expense (gas, oil and wear) occur only when the tractor is working.

The fixed expenses being a much smaller proportion of the total in comparison to the same for horses, results in a much flatter curve. An increase of 100 per cent in the annual use resulted in a decrease of less than 25 per cent in the average cost per hour.

Equipment Costs

The annual cost of various pieces of field equipment in the two areas is shown in Tables 10 and 11. Annual costs were considerable higher in the Carroll area than in the Lafayette-Saline area. There

TABLE 10. - ANNUAL COST OF FIELD EQUIPMENT USED IN CARROLL AREA

| Implement | No. | Cost New | Estimated Life (years) | Present Age (years) | Present Value | Annual Depreciation | Interest Taxes and Insurance | Repair | | Total Annual Cost |
|--------------------------|-----|----------|------------------------|---------------------|---------------|---------------------|------------------------------|--------|------------|-------------------|
| | | | | | | | | Cash | Home Labor | |
| Corn planter | 46 | \$108.10 | 17.5 | 8.6 | \$62.27 | \$7.42 | \$4.36 | \$1.78 | \$0.30 | \$13.86 |
| Cultipacker | 12 | 87.80 | 15.5 | 4.8 | 65.89 | 6.24 | 4.61 | 0.81 | 0.21 | 11.87 |
| Corn cultivator | 67 | 128.41 | 11.7 | 3.9 | 89.11 | 10.98 | 6.25 | 2.51 | 0.16 | 19.90 |
| Disc harrow (tandem) | 39 | 130.74 | 12.7 | 6.1 | 73.20 | 11.37 | 5.13 | 2.17 | 0.30 | 18.97 |
| Endgate seeder | 6 | 37.30 | 9.6 | 2.3 | 29.48 | 4.18 | 2.06 | 1.93 | 0.22 | 8.39 |
| Grain binder | 6 | 220.00 | 19.5 | 13.3 | 99.83 | 12.87 | 6.99 | 4.17 | 0.38 | 24.41 |
| Grain drill | 38 | 169.73 | 20.3 | 11.0 | 95.76 | 10.48 | 6.70 | 1.59 | 0.12 | 18.89 |
| Harrow | 52 | 40.34 | 10.2 | 5.8 | 21.38 | 4.06 | 1.50 | 1.78 | 0.07 | 7.41 |
| Hay rake (side delivery) | 12 | 127.45 | 14.8 | 6.7 | 81.04 | 11.81 | 5.67 | 3.10 | -- | 20.58 |
| Mower | 29 | 128.06 | 9.9 | 4.0 | 79.63 | 13.24 | 5.57 | 8.60 | 0.08 | 27.49 |
| Plow (2-bottom) | 54 | 144.81 | 13.4 | 5.1 | 92.58 | 11.15 | 6.48 | 12.08 | 0.03 | 29.74 |
| Rotary hoe | 20 | 114.11 | 11.4 | 2.7 | 82.39 | 11.00 | 5.77 | 0.81 | 0.02 | 17.60 |
| Stalk cutter | 14 | 65.83 | 16.8 | 3.1 | 51.93 | 4.24 | 3.64 | 0.17 | -- | 8.05 |

were 11 comparable implements in the two areas and the cost of only one—a grain binder—was higher in Lafayette and Saline. There are several reasons for this generally higher cost. (1) The initial cost was higher in 10 cases out of 11, while the estimated life was lower in all cases, resulting in a greater depreciation cost in 10 cases out of the 11. (2) The present age was lower in the Carroll area and therefore the present value higher, resulting in a higher interest, taxes and insurance cost. (3) The cash repair cost was higher in 8 cases out of 11, while the home repair cost was higher in 7 cases. The home repair cost was unreasonably low on almost all implements.

TABLE 11. - ANNUAL COST OF FIELD EQUIPMENT USED IN LAFAYETTE-SALINE AREA

| Implement | No. | Cost New | Estimated Life (years) | Present Age (years) | Present Value | Annual Depreciation | Interest Taxes and Insurance | Repair | | Total Annual Cost |
|--------------------------|-----|----------|------------------------|---------------------|---------------|---------------------|------------------------------|--------|------------|-------------------|
| | | | | | | | | Cash | Home Labor | |
| Corn planter | 41 | \$94.12 | 23.8 | 11.5 | \$51.72 | \$4.95 | \$3.62 | \$1.53 | 0.04 | \$10.14 |
| Cultipacker | 12 | 73.76 | 25.3 | 5.9 | 60.74 | 3.51 | 4.24 | 0.49 | -- | 8.24 |
| Corn cultivator | 89 | 88.61 | 13.1 | 4.7 | 66.71 | 6.24 | 4.66 | 1.86 | 0.01 | 12.77 |
| Disc harrow (single) | 24 | 101.65 | 13.8 | 4.5 | 76.03 | 8.61 | 5.32 | 1.73 | -- | 15.66 |
| Disc harrow (tandem) | 19 | 119.87 | 13.3 | 6.4 | 71.95 | 9.89 | 5.04 | 1.45 | 0.03 | 16.41 |
| Grain binder | 19 | 256.11 | 22.1 | 14.5 | 105.52 | 15.12 | 7.39 | 8.03 | 0.02 | 30.56 |
| Grain drill | 27 | 156.49 | 25.5 | 15.1 | 79.96 | 7.35 | 5.60 | 2.38 | 0.15 | 15.48 |
| Harrow | 48 | 29.23 | 14.1 | 8.6 | 14.23 | 2.10 | 1.00 | 0.92 | 0.05 | 4.07 |
| Hay rake (side delivery) | 5 | 109.60 | 15.8 | 15.8 | 52.01 | 8.08 | 3.64 | 2.70 | -- | 14.42 |
| Hay rake (sulky) | 5 | 52.40 | 19.0 | 14.6 | 13.71 | 2.84 | 0.96 | 0.80 | -- | 4.60 |
| Mower | 12 | 95.87 | 15.0 | 9.8 | 39.40 | 7.40 | 2.76 | 8.56 | 1.17 | 19.89 |
| Plow (2-bottom) | 37 | 123.92 | 15.0 | 4.8 | 84.93 | 9.05 | 5.95 | 6.73 | -- | 21.73 |
| Rotary hoe | 5 | 92.00 | 14.2 | 7.2 | 45.32 | 6.95 | 3.17 | 2.60 | 0.12 | 12.84 |

While it is probably true that during the last few years farmers have been so busy that they have more of their repair work done than formerly, the writer is strongly of the opinion that many small repair jobs and adjustments are still made by the operator but that these minor repairs are regarded as part of the regular field work which reduces the day's accomplishment. (4) Most equipment covers more acres in Carroll than in the Lafayette-Saline area, and although there are no data to confirm this point, it seems to be less well housed and taken care of during the idle season.

In the Carroll area the most expensive implement was a plow, followed closely by a mower, while in the Lafayette-Saline area a binder was high and a plow second and mower third. In the Carroll area, the binder has been largely displaced by the combine. What few binders are left cut very small acreages and when they are worn out it is very doubtful if any of them will be replaced. But in the Lafayette-Saline area, the operators place a higher value on the straw as feed and bedding for their livestock, and most of the small grain is bound and threshed. The high cost per plow in the Carroll area is partly the result of sand particles in the soil. Most of the operators have their plowshares stellite at least once a year, while in the Lafayette-Saline area, few cases of stellite were found.

The Cost of Special Machine Hire

Special machine hire includes the hire of corn pickers, combines, threshing machines, balers, etc. Many of the operators in both the Carroll and Lafayette-Saline areas owned combines; fewer of them owned corn pickers, while still fewer of them owned balers and threshing machines. Since for most of the operators these special machines were hired and were a direct cash cost and there was a fairly definite customary rate for the community, the computations were all made on the basis of the average custom rate. This rate included the machine itself, the power to operate the machine, and the customary crew furnished with the machine. The rate on all combines and corn pickers included one man; balers, a variable number; while a threshing machine crew was still more variable. However, it was possible to classify threshing machines into two groups: (1) self-crew, where all hands are furnished by the machine operator and (2) regular machine crew. Frequently the farm operator himself would be included in the self-crew and would receive the same wages as other members of the crew. The same applied to his horses and equipment. The self crew seems to be a variation of the old threshing ring; a device whereby the machine operator charges a rate high enough to cover all costs and pays each member of the

crew, thus relieving the farm operators of the task of settling with each other. All men, power and equipment not included in special machine hire was charged under man labor costs, horse and tractor cost, and equipment cost. Table 12 gives the average customary cash rates for these various special machine operations.

TABLE 12. - AVERAGE RATES FOR SPECIAL MACHINE HIRE¹

| Operation | Carroll Area | Lafayette-Saline Area |
|-----------------------------|------------------|------------------------------|
| Combining lespedeza | \$4.52 per acre | \$6.19 per acre ² |
| Combining oats and wheat | 3.07 per acre | 3.18 per acre |
| Combining soybeans | 4.10 per acre | - - - |
| Picking corn | 4.41 per acre | 4.69 per acre |
| Threshing oats - reg. crew | 4.91¢ per bushel | 5.82¢ per bushel |
| Threshing oats - self crew | - - - | 14.42¢ per bushel |
| Threshing wheat - reg. crew | 7.02¢ per bushel | 9.27¢ per bushel |
| Threshing wheat - self crew | - - - | 20.20¢ per bushel |

1. Weighted averages

2. Most rates quoted by pound or by share of crop

Cost of Seed

The cost of seed relative to the total cost of production varies with the crop. Moreover, there is no set practice as to who furnishes the seed. In some cases the operator paid all the seed cost, in others the landlord furnished all the seed and in still others the cost was born by both in varying proportions. Generally where the landlord received one-third of the crop, the tenant furnished all seed except clover, and where the landlord received one-half the crop, he furnished all the seed, although in some cases the split was 50-50 on all receipts and expenses except man labor. The average prices used and the average amounts used per acre are given in Table 13. The cost of seed treatment is included in the price of seed.

TABLE 13. - AVERAGE PRICE OF SEED AND AMOUNTS PER ACRE¹

| Kind of Seed | Carroll Area | | Lafayette-Saline Area | |
|------------------------|-----------------|--------|-----------------------|--------|
| | Amount per acre | Price | Amount per acre | Price |
| Corn | .124 bu. | \$8.65 | .110 bu. | \$8.67 |
| Lespedeza ² | 19.5 lbs. | 8.63¢ | 19.4 lbs. | 9.15¢ |
| Oats | 2.66 bu. | 79.3 ¢ | 2.21 bu. | 76.6 ¢ |
| Red clover | 8.67 lbs. | 28.6 ¢ | --- | --- |
| Soybeans | 1.00 bu. | \$2.44 | --- | --- |
| Wheat | 1.26 bu. | \$1.54 | 1.27 bu. | \$1.56 |

1. Weighted averages

2. Volunteer acreage omitted

COMPUTATION OF PRODUCTION COSTS

Tables 14 to 18 inclusive show the computed average cost of production, per acre and per unit yield, of corn, lespedeza seed, oats, soybeans, and wheat in each of the areas except soybeans in the Lafayette-Saline area where the sample was not large enough for a stable average. Where two methods of harvesting were common, the cost has been computed by both methods. In no case was the cost of marketing included. The cost, as computed was that of the operator as previously defined.

Theoretically, the entire per unit yield cost, including a land charge, should be the same as the operator's cost. The competition of tenants for farms and of landlords for tenants should, where there is ample opportunity to shift from tenant to owner, force a constant approach to a point of equilibrium where the division of the yield is proportional to the cost. Actually, however, such a point is seldom if ever reached on any particular farm or in any particular region. As an actual fact the share rent rate is very stable and is based on custom rather than equity. Infertile, low priced farms generally rent for almost the same share as better farms in spite of the fact that the owners cost relative to the tenants is far less. However, such poor farms will more frequently be tenantless. Moreover, the customary share rent rate continues the same over long periods of time. There is however some adjustment to changing relative costs in the way of cash charges for the dwelling house, pasture, etc., and the proportionate parts of the seed cost and machine hire paid by the two parties.

It should be remembered that these costs apply only to the two areas sampled, which are among the best in the state, and should be taken as typical of other sections only to the extent that methods of production and fertility of soil are similar.

The Cost of Producing Corn

The per acre cost of producing corn was some higher in the Lafayette-Saline area than in the Carroll area, although if corn alone were considered, the differences in cost could hardly be considered as significant. However, when it is noticed that the per acre cost of other crops are consistently higher in the Lafayette-Saline area, one begins to suspect costs are actually some higher in that area. The reason probably is that tractors and big machinery are not used so much as in the Carroll area with a consequent increase in the man labor charge. This slightly higher acre charge is more than off-set by a higher yield of corn resulting in a slightly lower bushel cost in

TABLE 14. - OPERATOR'S COST OF PRODUCING CORN
(Cost per acre except where otherwise specified)

| Item | Carroll Area | | Lafayette-Saline Area | |
|--|---|---------|--|---------|
| | 3670 1/2 acres harv. with picker 504 acres husked by hand 52 1/2 acres hogged | | 761 1/2 acres harv. with picker 2429 acres husked by hand 196 acres hogged | |
| Up to harvest | Quantity | Cost | Quantity | Cost |
| Man labor | 5.27 hrs. | \$1.97 | 6.57 hrs. | \$2.29 |
| Horse labor | 1.12 hrs. | .15 | 6.46 hrs. | .73 |
| Tractor labor | 4.66 hrs. | 2.83 | 4.01 hrs. | 2.62 |
| Seed ¹ | .075 bu. | .65 | 0.088 bu. | .76 |
| Fertilizer ² | 3.58 lbs. | .06 | 1.24 lbs. | .02 |
| Equipment | | .98 | | 1.03 |
| Cost up to harvest | | \$6.64 | | \$7.45 |
| Harvesting with picker | | | | |
| Man labor | 1.53 hrs. | \$0.84 | 1.77 hrs. | \$0.93 |
| Horse labor | | | 1.00 hrs. | .11 |
| Tractor labor | .85 hrs. | .52 | 0.61 hrs. | .40 |
| Equipment | | .07 | | .07 |
| Picker hire ³ | | \$4.41 | | \$4.69 |
| Cost of harvesting with picker | | \$5.84 | | \$6.20 |
| Harvesting by hand | | | | |
| Man labor | 6.80 hrs. | \$3.85 | 6.89 hrs. | \$3.72 |
| Horse labor | 13.60 hrs. | 1.88 | 13.78 hrs. | 1.56 |
| Equipment | | .07 | | .07 |
| Cost of harvesting by hand | | \$5.80 | | \$5.35 |
| Total cost-harvested with picker | | \$12.48 | | \$13.65 |
| Total cost-harvested by hand | | \$12.44 | | \$12.80 |
| Cost per bushel-harv. with picker ⁴ | | 52.7¢ | | 51.9¢ |
| Cost per bushel-harv. by hand ⁴ | | 52.5¢ | | 48.7¢ |

¹ Only the part furnished by operator: 60.1% in Carroll area; 73.4% in Lafayette-Saline area. The balance was furnished by landlord.

² Only the part furnished by operator: 57.3% in Carroll area; 60.0% in Lafayette-Saline area. The balance was furnished by landlord.

³ Included picker, tractor and one man. Does not include men, horses or tractors and equipment to take care of corn.

⁴ Yield in Carroll area: 45.5 bu. of which 23.7 bu. was the operator's part.
Yield in Lafayette-Saline area: 50.7 bu. of which 26.3 bu. was the operator's part.

the Lafayette-Saline area than in the Carroll area. There was not much difference in the cost of machine picking and husking by hand, although machine picking has the distinct advantage of being able to get the corn cribbed sooner. It seems that owners of machine pickers may to some extent be taking advantage of their ownership. It is to be hoped that when pickers become more plentiful competition among owners of pickers will result in a more equitable custom rate for picking.

The Cost of Producing Lespedeza Seed

Korean lespedeza has become, during the past 15 years, one of

the more common crops of Missouri. Among its many favorable features is the fact that it has three alternative uses: hay, summer pasture, and seed. As was to be expected it was found that in the Carroll area a larger percentage of the lespedeza acreage was combined for seed than in the Lafayette-Saline area where there was more livestock. Aside from its use in a mixture of other legumes and grasses in permanent pastures, it is produced almost exclusively as an extra crop following small grains so that practically the only expense up to harvest is sowing the seed (usually broadcast) and the seed itself which the landlord generally furnishes. A few operators harrowed the ground lightly after sowing the seed on top and a few also clipped the stubble and weeds after grain harvest. Where small grains follow small grains in the rotation with lespedeza following the first grain crop a good stand of volunteer lespedeza usually will be obtained in the second grain crop.

The cost of production per pound of seed as shown in Table 15, was almost 50 per cent higher in the Lafayette-Saline area than in the Carroll area. This was due almost entirely to two factors: (1) higher

TABLE 15. - OPERATOR'S COST OF PRODUCING LESPEDEZA SEED
(Cost per acre except where otherwise specified)

| Item | Carroll Area 1112 acres | | Lafayette-Saline Area 445 1/2 acres | |
|---|----------------------------|--------|--|--------|
| | Quantity | Cost | Quantity | Cost |
| Up to harvest | | | | |
| Man labor | 0.50 hrs. | \$0.19 | 0.58 hrs. | \$0.19 |
| Horse labor | .33 hrs. | .05 | .42 hrs. | .05 |
| Tractor labor | .20 hrs. | .12 | .02 hrs. | .01 |
| Seed ¹ | 5.03 lbs. | .43 | 1.80 lbs. | .16 |
| Equipment | | .14 | | .05 |
| Cost up to harvest | | \$0.93 | | \$0.46 |
| Harvesting | | | | |
| Man labor | 0.72 hrs. | \$0.38 | 0.59 hrs. | \$0.31 |
| Horse labor | .13 hrs. | .02 | .31 hrs. | .04 |
| Tractor labor | .17 hrs. | .10 | .08 hrs. | .05 |
| Equipment | | .03 | | .03 |
| Combine hire ² | | 2.31 | | 3.10 |
| Cost of harvesting | | \$2.84 | | \$3.53 |
| Total cost per acre | | \$3.77 | | \$3.99 |
| Total cost per pound of seed ³ | | 2.06¢ | | 3.00¢ |

¹ Only the part furnished by the operator: 28.8% in the Carroll area; 10.8% in the Lafayette-Saline area. The balance of the seed was furnished by the landlord. 117 volunteer acres in the Carroll area and 39 1/2 volunteer acres in the Lafayette-Saline area were included in the per acre seed requirement computation.

² Included combine, tractor and one man, but did not include man labor, horses or tractor and equipment to take care of seed. The cost given was only the part paid by the operator; 51% in the Carroll area and 50% in the Lafayette-Saline area.

³ Yield in Carroll area, 362 pounds of which operator got 183.
Yield in Lafayette-Saline area, 266 pounds of which operator got 133.

combine charges and (2) lower yields. Most of the custom charges in the Carroll area were per acre and averaged \$4.52, while most of the rates in the Lafayette-Saline area were based on the yield or a share of the crop, in several instances up to one-half the crop. Of course, the operator paid only part of these charges as explained in

TABLE 16. - OPERATOR'S COST OF PRODUCING OATS
(Cost per acre except where otherwise specified)

| Item | Carroll Area | | Lafayette-Saline Area | |
|---|---|--------|---|--------|
| | 963 acres combined 208 acres cut & threshed 10 acres failed | | 198 acres combined 803 1/2 acres cut and threshed 41 acres failed | |
| | Quantity | Cost | Quantity | Cost |
| Up to harvest | | | | |
| Man labor | 1.58 hrs. | \$0.59 | 1.98 hrs. | \$0.70 |
| Horse labor | .15 hrs. | .02 | 3.13 hrs. | .35 |
| Tractor labor | 1.50 hrs. | .91 | 1.05 hrs. | .69 |
| Seed ¹ | 1.48 bu. | 1.17 | 1.90 bu. | 1.46 |
| Fertilizer ² | none | | 4.50 lbs. | .07 |
| Equipment | | .37 | | .44 |
| Cost up to harvest | | \$3.06 | | \$3.71 |
| Harvesting with combine | | | | |
| Man labor | 0.84 hrs. | \$0.47 | 0.54 hrs. | \$0.29 |
| Horse labor | .21 hrs. | .03 | 1.09 hrs. | .12 |
| Tractor labor | .51 hrs. | .31 | none | |
| Equipment | | .06 | | .06 |
| Combine hire ³ | | 1.94 | | 2.72 |
| Cost of harvesting with combine | | \$2.81 | | \$3.19 |
| Harvesting-cut and threshed | | | | |
| Man labor | 4.11 hrs. | \$2.30 | 3.23 hrs. | \$1.74 |
| Horse labor | 2.42 hrs. | .33 | 1.74 hrs. | .20 |
| Tractor labor | .66 hrs. | .40 | .55 hrs. | .36 |
| Equipment | | .72 | | .67 |
| Twine ⁴ | 1.96 lb. | .27 | 1.53 lbs. | .20 |
| Threshing ⁵ | 13.38 bu. | .88 | 18.62 bu. | 2.22 |
| Cost of harvesting-cut and threshed | | \$4.90 | | \$5.39 |
| Total cost-harvested with combine | | \$5.87 | | \$6.90 |
| Total cost-cut and threshed | | \$7.96 | | \$9.10 |
| Cost per bushel-harvested with combine ⁶ | | 49.8¢ | | 50.7¢ |
| Cost per bushel-cut and threshed ⁶ | | 67.5¢ | | 66.9¢ |

¹ Only the part furnished by the operator: 55.5% in the Carroll area; 86.0% in the Lafayette-Saline area. The balance of the seed was furnished by the landlord.

² Only the part furnished by the operator: 63.4% in Lafayette-Saline area. No fertilizer used in Carroll area.

³ Included combine, tractor and one man, but did not include man labor, horses or tractor and equipment to take care of grain. The cost given was only the part paid by the operator: 63.1% in Carroll area; 85.4% in Lafayette-Saline area.

⁴ Only the part furnished by operator: 100% in Carroll area; 91.7% in Lafayette-Saline area.

⁵ Included threshing machine, tractor and various crew members and equipment (see section on Cost of Special Machine Hire). The cost given was the part paid by operator (see note 3).

⁶ Yield in Carroll area 21.2 bushels, of which operator got 11.8 bushels; yield in Lafayette-Saline area 21.8 bushels, of which operator got 13.6 bushels.

footnote two, Table 15. Part of the lower Lafayette-Saline yield was due to later combining and consequent shattering. Corn harvest and lespezea seed compete for the operator's labor. Having more corn pickers, the Carroll area operators finished both jobs far earlier than did the Lafayette-Saline operators.

The Cost of Producing Oats

The per bushel cost of producing oats in the two areas studied shown in Table 16, is not typical because of the low area yields, 21.2 bushels in the Carroll area and 21.8 bushels in the Lafayette-Saline area. It is impossible to obtain the normal yields for these two areas but the average yield for the ten-year period 1935 to 1944 inclusive was 28.0 bushels for Carroll County, 30.8 for Lafayette County, and 28.2 for Saline County. The normal yield for the areas studied should be somewhat above the county yields. However, the cost up to harvest is not affected by the area yields while the cost of combining is affected only to the extent that the combining is done on a bushel basis and the extra cost of taking care of the grain. In practically all cases the combining was on a per acre basis and since this constituted the principal expense of harvesting, the per acre cost of producing oats in the two areas may be accepted as fairly typical of this high priced labor period. Threshing rates are, however, on a per bushel basis, so that the per acre costs would be too low for a normal yield while all bushel costs would be too high.

The Cost of Producing Soybeans

The per acre and per bushel cost of producing soybeans in the Carroll area are given in Table 17. There were only three fields of soybeans among the 50 records in the Lafayette-Saline area, and those were all used for hay. Soybeans, in general, are not grown on rolling land because of soil erosion both during their period of growth, if they are planted in rows and cultivated, and after they are harvested. The production of soybeans in the Carroll area, where the topography is ideally suited to the crop, has greatly increased due to the war need for oil crops.

The Cost of Producing Wheat

It seems that the average cost of producing wheat is somewhat higher in the Lafayette-Saline area than in the Carroll area. The cost even by the same method of harvesting is some higher but the principal cause of higher production cost is brought out only indirectly in Table 18, i. e., the fact that approximately 50 per cent of the crop is cut and threshed in the Lafayette-Saline area while only about 2 per cent of the Carroll area crop is harvested in this way. The cost

TABLE 17. - OPERATOR'S COST OF PRODUCING SOYBEANS
IN THE CARROLL AREA
(Cost per acre except where otherwise specified)
(25 operators - 538 1/2 acres)

| Item | Quantity | Cost |
|--------------------------------|-----------|---------|
| Up to harvest | | |
| Man labor | 5.16 hrs. | \$2.06 |
| Horse labor | 1.05 hrs. | .14 |
| Tractor labor | 3.86 hrs. | 2.34 |
| Seed (66.2%) ¹ | .66 bu. | 1.63 |
| Equipment | | .79 |
| Cost up to harvest | | \$6.96 |
| Harvest | | |
| Man labor | .74 hrs. | \$0.40 |
| Horse labor | .17 hrs. | .02 |
| Tractor | .65 hrs. | .39 |
| Equipment | | .08 |
| Combining (67.3%) ² | | 2.63 |
| Cost of harvesting | | \$3.52 |
| Total cost per acre | | \$10.48 |
| Cost per bushel ³ | | 77.1¢ |

¹ Only the part furnished by the operator. The balance was furnished by the landlord.

² Included combine, tractor and one man, but did not include man labor, horses or tractor to care for grain. The cost given was only the part furnished by the operator.

³ Yield 24.3 bushels, of which 13.6 bushels went to the operator.

of combining is much less but a much higher value is attached to the straw stacks in the Lafayette-Saline area where the livestock are allowed access to them all winter. They are valued both as a shelter and as a source of cheap roughage.

By-Products and Crop Residues

In the tables on the cost of producing the various crops, no allowance was made for the value of by-products and crop residues. There is no regularly established market for corn stalk pastures and the value of straw varies considerably with localities. Most operators had a rather vague idea of the value of these residues but a few had sold baled straw and knew exactly what they received. Unless receipts were net, the cost of baling, extra man labor, etc., was deducted. If a residue was not utilized, it was recorded zero value and was averaged with others, using acres as weights. Thus the values given in Table 19 represent values other than as humus. Their value as humus, if not otherwise utilized is hard to estimate and varies considerably with the soil's need. It is to be assumed that if fed to livestock on the farm, some of the humus value is recovered but in such cases to the variability of the soil is added the way the residue was fed and manure taken care of. In most cases the residue, if utilized on the farm, belonged to the operator but in livestock share leases, the

TABLE 18. - OPERATOR'S COST OF PRODUCING WHEAT
(Cost per acre except where otherwise specified)

| Item | Carroll Area | | Lafayette-Saline Area | |
|---|---|--------|---|---------|
| | 3309 acres combined 64 acres (6 records) cut and threshed | | 560 acres combined 550 acres cut and threshed | |
| | Quantity | Cost | Quantity | Cost |
| Up to harvest | | | | |
| Man labor | 2.43 hrs. | \$0.91 | 3.40 hrs. | \$1.19 |
| Horse labor | .26 hrs. | .04 | 4.34 hrs. | .49 |
| Tractor labor | 2.34 hrs. | 1.42 | 2.17 hrs. | 1.42 |
| Seed ¹ | .51 bu. | .79 | .99 bu. | 1.54 |
| Fertilizer ² | .71 lb. | .01 | 1.10 lb. | .02 |
| Equipment | | .53 | | .61 |
| Cost up to harvest | | \$3.70 | | \$5.27 |
| Harvesting with combine | | | | |
| Man labor | .78 hrs. | \$0.43 | .80 hrs. | \$0.44 |
| Horse labor | .12 hrs. | .02 | 1.63 hrs. | .18 |
| Tractor | .52 hrs. | .32 | none | |
| Equipment | | .06 | | .06 |
| Combine hire ³ | | 1.69 | | 2.40 |
| Cost of harvesting with combine | | \$2.52 | | \$3.08 |
| Harvesting-cut and threshed | | | | |
| Man labor | 5.86 hrs. | \$3.25 | 3.26 hrs. | \$1.81 |
| Horse labor | 3.34 hrs. | .46 | 1.94 hrs. | .22 |
| Tractor labor | .82 hrs. | .50 | .42 hrs. | .27 |
| Twine ⁴ | 2.56 lb. | .32 | 2.32 lb. | .31 |
| Equipment | | .72 | | .66 |
| Threshing ⁵ | 9.97 bu. | .70 | 13.89 bu. | 2.51 |
| Cost of harvesting-cut and threshed | | \$5.95 | | \$5.78 |
| Total cost-harvested with combine | | \$6.22 | | \$8.35 |
| Total cost-cut and threshed | | \$9.65 | | \$11.05 |
| Cost per bushel-combined ⁶ | | 62.7¢ | | 75.3¢ |
| Cost per bushel-cut and threshed ⁶ | | 97.3¢ | | 99.6¢ |

¹ Only the part furnished by the operator: 40.7% in Carroll Area; 77.9% in Lafayette-Saline Area.

² Only the part furnished by the operator: 55.5% in the Carroll Area; 57.9% in the Lafayette-Saline Area.

³ Included combine, tractor and one man but did not include man labor, horses or tractors and equipment to take care of grain. The cost given was only the part paid by the operator: 54.9% in Carroll Area; 75.4% in Lafayette-Saline Area.

⁴ 100% paid by operators in both areas.

⁵ Included threshing machine, tractor and various crew members and equipment (see section on Cost of Special Machine Hire): the cost given was the part paid by the operator. (see note 3).

⁶ Yield in Carroll Area 18.16 bushels of which 9.92 bushels went to the operator; 18.42 bushels in Lafayette-Saline area of which 11.09 bushels went to operator.

value was divided between the landlord and operator in the same proportions as the livestock and livestock products.

There seems to be no question that crop residues and by-products are utilized by a larger per cent of the operators in the Lafayette-

Saline area than in the Carroll area and that they have a higher per acre value. This was to be expected because of the greater livestock density. In the Carroll area the average value of corn stalks husked by a picker was higher than those husked by hand. This is the reverse of what was expected and may have been the result of random

TABLE 19. - BY-PRODUCTS OR CROP RESIDUES

| By-Product or residue | Carroll Area | | Lafayette-Saline Area | |
|--------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| | % of operators reporting some value | Average value per acre ¹ | % of operators reporting some value | Average value per acre ¹ |
| Corn stalks - all reports | 63.0 | 70.6¢ | 82.6 | 85.0¢ |
| Corn stalks - husked by hand | | 66.2¢ | | 94.4¢ |
| Corn stalks - husked by picker | | 71.8¢ | | 57.4¢ |
| Oat straw | 25.6 | 43.9¢ | 62.2 | \$1.49 |
| Wheat straw | 32.5 | 51.4¢ | 65.7 | \$1.83 |

1. Weighted average value, above cash costs.

fluctuations in the small sample of those husking by hand, or may have been due to more corn left in the field with machine picking than with hand husking. Corn was "down" in the Carroll area worse than in the Lafayette-Saline area. There is no doubt that the stalk pasture is more valuable when the corn is husked by hand if an equal amount of corn is left. Oats straw seemed to be less valuable than wheat straw but this difference was probably due to a poor oats crop and less straw per acre.

The Relationship Between Yield per Acre and the Per Unit Cost of Production

For some purposes the average cost of producing crops over a given region is the desired information. For other purposes the cost of production for certain specified acre yields is desired. The general public as well as the farmer is interested in reducing the cost of the product as much as possible. While it is recognized that there are many other factors which influence cost, the yield per acre is one of the most influential and offers the most obvious method of reducing the per unit cost. The theoretical relationship between acre yield and unit cost follows a rather definite pattern set by the combined action of three classes of costs.

(1) There are certain fixed costs which in total are entirely independent of yield. A minimum cost is incurred for soil preparation, seed, etc., regardless of yield. Any increase in yield spreads such costs over more units with a consequent decrease in the unit cost in so far as these elements are concerned.

(2) A second class of costs are in direct proportions to the yield and therefore any increase in yield does not affect the unit cost of these items. A combining or threshing charge per bushel is a perfect example of such costs but a flat rate per acre would fall in the first class. To the extent that straw yield and grain yield are associated, the cost of binder twine for bound grain would belong in this second class of costs.

(3) The third class of costs affects costs in a different manner from either of the above. Any given unit increase in the minimum soil preparation, seed, cultivation, fertilizer, etc., results in a greater proportional increase in the yield than in the cost so that the unit cost is decreased. However each additional unit of cost produces a smaller increase in yield until a point is finally reached where the proportional increase in yield exactly equals the proportional increase in total cost. Any additional unit of cost may result in an increase of yield but at a higher unit cost. In fact, with some elements of cost (fertilizer for instance) a point may be reached where additional units may decrease the yield.

The combined effect of these three classes of costs results in a theoretical yield-cost (per unit yield) curve which drops very rapidly

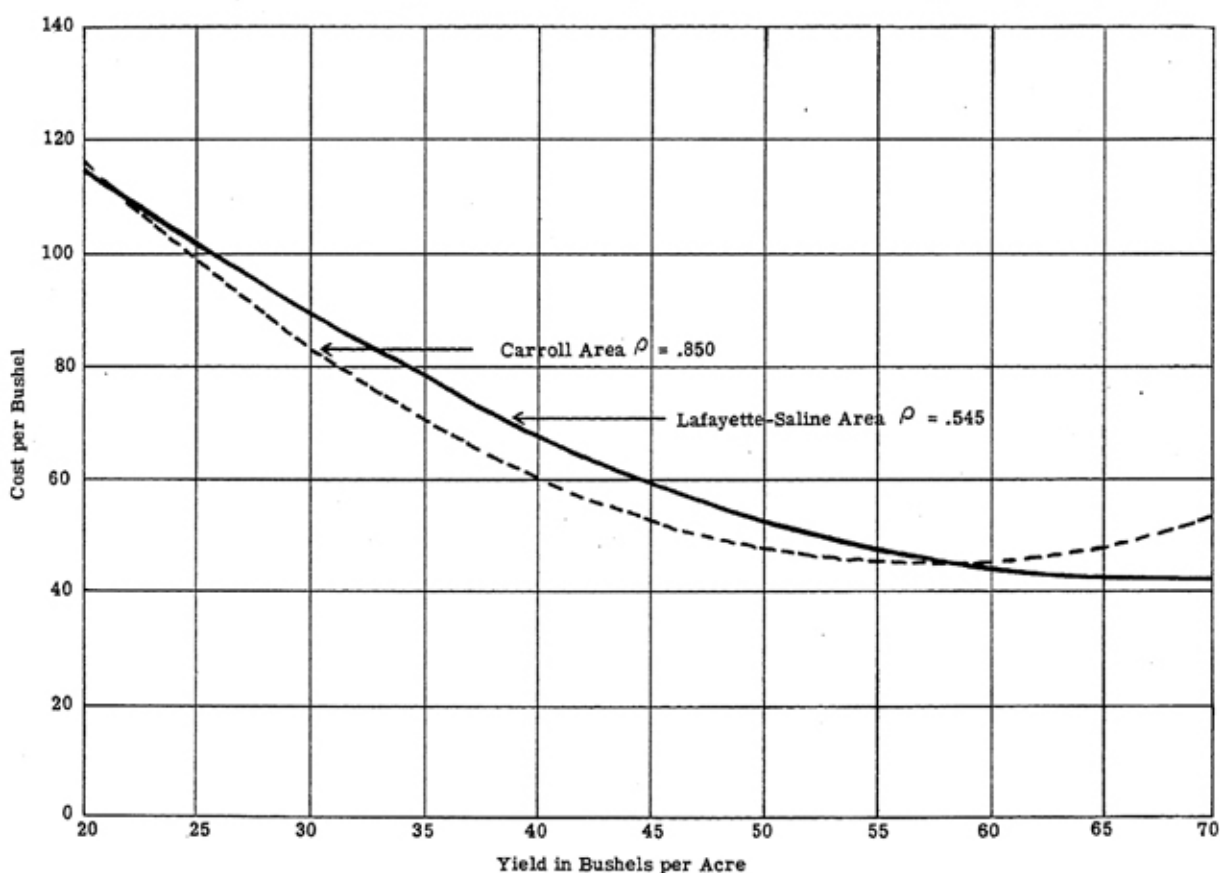


Fig. 3. The Relationship Between Yield and Cost of Producing Corn (tractor farms only).

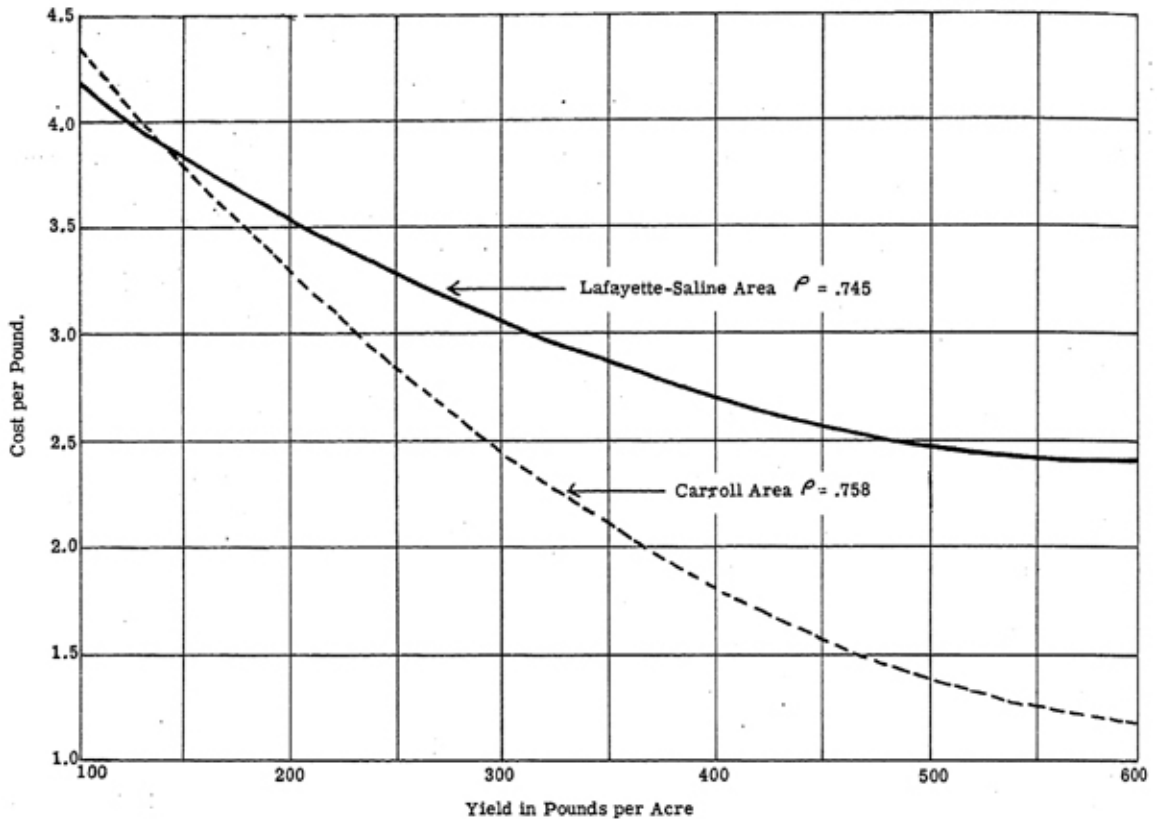


Fig. 4. The Relationship Between Yield and Cost of Producing Lespedeza Seed.

at first, gradually flattens out, and, if carried to high yields finally starts back up. Such a curve is referred to in statistics as a second degree parabola. The low point on the curve is greatly influenced by weather conditions as well as acre costs. It varies from year to year and from district to district, but is probably always considerably above average yields of any district. Moreover the particular yield which results in the lowest cost does not necessarily correspond to the optimum profit per acre point. The yield-cost curves in Figures 3 to 7 inclusive are all of the second degree parabolic type described above. The similarity of the corn yield-cost of production curves in the two areas is very good; better than for any other crop. This was expected because only tractor farms were used in the two areas and with the exception of harvesting, the methods of production were similar. It is true that most of the corn in Carroll was mechanically picked while most of the Lafayette-Saline corn was husked by hand, but an examination of the cost figures shows that there wasn't much difference in the cost of the two methods.

There was a wide divergence in the two curves for lespedeza yield and cost of production. The principal reason for such divergence was the difference in the harvesting charge. In the Carroll area the

charge was made on the acre basis which meant that as the yield increased the cost per pound decreased whereas in the Lafayette-Saline area the usual charge was based upon the pounds or share of crop so that yield, in so far as combines were concerned, had less effect on the per pound cost. The yield-cost curves for the other three crops (oats, soybeans and wheat) cannot be compared as between the two areas. In the Lafayette-Saline area, the number of records of combined oats and combined wheat were each too few for a reliable sample and therefore the cut and threshed records were used whereas in the Carroll area practically all oats and wheat were combined. As previously noted there were no records of soybeans for seed in the Lafayette-Saline area.

There is frequently a question as to the adequacy of yield-cost curves unless they are based on much larger samples than were available in this study. Small samples drawn from a non-correlated population will generally show a relationship of some sort. However there are two sources of evidence that the relationship between yield and cost per unit is of the general type as shown in these curves. (1) It would be very unusual that all nine curves would assume the same

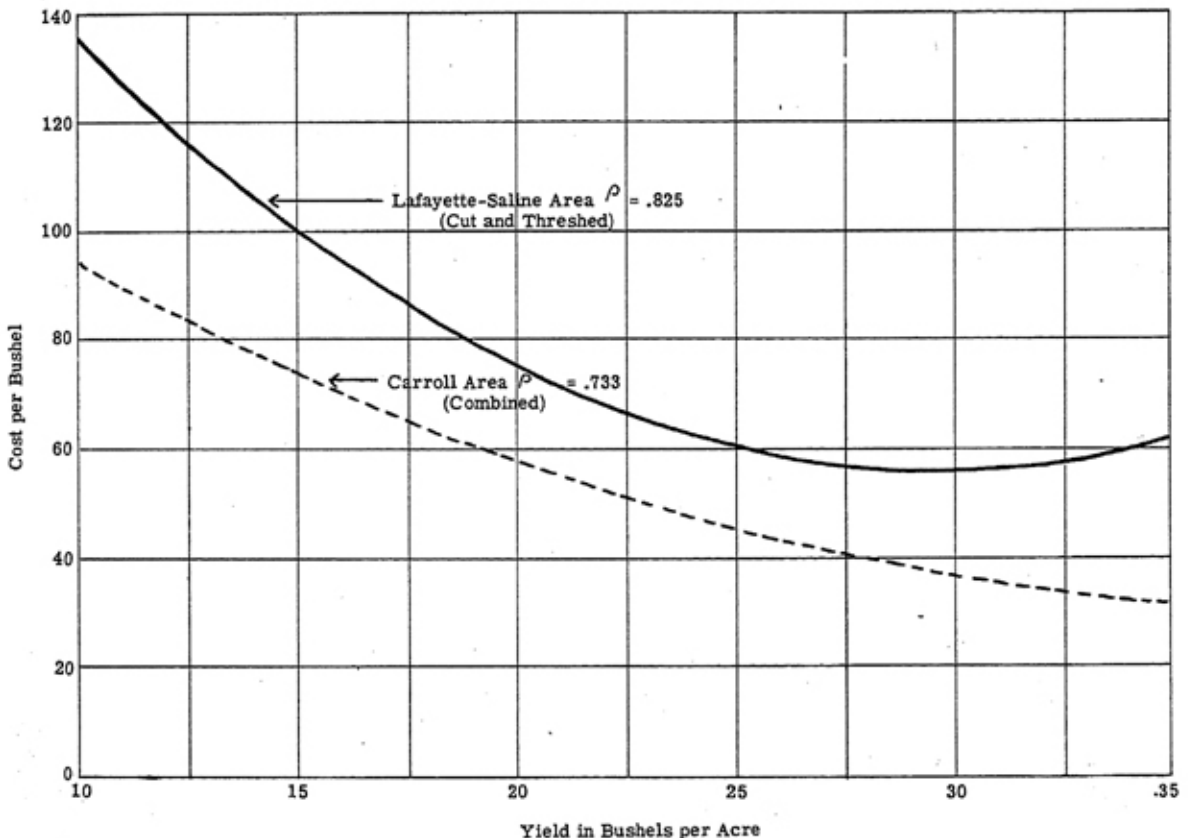


Fig. 5. The Relationship Between Yield and Cost of Producing Oats.

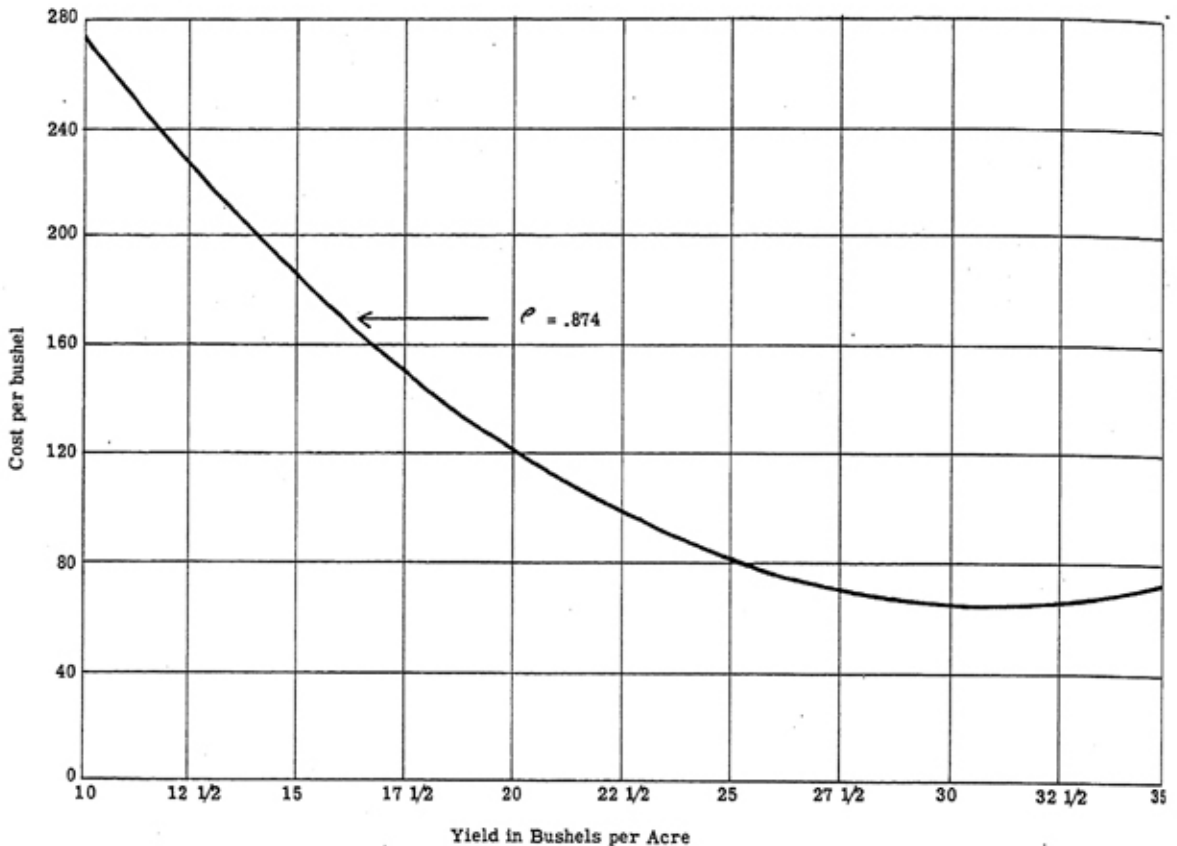


Fig. 6. The Relationship Between Yield and Cost of Producing Soybeans in Carroll Area.

shape unless such was the basic shape in the population. (2) The measure of association (ρ) is fairly high, being more in all cases than would be required for a probability of .01 that the data came from an uncorrelated population. Table 20 summarizes the curves, the magnitude of the association (ρ), the number of observations used, and the ρ which one might expect with the given sized samples, to appear about once in every hundred times as the result of chance alone from an uncorrelated population.

TABLE 20. - THE ASSOCIATION BETWEEN YIELD AND COST

| Curve | ρ | Observation used | Required for ρ of .01 |
|-----------------------------------|--------|------------------|----------------------------|
| Corn - Carroll Area | .850 | 50 | .372 |
| Corn - Lafayette-Saline Area | .545 | 45 | .393 |
| Lespedeza - Carroll Area | .758 | 36 | .449 |
| Lespedeza - Lafayette-Saline Area | .745 | 21 | .561 |
| Oats - Carroll Area | .733 | 36 | .449 |
| Oats - Lafayette-Saline Area | .825 | 31 | .463 |
| Soybeans - Carroll Area | .874 | 24 | .526 |
| Wheat - Carroll Area | .826 | 43 | .393 |
| Wheat - Lafayette-Saline Area | .781 | 24 | .526 |

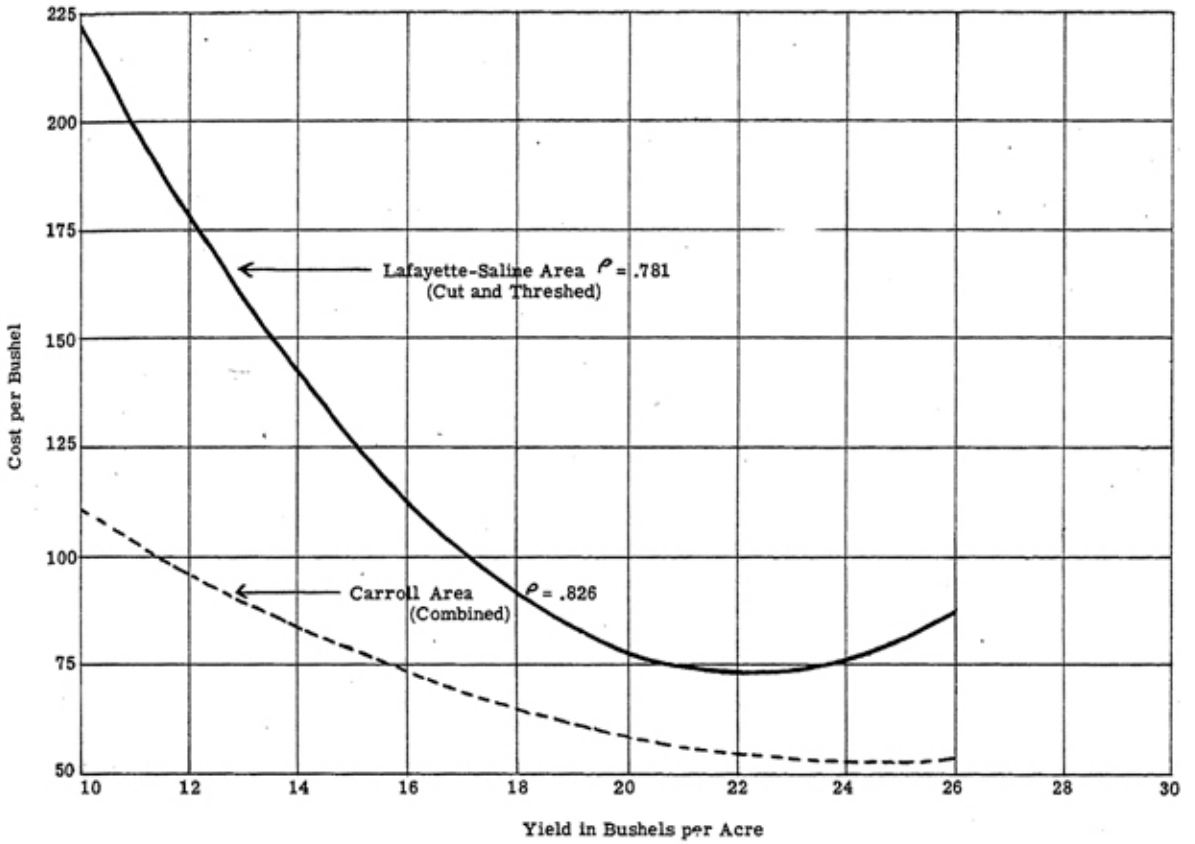


Fig. 7. The Relationship Between Yield and Cost of Producing Wheat.

SUMMARY

1. Fifty survey records on the cost of producing some common field crops in 1944 were obtained in each of two areas in west-central Missouri. One of the areas was located in the Missouri river bottom in the south part of Carroll County. This area, above the flood district, is mostly clay loam in texture but interspersed with heavy dark clay spots, and is very fertile. The other area, in Lafayette and Saline Counties, is an upland soil of silt loam and is also one of the most fertile areas of the State. The livestock population in the Lafayette-Saline area is of greater density than in the Carroll area and consequently the land use pattern is different. In the Lafayette-Saline area 30.4% of the total land is in pasture, 10% in wheat and 7.1% in miscellaneous crops while in the Carroll area the percentages are 14.7 in pasture, 25.5 in wheat, and 2.6 in miscellaneous crops. Other land uses vary to a smaller extent. Korean lespedeza, sown in small grains—especially oats—is used quite extensively in both areas but whereas practically all the crop is combined for seed in the Carroll area it is utilized for hay, pasture and seed in the Lafayette-Saline area.
2. The survey gathered information on the amount and cost of man labor, horse labor and tractor use; the cost of equipment, seed, fertilizer, twine, etc., the cost of special machine hire such as combining, threshing, corn picking, baling, etc., and also the division of the costs and yields between tenant and landlord.
3. The costs as computed were costs to the operator as distinguished from the landlord. The operator's per acre costs were divided by his share of the crop to arrive at his per unit cost. It is only on the assumption that normally the division of the crop between tenant and landlord is proportional to their contributions to the total cost that these unit costs can be interpreted as total unit costs of production.
4. During the past few years there has been a very significant decrease in the man labor requirement for producing field crops. Part of the decrease has been due to the use of larger power units and implements for the same operations and part has been due to a radical change in the operations themselves. This latter change is illustrated in the substitution of the combine for the binder and the use of the mechanical corn picker for hand picking. From comparisons of operational requirements between the two areas, where such is possible, i. e., the time required for the same operation using identical power, it seems that man labor was slightly more efficient in the Carroll area. The time required

for 16 such operations averaged 5% more in the Lafayette-Saline area than in the Carroll area. Actually there was more difference in the efficiency in the use of man labor than the above difference seems to indicate. This is due to the fact that more of the power requirements in the Lafayette-Saline area is supplied by horses and less by tractors than in the Carroll area.

5. The average man labor requirements per acre for different crops were:

| | Carroll Area | | Lafayette- Saline Area | |
|----------------------------------|-----------------|-------|---------------------------|-------|
| Corn—husked by hand | 12.57 | Hours | 14.33 | Hours |
| Corn—husked by picker | 7.44 | “ | 8.37 | “ |
| Lespedeza seed | 2.07 | “ | 2.19 | “ |
| Oats—combined | 2.99 | “ | 3.75 | “ |
| Oats—cut and threshed | 6.89 | “ | 7.27 | “ |
| Soybeans (seed) | 6.74 | “ | | |
| Wheat—combined | 3.83 | “ | 4.55 | “ |
| Wheat—cut and threshed | 9.49 | “ | 10.01 | “ |

6. In the Carroll area the average cost of hired hands was 37.7¢ per hour for non-harvest labor and 56.6¢ per hour for harvest labor as compared to 35.3¢ and 54.1¢ respectively in the Lafayette-Saline area.
7. In both areas there was a high negative correlation between the cost per hour of horse labor and the hours of annual use. The average annual cost in the Carroll area was \$89.47 per head and \$106.01 in the Lafayette-Saline area but because of greater use the average per hour cost was 13.8¢ in the Carroll area as compared to 11.3¢ in the Lafayette-Saline area.
8. The per hour cost of tractor operation also drops with increased use but because a larger proportion of the costs are operational in character the decrease in per hour cost is not so sharp as in the case of horse labor. The average cost per hour of tractor use was 60.7¢ in the Carroll area and 63.5¢ in the Lafayette-Saline area.
9. The annual equipment cost was somewhat higher in the Carroll area than in the Lafayette-Saline area but due to greater use the per acre cost seems to have been slightly lower. It is doubtful if this slightly lower cost was significant. No attempt was made to compute the per acre cost for separate pieces of equipment.
10. Special machine hire is an important element in the production of small grains regardless of whether they are combined or cut

and threshed. Custom rates were used in both areas. The custom rates were significantly higher in the Lafayette-Saline area than in the Carroll area. This was especially true for combining lespedeza which was frequently combined for $\frac{1}{3}$ to $\frac{1}{2}$ of the crop in the former area. Machine owners seemed to be taking undue advantage of the relative scarcity of combines and corn pickers.

11. The total operator's costs of production for various crops were found to be as follows:

| | Carroll Area | Lafayette- Saline Area |
|--------------------------------|-----------------|---------------------------|
| Corn—machine picked | 52.7¢ per bu. | 51.9¢ per bu. |
| Corn—hand picked | 52.5¢ “ “ | 48.7¢ “ “ |
| Lespedeza seed | 2.06¢ “ lb. | 3.00¢ “ lb. |
| *Oats—combined | 49.8¢ “ bu. | 50.7¢ “ bu. |
| *Oats—cut and threshed | 67.5¢ “ “ | 66.9¢ “ “ |
| Soybeans | 77.1¢ “ “ | |
| Wheat—combined | 62.7¢ “ “ | 75.3¢ “ “ |
| Wheat—cut and threshed . . | 97.3¢ “ “ | 99.6¢ “ “ |

It appears that although a mechanical corn picker greatly lowers the man labor requirement of corn production it has little effect on the cost. There is little difference in cost between a \$4.50 per acre picker charge and 10¢ per bushel for husking by hand. This may be changed as pickers become more plentiful. However at the present time the chief advantage of the mechanical picker seems to be that picking can be finished sooner. Three men with a two row picker can pick and crib 10 to 15 acres per day as compared to about $4\frac{1}{2}$ to 5 acres by hand.

There is however, a very significant saving from the use of the combine in both man labor and in cost. There are two harvest operations (shocking and threshing) completely eliminated by the use of the combine. With same size combine as binder, combining can be done about as fast as binding.

12. Assuming any given level of technique of production, per acre yield is probably the most important element determining the unit cost. Doubling the yield does not however decrease the cost by one-half. Certain per acre costs do not change regardless of the yield, others increase slightly with increased yields and still others increase in direct proportion to the yield. The combined effect

*The high per bushel cost for oats was due to low per acre yields in 1944.

of these different classes of costs is a rather sharp decrease in the per unit cost with yields slightly above average, with further increases in yield resulting in smaller decreases in the unit cost until a point is reached where no further decrease in cost results. In fact, the unit cost may increase with still higher yields. Curves corresponding to the above theory were fitted to the yield-cost data and the degree of correlation computed. The index of correlation varied from .545 for corn in the Lafayette-Saline area to .874 for soybeans in the Carroll area. The index was very significant in each case, being far above that required for a probability of .01.