

Table 6. Gross operating expense per acre with tractor power and mule power for specified crops, Northern Coastal Plains, 1943

Crop	Gross operating expense	
	Tractor power	Mule power
	Dollars	Dollars
Cotton	38.45	47.07
Peanuts	32.71	44.36
Corn	11.96	17.30
Soybeans	8.71	16.56
Small grains	10.51	17.07

Significant variations in expense items for different methods of production.

Labor and power costs were larger where mules were used as the chief source of power. Equipment costs were less where mules were used. Other expenses were approximately the same for both methods of production with the exception of contract work. Where mules were used, combining grains or soybeans and peanut picking were usually hired at contract rates. The cost per acre of combining small grains and soybeans and of picking peanuts was larger where it was performed on a contract rate basis.

EFFECTS OF SUBSTITUTING MECHANICAL FOR ANIMAL POWER
ON FARMING SYSTEMS

The mechanization of farming raises many different problems in the organization of the farm. It must be remembered, however, that in the area to which this study applies, the substitution of tractors for animal power is only one of several causal factors that have influenced production patterns. For instance, during the past decade the program of the Agricultural Adjustment Agencies has had a pronounced effect on production of intensive row crops. Since 1941 the wartime food production program has encouraged adjustments in crop and livestock production in such a way as to most effectively meet national needs. Nevertheless, the

mechanization of farm operations has had an effect on the production of certain crops, especially those that are adapted at least in part to mechanization.

The over-all effect of substituting mechanical for animal power on farming systems may be shown by comparing the distribution of crops found on 61 highly mechanized farms with the average for the area as a whole. Such a comparison, though not strictly valid because small farms have a higher proportion of row crops, is shown in table 7. This comparison is indicative of the possibilities of

Table 7. Distribution of crop acreage for the 61 highly mechanized farms in the Northern Coastal Plains Area, 1943, with comparisons.

Crop	Distribution as percent of total crop acreage for		
	61 Highly mechanized farms <u>1/</u>	Halifax County <u>2/</u>	Northern Coastal Plains Area <u>2/</u>
	Percent	Percent	Percent
Corn	19.2	20.8	27.2
Cotton	12.8	19.9	11.9
Peanuts	21.7	23.9	27.5
Tobacco	2.9	4.5	4.3
Soybeans for beans	11.3	3.4	4.2
Soybeans for hay	.4	1.6	1.7
Wheat for grain	2.1	.7	.5
Oats for grain	4.1	1.7	.9
Barley for grain	1.7	.3	.2
Rye for grain	1.0	.1	.1
Small grain hay	.8	1.1	.8
Lespedeza hay	2.7	- <u>3/</u>	- <u>3/</u>
All tame hay <u>4/</u>	-	4.4	4.9
Lespedeza seed	4.1	1.4	.5
Cover crops	13.6	11.0	11.1
Other	1.6	5.2	4.2
Total	100.0	100.0	100.0

1/ Distribution as percentage of the average crop acreage for the 61 highly mechanized farms surveyed in the Northern Coastal Plains.

2/ Distribution as percentage of the reported acreage for 1943, North Carolina Department of Agriculture.

3/ Included in all tame hay.

4/ Except soybeans, cowpeas, peanuts, and small grains.

increasing certain crops which are particularly adaptable to mechanized methods of production for those less adaptable and requiring greater relative amounts of hand labor.

The highly mechanized farms had approximately 58 per cent of the crop acreage in row crops, 28 per cent in small grains, hay, and soybeans, and the remaining 14 per cent in cover crops. In 1943 the distribution of crop acreage in Halifax County on all farms was 78 per cent in row crops, 12 per cent in small grains, hay, and soybeans, and 10 per cent in cover crops. For the Northern Coastal Plains Area approximately 75 per cent of the total acres was in row crops, 14 per cent in small grains, hay, and soybeans, and 11 per cent in cover crops.

The conclusions drawn in this section are based upon the records of the 61 mechanized farms. The average crop organization for these farms is presented in table 8. Although the average cropping system may not be identical with any particular farm, it does provide a basis for a quantitative analysis of the relative economy of farming methods. The kind of power as well as the combination of tractor and mule power that is employed in crop production affects the requirements for man labor, mule power, tractor power, operating expense, and capital investment.

The analysis of production requirements under mechanized and non-mechanized methods of farming indicates that the substitution of tractors for mules usually accomplishes the following: (1) A reduction in the cost of power, (2) a reduction in the amount and consequently the cost of labor, and (3) an increase in output per worker. Some other effects of shifting from animal to tractor power are higher capital requirements, additional opportunities for changing the cropping system and the livestock organization, and finally a greater managerial responsibility.

The following statements as to the comparative economy and operation with mule and tractor power are based upon the average mechanized farm in this study-- a farm with 515 acres in crops, including cover crops and double cropping, table 8. Production requirements and other related data are compared for both methods of production in table 9. It was estimated by the farmers in this study that one

Table 8. The average acres in crops for 61 highly mechanized farms in the Northern Coastal Plains, 1943.

Crop	Acres	Crop	Acres
Tobacco	15	Barley for grain	9
Corn	99	Rye for grain	5
Cotton	66	Small grain for hay	4
Peanuts harvested	111	Lespedeza for hay	14
Peanuts hogged	1	Lespedeza for seed	21
Soybeans for beans	58	Cover crops	20
Soybeans for hay	2	Cover crops, small grains	50
Wheat for grain	11	Garden	8
Oats for grain	21		
		Total acres in crops	515

Table 9. Comparison of production requirements and related data for mechanized and non-mechanized methods of farming in the Northern Coastal Plains, 1943.

Item	Tractor power	Mule power
Acres in crops <u>1/</u>	515	515
Investment <u>2/</u>	\$ 8,233	\$ 6,752
Number of mules	2	19
Number of tractors	3	0
Number of men (man equivalent)	11	14
Hours of mule work	1,987	14,926
Hours of tractor work	2,773	302
Hours of man labor	21,513	28,491
Bushels of corn required to feed mules	120	1,140
Tons of hay required to feed mules	6	57
Total operating expense	\$11,010	\$14,473

1/ See table 8 for the crop organization.

2/ Includes tractors, mules, machinery, and equipment.

medium tractor could accomplish as much work as 3 teams of mules or 6 mules. This estimate was not based upon physical limits of accomplishment alone, but also upon the practical limits of substitution which are determined by the normal distribution of work. Since it was determined that 3 medium tractors could accomplish as much work as 18 mules in this illustration, the comparison of production requirements for mechanized and non-mechanized methods is made for the average farm when mules are used exclusively and when 3 tractors are substituted for 17 mules, leaving 2 mules on the farm for odd jobs.

Tractors are a cheaper source of power. The cost of power for producing crops in 1943 on the average farm of 515 acres was less with tractors than with mules. The operating expense for this farm using 19 mules is estimated to be \$14,473 at 1943 prices. If three tractors were substituted for 17 mules, the total operating cost would be \$11,010 or \$3,463 less where 3 tractors were substituted for 17 mules.

The labor organization of farms varies with the type of power used. When tractors replace mules as the source of power there must be corresponding adjustments in the farm labor force to achieve maximum efficiency in the use of labor. Quantitative estimates of labor needs for this large peanut, cotton, and tobacco farm indicate that less labor is required under mechanized conditions.

Approximately 28,491 hours of labor are required to produce the crops for the cropping system shown in table 8, when 19 mules are the source of power. When 3 tractors were used to replace 17 mules on the same crop organization, only 21,513 hours of man labor are required. The mechanization of this farm results in a reduction of 6,978 hours of man labor required or about 24 per cent.

The distribution of labor throughout the year is materially changed with mechanization. Where mules are used entirely, there exists two distinct labor

peaks; one occurring in May, June, and early July during planting, cultivating, and small grain harvest; and the other occurring in the fall during the harvest season, figure 3. As tractor power is substituted for mules, the early labor peak is reduced, figure 4, because of the higher accomplishments per man and because modern tractors and equipment have been adapted to practically all important farm operations during this period. The number of workers required during the spring and summer months was reduced approximately 50 per cent where tractors were used to replace mules. However, since the harvesting of the important crops--cotton, peanuts, and corn are as yet not mechanized in the Northern Coastal Plains, the mechanization of agriculture has not materially reduced the hours of unskilled hand labor necessary to harvest the crops.^{3/} Therefore, the problem is one of "partial mechanization." Unless the harvesting of major crops is mechanized, there will persist serious limitations to the mechanization of agriculture in the Northern Coastal Plains.

The limitations of partial versus complete integral mechanization are obvious. The individual farmer has found it possible to reduce the number of workers 50 per cent or more during the pre-harvest season by substituting tractors for mules. Until the harvesting operations are mechanized, approximately the same amount of unskilled hand labor is required on tractor farms as on mule farms. There are several alternative ways in which this problem may be handled. In each of the following cases it is assumed that full and efficient utilization of the farm resources will be had.

- (1) The tractor farmer may continue the present cropping system and utilize the "on farm" labor efficiently provided there is sufficient seasonal labor

^{3/} It has been shown previously that the largest relative and absolute reduction in man labor requirements under mechanized conditions was obtained in pre-harvest operations.

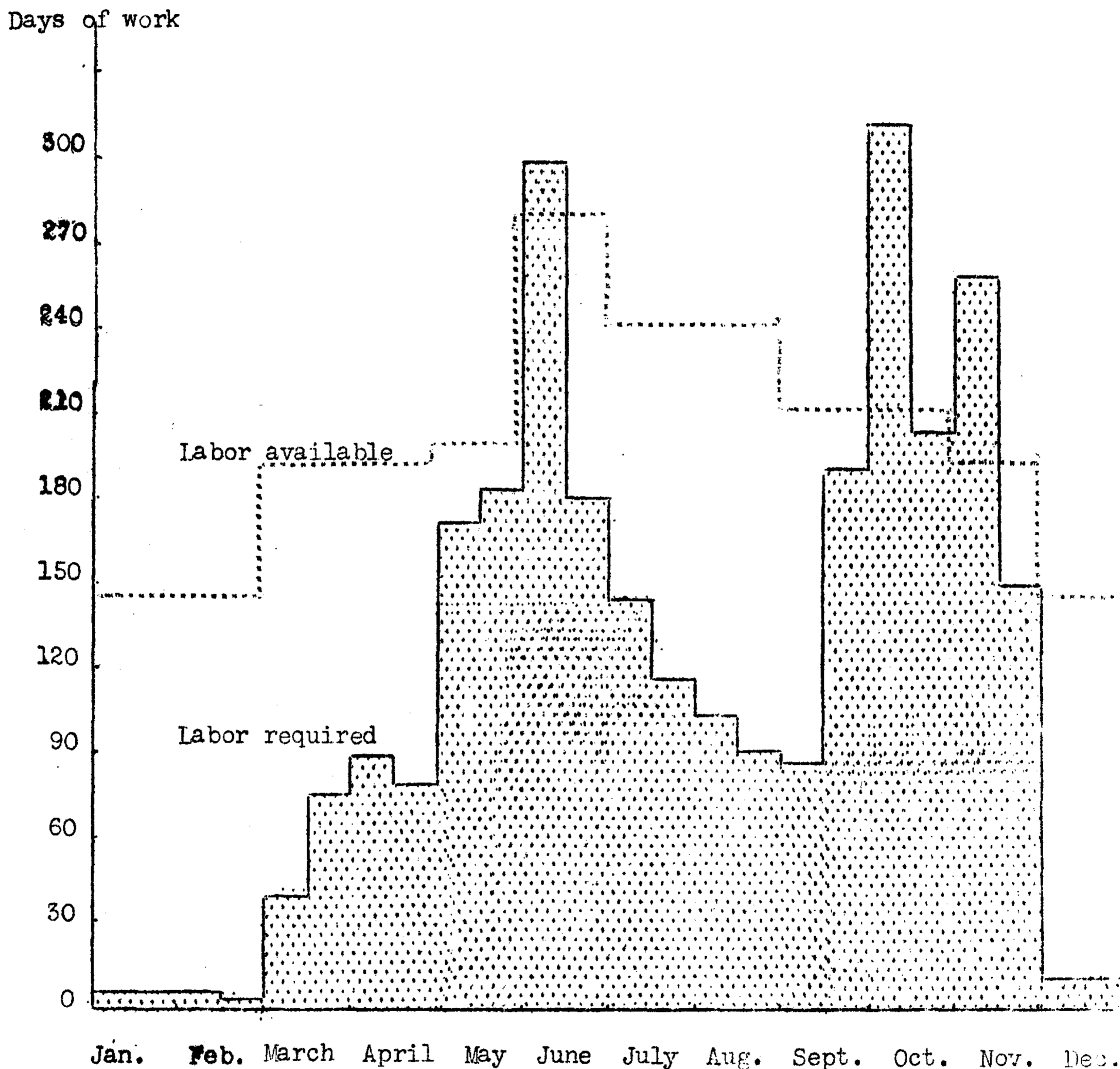


Figure 3. The semi-monthly distribution of man labor required and the total labor available on a typical farm with 515 acres in crops that is operated with mules. The total labor available is based upon an average of 10 cropper families.

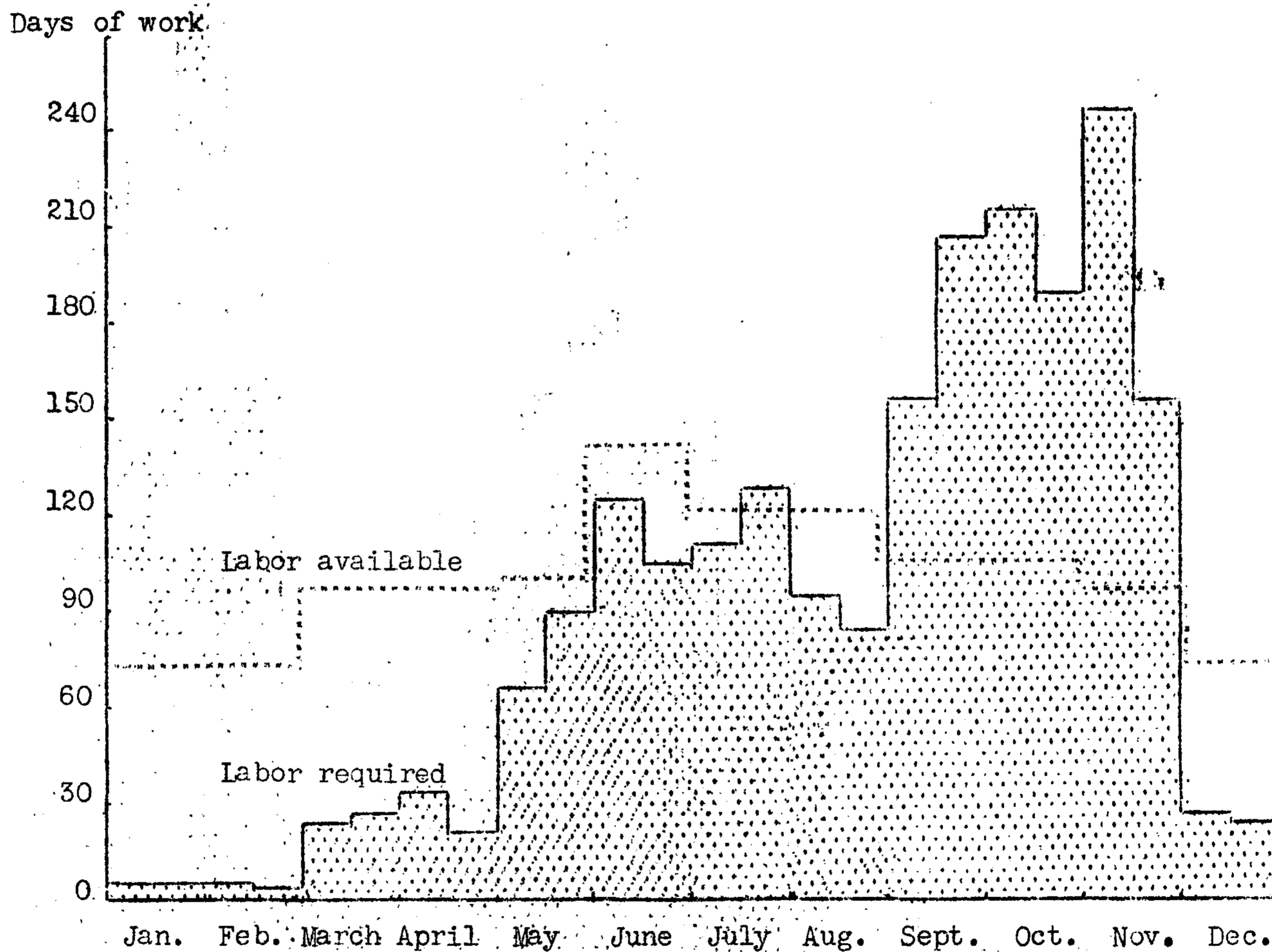


Figure 4. The semi-monthly distribution of man labor required and the total labor available on a typical mechanized farm with 515 acres in crops. The total labor available is based upon an average of 5 crop-per families.

available for agricultural employment during the harvesting season.

- (2) The tractor farmer may make adjustments in the cropping system, reducing those crops with high labor requirements at harvest time and increasing those that can be harvested with machinery. The extent of these adjustments would depend upon the composition of the farm labor force and the price relationship of the various commodities.
- (3) The degree to which labor-intensive and high profit crops will be maintained in the cropping system will depend finally upon the development, perfection, and adoption of harvesting machinery for cotton, corn, and peanuts that will reduce the labor requirements during the harvesting season. That is, if the farm labor is to be efficiently utilized, the harvesting of crops must be mechanized proportionally to pre-harvest operations. Until the labor required for harvest is reduced by mechanization, farmers will be confronted with the decision of whether sufficient harvest labor is to be maintained on the farm throughout the year for only two to three months work. The development of a cotton picker and corn harvester adapted to local conditions will do much to remove this maladjustment in labor distribution.

The output per hour of work is greater with mechanization. When 3 tractors displaced 17 mules on this 515 acre farm, the hours of man labor required to produce the crops enumerated was reduced from 28,491 to 21,513. There is no evidence that there are significant variations in yield when different types of power are used provided other production practices are the same. With this assumption it is possible to calculate the increased output per hour of man labor. The reduction of 24 per cent in the man labor required results in an increase in output per hour of man labor of about 32 per cent.

Larger capital outlays are required on mechanized farms. Assuming that capital requirements, other than for power and equipment, would be the same whether or not the farm was mechanized, it is possible to compare the capital outlay for power and equipment on mechanized and non-mechanized farms. The investment in mules and equipment when the farm was operated entirely with mules is estimated to be \$6,752. After 17 mules are replaced with 3 tractors and the complementary equipment, the capital outlay is estimated to be \$8,233 or an increase of \$1,481. This increase in capital outlay is due entirely to the larger investment in tractors and equipment.

The reduction of workstock makes it possible to increase commercial livestock enterprises. If workstock are reduced in number from 19 to 2 head, the amount of corn needed for workstock is reduced 1,020 bushels and hay requirements are reduced 51 tons. The 1,020 bushels of corn is sufficient to produce approximately 15,000 pounds of pork or 75 hogs weighing 200 pounds, assuming that sufficient supplements are available. The 51 tons of peanut hay is sufficient to winter approximately 51 head of beef cattle according to the feeding standards practiced in the area.

The mechanization of farms and the consequent reduction in workstock makes it possible for the individual farmer to increase the sale of feed crops, or to develop commercial livestock enterprises as an important source of farm income. An increase in livestock would probably result in a better distribution and more complete utilization of farm labor and management.

Mechanization as related to adjustments in crop acreages. At the beginning of this section the average crop organization for 61 highly mechanized farms was compared with the over-all crop organization of Halifax County and the Northern Coastal Plains Area. Again emphasis is necessary to prevent misunderstanding that

mechanization dictates changes in crop acreages. More frequently mechanization is the result of changing crop patterns, changing labor conditions, changing cost structure, and other factors. In discussing adjustments in cropping systems, it is expedient to think of mechanization of farming as interrelated with various factors affecting farm organizations, such as, the composition of the farm labor force, governmental programs as they affect crop patterns and other organizational factors.

Some of the more significant adjustments that appear feasible as farming becomes more highly mechanized are as follows:

- (1) There is a tendency toward larger farm operating units. The business is usually enlarged by buying more land or renting additional land.
- (2) Cash crops such as peanuts, cotton, and tobacco are maintained at levels near the allotment, depending more upon the availability of farm labor than any other factor. The increase in labor extensive crops, such as soybeans, small grains, and corn are dependent primarily upon the possibility of obtaining additional cropland or the loss of farm labor.
- (3) There is a tendency to use farm land more completely throughout the year when tractors are used. Land which might otherwise remain idle during part of the year is more likely to be planted to cover crops, small grains, lespedeza, or soybeans.
- (4) As long as the labor supply is adequate, it is not likely that the more profitable labor intensive crops will be abandoned in favor of the more extensive crops--soybeans, small grains, and lespedeza--even though the latter are more adaptable to mechanized methods of production.

Data are not available to show detailed changes in cropping systems that were the direct result of substituting tractors for mules. The causes of the

principal changes that are apparent are so complex and closely interrelated that it is extremely difficult to separate the influence of mechanization.

The mechanization of farming has increased the responsibilities of management. More of the farm labor is hired on a cash wage basis on tractor farms than on farms operated with mules. The use of tractor equipment requires more skilled management for the adjustment, repairs, and operation of the equipment. The average wage hand has had very little training in the care of modern machinery, therefore, more supervision is usually required by the management.

CONDITIONS FOR LOWEST PER ACRE COSTS

The combination of crops on an individual farm reflects price and cost relationships and the choice of crops is made with the view of maximizing net income. It is important to obtain the most efficient utilization of power that is possible within the limits of the farm organization and, of course, without reducing the net farm income. The maximum use of the tractor and the complementary machinery is essential for lowest cost operation. This section sets forth an example of a typical cropping system representing the maximum acreage which can be handled with one medium tractor and one mule, table 10.

Table 10. Typical cropping system representing the maximum acreage which can be handled with one medium-size tractor and one mule.

Crop	Acres	Crop	Acres
Tobacco	5	Small grain hay	1
Corn	33	Lespedeza hay	5
Cotton	22	Lespedeza seed	7
Peanuts	37	Cover crops	23
Soybeans for beans	19	Garden & other	3
Small grains	15		
		Total	170