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Workstock vs. Tractors in the Yazoo-Mississippi Delta

James P. Gaines

Grady B. Crowe

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in the

Yazoo-Mississippi Delta

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director
STATE COLLEGE MISSISSIPPI

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SUMMARY AND CONCLUSIONS

1. The average cost of keeping workstock in the Delta in 1947 was $227 per animal. Mules worked an average of 78 days during the year. In many instances, costs can be reduced by providing more grazing and feeding less hay.

2. The average cost of operating medium tractors in the Delta in 1947 was $518; the average cost of operating large tractors was $736. Medium tractors were used an average of 75 days per year, and large tractors, 105 days.

3. In terms of performance rates, a medium tractor is equivalent to 6 mules and a large tractor is equivalent to at least 10 mules.

4. The data indicate that two mules are a cheaper source of power than medium or large tractors on family farms with 30 acres or less in crops, on which the family can perform nearly all the labor. On 30-acre crop units on which considerable hired labor is necessary, the medium sized tractor may be cheaper.

5. The data indicate that the medium tractor is a cheaper source of power than mules or a large tractor on units that provide as much as 18 and less than 36 days of work for the medium tractor. Such a unit would have 30 to 60 acres of crops, half of which would be planted to cotton.

6. The data indicate that the large tractor is the cheapest source of power on units with 60 acres or more in crops.

7. The medium sized tractor can replace economically at least three mules, and, if most man labor is hired, even two mules on cotton farms with 30 to 60 acres of cropland. The large tractor can replace economically at least 4 mules and in some cases as low as two. However, on large farms requiring considerable power, the most efficient rate of substitution is a medium tractor for 6 mules and a large tractor for 10 mules.

8. Many farms are carrying a surplus of power, usually as workstock. In view of the high cost of maintaining such animals, it would often be to the advantage of farmers to sell this surplus at any price.

Workstock vs. Tractors in the Yazoo-Mississippi Delta

By JAMES P. GAINES and GRADY B. CROWE[1]

Prior to 1930, horses and mules were the principal power units of the farm. Since 1930, however, the importance of work animals on farms has declined steadily. Today, only in sections beset by unfavorable economic and physical conditions do work animals supply most of the source in the operation of farms.

In the 1930's, Mississippi, and the South in general, lagged behind other areas in the United States in the mechanization of farms. Labor was so abundant and inexperienced technically that expensive mechanical power had difficulty gaining a foothold. However, the large-scale movement of farm wage hands to high-paying industrial jobs during World War II provided the spark which touched off a tremendous demand for mechanical power by Mississippi farmers. Wartime restrictions on production of tractors retarded but did not suppress the shift to mechanical power. For example, census figures show that in 1945, 65 percent more tractors were on farms in the Delta area than in 1940. The increase in tractor number in upland areas was less pronounced but was very significant during that period. Since 1945, farmers in all areas of the state have bought tractors at a rapid rate. In August, 1949, most dealers in the Delta reported that since 1945 they had sold every field tractor that could be obtained.

The widespread shift from animal to mechanical power has introduced a number of management problems. These problems are both economic and physical in nature and vary from area to area. It would be difficult to cover in one report all of the physical and economic implications in all areas of the state. This report is concerned primarily with some of the mechanization problems of operators in the Delta. The purposes are to show the average costs of maintaining workstock and of operating tractors in the Delta in 1947, and to compare work animals and tractors as sources of farm power in terms of performance rates, operating costs, reserve power, etc. It is intended to provide farmers with guides to be used in determining economic rates of substitution of mechanical for animal power, and in ascertaining the smallest sized units that can utilize tractor power and equipment more efficiently and economically than animal power and equipment. Also, it provides data for comparing medium- and large-sized tractors and determining within limits the conditions under which each is more economical.

Cost of Maintaining Workstock

In 1947, the average cost of keeping workstock used in the Delta was $227 per animal, according to data collected from operators owning a total of 143 mules and 16 horses, table 1. This cost figures includes charges for shelter and pasture, service labor, harness costs, depreciation, interest on investment, value

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[1]Agricultural economist, Mississippi Agricultural Experiment Station and agricultural economist, Bureau of Agricultural Economics, respectively.

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of feed used, and other cash costs. Feed, which constituted 76 percent of total costs, was the chief cost item, followed by service labor and depreciation.

Feed used was charged at market value, even though it may have been produced on the farm at lower cost. The use of tractors for power leaves that part of feed which ordinarily goes to workstock to be sold at market prices. Therefore, to compare tractor and workstock costs, the market value of feeds used by work animals should be charged to workstock, the more practicable procedure, or credited to tractors.

As feed comprises such a large proportion of total workstock costs, the efficiency of feeding has a major bearing on the cost of using mules and horses. In the area studied, the usual feed ration consisted of corn, oats, and hay. However, some farmers fed only corn and hay, and others fed oats and hay. Alfalfa, lespedeza, and soybean hay were the more common roughages used. On an average, 17 bushels of corn, 22 bushels of oats, and 3.8 tons of hay were fed per work animal. The high rate of hay feeding is explained by the fact that little grazing was provided. An average of only two months of grazing on improved pasture and less than one month of grazing on native pasture was provided each animal.

Table 1. Cost of keeping workstock, Delta of Mississippi, 1947

Cost items	Value
Variable costs:	**Dollars per animal**[1]
Feed:	
Corn, 17 bu.	$ 34.00
Oats, 22 bu.	23.10
Hay, 3.8 tons	114.00
Veterinary costs	1.67
Other cash costs	1.56
Service labor, 54 hrs. @ 30c	16.20
Total variable costs	$190.53
Fixed costs:	
Depreciation[2]	$ 20.62
Interest[3]	4.12
Harness (Dep. & Int.)	2.35
Shelter and pasture	9.00
Total fixed costs	$ 36.09
Total costs for year	$226.62
Total costs per 10-hour day used[4]	$ 2.91

[1] Average for 143 mules and 16 horses.

[2] Computed at 12.5% of value of 5-year old animal.

[3] Computed at 5% of average value of 5-year old animals.

[4] Average for 78 days of use.

Experiment Station studies show that feed costs can be reduced considerably by providing good pasturage to animals during the off-season and when they are idle during the work season. When workstock are idle, an improved pasture usually furnishes sufficient feed to maintain them, and concentrates need to be fed only when animals appear to be running down in condition. Experimental results indicate that when at work, animals that are on good pasture at night need about ¾ pound of concentrates and ¾ pound of hay per 100 pounds of live weight, whereas animals not on pasture require about one pound of concentrates and one pound of hay per 100 pounds of live weight. If operators who were interviewed had provided improved pasture and fed at these rates, they would have used about 30 bushels of corn and about one ton of hay per animal. Actually they were feeding concentrates near this level, but with considerably more hay and less grazing. Apparently, hay was substituted for pasture. In most instances, grazing could be provided considerably cheaper than hay.

As a general rule, then, feeding practices followed on farms were less efficient than those recommended by the Experiment Station. However, farmers strive toward the use of efficient practices. It was felt that over the long run recommended rates formed a sounder basis for computing workstock costs than did those actually followed in 1947. For this reason, these rates were used in comparing workstock and tractor costs, even though they are somewhat favorable to workstock. In

addition, 1949 prices are used in order to give the data more current applicability. The estimated annual cost of keeping a mule with efficient feeding practices and 1949 prices was $142, table 2. In comparisons in later sections this figures forms the basis for computing workstock costs.

Cost of Operating Tractors

The costs of operating medium and large tractors in the Delta in 1947 are shown in table 3. [2]Medium tractors were operated at a lower average annual cost than large tractors, but they were used fewer days and did considerably less work.

For purposes of this analysis, a medium tractor is defined as one having a maximum horsepower rating of 15 to 24, while a large tractor is one having a horsepower rating 25 or more. Medium tractors are generally used with two-row equipment, and large tractors with four-row equipment. Small tractors are not used for field operations to a large extent in the area, and are not considered in this study. Later studies in other areas will give more attention to the small tractor.

Questions often asked by farmers are "How many mules **can** a tractor replace on my farm?" "How many mules **should** a tractor replace on my farm?" and "What sized tractor should I use?" These are some of the important considerations that have developed out of the transition from mule to tractor farming. There is no unqualified answer to these questions. Variations in soil types, topography, size of farm, attitude of farm operators, available workers in the operator's family, efficiency of farm workers, financial position of operators, prices and many other things have considerable influence. It would be extremely difficult to give all the many variables their due weight and ar-

[2]Data taken from Experiment Station Circular No. 147.

Table 2. Annual cost of maintaining a mule in the Mississippi Delta with efficient feeding practices and 1949 prices

Cost items	Value
Feed:	
Corn, 30 bus. @ $1.30	$ 39.00
Hay, 1.5 tons @ $25	37.50
Pasture, 1.5 acres[1]	20.16
Veterinary costs	1.67
Other costs	1.56
Service labor, 54 hrs. @ 30c	16.20
Depreciation[2]	15.50
Interest[3]	3.10
Harness	2.35
Shelter	4.75
Total costs	$141.79

[1]Per acre costs: Fertilizer, $3.30; seed $2.49; land preparation, $.68; clipping, $1.60; fencing, $.35; and interest on land, $5.00; Pasture available 8 months per year.

[2]Computed at 12.5% of value of 5-year-old animal.

[3]Computed at 5% of one-half the average of 5-year-old animals.

Table 3. Cost of operating medium and large tractors, Delta of Mississippi, 1947

Cost items	Size of tractor	
	Medium	Large
Variable costs:	Dollars per tractor	
Fuel	$192.77	$329.02
Oil	15.17	22.75
Grease	3.87	4.02
Repairs	123.68	155.75
Service labor	12.54	24.18
Total[2]	$348.03	$535.72
Fixed costs:		
Interest[3]	$ 41.25	$ 48.75
Depreciation[4]	123.75	146.25
Housing	4.74	4.88
Total	$169.74	$199.88
Total costs for year	$517.77	$735.60
Cost per 10-hour day[5]	$ 6.87	$ 7.04

[1]Gasoline computed at 16.8 cents per gallon; fuel oil at 13 cents per gallon; oil at 15.8 cents per quart; grease at 13.4 cents per pound; and service labor at 40 cents per hour.

[2]Does not include operator labor.

[3]Computed at 5 percent of one-half of 1947 purchase price.

[4]Purchase price less 10 percent divided by average life expectancy.

[5]Medium tractors were used an average of 75.3 days, large tractors 104.7 days.

rive at a well-defined conclusion. However, it is possible to evaluate the costs and to determine within relatively narrow limits which is the more economical source of power and to indicate what influence these other factors might have. That is the objective of this section.

Performance Rates: A tractor can do much more work than a mule during the same period of time. Two mules will bed 3 to 6 acres of land per day, while a medium tractor will bed 12 to 15 acres, and a large tractor, 20 to 25 acres in a 10-hour day. Two mules will cultivate 5 to 8 acres, a medium tractor 20 to 25 acres, and a large tractor, 40 to 50 acres, in a day. The same general relationship between rates of accomplishment exists for all field operations. Thus, in terms of performance, a medium tractor is equivalent to about 6 mules and a large tractor is equivalent to at least 10 mules.

Operating Costs: Relative performance rates are an important consideration in any comparison of power unit costs. Costs per hour of operation, unless considered in the light of performance rates, do not constitute a valid basis of comparison. For example, if it cost $1.00 an hour to operate a tractor and $.50 an hour to operate a team of mules, with only cursory examination of these figures, one might be led to believe that mule power is cheaper. However, if the tractor does three times as much work as the team of mules during the hour, it can readily be seen that the tractor would provide a cheaper source of power for a given quantity of work. The total cost of power and the effect that it has on labor costs on a farm are the most important considerations and are used as a basis for comparison in this section.

Two sizes of farms were selected for comparative study of power units commonly used in the Delta. One is a 30-acre crop unit and the other, a 60-acre crop unit. These were selected because they are typical two-mule and four-mule units and as such are a good basing point around and from which to develop this discussion. For purposes of analysis, the units are assumed to be composed of ½ cotton, ⅓ corn, and ⅙ soybeans for beans. With such a crop distribution, a 30-acre unit would be composed of 15 acres of cotton, 10 acres of corn, and 5 acres of soybeans, while a 60-acre unit would have 30 acres of cotton, 20 acres of corn, and 10 acres of soybeans.

How Costs are Computed: In making the comparison of costs of operating tractors and mules on a 30-acre and a 60-acre farm shown in tables 6 and 7, the computations are based on 1949 prices. Workstock costs are about $142 per head as shown in table 2. Labor, power and equipment costs for operating the units with mule and tractor power are based on the pre-harvesting requirements of these units shown in table 4. Since harvesting methods, and consequently harvesting costs, on units of this size do not vary significantly by type of

Table 4. Pre-harvesting labor, power, and equipment requirements per acre for cotton, corn, and soybeans with three levels of mechanization, Delta of Mississippi

Item	Unit	Level of mechanization								
		One-row mule			Two-row tractor			Four-row tractor		
		Cotton	Corn	Soybeans	Cotton	Corn	Soybeans	Cotton	Corn	Soybeans
Skilled lbr.	Hrs.	----	----	----	7.7	4.8	3.8	4.6	3.3	2.5
Common lbr.	do.	57.5	13.9	15.1	35.0	----	----	35.6	.6	.6
Tractor	do.	----	----	----	7.7	4.8	3.8	4.6	3.3	2.5
Mule	do.	46.8	31.0	44.2	----	----	----	----	----	----
Tractor equip.	do.	----	----	----	7.7	4.8	3.8	4.6	3.3	2.5
Mule equip.	do.	46.8	31.0	44.2	----	----	----	----	----	----

power, there is no need to include harvesting labor, power and equipment requirements.

Tractor and machinery costs are derived from special studies conducted in the Delta, table 3. In these studies, however, costs are averages based on average tractor and machinery use. When considering small units where tractor or machine use is far below the average, certain adjustments in these costs are necessary. In this report, costs classified as variable in table 3 are reduced in corresponding proportions as days used. For example, if tractors were used a third less on the assumed units than on average crop units in the studies, then fuel and repair costs were reduced a third. On the other hand, interest is a fixed cost and was not changed. However, depreciation, another relatively fixed cost, varied with use to a certain extent. Depreciation is due to two things—obsolescence and use. Deterioration in value due to obsolescence is fixed in character and does not vary with the extent of use of a machine. However, deterioration in value from wear, or use, is related to the amount of work a machine does. A machine which is used to capacity will wear out sooner than a like one used at only half-capacity, assuming that the same care is given both. It is difficult to determine the extent to which this will be true, and even more difficult to determine the relative degree to which use and obsolescence affect total depreciation. So any method of varying annual depreciation with use must be arbitrary. In this report, depreciation is considered due half from obsolescence and half from use. The part due to use varies directly with the number of days the machine is used, while the part due to obsolescence is fixed. The cost of tractor power under this assumed situation is shown in table 5 for the 30-acre and the 60-acre units.

Medium tractor equipment is assumed to be two-row in size, while large tractor equipment is assumed to be four-row. The equipment necessary to perform field operations on the units include a disc, a middle buster, a planter, a cultivator, and a fertilizer distributor. Figures showing the average cost of operating this equipment have not been published but are available at the Delta or Main Experiment Station. Mule equipment is one-row and is charged at 3.1 cents per hour of mule work (not equipment work). This cost, too, is based on other studies.

Costs Compared on a 30-Acre Unit: On the 30-acre unit, the data show that two mules are a cheaper source of power than a medium or large tractor, if family labor is adequate to do nearly all field work required and labor is not considered as a

Table 5. Tractor costs for field operations on a 30-acre crop unit and a 60-acre crop unit, Delta of Mississippi, 1949[1]

Item	30-acre unit		60-acre unit	
	Medium tractor	Large tractor	Medium tractor	Large tractor
	Dollars per tractor			
Fuel and grease	50.83	39.95	101.66	79.90
Repairs	29.67	20.60	59.34	41.20
Service labor	2.24	1.99	4.28	3.98
Interest on investment[2]	41.25	55.00	41.25	55.00
Depreciation[3]	61.87	91.60	91.57	100.70
Housing	4.74	4.74	4.88	4.88
Total costs	190.60	213.88	302.98	285.66

[1] Assumes ½ of cropland on cotton, ⅓ in corn and 1/6 in soybeans for grain.
[2] Computed at 5 percent of one-half the 1949 purchase price.
[3] For method of calculating, see text.

cost, table 6. If it were necessary to hire as much as 15 days of man labor for field work excluding harvesting, the medium tractor could be operated more cheaply than two mules under the conditions outlined.

If family labor is considered an item of cost at prevailing wage rates, the data then show that either the medium tractor or the large tractor is cheaper than two mules. In areas in which off-farm employment of family workers is available when they are not working on the farm, time spent on the farm is an important consideration. As a general rule, however, there is little such alternative employment in the Delta.

Whether family labor is or is not considered a cost, a medium tractor apparently is a cheaper source of power than a large tractor on 30-acre crop units. This is explained by the larger fixed costs on four-row tractors and the limited amount of work provided them on such small units.

It may be concluded, then, that two mules are a cheaper source of power, on the average, for crop-units of 30 acres in which half the cropland is planted in cotton and nearly all labor is provided by the farm family. Such a unit would provide only 12 days of field work for a large tractor and 18 days of field work for a medium tractor. However, units that are a little larger apparently can be operated more cheaply with a medium tractor. A unit large enough to require 3 mules would be in this category. Thus, it might be further concluded that a medium tractor can replace as few as 3 mules on a farm large enough to require that much power, and that, under some circumstances, it can economically replace 2 mules.

The preceding analysis is applicable primarily to family farms on which a large proportion of the labor is supplied by the farm family. Farms of this size on which most labor is hired probably would find a medium or large tractor a more economical source of power than workstock for even 30-acre units.

Costs Compared on a 60-acre Unit: Data presented in table 7 indicate that either the large or medium tractor is a more economical source of power than 4 mules

Table 6. Pre-harvesting labor, power and equipment costs on 30-acre crop unit[1] when two mules, a medium or large tractor is used for power.

Costs	Two mules 1-R equip.	Med. tractor 2-R equip.	Large tractor 4-R equip.
Tractor[2]		$188.36	$211.89
Tractor machinery	-------	137.31	185.05
Mules[2]	$251.18	-------	-------
Mule machinery	" 38.22	-------	-------
Necessary hired labor[3]	3.00	-------	-------
Total power, equip. and hired labor costs	$292.40	$325.67	$396.94
Skilled labor (tractor drivers)[4]	-------	82.13	51.52
Common labor[5]	352.50	159.74	164.89
Pre-harvest, total power, equip. and all labor costs	$644.90	$567.54	$613.35

[1] Composed of 15 acres of cotton, 10 acres of corn, and 5 acres of soybeans for grain.

[2] Service labor included in common labor.

[3] On this unit, the average farm family would need to hire only one day of man labor (in May), under average weather conditions, when mules are used for field work.

[4] Charged at 45 cents an hour.

[5] Charged at 30 cents an hour.

on a 60-acre farm of the type assumed, even if the farm family does most of the work, and considerably more economical than 4 mules if all labor must be hired.

Furthermore a large tractor is a slightly more economical source of power than a medium tractor when all labor is hired.

On units larger than the one assumed, the four-row tractor and equipment would be even more economical than other power alternatives. Apparently, then, operators of large farms would find it advantageous from an economic standpoint to use the large power units and equipment.

Other Considerations: Although the data presented show that medium and large tractors can be used economically on relatively small units, often there are other considerations. If capital is limited, purchase of such expensive items places a serious financial burden on operators. Many small units make barely enough for family living and they cannot meet large payments on equipment each year out of their earnings. It may cost a little more to operate mules or a small tractor, but they can meet those operating costs while they may not be able to meet the smaller operating costs of larger tractors, plus a large annual payment. Therefore, the financial position of the farm operator is an important factor in a consideration of power and equipment needs of a particular farm unit.

Another factor of importance is timeliness. Tractors permit more timely performance of field operations than do work animals; large tractors permit more timeliness than medium tractors. Too, power units with high rates of performance provide more leisure for the farm family. Work is done faster and more time is available for loafing, fishing, hunting, etc. Also, when tractors are used, work is less strenuous. In many instances, these considerations may over-shadow costs.

Workstock and Tractors as Reserve Power: Most farmers keep a certain amount of power in excess of average needs to guard against losses from unusual weather conditions. In most instances the tendency is to keep more such reserve power than is actually necessary.

Table 7. Pre-harvesting labor, power, and equipment costs on 60-acre crop unit[1], when two mules, a medium or large tractor is used for power.

Costs	Two mules 1-R equip.	Med. tractor 2-R equip.	Large tractor 4-R equip.
Tractor[2]	-------	$298.70	$281.68
Tractor machinery	-------	184.12	213.18
Mules[2]	$ 502.36	-------	-------
Mule machinery	76.44	-------	-------
Necessary hired labor[3]	142.20	76.80	58.80
Total pre-harvest power, equipment and hired labor costs	$ 721.00	$559.62	$553.66
Skilled labor (tractor driver)[4]	-------	164.25	103.05
Common labor[5]	536.40	242.48	265.58
Total pre-harvest power, equipment, hired labor and family labor costs	$1,257.40	$966.35	$922.29

[1] Composed of 30 acres of cotton, 20 acres of corn, and 10 acres of soybeans for grain.

[2] Service labor included in common labor.

[3] A part of labor for cotton chopping would have to be hired, assuming an average sized family and average weather conditions.

[4] Charged at 45 cents an hour.

[5] Charged at 30 cents an hour.

Any power in excess of that needed to insure timeliness is surplus.

In many instances, surplus power is in the form of work animals. Many farmers keep work animals after buying tractors. According to census figures, the widespread adoption of tractor power has not produced a substantial decline in the number of workstock on Mississippi farms. In fact, from 1935 to 1945, when the number of tractors on farms in the state increased from 5,000 to 21,000, mules and horses increased in number from 427,000 to 452,000. Since 1945, workstock numbers have declined significantly but not proportionately to increases in tractor numbers.

Many farmers have bought adequate mechanical power to operate their farms but have not disposed of unneeded workstock.

There are several reasons for this tendency. At first farmers were skeptical of the ability of the tractor to displace totally the use of workstock in the field. They wanted to observe the tractor perform under varied conditions before disposing of work animals. However, most doubts of that nature have been dispelled, and it is no longer a major factor contributing toward the maintenance of surplus power. Others have a sentimental attachment to their mules and prefer to keep them until they die, then they are not replaced. The major reason, however, is that the market for workstock is limited. Rather than sell at low prices, most farmers prefer to keep work animals around for odd jobs until they die. However, in view of the high cost of keeping surplus power, it often would be to their advantage to dispose of unnecessary work animals at any price.