ECONOMIC COMPARISON OF ALTERNATIVE COTTON HARVESTING SYSTEMS

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Abstract

This study provides cost estimates of alternative cotton harvesting methods, including four, six, eight, and two individual four-row stripper and equipment combinations without and with bur-extractors and two, four, and six-row picker and equipment combinations. The least cost harvesting systems for strippers without and with bur-extractors and pickers by size of operation in Texas were determined by comparing the corresponding estimated average harvesting costs and custom harvesting charges. In the case of stripper and equipment combinations without and with bur-extractors, the alternative with the minimum harvesting cost was found to be the four-row stripper for all farm sizes examined. However, if the length of the harvesting season was constrained to about 30 days, the six-row stripper and equipment combination without and with a bur-extractor became optimal for farm sizes of about 1,300 acres and between 1,000 and 1,200 acres, respectively. The eight-row stripper and equipment combination with a bur-extractor became the most efficient harvesting alternative starting at about 1,300 acres. For picker and equipment combinations, the average harvesting cost was minimized by the two-row picker and equipment combination up to 600 acres. The four and six-row picker and equipment combinations became optimum between 700 and 1,200 acres and at about 1,300 acres, respectively.

Introduction

Cotton has consistently ranked as a leading cash crop in Texas. Texas led the United States in 1997 in the production of Upland cotton and ranked second in the nation in the production of American Pima cotton (TDA homepage). Texas has eight distinct regions consisting of over one hundred counties in which cotton is produced. Stripper harvesting is primarily used in the High Plains, Rolling Plains, Central Blackland, Coastal Bend, and Winter Garden regions. Picker harvesting mainly occurs in the Upper Gulf Coast, Rio Grand Valley, and El Paso/Trans-Pecos regions. Eighty-five percent of the cotton produced in these eight regions is currently stripper harvested, while the remaining 15% is machine picked (Glade et al., 1996). Picker harvested cotton consists mainly of cotton lint and seed, with a relatively small amount of foreign matter. The stripper harvesting process removes much more foreign matter, such as burs, sticks, leaves, hulls, and non-plant materials such as sand and rocks with the cotton lint and seed. Therefore, bur-extractors are currently being adopted into the stripper harvesting method by an increasing number of producers. Bennett et al. (1997) found that investment in bur-extractors for a Texas producer was profitable for all irrigated and most dryland cotton production situations with an operation of at least 750 acres. McPeek (1997) found that about 25% of cotton in Texas is currently harvested with the use of a bur-extractor. The use of a bur-extractor helps to remove foreign matter in cotton during stripper harvesting. According to Bennett et al. (1995), the bur-extractor, when incorporated into the harvesting process, reduces bur and stick percentage in cotton by about 70% and 29%, respectively.

Currently, there are three types of strippers (four-row, six-row, and eight-row) and pickers (two-row, four-row, and six-row) that are most commonly used to harvest cotton in Texas. Each of the three types of cotton strippers can also be equipped with bur-extractors. Additional equipment, such as a boll buggy and a module builder, are usually used in combination with the stripper and picker harvesting machines. Both of these pieces of equipment require the use of a tractor of at least 90 horsepower. The combination of equipment most commonly used with a four-row stripper and two-row picker are a module builder and a tractor. The combination of a straight-tongue boll buggy, a module builder, and two tractors are usually used with a six-row stripper and a four and six-row picker. The eight-row stripper is generally used with a swing-tongue boll buggy, a module builder, and two tractors.

Producers have many cotton harvesting alternatives to choose from. However, the harvesting costs associated with each alternative are not available. There is currently a need for information on performance rates and ownership costs of alternative cotton harvesting methods. This information would help producers make informed choices among alternative harvesting systems and custom harvesting given their individualized production scenarios. The objective of this study was to determine the least cost stripper (without and with bur-extractors) and picker harvesting systems by size of cotton operation in Texas. This was accomplished by compiling and comparing cost data on the different types of cotton harvesting methods, including the ownership costs, performance rates of the different machines, and the average costs to the producer for the different options of harvesting.

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Methods and Procedures

Data regarding investment costs, maintenance costs, and performance rates corresponding to each size of cotton stripper and picker and the additional harvesting equipment were collected from cotton producers, harvesting equipment owners, equipment dealers, and custom cotton harvesters. This information was obtained through in-person and telephone interviews between the months of June and September 1999. Data gathered consisted of purchase costs, maintenance costs per season, fuel costs, fuel consumption, labor costs, performance rates, useful life, and salvage value for each harvesting machine. The data gathered from respondents were averaged for each harvesting machine and were used in this analysis.

The collected information was categorized by the size of the harvesting machine. Data regarding stripper harvesting equipment were organized into eight main categories of strippers, including four-row, four-row with a bur-extractor, six-row, six-row with a bur-extractor, eight-row, eight-row with a bur-extractor, two individual four-row, and two individual four-row with bur-extractors. Picker harvesting data were organized into three categories, including two-row, four-row, and six-row. This analysis considered a limited number of equipment configurations (i.e. it only considered single machine ownership except for the two individual four-row stripper and equipment combination). It is generally believed that for farm sizes greater than 1,500 acres, a producer would prefer to use multiple harvesting machines. Therefore, this analysis was limited to cotton operation sizes ranging from 500 to 1,500 acres. The fixed costs, variable costs, total costs, and average costs of owning and operating each machine were calculated using the gathered information for cotton operation sizes ranging from 500 to 1,500 acres.

The cotton harvesting costs were separated into fixed and variable costs. The fixed costs associated with cotton harvesting consisted of equal amortized annual payments of the purchase cost of the machine. These payments accounted for accrued interest and depreciation. Other ownership costs, including taxes, housing, and insurance, comprised the remaining fixed costs. The variable costs of cotton harvesting included the seasonal maintenance costs of the equipment and the cost of fuel and labor per day used by each machine.

Fixed Cost Estimates

The investment cost was determined assuming that the machine was purchased with 100% liability. It was calculated by amortizing the purchase cost into equal annual payments with the salvage value used as the future value. The purchase cost was amortized using an annual real interest rate for 7 years. The real interest rate was determined by adjusting the nominal interest rate by the inflation rate using the following equation (Bowlin et al. 1990):

$$k^* = [(1+k)/(1+i)] - 1 \qquad [1]$$

where k^* is the real interest rate, k is the average of the nominal fixed interest rates from 1996 to 1999 (Federal Reserve Bank of Dallas, 1996 to 1999), and i is the inflation rate from the Producer Price Index for farm machinery and equipment for 1999 (Bureau of Labor Statistics Data, 2000). Survey participants indicated that the salvage value of a 7 year old cotton stripper and picker was about 45% of the original purchase cost. Therefore, the annual amortized investment cost accounted for the purchase cost of the machine as well as any accrued interest and depreciation over the specified period of time.

According to the American Society of Agricultural Engineers (1998), other fixed ownership costs, including taxes, housing, and insurance, can be estimated as 1%, 0.75%, and 0.25%, respectively, of the purchase cost. Therefore, a total of 2% of the purchase cost can be used to estimate the tax, housing, and insurance costs of a machine. The annual fixed cost was calculated by summing the annual amortized investment cost and the estimated annual cost of taxes, housing, and insurance. The annual fixed cost was calculated for each size of stripper and picker, as well as each piece of additional harvesting equipment.

Variable and Total Cost Estimates

The variable costs for stripper and picker harvesting included fuel and labor costs per day and seasonal maintenance costs. The daily fuel and labor costs were gathered from cotton stripper owners and custom harvesters. The seasonal maintenance cost estimates for the strippers, pickers, and additional harvesting equipment were obtained from cotton harvesting equipment owners and dealers. It was found that the average life of each cotton harvesting equipment is 7 years. Therefore, the maintenance cost estimates were based on regular repairs anticipated for 7 years. The present value of the variable costs associated with operating a cotton stripper or picker over a 7 year period was calculated using the following formula:

$$TPV_{VC} = \sum_{t=1}^{n} \frac{VC_t}{(1+k^*)^t} \qquad [2]$$

where TPV_{VC} is the present value of the specific variable cost of the machine over its useful life, VC is the specific variable cost, t is time, k^* is the real interest rate, and n is the life of the machine in years. Equation 2 was used to calculate the present value of the fuel cost, labor cost, and maintenance cost. The results from Equation 2 were then averaged over the seven years to determine the average present value of the specific variable cost. It was assumed that each piece of equipment (strippers, pickers, and additional harvesting equipment) would be used each season, therefore there would

be maintenance costs each year. Any unforeseen repairs not included in the anticipated seasonal maintenance that might be encountered by the producer throughout the life of the equipment were not accounted for in this study.

The number of acres harvested in one hour varied according to the number of row units of each stripper and picker. As a result, the number of days required for each machine to harvest a specific number of acres also varied. The number of days, D, was determined using the following formula:

$$D = A / (H * P) \quad [3]$$

where A is the number of acres, H is the average number of hours worked in one day, and P (performance rate) is the number of acres each size of stripper and picker could harvest in one hour.

The total cost of each cotton harvesting machine (strippers, pickers, boll buggy, module builder, and tractor) which combined the fixed and variable costs corresponding to each machine, was calculated using the following equation:

$$TC = FC + (APV_{MC} + (APV_{L+F} * D)) \quad [4]$$

where TC is the total cost per year associated with each piece of harvesting equipment, FC is the fixed cost per year associated with each machine, APV_{MC} is the average present value of the annual maintenance cost over the life of the machine, APV_{L+F} is the average present value of the daily cost of labor and fuel over the life of the machine, and D is the number of days required for a specific number of acres to be harvested by each size of stripper or picker. Harvesting equipment dealers and owners implied that an average of 20 percent of a tractor's annual use is used in the harvesting process of cotton. Therefore, only 20 percent of the tractors' fixed and variable costs were accounted for when calculating the tractor(s) total cost in this study. The total cost was then determined for the equipment configuration associated with each size of stripper and picker. This was accomplished by summing the total costs of the equipment components associated with each stripper and picker. The total cost of each equipment configuration was calculated using the following equation:

$$TC = TC_{S \text{ or } P} + TC_{BB} + TC_{MB} + TC_{T(s)} \quad [5]$$

where $TC_{S \text{ or } P}$ is the total cost of the stripper or picker, TC_{BB} is the total cost of the boll buggy (straight or swing-tongue), TC_{MB} is the total cost of the module builder, and $TC_{T(s)}$ is the total cost of the tractor(s) used to run the boll buggy and/or module builder. If a boll buggy was not used in the harvesting process, the total cost for the boll buggy was assumed to be zero.

Average Cost Estimates

Segarra et al. (1990) indicated that cotton lint yield reductions occur when harvest is delayed. The reductions in yield are expected to increase at an increasing rate as the harvesting of the cotton is delayed. The model used to estimate the percentage of cotton lint yield (Segarra et al., 1990) was:

$$Y_W = 0.93944 - 0.005971 * W^2 \quad [6]$$

where Y_W is the percentage of cotton lint yield for each week (W = 1 to 12) and W is the week number during the harvesting season. The percentage of cotton lint yield remaining after lint loss due to delayed harvest, Y, was determined using the following equation:

$$Y = 1 - [Y_{W-1} - Y_W] \quad [7]$$

where Y_{W-1} is the percentage of cotton lint yield for the week prior to Y_W, and Y_W is the percentage of cotton lint yield for each week. According to Segarra et al. (1990), harvesting in the Southern High Plains usually occurs during the months of November, December, and January. The yield remaining after lint reductions, Y_{end}, was calculated using the following equations:

$$Y_{end} = Y_{begin} * Y \quad [8]$$

where Y_{begin} is the yield prior to any lint loss and Y is the percentage of cotton lint yield remaining after lint loss. The 1998 Texas average lint yields of 524 pounds per stripper harvested acre and 791 pounds per picker harvested acre (Texas Agricultural Statistics Service, 1998), were used for Y_{begin} due to a lack of a better estimate. While Equation 8 accounted for lint loss due to a delay in harvest, it should be noted that costs associated with cotton quality reductions due to delayed harvest were not accounted for in this study.

The average cost of owning and operating the equipment configuration associated with each size of stripper or picker was calculated for farm sizes ranging from 500 to 1,500 acres. The average cost, which combined the fixed and variable costs corresponding to each equipment configuration, was calculated using the following equation:

$$AC = TC / (Y_{end} * A) \quad [9]$$

where AC is the average cost per pound of lint associated with owning and operating each equipment configuration, TC is the total cost of each combination of equipment per year, Y_{end} is the yield per acre in pounds remaining after lint reductions, and A is the number of acres to be harvested. The most cost effective methods of harvesting for strippers (without and with bur-extractors) and pickers were then

determined by comparing the corresponding estimated average costs and custom harvesting charges.

Results

Fixed Cost Estimates

The purchase cost, investment cost, THI (taxes, housing, and insurance), and fixed cost for each component of the equipment configurations associated with each size of stripper and picker are presented in Tables 1, 2, and 3.

Stripper Fixed Cost Estimates

The annual investment costs over the life of the equipment configurations associated with the four, six, eight, and two individual four-row strippers without a bur-extractor were $17,627, $21,686, $23,236, and $34,227, respectively (Table 1). The addition of a bur-extractor to the harvesting process increased the annual investment cost of the four, six, and eight-row stripper and equipment combinations by approximately $1,832. The two individual four-row stripper and equipment combination was increased by $3,664 through the addition of a bur-extractor. Therefore, the equipment combinations associated with the four, six, eight, and two individual four-row strippers with bur-extractors had annual investment costs of $19,459, $23,518, $25,068, and $37,891, respectively (Table 2). These annual investment costs were calculated assuming that at the end of the life of the machine, the owner would either sell the machine for the salvage value or trade the current machine in for a new one. The calculated annual investment costs account for accrued interest (using a real interest rate of 7.91% for this study) on the entire purchase value over the life of the machine, as well as depreciation.

After accounting for taxes, housing, and insurance, the equipment configurations for the four, six, eight, and two individual four-row strippers without bur-extractors had fixed costs per year of $17,985, $22,126, $23,707, and $34,920, respectively (Table 1). The fixed costs per year for equipment combinations associated with the four, six, eight, and two individual four-row strippers with bur-extractors were about $19,854, $23,995, $25,576, and $38,658, respectively (Table 2).

As the stripper size, without and with a bur-extractor, increased from a four-row to a six-row, the fixed costs of the equipment increased by approximately $4,141 per year. The fixed costs of the equipment increased by an additional $1,581 per year as the stripper size increased from a six-row to an eight-row, without and with a bur-extractor (Tables 1 and 2). The annual fixed costs for the equipment associated with two individual four-row strippers without and with bur-extractors were $11,213 and $13,082, respectively, higher than the costs associated with the eight-row stripper (Tables 1 and 2).

Picker Fixed Cost Estimates

The total annual investment costs for the equipment configurations associated with the two, four, and six-row pickers were $21,594, $35,494, and $46,717, respectively (Table 3). After accounting for taxes, housing, and insurance, the equipment configurations for the two, four, and six-row pickers had fixed costs per year of $24,101, $39,541, and $52,357, respectively (Table 3). As the picker size increased from a two-row to a four-row, the fixed costs of the equipment increased by approximately $15,440 per year. The fixed costs of the equipment increased by an additional $12,816 per year as the picker size increased from a four-row to a six-row (Table 3).

Variable Cost Estimates

The variable costs per day associated with stripper and picker harvesting were constant across the stripper and picker sizes. The two variable costs accounted for in this study were the cost of fuel and labor. Data gathered from the industry indicated that each size of stripper and picker operates an average of 10 hours per day and uses about 50 gallons of diesel per day. Therefore, the cost of fuel and labor for each machine were about $30 and $51.50 per day, respectively. The average present value of the daily fuel and labor costs was $60.50.

The variable costs varied according to the number of days required to harvest a given number of acres. Survey results indicated that the number of acres that each stripper and picker size was capable of harvesting in one hour, which directly affected the number of days required to harvest a given number of acre, increased as the size of the stripper and picker successively increased (Tables 1, 2, and 3). However, the stripper without a bur-extractor was capable of harvesting approximately 1 acre per hour more than a stripper with a bur-extractor (Tables 1 and 2).

Stripper Variable Cost Estimates

The annual present values of the maintenance costs over the lives of the equipment configurations associated with the four, six, eight, and two individual four-row strippers without bur-extractors were $680, $835, $956, and $1,006, respectively (Table 1). The equipment configurations associated with the four, six, eight, and two individual four-row strippers with bur-extractors had annual present values of maintenance costs of $1,276, $1,431, $1,553 and $2,198, respectively, over the lives of the machinery (Table 2). The annual present value of the equipment maintenance cost increased by about $155 and $122 as the stripper size increased from a four-row to a six-row and from a six-row to an eight-row, respectively (Tables 1 and 2). The annual present value of the maintenance cost of the two individual four-row strippers was about $50 and $645 higher than that of the eight-row stripper, without and with bur-extractors, respectively. The addition of the bur-extractor into the

harvesting process increased the annual present value of the maintenance cost over the life of the four, six, and eight-row strippers by about $596. When a bur-extractor was added to the two individual four-row strippers, the annual present value of the maintenance cost increased by about $1,192 (Tables 1 and 2).

Picker Variable Cost Estimates

The annual present values of the maintenance costs over the lives of the equipment configuration associated with the two, four, and six-row pickers were about $3,417, $6,432, and $9,412, respectively (Table 3). The annual present value of the equipment maintenance cost increased by about $3,015 and $2,980 as the picker size increased from a two-row to a four-row and from a four-row to a six-row, respectively (Table 3).

Average Cost Estimates

The average cost analysis was separated into three categories; strippers without and with bur-extractors and pickers. Figures 1 and 2 present the average cost estimates for the four, six, eight, and two individual four-row strippers without and with a bur-extractor, respectively, by the size of the operation. Figure 3 displays the average cost estimates of the two, four, and six-row pickers by the size of the operation in Texas. The Texas average yields of 524 pounds per acre of stripper harvested cotton and 791 pounds per acre of picker harvested acre were assumed. Producers indicated that once a cotton crop is mature, it becomes a priority to harvest the crop as quickly as possible. When harvest is delayed, the crop may experience weather damage that might considerably reduce the cotton quality, which has not been accounted for in this study. It is generally believed that a mature cotton crop should not remain in the field for more than approximately 30 days.

Stripper Alternatives without Bur-Extractors

The four-row stripper and equipment combination without a bur-extractor exhibited the minimum average cost between the four stripper alternatives for all farm sizes examined in this study (Table 4). However, when the length of the harvesting season is limited to 30 days, the six-row stripper and equipment combination becomes the most efficient harvesting alternative at around 1,300 acres, at which the average harvesting cost would be about 4.24 ¢/lb of lint (Table 4 and Figure 1).

Assessing average costs of strippers individually, it was observed that the harvesting costs of the four, six, eight, and two individual four-row strippers and equipment combinations continually decreased for the farm sizes examined in this study (Table 4). Results indicated that a producer could reduce harvesting costs for a farm size of 1,500 acres to about 3.16 ¢/lb of lint (Table 4) by using a four-row stripper and equipment combination. However, harvesting a 1,500 acre farm with a four-row stripper and equipment combination would require about 38 days. Similarly, it would take a six-row, eight-row, and two individual four-row stripper and equipment combinations about 30, 23, and 19 days, respectively, to harvest 1,500 acres. Therefore, a producer might choose to incur a higher cost of harvesting in order to harvest the crop in less time.

Stripper Alternatives with Bur-Extractors

The average costs of stripper and equipment combinations with bur-extractors ranged from 0.43 to 2.33 cents per lint pound higher than stripper and equipment combinations without bur-extractors (Tables 4 and 5). Similar results indicated that the four-row stripper and equipment combination with a bur-extractor had the lowest average cost of the four stripper alternatives for all farm sizes examined. However, when a 30 day time constraint was placed on the length of the harvesting season, the six-row stripper and equipment combination became the optimal alternative for farm sizes between 1,000 and 1,200 acres, at which the average harvesting costs were about 5.97 and 5.19 ¢/lb of lint (Table 5). The eight-row stripper became the most efficient harvesting alternative starting at 1,300 acres, where the harvesting cost was about 4.81 ¢/lb of lint (Table 5).

When the average costs of strippers were evaluated individually, it was again found that the average harvesting costs continually declined for the four, six, eight, and two individual four-row stripper and equipment combinations for all farm sizes examined. A producer with a 1,500 acre farm could reduce harvesting costs to about 3.80 ¢/lb of lint by using a four-row stripper and equipment combination. However, it would take a four-row about 50 days to harvest 1,500 acres of cotton, while a six-row, eight-row, and two individual four-row strippers would take about 38, 27, and 25 days, respectively. If a 30 day harvesting time constraint were considered, a producer might prefer to use either an eight-row or two individual four-row stripper and equipment combinations.

Picker Alternatives

The two-row picker and equipment combination had the lowest average cost of the three picker alternatives for all farm sizes examined (Table 6). When the length of the harvesting season was constrained to about 30 days, the four-row picker and equipment combination became the most efficient alternative for farm sizes ranging from 700 to 1,200 acres. The average harvesting costs for the four-row picker and equipment combination at these farm sizes ranged from 9.14 to 5.72 ¢/lb of lint, respectively (Table 6). The six-row picker and equipment combination became the optimal harvesting alternative, assuming a harvesting time constraint of 30 days, starting at about 1,300 acres, where the average cost was about 6.53 ¢/lb of lint (Table 6).

When the average costs of pickers and their associated equipment configurations were evaluated individually, it was found that the average harvesting costs continually declined for each picker size for the farm sizes examined. A producer with a farm size of 1,500 acres could minimize harvesting costs to about 3.53 ¢/lb of lint by using a two-row picker and equipment combination; however, it would take about 75 days. Similarly, the four-row and six-row picker and equipment combinations would take about 38 and 21 days, respectively. Most picker harvested cotton is grown in areas where a risk of bad weather is high. Therefore, a producer might prefer to incur a higher cost of harvesting in order to harvest the crop in less time.

Comparison of Stripper and Picker Ownership with Custom Harvesting

Stripper Ownership

The custom harvesting charges were found to be 7.00 and 8.00 ¢/lb of lint without and with a bur-extractor, respectively (personal communication with current custom harvesters). Results indicated that the average cost of the four stripper and equipment combinations without and with bur-extractors became competitive with the custom harvesting charge at around 600 acres (Tables 4 and 5 and Figures 1 and 2). Therefore, it could be implied that custom harvesting is less expensive than buying a stripper and equipment combination without and with a bur-extractor up to 600 acres.

Picker Ownership

The custom picker harvesting charges were found to be 13.00 ¢/lb of lint (personal communication with current custom harvesters). Results indicated that the average harvesting cost of the two-row and four-row picker and equipment combinations were less expensive than the custom harvesting charge for all farm sizes examined. The six-row stripper and equipment combination became less expensive than the custom harvesting charge at around 700 acres (Table 6 and Figure 3).

The producers' decision to have a crop custom harvested or to purchase harvesting machinery is not always solely dependent on cost consideration. From the time the crop is ready to be harvested until it is actually harvested, there is a possibility that the crop may experience quality reductions due to weather. Many producers choose to pay the additional cost to purchase a harvesting equipment combination in order to avoid dependence on custom harvesters and a possible delay in harvesting.

Conclusion

This study estimated the ownership and maintenance costs associated with cotton harvesting machinery, including the four, six, eight, and two individual four-row strippers, without and with bur-extractors, the two, four, and six-row pickers, boll buggy, module builder, and tractor(s). These estimated average harvesting costs and custom harvesting charges corresponding to strippers (without and with bur-extractors) and pickers were compared to determine the least expensive methods of cotton harvesting given a specific number of acres. A typical Texas cotton producer (with a yield of 524 pounds per stripper harvested acre and a farm size of 582 acres) would minimize the cost of harvesting by investing in a four-row stripper without or with a bur-extractor at 6.71 or 7.72 ¢/lb of lint, respectively. If an average yield of 791 pounds per picker harvested acre and the Texas average farm size of 582 acres were assumed, the harvesting cost would be minimized with the ownership of a two-row picker and equipment combination, which would be about 6.93 ¢/lb of lint.

The four-row stripper and equipment combination without or with bur-extractors minimized harvesting costs between the four stripper and equipment combinations for all farm sizes examined. However, producers have implied that a mature cotton crop should not remain in the field any longer than necessary. Therefore, if a time constraint of about 30 days were placed on the length of the harvesting season, the six-row stripper and equipment combination without and with a bur-extractor would become optimal for farm sizes of about 1,300 acres and between 1,000 to 1,200 acres, respectively. The eight-row stripper and equipment combination with a bur-extractor became the most efficient harvesting alternative starting at about 1,300 acres. It was also found that the eight-row stripper and equipment combination was always less expensive than the two individual four-row stripper and equipment combination. For picker and equipment combinations, the two-row picker and equipment combination had the lowest average cost of the three picker alternatives up to 600 acres when a harvesting period of 30 days was considered. The four-row picker and equipment combination had the minimum average cost between 700 and 1,200 acres, while the six-row picker and equipment combination became optimum starting at about 1,300 acres.

Further, a comparison of the estimated harvesting cost with the costs of custom harvesting indicated that having a crop custom stripper harvested was less expensive until the farm size reached 600 acres for stripper and equipment combinations without and with bur-extractors. Owning a picker and equipment combination was found to be less expensive than custom picker harvesting. When a crop is custom harvested, there is the possibility that the harvesting process could be delayed, which could result in unusual yield and quality damage due to weather. Therefore, many producers might be willing to pay the additional cost to purchase a stripper or picker and equipment combination in order to avoid a delay in harvesting.

This study fills a critical void by providing estimates for cotton harvesting costs for both stripper and picker alternatives that are currently unavailable. However, the results should be used with caution because, for a lack of a better option, all reported estimates are based on the Texas average yield of 524 pounds per acre of stripper harvested cotton and 791 pounds per acre of picker harvested cotton. Also, results were analyzed based on a harvesting season that was constrained to 30 days. It is obvious that the results of this study are not applicable to production scenarios that are different from what was considered in this study. However, it should be recognized that this study provides a simple method that can be employed by cotton producers in various parts of the United States to determine the cost of harvesting given individualized production scenarios.

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Table 1. Cost Estimates for Equipment Configurations Associated with Stripper Harvesting Alternatives without Bur-Extractors.

	4-row	6-row	8-row	2-4-row
Purchase Cost ($)				
Stripper (w/out BE)	92,500	96,000	106,000	185,000
Boll Buggy	0	13,300	14,300	13,300
Module Builder	20,600	20,600	20,600	20,600
Tractor(s)	12,000	24,000	24,000	24,000
Total Purchase Cost	125,100	153,900	164,900	242,900
Annual Investment Cost ($/yr)				
Stripper (w/out BE)	13,034	13,527	14,936	26,068
Boll Buggy	0	1,874	2,015	1,874
Module Builder	2,903	2,903	2,903	2,903
Tractor(s)	1,690	3,380	3,380	3,380
Total Investment Cost	17,626	21,686	23,236	34,227
Annual THI[1] ($/yr)				
Stripper (w/out BE)	264	274	302	528
Boll Buggy	0	38	41	38
Module Builder	59	59	59	59
Tractor(s)	34	68	68	68
Total THI	357	439	470	693
Annual Fixed Cost ($/yr)				
Stripper (w/out BE)	13,298	13,802	15,239	26,596
Boll Buggy	0	1,912	2,056	1,912
Module Builder	2,962	2,962	2,962	2,962
Tractor(s)	1,725	3,450	3,450	3,450
Total Fixed Cost	17,985	22,126	23,707	34,920
Annual PV_{MC}[2] ($/yr)				
Stripper (w/out BE)	292	413	534	584
Boll Buggy	0	19	19	19
Module Builder	373	373	373	373
Tractor(s)	15	30	30	30
Total Annual PV_{MC}	680	835	956	1,006
Performance Rate; ac/hr	4	5	6.5	8

Note: W/out BE refers to without the use of a bur-extractor.

1 THI refers to the annual taxes, housing, and insurance over the life of the machine.

2 PV_{MC} refers to the annual present value of the maintenance cost over the life of the machine.

Table 2. Cost Estimates for Equipment Configurations Associated with Stripper Harvesting Alternatives with Bur-Extractors.

	4-row	6-row	8- Row	2-4-row
Purchase Cost ($)				
Stripper (w/ BE)	105,500	109,000	119,000	211,000
Boll Buggy	0	13,300	14,300	13,300
Module Builder	20,600	20,600	20,600	20,600
Tractor(s)	12,000	24,000	24,000	24,000
Total Purchase Cost	138,100	166,900	177,900	268,900
Annual Investment Cost ($/yr)				
Stripper (w/ BE)	14,866	15,359	16,768	29,732
Boll Buggy	0	1,874	2,015	1,874
Module Builder	2,903	2,903	2,903	2,903
Tractor(s)	1,690	3,380	3,380	3,380
Total Investment Cost	19,459	23,518	25,068	37,891
Annual THI[1] ($/yr)				
Stripper (w/ BE)	301	311	340	602
Boll Buggy	0	38	41	38
Module Builder	59	59	59	59
Tractor(s)	34	68	68	68
Total THI	394	476	508	767
Annual Fixed Cost ($/yr)				
Stripper (w/ BE)	15,167	15,671	17,108	30,334
Boll Buggy	0	1,912	2,056	1,912
Module Builder	2,962	2,962	2,962	2,962
Tractor(s)	1,725	3,450	3,450	3,450
Total Fixed Cost	19,854	23,995	25,576	38,658
Annual PV_{MC}[2] ($/yr)				
Stripper (w/ BE)	888	1,009	1,131	1,776
Boll Buggy	0	19	19	19
Module Builder	373	373	373	373
Tractor(s)	15	30	30	30
Total Annual PV_{MC}	1,276	1,431	1,553	2,198
Performance Rate (ac/hr)	3	4	5.5	6

Note: W/ BE refers to with the use of a bur-extractor.

1 THI refers to the annual taxes, housing, and insurance over the life of the machine.

2 PV_{MC} refers to the annual present value of the maintenance cost over the life of the machine.

Table 3. Cost Estimates for Equipment Configurations Associated with Picker Harvesting Alternatives.

	2-row	4-row	6- Row
Purchase Cost ($)			
Picker	120,650	194,000	273,650
Boll Buggy	0	13,300	13,300
Module Builder	20,600	20,600	20,600
Tractor(s)	60,000	120,000	120,000
Total Purchase Cost	201,250	347,900	427,550
Investment Cost ($/yr)			
Picker	17,001	27,337	38,560
Boll Buggy	0	1,874	1,874
Module Builder	2,903	2,903	2,903
Tractor(s)	1,690	3,380	3,380
Total Investment Cost	21,594	35,494	46,717
Annual THI[1] ($/yr)			
Picker	345	554	782
Boll Buggy	0	38	38
Module Builder	59	59	59
Tractor(s)	34	68	68
Total THI	438	719	947
Annual Fixed Cost ($/yr)			
Picker	19,414	31,217	44,033
Boll Buggy	0	1,912	1,912
Module Builder	2,962	2,962	2,962
Tractor(s)	1,725	3,450	3,450
Total Fixed Cost	24,101	39,541	52,357
Annual PV_{MC}[2] ($/yr)			
Picker	3,029	6,010	8,990
Boll Buggy	0	19	19
Module Builder	373	373	373
Tractor(s)	15	30	30
Total Annual PV_{MC}	3,417	6,432	9,412
Performance Rate (ac/hr)	2	4	7

1 THI refers to the annual taxes, housing, and insurance over the life of the machine.

2 PV_{MC} refers to the annual present value of the maintenance cost over the life of the machine.

Table 4. Average Cost Estimates for Equipment Configurations Associated with Strippers Without Bur-Extractors by Size of Operation.

Acres	4 Row	6 Row	8 Row	2-4 Row
			------- cents / lint pound -------	
500	7.84	9.63	10.13	14.14
600	6.71	8.15	8.53	12.08
700	5.84	7.08	7.39	10.41
800	5.18	6.36	6.53	9.17
900	4.73	5.73	5.87	8.20
1000	4.32	5.23	5.40	7.42
1100	3.98	4.88	4.96	6.79
1200	3.75	4.53	4.59	6.34
1300	3.51	4.24	4.28	5.88
1400	3.30	3.99	4.06	5.49
1500	3.16	3.82	3.83	5.16

Table 5. Average Cost Estimates for Equipment Configurations Associated with Strippers With Bur-Extractors by Size of Operation.

Acres	4 Row	6 Row	8 Row	2-4 Row
		------- cents / lint pound -------		
500	9.11	10.76	11.18	16.47
600	7.72	9.23	9.43	13.82
700	6.73	8.04	8.17	11.93
800	6.06	7.14	7.32	10.51
900	5.55	6.53	6.58	9.52
1000	5.07	5.97	5.99	8.63
1100	4.75	5.51	5.50	7.90
1200	4.42	5.19	5.16	7.29
1300	4.20	4.86	4.81	6.86
1400	3.96	4.58	4.52	6.41
1500	3.80	4.39	4.26	6.03

Table 6. Average Cost Estimates for Equipment Configurations Associated with Pickers by Size of Operation.

Acres	2 Row	4 Row	6 Row
	------- cents / lint pound -------		
500	8.06	12.41	15.93
600	6.93	10.57	13.58
700	6.06	9.14	11.68
800	5.47	8.08	10.27
900	5.02	7.33	9.16
1000	4.66	6.66	8.28
1100	4.32	6.11	7.65
1200	4.08	5.72	7.04
1300	3.88	5.33	6.53
1400	3.67	4.99	6.08
1500	3.53	4.76	5.70

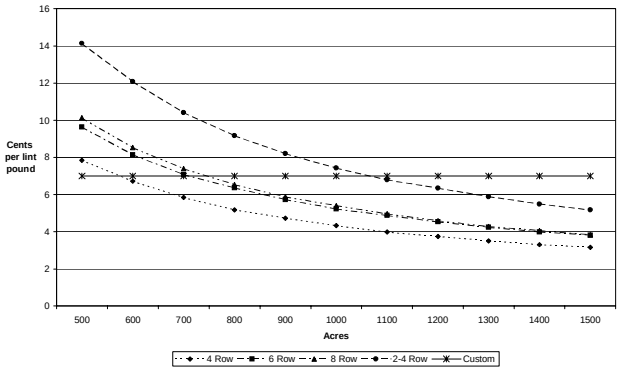

Figure 1. Average Cost Estimates for Equipment Configurations Associated with Strippers without Bur-Extractors by Size of Operation.

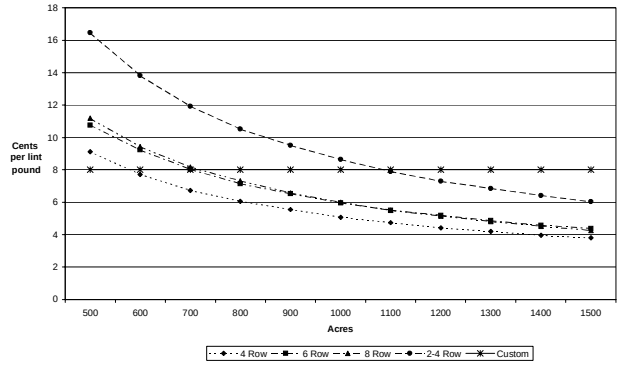

Figure 2. Average Cost Estimate for Equipment Configurations Associated with Strippers with But-Extractors by size of operation.

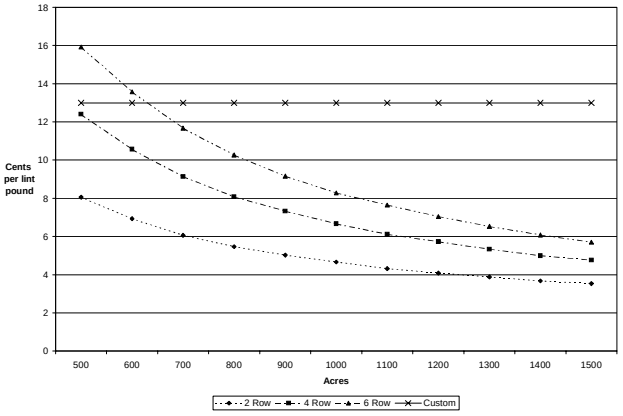

Figure 3. Average Cost Estimate for Equipment Configurations Associated with Pickers by Size of Operation.