A WEB BASED COTTON HARVESTING COST CALCULATOR

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Abstract

The Cotton Harvesting Cost Calculator (CHCC) is a web based program designed and developed to provide cotton producers a user-friendly means to accurately estimate the harvesting cost associated with a specific harvesting equipment configuration. CHCC can calculate the average harvesting cost for a specific cotton stripper or picker harvesting equipment configuration, as well as compare costs of alternative harvesting equipment configurations and identify the least cost configuration.

Introduction

A combination of recent economic and farm conditions have resulted in reduced profits for cotton producers. Cotton producers have been subject to volatile cotton prices, changes in government support programs, increasing input costs, and unfavorable farming conditions. Since producers have no control or influence on any of these economic or farm conditions, it has become increasingly important for producers to manage their costs more efficiently. Cotton producers have expressed concern regarding the costs associated with the harvesting process. The multiple alternative harvesting options that are currently available to producers make minimizing harvesting costs a possibility. However, many producers have difficulty determining the harvesting equipment configuration that would result in minimized harvesting costs given their individualized production scenario.

The objective of this manuscript is to report on a program designed to help producers determine the least cost stripper or picker harvesting systems given their individualized production scenario. The web-based software, Cotton Harvesting Cost Calculator (CHCC), can be used to estimate harvesting costs under a variety of operating conditions. CHCC provides default values, including purchase costs of equipment, maintenance costs, operating costs, performance rate, etc., for each component of the harvesting system. These values can be used as estimates in the calculation of harvesting costs. However, CHCC is designed to utilize user-supplied data to calculate harvesting costs by allowing each of the default values to be changed. This allows the calculated harvesting costs to be specific to the user's individualized production scenario.

CHCC is unique for several reasons. The software concentrates on the calculation of costs associated with cotton harvesting equipment. The program asks for detailed cost and production information that make the resulting harvesting costs specific to the user's individualized production scenario. CHCC can be easily accessed on the Internet from any location without the need for additional software.

Software Overview

The CHCC can be utilized in two ways. First, the user can determine the harvesting cost of a specific stripper or picker harvesting system. The CHCC allows the user to choose from three types of strippers (four-row, six-row, and eight-row) and pickers (two-row, four-row, and six-row). The three types of cotton strippers can be chosen with or without bur-extractors. Additional equipment may also be used in combination with the stripper and picker harvesting machines, such as a boll buggy and module builder. Both of these pieces of equipment require the use of a tractor of at least 90 horsepower. Each of the three types of strippers and pickers has a common equipment configuration that is used as the default combination. 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, module builder, and two tractors are usually used with a six-row stripper and four- and six-row pickers. The eight-row stripper is often used with the aid of a swing-tongue boll buggy, a module builder, and two tractors. However, the user can specify the number of each piece of equipment so that it exactly corresponds with his production scenario. The producer can select one to five strippers or pickers, boll buggies, and module builders, while one to ten tractors may be specified.

The second application of the CHCC allows the user to compare costs associated with up to three alternative stripper or picker harvesting systems. Again, default equipment combinations and associated costs are provided; however the user can customize the configuration so that it exactly corresponds with his production scenario. The harvesting system with the lowest cost, given the specified production scenario, is determined and presented to the user along with the costs of other harvesting systems. If the user knows the local custom harvesting rates, a comparison can also be made between ownership harvesting costs and local custom harvesting charges.

Data Needs

The CHCC provides default cost values for each size of cotton stripper and picker and the additional harvesting equipment. These values were collected from cotton producers, harvesting equipment owners, equipment dealers, and custom cotton harvesters 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 consumption, labor costs, performance rates, useful life, and salvage value for each harvesting machine. The data gathered from respondents were averaged and used as default values in the CHCC. The user has the option to change each of the default values so that the resulting harvesting costs are calculated using the producer's individualized production scenario. Additional individualized information that is critical to the calculation of harvesting costs include the financing terms of the equipment, total acres of cotton to be harvested, expected cotton yields, length of harvesting season, and harvesting hours per day.

Cost Calculations

The CHCC computes the fixed, variable, total, and average costs associated with the harvesting equipment system(s) that is specified by the user. The fixed costs include investment costs, which are amortized over the life of the machine, and taxes, housing, and insurance. The variable costs calculated by the CHCC include maintenance, fuel, and labor costs. The cost calculation procedure used in the CHCC is similar to that of Nelson et al. (2000).

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Fixed Cost Estimates

Data regarding the financing of the specified equipment is used to determine the investment cost of the harvesting system. CHCC gives the user the option to purchase the harvesting system using debt or equity capital. When debt is used, the investment cost is calculated by amortizing the purchase cost into equal annual payments. This is accomplished by using an annual interest rate over the lifetime of the equipment, which is user specified. The salvage value entered by the user is used as the future value. If the user does not enter an annual interest rate, the real interest rate is used. The real interest rate is determined by adjusting the nominal interest rate by the inflation rate using the following equation (Bowlin et al. 1990):

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

where k^* is the real interest rate, k is the nominal fixed interest rate, and i is the inflation rate. The default value for k used by the CHCC is the average of the nominal fixed interest rates from 1996 to 1999 (Federal Reserve Bank of Dallas, 1996 to 1999), while the inflation rate from the Producer Price Index for farm machinery and equipment for 1999 is used for i (Bureau of Labor Statistics Data, 2000). The default equipment life and salvage value were obtained by averaging the responses from survey participants. The annual amortized investment cost accounts for the purchase cost of the machine, as well as any accrued interest and depreciation over the specified time period. When the producer chooses to purchase a harvesting system using equity, no interest accrues. However, the investment cost is still annually amortized to account for depreciation.

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 is used to estimate the tax, housing, and insurance costs of a machine. The annual fixed cost is calculated by summing the annual amortized investment cost and the estimated annual cost of taxes, housing, and insurance. The annual fixed cost is calculated for each specified stripper or picker, as well as each piece of additional harvesting equipment.

Variable and Total Cost Estimates

The variable costs for stripper and picker harvesting include fuel and labor costs per day and seasonal maintenance costs. The present value of the variable costs associated with operating each piece of equipment over the equipment lifetime, which is specified by the user, is calculated using the following formula:

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

where TPV_{VC} is the present value of the specific variable cost of the equipment 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 equipment in years. Equation 2 is used to calculate the present value of the fuel cost, labor cost, and maintenance cost. The results from Equation 2 are then averaged over the equipment lifetime to determine the average present value of the specific variable cost, assuming that each piece of equipment (stripper, picker, and additional harvesting equipment) will be used each season.

The performance rate of the specified harvesting system strongly affects the efficiency and cost effectiveness of the system. The number of acres that can be harvested in one hour vary according to the number of row units of each stripper or picker. As a result, the number of days required for each machine to harvest a specific number of acres also varies. The number of days is determined by dividing the acres to be harvested by the average number of hours worked in one day and the performance rate (the number of acres each size of stripper and picker can harvest in one hour). In order for the number of days to be consistent with the user's production scenario, all of the data used in calculating the number of days should be entered by the user.

The total cost of each cotton-harvesting machine (stripper, picker, boll buggy, module builder, and tractor) is calculated by summing the fixed cost per year with the average present value of the annual variable costs. The variable cost component consists of the average present value of the annual maintenance cost and the average present value of the cost of labor and fuel over the life of the machine (daily labor and fuel multiplied by 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% of a tractor's annual use is utilized in the cotton harvesting process. The user has the option of changing this default value to one that better suits his operation. Thus, when calculating the tractors' total cotton harvesting cost, only the specified percentage of the fixed and variable costs are accounted for. The total cost for each stripper and picker harvesting system is determined by summing the total costs of the equipment components (stripper or picker, boll buggy, module builder, and tractor(s)) associated with each stripper and picker size. If a boll buggy is not used in the harvesting process, the total cost for the boll buggy is assumed to be zero.

Average Cost Estimates

Segarra et al. (1990) indicated that when the harvesting of cotton is delayed, cotton lint yield reductions occur and are expected to increase at an increasing rate as the length of the delay increases. The model used to estimate the percentage of cotton lint yield lost for each week of the harvest period (Segarra et al., 1990) is:

$$Y_W = 0.93944 - 0.005971 * W^2 \quad [3]$$

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

$$Y = 1 - [Y_{W-1} - Y_W] \quad [4]$$

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. The yield remaining after lint reductions, Y_{end}, is calculated by multiplying the yield prior to any lint loss (Y_{begin}) by the percentage of cotton lint yield remaining after lint loss (Y). The expected yield that the user anticipates harvesting with the alternative harvesting system is used as Y_{begin}. While Equation 4 accounts for lint loss due to a delay in harvest, it should be noted that costs associated with cotton quality reductions due to delayed harvest are not accounted for in CHCC.

The average cost of owning and operating each stripper or picker harvesting system is calculated for the farm size specified by the user. The average cost, which combines the fixed and variable costs corresponding to each equipment configuration, is calculated using the following equation:

$$AC = TC / (Y_{end} * A) \quad [5]$$

where AC is the average cost per acre of lint associated with owning and operating each harvesting system, TC is the total cost of each harvesting system per year, Y_{end} is the yield per acre remaining after lint reductions, and A is the number of acres to be harvested.

CHCC Output

The average harvesting cost is presented in three units, including the cost per lint pound (cents), cost per acre (dollars), and cost per bale (dollars). The results also identify the number of days that would be required for the chosen harvesting system to harvest the acreage specified by the user. Survey participants providing default values indicated that a mature cotton crop should not remain in the field for more than 30 days (personal communication with cotton producers). When harvest is delayed, a crop may experience weather damage that might considerably reduce the cotton quality, which is not accounted for in CHCC. Therefore, when the user attempts to determine and compare the harvesting costs of multiple harvesting systems, the user must enter what he thinks to be an optimal number of days that would be required to harvest his acreage, given his unique scenario. When comparing multiple stripper or picker harvesting systems, the output consists of a list of each of the three stripper or picker harvesting systems, along with their corresponding cost per lint pound, cost per acre, cost per bale, and the number of days required for each system to harvest the specified acreage. The number of days that the user considers to be optimal acts as a time constraint when the least-cost alternative is identified by CHCC.

The least-cost harvesting alternative is identified based on both the actual harvesting costs and the time constraint. Therefore, the CHCC first identifies the harvesting alternatives that meet the time constraint. From these choices, the alternative harvesting system with the lowest cost is identified as the optimal harvesting system, given the production scenario. In this case, one alternative may be highlighted as the least-cost alternative. However, another alternative may have a slightly lower cost, but may require a few more harvest days than the time constraint. If the number of days required to harvest a given acreage is not strictly limited to the time constraint, the user may consider choosing the next best alternative. Once an optimal harvesting system and its harvesting cost has been identified, a comparison can be made between the ownership harvesting cost and the local custom harvesting charges.

Conclusion

The CHCC is a web-based calculator designed to provide cotton producers a user-friendly means to accurately estimate the harvesting cost associated with a specific harvesting equipment configuration. As economic and farm conditions continue to negatively effect cotton producers, questions regarding minimizing costs, specifically harvesting costs, will increase. Many producers may question the feasibility of a harvesting system that is currently owned, while others may attempt to identify a future harvesting equipment purchase that might minimize their harvesting costs. For example, many producers have questioned whether an eight-row or two four-row strippers is more efficient. This answer, along with many others, can be quickly and accurately answered using the CHCC. The CHCC also has potential of being used for extension and research purposes. The CHCC is available on the Internet at <http://www.aeco.ttu.edu>. Anyone with access to the Internet can easily utilize this user-friendly software.

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