

H-OPCO\$T: A software package for analyzing the costs of operating a mechanical wild blueberry harvester

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Sibley, K.J. and Arsenault, D.L. 1997. **H-OPCO\$T: A software package for analyzing the costs of operating a mechanical wild blueberry harvester.** Can. Agric. Eng. 39:069-072. Operating cost analysis software was developed for a mechanical wild blueberry harvesting operation. It allows growers and harvester owners to estimate total annual operating costs and operation component costs. Costs can also be calculated on a per hour and per pound harvested basis. User defined variable data allow for the calculations to be tailored to a specific operation or to predict future costs resulting from the alteration of any operating variables. Results can be viewed in financial statement, tabular, or graphical form. The program was developed using Microsoft Visual Basic 3.0 for Windows and runs on an IBM or compatible computer under the Windows 3.1 environment.

Un logiciel pour analyser les frais d'opération a été développé pour la cueillette mécanique du bleuets sauvage. Il permet au cultivateur et au propriétaire de l'appareil de récolte d'estimer les frais d'opération annuels totaux et les frais d'opération par secteurs. Les frais peuvent aussi être calculés sur une base horaire ou par livre de bleuets récoltés. Les données définies par l'utilisateur permettent le calcul d'être adapté à une opération spécifique ou de prédire les frais futurs résultant de l'altération des variables d'opération. Les résultats peuvent être utilisés dans des rapports financiers, sous forme de tableaux ou de graphiques. Le programme a été élaboré avec un logiciel basé sur " Microsoft Visual Basic 3.0 " pour " Windows " et sur un ordinateur IBM ou compatible avec " Windows 3.1 " ou plus élevé.

INTRODUCTION

H-OPCO\$T (Harvester Operating Cost) is a software program that allows the operating costs of a mechanical wild blueberry harvester to be estimated based on user-defined input variable values. It was created to aid blueberry farmers and extension workers by eliminating lengthy hand and/or cumbersome spreadsheet calculations. Each user can tailor the cost calculations specifically to his/her

own operations to get a detailed statement of annual, per hour of operation, and per pound harvested operating costs. The software can also be used to project future operating costs for various scenarios. Cost calculations are performed using the most up-to-date generally accepted accounting principles and formulae and are adjusted for inflation to give the most accurate results possible.

SOFTWARE DESIGN

H-OPCO\$T was developed using Microsoft Visual Basic 3.0 for Windows. Visual Basic's Setup Wizard was then used to create a stand alone software package that runs under the Microsoft Windows 3.1 environment. Windows based development software was used to give the user a visually pleasing and easy-to-use working environment. The program is mouse and keyboard driven. Results windows can be viewed on screen by clicking on the appropriate buttons. As well, each

Tractor	Harvester	Labour	Operating	Bank
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OPERATING STATEMENT	
Annual Fixed Costs	<input type="button" value="Show Detail"/>
Depreciation and interest	\$ <input type="text" value="3603.75"/>
Insurance	\$ <input type="text" value="128.00"/>
Housing	\$ <input type="text" value="450.00"/>
Total	\$ <input type="text" value="4181.75"/>
Annual Variable Costs	<input type="button" value="Show Detail"/>
Repairs and maintenance	\$ <input type="text" value="1724.76"/>
Fuel	\$ <input type="text" value="977.11"/>
Lubrication	\$ <input type="text" value="173.84"/>
Hydraulic oil	\$ <input type="text" value="181.80"/>
Total	\$ <input type="text" value="3057.51"/>

<input type="button" value="Print Form"/>
<input type="button" value="Graph"/>
<input type="button" value="Next Page"/>

Fig. 1. Page 1 of the Operating Cost Statement window.

	Tractor	Harvester	Labour	Operating	Bank
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Operating Statement..Page 2

Labor	
Wages	\$ 3456.00
Benefits	\$ 155.52
Bonuses	\$ 103.68
Total	\$ 3715.20
Interest on Operating Capital	\$ 84.12
Total variable	\$ 6063.18
Annual Administration and Overhead	\$ 508.14
Total Annual Operating Cost	\$ 10670.93
\$/Hr Operated	\$ 59.28

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Fig. 2. Page 2 of the Operating Cost Statement window.

	Tractor	Harvester
Depreciation and interest	\$ 1442.56	\$ 2439.05
Insurance	\$ 48.00	\$ 80.00
Housing	\$ 90.00	\$ 0.00
Total	\$ 1580.56	\$ 2519.05

OK Print

Fig. 3. Annual Fixed Cost detail window.

window can be printed to give hard copy of a scenario created.

H-OPCOST is set up to display three result viewing windows: (1) the Operating Cost Statement window, (2) the Operating Cost Matrix window, and (3) the Operating Cost Graph window.

The Operating Cost Statement (Figs. 1 and 2) is set up as a standard financial statement. Ownership, Variable, Labour, Operating Capital, and Administration and Overhead costs are displayed along with Total Annual Operating and Dollars per Hour Operated costs. Each cost total (Variable, Fixed, and Dollars per Hour Operated) has a pop-up detail window (activated by the appropriate Show Detail button) which shows a breakdown of costs for each component of the operation and each component of the cost total. Figure 3 shows an example of Annual Fixed Cost details.

The Operating Cost Matrix window (Fig. 4) displays operating costs on a per pound harvested basis in a tabular format. Cost per pound values are shown for various combinations of Harvested Yield and Effective Field Capacity (work rate in the field). The Effective Field Capacity choices displayed across the top of the Matrix will change automatically to

correspond with the Number of Picking Heads on the harvester indicated by the user in the Harvester data entry window.

The Operating Cost Graph window (Fig. 5) is a graphical presentation of the Operating Cost Matrix, showing the Operating Costs per pound versus Effective Field Capacity for a selected Harvested Yield. Various harvested yields can be selected using a drop down box and an updated graph is automatically drawn after each new selection.

Data can be entered or changed from any of the program's results viewing windows by clicking on the appropriate data entry button and entering new data in the pop-up data entry window. Figure 6 shows a sample data entry window as would appear on the screen when running the program. Closing the window then automatically initiates costs recalculation using the new data and displays

the new costs in the current results viewing window. This allows easy comparisons of previous costs with the new costs resulting from the alteration of any operating variable. The data in each data entry window can also be reset to the pre-programmed default values.

H-OPCOST will run on any computer running Windows 3.1 (or later) and supporting SVGA resolution.

The user input variables built into H-OPCOST for each data entry category, along with their default values, are shown in Table I.

COST CALCULATIONS SUMMARY

H-OPCOST's operating statement breaks the total operating cost down into fixed, variable, and administration and overhead costs.

Annual fixed costs

Annual fixed costs are those associated with owning the equipment (ie. tractor and harvester). They are constant no matter how much or how little the equipment is used. H-OPCOST includes Depreciation and Interest on Investment, Insurance, and Housing in its Annual Fixed costs calculations.

Depreciation and Interest on Investment are determined using the Capital Recovery with Return Method. This method accounts for the "opportunity cost" of not being able to invest the purchasing funds of the equipment elsewhere (if purchaser uses cash-on-hand) or for the cost of borrowing the purchasing funds. It uses a real rate of interest based on the current market interest rate and the average expected inflation rate over the useful life of the equipment. Depreciation is based on industry averages of remaining value as reported in the ASAE D497.1, *Agricultural Machinery Management Data* (ASAE 1993). The Capital Recovery with Return

Method has been reported by Bartholomew (1981) to give the most accurate estimate of true Depreciation and Interest, especially in times of high inflation. Calculations based on the alternate Straight Line Depreciation, Interest on Average Investment Method can underestimate Depreciation and Interest costs by 15% for a market interest rate of 10% and a useful life of 20 years. Default Annual Hours of Use for the

repairs and maintenance costs, and a decreased useful life. Both are determined based on the purchase price of the equipment as defined by the user. Default multiplication factors are industry averages as reported in the ASAE D497.1, Agricultural Machinery Management Data (ASAE 1993) and in the Atlantic Committee on Agricultural Engineering publication Minimum Cost of Custom Rates for Agricultural Machines (Watts 1986).

OPERATING COST MATRIX (¢/LB)

Harvested Yield (lbs/ac)	Effective Field Capacity(ac/hr)				
	.2	.24	.28	.32	.36
1000	29.6	24.7	21.2	18.5	16.5
1500	19.8	16.5	14.1	12.4	11.0
2000	14.8	12.4	10.6	9.3	8.2
2500	11.9	9.9	8.5	7.4	6.6
3000	9.9	8.2	7.1	6.2	5.5
3500	8.5	7.1	6.0	5.3	4.7
4000	7.4	6.2	5.3	4.6	4.1
4500	6.6	5.5	4.7	4.1	3.7
5000	5.9	4.9	4.2	3.7	3.3
5500	5.4	4.5	3.8	3.4	3.0
6000	4.9	4.1	3.5	3.1	2.7
6500	4.6	3.8	3.3	2.9	2.5
7000	4.2	3.5	3.0	2.6	2.4
7500	4.0	3.3	2.8	2.5	2.2
8000	3.7	3.1	2.6	2.3	2.1
8500	3.5	2.9	2.5	2.2	1.9
9000	3.3	2.7	2.4	2.1	1.8
9500	3.1	2.6	2.2	2.0	1.7

Print Matrix
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Fig. 4. Operating Cost Matrix window.

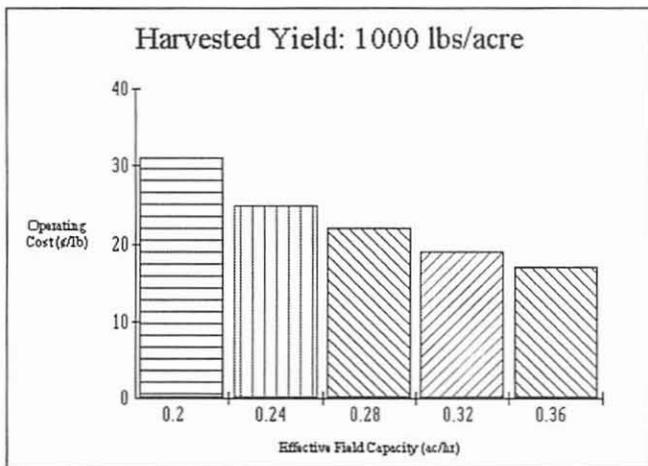


Fig. 5. Operating Cost Graph window.

tractor are based on industry averages as reported in Alberta Agriculture's publication *Farm Machinery Costs as a Guide to Custom Rates* (Alberta Agriculture 1990). Annual Hours of Use for the harvester are based on the number of days used and the daily operating time as input by the user.

Insurance and Housing costs have been included in Annual Fixed Costs, even though some owners may not insure their equipment or may leave it outside unprotected from the weather. Inclusion of these costs gives a more realistic estimate of the true costs of owning the equipment, especially since not properly housing the equipment results in increased

Unlike other machinery costing software, Annual Fixed costs may also be increased or decreased by a Severity of Use Factor built into H-OPCOST's financial model. In real life, if the equipment is harshly used or not maintained properly, its useful life and remaining value can be decreased significantly. Decreasing the useful life and remaining value of the equipment increases the actual ownership costs. The converse is also true for equipment that is properly used and well cared for. In H-OPCOST, increasing the Severity of Use Factor above 1.0 decreases useful life. Decreasing it below 1.0 increases useful life. Since this is a new concept being built into a financial model, there are no background data in the literature and collecting such data was beyond the scope of this project. It is available for users to use if they feel their particular circumstances warrant. Otherwise it can be left set to its default value of 1.0 which will have no effect on the cost calculations.

Annual variable costs

Annual Variable costs are those associated with operating the equipment. They vary according to how much the equipment is used. H-OPCOST includes Repairs and Maintenance, Fuel, Lubrication, Hydraulic Oil, Labour, and Interest on Operating Capital in determining Annual Variable Costs.

Repairs and Maintenance costs are determined based on the annual use of the equipment and its purchase price. Default multiplication factors for Repairs and Maintenance costs are industry averages as reported in Saskatchewan Agriculture's *Farm Machinery Custom & Rental Rate Guide* (Saskatchewan Agriculture 1987).

Fuel costs are determined based on the annual use of the

Purchase price	\$	40000	
Average annual hours of use		600	Hrs
Useful life		10000	Hrs
Severity of use factor (decimal)		1	
Insurance rate factor(% of list)		.4	%
Housing cost factor (% of list)		.75	%
Repair and maintenance factor		.0833	\$/Hr/\$1000 list
Fuel use		13.24	L/Hr
Fuel price	\$.41	/L
Lubrication cost factor(% of fuel costs)		15	%

Reset to default values Done Print

Fig. 6. Tractor data entry window.

Table I: User input variables and their default values

Tractor	Purchase price	\$40,000
	Annual hours of use	600 h
	Useful life	10,000 h
	Severity of use factor	1
	Insurance rate factor	0.4%
	Housing cost factor	0.75%
	Repair and maintenance factor	0.0833 \$/h/\$1000 list
	Fuel use	13.24 L/h
	Fuel price	\$0.41/L
	Lubrication cost factor	15%
Harvester	Purchase price	\$20,000
	Number of heads	1
	Useful life	2000 h
	Severity of use factor	1
	Housing cost factor	0.75%
	Repair and maintenance factor	0.3125 \$/h/\$1000 list
	Hydraulic oil use	90 L/yr
	Hydraulic oil price	\$2.02/L
	Lubrication cost factor	15%
Labour	Wage rate for driver	\$8/h
	Wage rate for boxer(s)	\$6/h
	Number of boxers	1
	Wage benefit factor	4.5% of wages
	Wage bonus factor	3% of wages
	Administration and overhead factor	5% of total costs
Operating	Number of days used	18 d
	Average daily operating time	10 h
	Average daily service time	1 h
	Average daily travel time	1 h
Bank	Operating capital repayment factor	60 d
	Current interest rate	8.5%
	Average inflation rate	1.5%

equipment and the current price for fuel. Lubrication costs are determined as a percentage of Fuel costs. The default percentage is based on industry averages as reported in the ASAE D497.1, *Agricultural Machinery Management Data* (ASAE 1993). Hydraulic Oil costs are determined based on annual oil use and the current price for oil as input by the user.

Labour costs are determined based on the number of equipment operators, the annual hours the equipment is operated, average daily service time, and average daily travel time to and from the work site as input by the user. Benefits and Bonuses costs are also included and are determined based on

a user input percentage of wages paid.

Interest on Operating Capital accounts for the “opportunity cost” of not being able to invest funds used during harvesting (ie. to pay variable costs) elsewhere, if cash-on-hand is being used to float the operation of the equipment, or for the cost of borrowing funds during such time. It is determined based on the Operating Capital Repayment Period, current market Interest Rate, and Total Variable costs.

Administration and overhead costs

Administration and Overhead costs are determined based on a user input percentage of total Annual Fixed and Annual Variable costs.

CONCLUSIONS

H-OPCO\$T gives the user the following capabilities:

1. Growers can estimate mechanical harvesting costs and negotiate the best price for having their fields custom picked.
2. Harvester owners and custom operators can use it to predict operating costs.
3. Ability to analyze labour costs versus operating costs for different levels of operating performance.
4. Ability to analyze operating costs per pound versus harvested yield.
5. Ability to analyze the implications of changing operating variables on costs.

Currently, H-OPCO\$T is being used by Farm Business Management and Agricultural Engineering Extension personnel in New Brunswick, PEI, and Maine, USA. Comments received from these users indicate that the software is extremely easy to use, is visually pleasing, and produces accurate cost figures.

REFERENCES

- Alberta Agriculture. 1990. *Farm Machinery Costs as a Guide to Custom Rates*. Agdex No. 825-4. Olds, AB: Alberta Agriculture, Farm Business Management Section.
- ASAE. 1993. ASAE D497.1 - *Agricultural machinery management data*. In *ASAE Standards 1993*, 328-334. St. Joseph, MI: ASAE.
- Bartholomew, R.B. 1981. Farm machinery costing under inflation. *Transactions of the ASAE* 24(4):843-845.
- Saskatchewan Agriculture. 1987. *Farm Machinery Custom & Rental Rate Guide (Revised)*. Regina, SK: Saskatchewan Department of Agriculture, Economics Branch, Farm Management Section.
- Watts, K.C. 1986. *Minimum Cost of Custom Rates for Agricultural Machines*. Agdex No. 740. Truro, NS: Atlantic Committee on Agricultural Engineering.