

On the farm having 60 acres in crops, which was used to illustrate the minimum size farm suitable for tractor operation, the cost of power and labor at 1933 prices was 34 cents less per acre where mules were used. On the farm having 170 acres in crops, which was used to illustrate the maximum acreage one tractor could handle, the cost of power and labor at 1933 prices was \$1.66 more per acre where mules were used. Thus, it is evident that the farmer must consider size of business along with general price level in determining the type of power that should be used.

MECHANIZATION IN RELATION TO ADJUSTMENTS IN AGRICULTURE

The trend toward mechanization in agriculture may be indicated by (1) the substitution of tractor power for animal power, (2) the use of specialized equipment such as combines and other implements that are associated with tractor use, (3) the use of automobiles and trucks for transportation, and (4) the use of electricity on the farm. This combination of technological improvements is what is usually meant by the broad term mechanization. It is impossible to separate the influence of the different phases of technological improvements as they are all part of the broad impact of mechanization in agriculture. For instance, the tractor at the present time is usually required in conjunction with the use of most specialized items of farm equipment; and since the development of rubber tires and trailer equipment for tractors, it is frequently used for transportation both on and off the farm.

This study has been limited to the use of tractors as a source of power and to the use of tractor equipment. The influence of automobiles and trucks and the use of electric power on adjustments in agriculture are recognized but no detailed attempt was made in this report to separate their influence. In fact, this treat-

ment of mechanization is gauged principally by the adoption of tractors for farm use and it is believed that this serves as a meaningful index of the extent of mechanization in North Carolina. The adoption of tractors in the South has lagged far behind that of other farming areas throughout the United States, and in most southern areas the adoption of tractors for farm use has lagged behind the adoption of improved means of transportation.

The consequences of mechanization in agriculture not only affect the economic organization of society in general, but its impact is carried to nearly every phase in the organization of individual farms. From the economic viewpoint the influences of mechanization increase the choices among combinations of the factors of production--labor, management, and capital. Also mechanization widens the choice in enterprise combinations.

This section elaborates upon desirable adjustments that stem from the adoption of tractors and the subsequent reduction in labor required for farming and the displacement of workstock. It is not sufficient to appraise mechanization only as it exists today, for with new improvements in implement and machine design the adjustments in agriculture must be fluid. To achieve fully the advantages offered by mechanization, farming systems must be adjusted to most effectively utilize the productive capacity of the farm. Finally, it should be helpful to enumerate some of the problems that are apparent with the mechanization of farming and the accompanying adjustments in farming systems. Suggestions are offered for facilitating adjustments in the agricultural pattern and the use of productive resources with the purpose of ~~maximizing~~ maximizing the benefits to be gained from technological improvements in agricultural production.

The mechanizing of farm operations affects the economic organization of the farm. The substitution of modern mechanized methods of production for the prac-

tices normally associated with the use of mule power creates additional opportunities for choice on the part of the farmer in the use of productive resources. Improvements in mechanical power and implements tend to strengthen the position of machinery relative to labor in the farm organization. Thus, farm operators are finding it increasingly profitable to substitute machinery for labor.

During periods when job opportunities in industry are plentiful for relatively unskilled labor, farm wage rates tend to increase. It is in these periods that farm operators strive to mechanize farm operations and reduce the cost of farm labor. Since farm wage rates are determined by alternative job opportunities, the reduction in farm labor cost can be accomplished only by reducing the amount of farm labor required.

Prior to the war the supply of farm labor on most coastal plain farms was large in relation to that required for the normal farming operations. Consequently, labor was the relatively cheap resource, a condition which was not favorable to rapid mechanization as it is to the advantage of the farmer to make full use of the cheaper resources in production.

The substitution of machinery for labor is only one of several mutually related points to consider. One of the major considerations is the comparative cost of mechanical and animal power. When mule power is high in relation to mechanical power, as it usually is in periods of high industrial employment and high farm prices, the effect of substituting mechanical for animal power is usually cost reducing.

Other considerations such as the timeliness of performing farm operations, the utilization of farm land, the possibilities of increasing the size of the farm business either by adding additional acreages or substituting a productive livestock enterprise for workstock, and the problems inherent in partial mechan-

ization are of extreme importance in applying the principle of substitution in the organization of productive resources.

Mechanization of agriculture widens the choice of enterprises and affects the combination of enterprises on the individual farm. The relative economies concomitant with mechanization vary for different crops depending upon the resulting reduction in man labor and power costs--that is, some crops are more adaptable to mechanized conditions than others. For example, the greatest relative reduction in man labor for mechanized methods as compared with non-mechanized methods is obtained for small grains followed by soybeans, corn, peanuts, and cotton in the order enumerated. As for power cost, the greatest relative reduction is for small grains, followed by soybeans, peanuts, cotton, and corn.

The choice of alternative enterprises is not based on the cost aspects alone but depends on both cost and price relationships for the various commodities produced. The relative profitableness of enterprises varies from time to time depending on price and cost relationships.

In order to most effectively organize the farm business and make the allocation of resources to the various farm enterprises that will maximize the net farm income, every farm operator must estimate the probable price of farm products, the probable cost outlays for producing them and lastly the most profitable combination of enterprises. In determining the most profitable combination of enterprises additional considerations are necessary; such as spreading the use of man labor throughout the year, the utilization of farm by-products, the risks prevalent with specific enterprises, the maintenance of soil productivity as a conservation measure, and the advantages of diversification and specialization.

The adoption of tractors for farm power reduces the amount of farm labor required and displaces workstock. In recent years many farmers have substituted

tractors for mules because farm laborers have left the farm for other jobs and it was necessary to increase the accomplishments per worker if the usual cropland was to be utilized. Where labor becomes scarce and mechanical equipment has been adopted, there is usually some shift in enterprises in which those crops which are particularly adapted to mechanization are increased. Since the reduction in labor required has occurred only in pre-harvest operations for some crops--cotton, peanuts, and corn--the substitution of mechanical equipment for mules does not reduce labor requirements evenly throughout the season. In fact, peak requirements during the harvesting season are proportionally greater (see figure 4, page 21). This point will be considered further under problems of mechanization.

One of the most significant changes occurring with the transition from animal to mechanical power is the displacement of workstock. This reduction in workstock offers promising possibilities of substituting productive livestock enterprises on the farm and consequently adding an additional source of farm income. The reduction of workstock releases land that was formerly needed to produce feed for mules. If average yields are assumed for the area, the acreage required to produce grain for one mule ranges from about 3 to 3.5 acres. Usually mules are fed about 3 tons of peanut hay in this area and this hay could be used for other livestock. The particular enterprise to be chosen on any individual farm will, of course, depend upon special conditions such as the relative prices of the livestock products and upon the facilities available on the specific farm.

Progress in the development of new improvements in mechanical equipment will very likely increase the advantages of mechanized farming. If agriculture is to make the most of available opportunities, it will be necessary to make desirable adjustments in the utilization of farm resources as speedily as possible.

The development of the general purpose tractor is one of the outstanding factors which made mechanical power readily substitutable for animal power. Other

improvements such as the power-take-off and the power-lift have made the tractor more useful in performing farming operations. Improvements also have been made in tractor machinery. The size of machines have been made flexible to fit special circumstances and other improvements have increased their effectiveness.

With the development of smaller tractors and smaller implements the economy of mechanization has been extended to smaller farms. A continuation of this trend will very likely result in economical substitution of mechanical for all animal power on some farms with as little as 40 to 50 acres in crops, depending to a large extent on the cropping system.

In general improvements in machine design that reduce the cost of power and labor and increase the effectiveness can be expected in the future as in the past. These will tend to make mechanical methods of production adaptable to more farm jobs and feasible on smaller farms which should result in an increased output per unit of farm labor employed.

Many new problems in the organization of farm resources are resulting from the mechanization of agriculture. Mechanizing of farm operations in the Northern Coastal Plains of North Carolina has proceeded rapidly in recent years and without doubt the impacts of war have stimulated the use of mechanical methods. Smaller than normal supplies of farm labor have encouraged more complete use of available tractor power than ever before. The transition from animal to mechanical power is being made so rapidly in this area and certain other areas throughout the South that numerous problems have become apparent. Some of the more important problems associated with a mechanized agriculture are enumerated as follows:

1. Farmers that have adopted tractors are frequently not reducing the cost of power as they should. This results from the fact that when tractors are purchased, there is a reluctance to reduce the number of mules. Conse-

quently, per acre power costs are not decreased as much as they should be because mule power is only partially utilized.

2. Much of the farm labor left on farms is relatively unskilled in the use of mechanical equipment. This, of course, is a short-run problem in that with experience over a period of time this unskilled labor will be educated to the proper ways of using the new machinery. Until this experience is gained the cost of mechanical power will be higher than it normally should be.
3. Mechanization in the Northern Coastal Plains as in most parts of the South is only partial. Where mechanical power is used, the preparation of land, planting, and cultivating is completely mechanized for most crops, but the harvesting of cotton, peanuts, and corn is still performed mainly by hand labor. Not until satisfactory harvesting equipment is developed for these crops will it be possible to obtain the full economy offered by mechanization. Tractors and tractor equipment reduce the peak labor problems during the pre-harvest season, but until harvesting equipment is adopted for corn and perfected for cotton will it be possible to solve the peak labor problems occurring during the harvest season. Because of the importance of quality and the curing of peanuts for the edible trade, the possibilities of completely mechanizing the harvest operation for this crop are not bright in the eastern producing areas where rainfall is likely to be heavy during the harvest season.
4. The impact of mechanization has far reaching implications on the choice of crops and the expansion of the farm business. The use of tractors and tractor machinery often change the relative profitableness of the crops grown. This, together with changes in price relationships, usually calls for a reorganization of the cropping system to most effectively allocate

productive resources.

5. Where workstock have been displaced, many farmers have **not fully devel-**oped the potentialities of increasing productive livestock enterprises that would increase the size of the farm business. Productive livestock enterprises, particularly, beef cattle, poultry, and to some extent hogs, could utilize farm by-products and thereby increase the net farm income on many farms.
6. Extending the use of modern mechanized methods of farming increases the productivity of farm labor. Under normal peace-time conditions this would tend to increase the surplus of farm labor. It has been shown that man labor requirements per unit of production are much less where farm operations are mechanized. The surplus farm labor on farms would be confronted with the problem of finding jobs outside of agriculture or in other agricultural areas. This is an important social problem and emphasizes the need for maintaining a high level of industrial employment.

The problems that were enumerated are not insurmountable. In fact, most problems relating to mechanization are short run in nature and exist only because it is difficult to make adjustments speedily. The following suggestions are offered as a means of improving efficiency in the use of resources on mechanized farms.

1. When tractors are purchased, reduce the number of mules. One medium-size tractor is capable of replacing about 6 mules throughout the year.
2. Farm laborers should be trained in the proper use and care of tractors and farm machinery. This training will rest principally upon farm operators, but should result in more efficient work at lower cost.
3. The harvesting operations must be mechanized in order to reduce the peak

labor requirements during the harvest season. This applies particularly to cotton and corn.

4. Farm operators should continually explore price and cost relationships with the purpose of substituting more profitable crops for less profitable ones.
5. Add a productive livestock enterprise to the farm business when mules are displaced. This should afford utilization of farm by-products and increase the farm income.
6. Increase the use of farm machinery by using it to do more jobs. Labor requirements will be reduced but the productivity of labor will be increased. Surplus farm labor must find employment in industry, therefore, it is necessary for society to maintain a high level of industrial activity.

SUMMARY

1. The number of tractors on farms in North Carolina remained about the same from 1930 to 1940, but almost doubled from 1940 to 1944.
2. The average cost of operating the 125 tractors studied was 54 cents an hour.
3. The cost of operating tractors varies with the amount of use, ranging from \$5.00 a day when used 121 days a year to \$9.51 when used only 20 days.
4. The average annual cost of operating 49 six-foot combines was \$178.06. The average six-foot combine harvested 144 acres of grain, soybeans, and lespedeza at a cost of \$1.24 an acre.
5. The average annual cost of operating 56 peanut pickers was \$115.60. The average machine was used to pick 124 acres of peanuts at a cost of 93 cents an acre.
6. The average annual gross cost of keeping workstock, excluding the cost of shelter and taxes, was \$197.87 per head; the average annual net cost was \$185.87 per head.