Custom Rates and the Total Cost to Own and Operate Farm Machinery In Kansas

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Farm Management

Farm machinery is a vital part of most farming operations, from the physical work it performs in the production process to the enjoyment provided from its operation. For producers, landowners, or farm managers who do not have the capital, time, or desire to perform machinery operations themselves, hiring a custom operator to perform machinery operations is an alternative method of obtaining machinery services. For others, custom farming may be a method to spread fixed costs of machinery over more acres, reducing per unit costs and increasing cash flow. Regardless, whether a business is a user or provider of machinery services, determining a rate to charge for machinery services can be difficult due to the various costs of farm machinery.

One alternative to calculating ownership and operation costs to help determine charges for machinery services is to simply use custom rates, for example, those published annually in *Kansas Custom Rates* (Kansas Agricultural Statistics). However, research of farms in Illinois indicates published custom rates do not represent the full cost to own and operate machinery (Schnitkey).

This publication discusses the following issues regarding machinery costs and custom rates: (1) to what degree do custom rates cover all ownership and operating costs of farm machinery? (2) why don't custom rates cover the total cost to own and operate machinery? (3) what are the total costs to own and operate machinery on average? (4) how can a farmer apply these results to his or her operation? and (5) how can a producer benchmark machinery costs?

This research does not question that the Kansas Agricultural Statistics (KAS) custom rates published in *Kansas Custom Rates* are truly what are charged and paid for custom-provided machinery services. Rather, it questions whether the published custom rates cover all costs an individual or entity incurs to own and operate farm machinery. The competitive market of custom machinery operations will ultimately determine the price of custom rates. However, discussion of the issues surrounding custom farming, and determining average rates that cover all ownership and operating costs will aid custom operators and individuals hiring the service of custom operators.

Do published custom rates cover all costs?

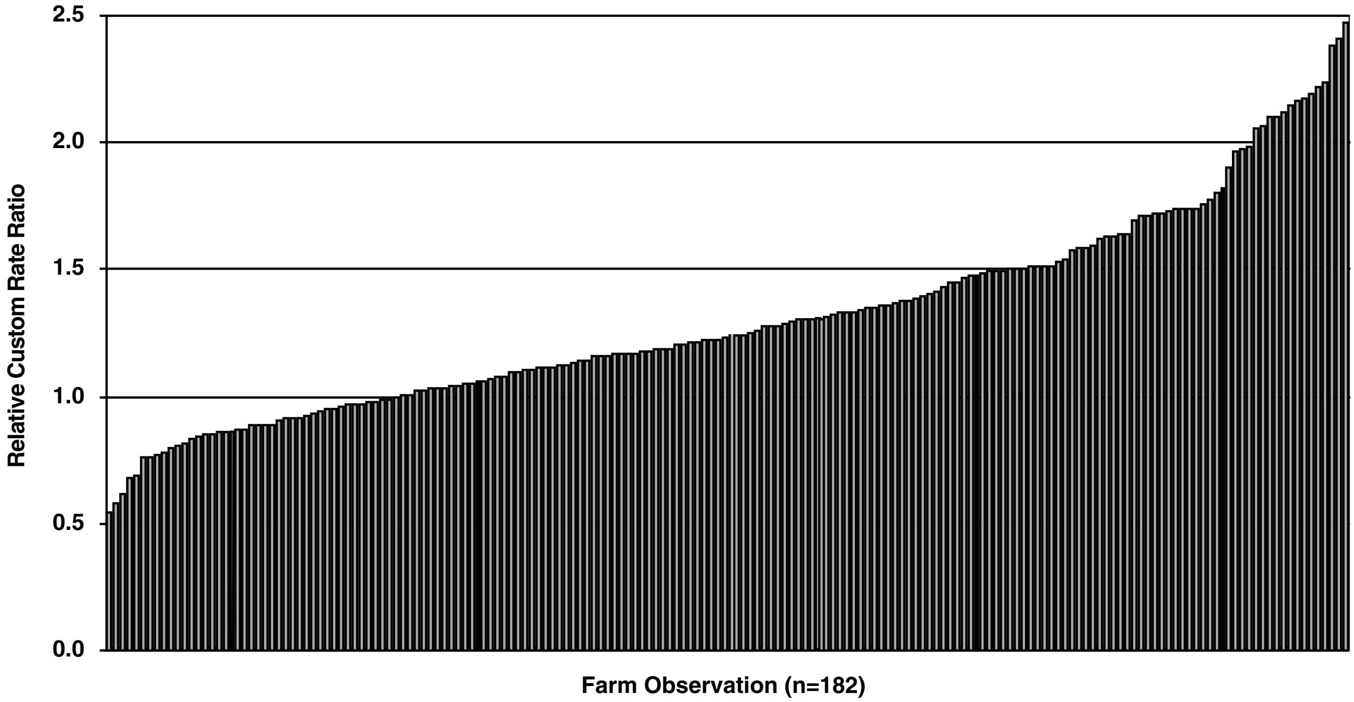
Based on Illinois data, Schnitkey concluded that, on average, it costs Illinois farmers $90.60 per acre annually to perform machinery operations. Alternatively, if the operations would have been hired at the state average custom rate, he estimated that it would cost approximately $70 per acre annually. Thus, he estimated that actual costs are almost 30 percent higher than custom rates.

Using KAS-reported custom rates along with financial and field-operation data from the Kansas Farm Management Association (KFMA), a "Relative Custom Rate Ratio" was developed. This ratio measures what it actually costs Kansas farmers to perform machinery operations relative to the statewide average published custom rates. If a particular farm has a ratio less than, equal to, or greater than 1.0, then the farm can perform machinery operations for less than, equal to, or greater than the published custom rates, respectively. Figure 1 displays the Relative Custom Rate Ratio (vertical axis) for 182 KFMA member farms (horizontal axis) that participated in a survey pertaining to the number of field operations they performed in 2001. Each bar represents a farm in this data set.

From Figure 1, the wide variability of machinery costs between farms can be seen. One farm performed machinery operations at 55 percent of the cost of published custom rates while another farm incurred costs of almost 247 percent of the published custom rates. The average (across farms) of the relative custom rate ratio is 1.31. This initial estimate indicates that 31 percent needs to be added to custom rates to cover the full costs of ownership and operation across farms. However, it is important to note that almost a fourth of the farms (23.6 percent) performed machinery operations for less than custom rates.

This publication accompanies the spreadsheet KSU-MachCost.xls located at *www.agmanager.info* (in the *machinery* section of the *farm management* area) that can be used to calculate farm-specific custom hire rates for machinery and benchmark a farm's machinery costs. The Excel® spreadsheet performs the calculations that may be performed manually as demonstrated in the worksheet at the end of this publication.

Figure 1. Relative Custom Rate Ratio.



Possible reasons why custom rates do not cover all ownership and operating costs

A reasonable question to ask is, Why do published custom rates not cover all costs? There are numerous possible answers to this question. One is that the ownership costs for the machinery a farmer owns are sunk costs. In short, the ownership costs of the machinery (already owned) are incurred whether or not the farm performs additional operations. Thus, if a farmer performs custom operations for others (without purchasing additional equipment), the fixed costs are spread over more acres, reducing per unit costs and generating cash flow. An important issue with this reason is how timely the operations are performed. That is, a farm might "have time" to perform custom activities only before or after the optimal time for such operations, meaning that such activities likely would be valued lower than optimally timed operations. This means that a farm considering the purchase of such activities as a less expensive alternative to machinery ownership may not necessarily enhance its profits. If such ill-timed activities dominate, then finding custom rates to be lower than full machinery costs for the average farm should not be surprising. Thus, there are rational economic reasons why neighbor-to-neighbor custom work is often performed below the full cost of owning and operating machinery.

It might be that operations that perform operations for others (and report their charges to KAS) are more efficient operators (than the "average" farm) and actually are covering all of their costs by charging the current published custom rates. That is, it may be that these farms have a relative custom rate ratio of less than or equal to 1.0. Other possible reasons why custom rates tend to be less than the total cost to own and operate the machinery are related to less control of the quality of work (planter or harvesting settings that directly affect quality or yield of the crop) and management of the activities performed. Custom hire activities must be managed, as to say, someone must determine when to perform the operation and how to set the machinery for those operations (depth of planting, tillage, etc.). If the individual hiring the operation makes these decisions, then less labor and management is provided by the custom operator. That is, the actual machinery costs calculated for Figure 1 might incorporate more labor and management than that provided by custom operators. Finally, in some instances, a producer might not charge friends, family, and neighbors the full cost to perform an operation to avoid upsetting friends or family.

Another reason why custom rates may be lower than actual farm machinery costs is because businesses specializing in custom operations (e.g., custom harvesters) likely have lower costs on a per unit basis. This is because they use the equipment – often specialized for a specific operation – more intensively (i.e., cover more acres per year) than most farmers, thus reducing the fixed costs per acre. Additionally, custom operators may be able to purchase machinery at a lower cost than most farmers due to volume discounts (i.e., a custom harvester purchasing multiple combines on a regular basis can likely negotiate a better purchase price than a farmer that purchases only one combine every several years).

In determining custom hire rates, one must consider the technology and maintenance of the machinery being used. Does the machinery perform the operations in a desirable manner, that is, does the planter plant an even stand at the desired population; does the combine separate the crop adequately without excess damage; does the sprayer have plugged nozzles; are skips left in the field; etc.? Although this does not necessarily explain why rates are lower than the true cost of ownership and operation, these factors affect costs and therefore should be considered when determining custom rates.

Based on total ownership and operating costs, what should custom rates be?

The first step in determining appropriate custom charges from total ownership (fixed) and operating (variable) costs is to define actual whole-farm crop machinery cost. Actual whole-farm crop machinery cost is defined as the crop share of Equation 1.

Equation 1

  Machinery repairs
\+ Gas, fuel, oil
\+ Farm automobile (pickup) expense
\+ Machinery and equipment depreciation
\+ Machine (custom) hire
\+ Machinery insurance
\+ Machinery shelter
\+ Opportunity interest on crop machinery investment
\+ Crop machinery labor
= Actual whole-farm crop machinery cost.

The crop share of each of these expenses should be included in these calculations (as compared to the total machinery costs which might include livestock-related machinery costs). That is, if a farm has livestock enterprises, or uses farm machinery for personal use (e.g., pickups, cars), only the crop share (portion) of the total expense should be included in the actual whole-farm crop machinery cost. Many farms do not keep detailed records of the amount each asset is used in each enterprise, but a subjective decision (by the producer) of how to prorate the costs among crop and livestock enterprises, as well as between business and personal use, is often adequate.

The following is a brief discussion of each of the costs. Machinery repairs consist of the expenses for replacement parts due to age, wear, or accident. Gas, fuel and oil expenses are simply the fuel and lubrication expenditures prorated to crop enterprises. Farm automobile (pickup) expenses are all of the pickup, car and other light vehicle expenses allocated to crop production. This should include all depreciation, taxes, gas, fuel, oil, insurance, and repairs on these vehicles that have not been included in other categories. Machinery and equipment depreciation is the market (as compared to tax) depreciation of all farm machinery. Market depreciation can be determined by looking through local classified ads, area auction results, or various Web site classified ads (e.g., Case IH, John Deere, New Holland). Mathematical depreciation formulas are also available to estimate market depreciation (Kastens; Williams and Kastens).

Machine (custom) hire expenses include what is paid to others to have machinery operations performed. Machinery insurance and shelter costs are the cost to insure and store machinery, respectively. Opportunity interest on the crop machinery investment is the revenue foregone had the capital invested in the crop machinery been invested in the next best investment. This is usually calculated as a percentage of the machinery (market) value. Currently, the Kansas Farm Management Association uses an opportunity cost charge of 8 percent of the machinery investment per year (Langemeier). Crop machinery labor cost includes only crop machinery labor (time dedicated to machinery operation, maintenance, repairs, and management), as compared to total crop labor cost that would also include time spent managing the crop enterprises (i.e., marketing, crop scouting, complying with government programs, etc.). For irrigated farms with newer machinery, this percentage would be expected to be lower than a dryland farm with older machinery. For more details on each of the costs or how to estimate these costs see *Farm Machinery Operation Cost Calculations,* MF-2244 (Kastens), or *Lease, Custom Hire, Rent or Purchase Farm Machinery: Evaluating the Options* (Williams and Kastens).

Actual whole-farm crop machinery costs (i.e., those shown in Equation 1) along with reported acres of various field operations for 182 farms participating in the KFMA were used to estimate the per-acre costs of owning and operating machinery for the different field operations. In addition to the specific field operations performed, the estimation procedure included a "scale factor" to account for farm size. This was done to capture the economies of size effect, if indeed it is present in the observed data. For more details of the data, methods, and estimation procedure, see *Per*

Table 1. *Estimated Rates and Published Rates.*[a]

Operation	Unit	Estimated Coefficients	Published Rates
Field cultivate without fertilizer	$/acre	5.55	5.92
Sweep/undercut without fertilizer	$/acre	5.39	5.38
Disk	$/acre	6.33	6.48
Chisel less than 12 inches deep	$/acre	7.88	7.79
Chisel greater than 12 inches deep	$/acre	9.42	9.54
Disk-chisel/disk deep-chisel	$/acre	9.27	9.54 [c]
Moldboard plow	$/acre	8.96	8.98
Row crop cultivate	$/acre	6.40	6.25
Drill/air-seed no-till without fertilizer	$/acre	10.03	9.89 [b]
Drill/air-seed conventional till without fertilizer	$/acre	5.88	6.49 [b]
Plant no-till without fertilizer	$/acre	9.79	10.02 [b]
Plant conventional till without fertilizer	$/acre	8.11	8.03 [b]
Spray chemical	$/acre	3.63	3.75
Spray fertilizer	$/acre	3.73	3.75 [c]
Spray chemical and fertilizer	$/acre	3.74	3.75 [c]
Anhydrous ammonia application	$/acre	5.50	5.61
Broadcast dry fertilizer	$/acre	3.41	3.53
Inject liquid fertilizer	$/acre	3.51	3.57
Harvest wheat	$/acre	13.64	13.77
Wheat yield above 20 bu/ac (bushels)	$/bushel	0.130	0.131
Harvest corn	$/acre	20.08	19.43
Corn yield above 48 bu/ac (bushels)	$/bushel	0.126	0.119
Harvest grain sorghum	$/acre	14.14	14.58
Grain sorghum yield above 35 bu/ac (bushels)	$/bushel	0.128	0.129
Harvest soybeans	$/acre	18.99	19.48
Soybean yield above 24 bu/ac (bushels)	$/bushel	0.127	0.127
Harvest sunflowers	$/acre	17.99	17.93
Swath	$/acre	8.36	8.20
Rake hay	$/acre	2.93	2.88
Round bales less than 1,500 lbs	$/bale	7.36	7.46 [b]
Round bales greater than 1,500 lbs	$/bale	7.99	8.15 [b]
Large square bales	$/bale	12.08	11.70
Small square bales	$/bale	0.533	0.535 [b]
Chop silage (no hauling or ensiling)	$/ton	3.07	3.09
Rotary mow	$/acre	7.83	7.90
Miles on farm pickups	$/mile	0.336	0.345 [c]
Miles on grain/hay trucks	$/mile	1.80	2.07 [c]
Fertilizer adjustment percentage	percent	1.124	1.134 [c]
Field cultivate with fertilizer	$/acre	6.24	6.72 [c]
Sweep/undercut with fertilizer	$/acre	6.06	6.10 [c]
Drill/air-seed no-till with fertilizer	$/acre	11.28	11.22 [c]
Drill/air-seed conventional till with fertilizer	$/acre	6.61	7.36 [c]
Plant no-till with fertilizer	$/acre	11.00	11.37 [c]
Plant conventional till with fertilizer	$/acre	9.11	9.11 [c]
Scale Factor[d]			
Constant		1.241	
1 ÷ harvested acres		33.026	

[a] *Estimated Rates = Estimated coefficient multiplied by the scale factor*

[b] *Indicates published custom rates had to be combined to arrive at these rates*

[c] *Indicates an estimated rate (based on related cost information)*

[d] *Scale Factor = 1.241 + 33.026 × (1 ÷ harvested acres)*

Unit Costs To Own and Operate Farm Machinery on Kansas Farms (Beaton).

The "Estimated Coefficients" reported in Table 1, along with the scale factor adjustment, represent the custom rates estimated to cover total ownership and operating costs. The operation column lists each operation, and the unit column identifies the units for each rate. The "Estimated Coefficients" column identifies the rates that cover total ownership and operating costs when adjusted by the scale factor. That is, the "Actual Rates" are the "Estimated Coefficients" multiplied by the "Scale Factor." The "Published Rate" column includes the 2001 published custom rates (KAS).

For clarification purposes, the four operations reported in Table 1 dealing with wheat, corn, grain sorghum, and soybean harvesting account for the extra harvesting charges associated with high yields. When making calculations (as defined in this paper), the total number of bushels (for the whole farm) that each of the crops exceeds the base yield must be included. If these production numbers are difficult to identify, \$3.47, \$7.88, \$4.77, and \$1.41 may be added to the per-acre cost to harvest wheat, corn, grain sorghum, and soybeans, respectively. These additional charges are based on the average additional per-acre cost for farms in the underlying research, due to high yields for the respective crops.[1]

Application of these results

Two methods are available to estimate a farm's expected per-unit machinery costs. The methods available require different amounts of time, effort, and information, with an inverse relationship to the specificity of the results to an individual operation (i.e., the more time spent finding farm-specific information, the more accurate the results will be).

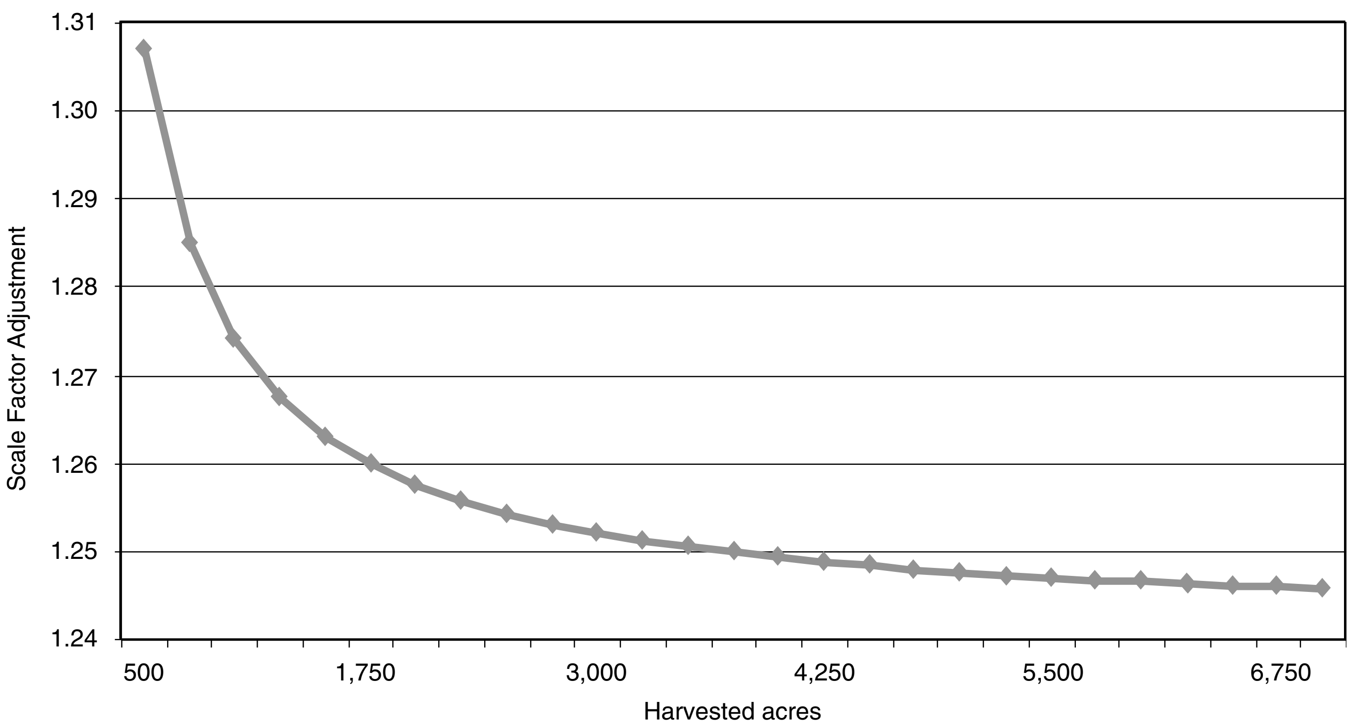
The first option would be to multiply the "Estimated Coefficient" for the operation of interest and the "Scale Factor" adjustment for the farm, taking into account the number of harvested acres of the farm. The "Scale Factor" adjustment takes into account the understatement of published custom rates relative to farm-level costs as well as the differences in farm size, and is calculated as follows:

$$\text{Scale Factor} = 1.241 + 33.026 \times (1 \div \text{harvested acres}),$$

where harvested acres is the number of acres the farm harvested during the year. This results in the expected per unit cost for that farm to perform the desired operation. However, this method does not take into account farm-specific cost information and is therefore not unique to an individual farm operation. Figure 2 plots the scale factor at various farm sizes (measured in harvested acres). Due to the mathematical form of the

[1] *In the KSU-MachCost.xls spreadsheet this generalization can be captured automatically by entering a negative one (-1) as the bushels for each of the respective crops.*

Figure 2. *Estimated Scale Factor Adjustment versus Harvested Acres.*



scale factor, as harvested acres increases, the scale factor will approach 1.241 asymptotically (i.e., the scale factor will approach 1.241, but never equal 1.241).

Consider the following example of how the scale factor is used to adjust the estimated rate for a specific field operation. A farm with 1,000 harvested acres wants to know its expected per-acre cost to disk. This farm's scale factor would be 1.274 (1.274 = 1.241 + 33.026 × (1 ÷ 1,000 harvested acres)), which is then multiplied by the Estimated Coefficient to disk ($6.33/ac), resulting in $8.06 per acre (1.274 × $6.33/ac). Thus, for a farm harvesting 1,000 acres, the estimated rates need to be adjusted up by 27.4 percent to arrive at an expected cost per unit (acre, ton, bale, mile) that covers total costs.

It is important to note that the "Scale Factor" reported in Table 1 should be used to adjust the "Estimated Coefficients" and not the "Published Rates," as they are not identical. On average, across all operations, the "Estimated Coefficients" were 1.4 percent lower than the "Published Rates." Therefore, if custom rates are used to estimate total machinery costs, as opposed to the estimated coefficients in Table 1, the 27.4 percent increase in the preceding example would be approximately 25.6 percent [1.274 × (1.0 – 0.014) – 1.0].

The second option to estimate costs can be used if a farm-specific operation cost is desired. It takes into account farm-specific information about the number of units of each operation performed during a time period (e.g., one year), and the aggregate crop machinery costs during the same time period. The following seven-step process outlines the procedure.

1. Calculate expected per unit machinery costs.
2. Calculate expected crop machinery costs for each field operation.
3. Calculate expected whole-farm crop machinery costs.
4. Calculate the field operation percentages.
5. Find actual whole-farm crop machinery costs.
6. Prorate actual whole-farm crop machinery costs to various field operations using the field operation percentages.
7. Calculate actual per unit machinery costs.

Step one, calculating expected per unit machinery costs, is the same as described in the first option of estimating per unit machinery costs. This provides the producer with the expected cost per unit to perform a specific operation.

Step two, calculate the expected crop machinery costs for each field operation by taking the product of the expected per unit machinery costs, step one, and the number of units (acres, tons, bales, miles) on which that operation was performed. This represents the expected cost for the farm to perform the operation of interest over the number of units that operation was performed.

Step three, calculate the expected whole-farm crop machinery costs by taking the sum of the expected machinery costs for each operation (step two) across all operations. This represents the farm's total expected crop machinery cost, based on farm size, as well as the type and number of operations performed.

Step four, calculating the field operation percentages is the division of the expected crop machinery cost per operation (step two) by the expected whole-farm crop machinery costs for the farm (step three), to determine the percentage of estimated costs each individual operation makes up of the total costs.

Step five, finding actual whole-farm crop machinery costs, is where the individual farm's management abilities and cost characteristics are taken into account. In this step, the farm would sum together the crop portion of market depreciation, farm automobile expense, opportunity charge on the machinery investment, machinery insurance, machinery shelter, repairs, fuel, lubrication, labor, machinery rent, and machinery leasing as well as custom farming performed for the farm (i.e., the farm-specific costs outlined in Equation 1). All of these costs are relatively easy to determine if a moderate amount of effort is put into farm financial tracking or record keeping for tax purposes. See pages 2 and 3 (Based on total ownership and operating costs, what should custom rates be?) for aid in calculating actual whole-farm crop machinery costs.

Step six, prorate actual whole-farm crop machinery costs to various field operations by multiplying the field operation percentages (step four) times the actual whole-farm crop machinery costs (step five). This represents the farm's prorated actual cost to perform the respective operation, as compared to the expected cost to perform the operation, as found in step two.

Step seven, calculate actual per unit machinery costs by dividing the prorated actual field operation costs (step six) by the number of units that particular operation was performed over. This is the farm-specific cost to perform that particular field operation on a per-unit basis. Because it includes the farm's own machinery costs it is not based on averages or assumptions that do not reflect the farm's individual management.

To further illustrate how option two would be calculated, consider the following example farm (Table 2). This table is divided into various parts and columns (denoted by capital letters) to display how to proceed through the steps. Part A, Part B, Part C, Column D, Column E, Column F, and Part K of this table are the "Estimated Coefficients" and other relevant cost and operation data needed to perform the necessary calculations. Part A of the table identifies the scale factor coefficients. Part B is the harvested acres of the example farm. This is used to calculate the farm-specific scale factor in Part C. Column D contains the labels for the operations the farm performed and appropriate units for each operation. In Column E, the Estimated Coefficients are displayed (values taken directly from Table 1). Column F shows the units of each operation for the example farm (in acres, bushels, tons, bales, miles) performed.

Column G represents step one of the seven-step process — the product of the scale factor (Part C) and the estimated coefficients (Column E). Column H represents step 2 and is the product of the units of the operation performed (Column F) and the expected per unit cost (Column G). Part I (the sum of Column H) is step three of the seven-step process, and is the expected whole-farm crop machinery cost. Column J is the percent each type of operation makes up of the expected whole-farm machinery costs (Column H divided by Part I). Part K (step five) is the actual whole-farm crop machinery cost for the farm. This is the step where the farm's individual management and costs enter into the calculations. Column L (step six) is the product of the actual whole-farm crop machinery costs (Part K) and the percent each type of operation makes up of the whole-farm crop machinery costs (Column J). Column M (step seven) is the final calculation of this process. This step divides the prorated actual crop machinery costs for each field operation (Column L) by the units over which the operations were performed (Column F) to arrive at a farm-specific actual cost of each operation.

Benchmarking machinery operations

For a farm to determine its relative standing to other farms with respect to machinery ownership and operating costs, it needs to benchmark its machinery costs. Benchmarking simply refers to comparing the costs for an individual farm with the average of other similar farms (i.e., compare actual costs to expected costs). To do this, the farm would calculate its relative crop machinery cost coefficient. If this relative crop machinery cost coefficient is one, then the farm can perform the operations at the average cost of other producers. If it is greater than one, the farm has relatively high machinery costs, and if it is lower than one, the farm has relatively low machinery costs.

In practice, the farm can benchmark its costs at the whole-farm level by comparing Part K to Part I or operation-specific costs by comparing Column M to Column G. The relative crop machinery cost coefficient for the example farm (Part N in Table 2) was calculated to be 0.954, indicating that this farm has machinery costs equal to 95.4 percent of what is expected of typical producers of the same size performing the same type of operations. The relative crop machinery cost coefficient, which compares farm-specific costs to average costs of other farms, should not be compared to the relative custom rate ratio shown in Figure 1, which compares to average custom rates, as the two ratios compare costs against different standards.

Although benchmarking machinery is important, one must remember that having the lowest whole-farm machinery cost is not necessarily the best management objective. If whole-farm machinery cost is minimized, losses in production may result from non-uniform fertilizer application, uneven plant stands, harvesting losses, or untimely field operations, just to name a few. Rather, the lowest cost per unit of production (bushel, ton, etc.) is more desirable in that it takes into account the effect machinery has on yields, but analyzing this is outside the scope of this publication. However, benchmarking whole-farm or per acre machinery costs can still be valuable to give the farm an idea of what it should aim for with regard to machinery costs.

These calculations may be performed manually in the worksheet provided at the end of this publication or performed automatically with the spreadsheet KSU-MachCost.xls located at *www.agmanager.info.*

Conclusions

This research found that, on average, custom rates for a Kansas farm harvesting 1,000 acres are 20.4 percent lower than the true cost to own and operate machinery. Therefore, "total" custom rates (i.e., ones that include total ownership and operating costs) were estimated. These estimated rates may be used to prorate a farm's actual machinery costs to different field operations to find a farm-specific custom rate. A farm's machinery costs can then be used to benchmark the farm's actual costs against its expected costs, allowing a farm manager to see the farm's strengths or weaknesses with regards to total machinery costs.

Even though this research found that custom rates need to be increased by 25.6 percent, on average, to cover all ownership and operating costs, the market place will still determine what is charged and paid for custom machinery services. As previously

Table 2. *Estimating Farm-Specific per Unit Machinery Costs.*

A. Scale Factor Coefficients	
Constant	1.241
1 ÷ harvested acres	33.026
Scale Factor = 1.241 + 33.026 × (1 ÷ harvested acres)	
B. Harvested Acres	1,218
C. Scale Factor	1.268
I. Step 3 – Expected whole-farm machinery costs (Sum of Column H)	$133,670
K. Step 5 – Actual whole-farm machinery costs (Calculated from farm records)	$127,563
N. Relative Crop Machinery Cost Coefficient (K ÷ I)	0.954

D **Operations**	**E** **Estimated Coefficients**	**F** **Units**	**G** **Step 1[a]** **(C×E)**	**H** **Step 2[b]** **(F×G)**	**J** **Step 4[c]** **(H÷I)**	**L** **Step 6[d]** **(J×K)**	**M** **Step 7[e]** **(L÷F)**
Field cultivate without fertilizer (acres)	$5.55	1,254	$7.04	$8,825.70	6.60%	$8,422.48	$6.72
Disk (acres)	$6.33	3,263	$8.03	$26,192.65	19.60%	$24,995.98	$7.66
Chisel less than 12 inches deep (acres)	$7.88	962	$9.99	$9,613.02	7.19%	$9,173.83	$9.54
Drill/air-seed conventional till without fertilizer (acres)	$5.88	1,005	$7.46	$7,493.80	5.61%	$7,151.43	$7.12
Plant conventional till without fertilizer (acres)	$8.11	563	$10.28	$5,790.12	4.33%	$5,525.59	$9.81
Spray chemical (acres)	$3.63	1,625	$4.60	$7,480.29	5.60%	$7,138.54	$4.39
Spray chemical and fertilizer (acres)	$3.74	563	$4.74	$2,670.17	2.00%	$2,548.18	$4.53
Broadcast dry fertilizer (acres)	$3.41	1,440	$4.32	$6,226.95	4.66%	$5,942.46	$4.13
Harvest wheat (acres)	$13.64	1,007	$17.30	$17,418.17	13.03%	$16,622.38	$16.51
Wheat yield above 20 bu/ac (bushels)	$0.130	25,842	$0.16	$4,260.18	3.19%	$4,065.55	$0.16
Harvest grain sorghum (acres)	$14.14	113	$17.93	$2,026.22	1.52%	$1,933.65	$17.11
Grain sorghum yield above 35 bu/ac (bushels)	$0.128	8,438	$0.16	$1,369.65	1.02%	$1,307.07	$0.15
Harvest soybeans (acres)	$18.99	450	$24.08	$10,836.68	8.11%	$10,341.58	$22.98
Soybean yield above 24 bu/ac (bushels)	$0.127	1,521	$0.16	$244.96	0.18%	$233.77	$0.15
Swath (acres)	$8.36	376	$10.60	$3,986.14	2.98%	$3,804.03	$10.12
Round bales greater than 1,500 lbs (bales)	$7.99	525	$10.13	$5,319.43	3.98%	$5,076.40	$9.67
Small square bales (bales)	$0.533	1,222	$0.67	$821.31	0.61%	$783.78	$0.64
Miles on farm pickups (miles)	$0.336	16,000	$0.43	$6,817.39	5.10%	$6,505.92	$0.41
Miles on grain/hay trucks (miles)	$1.80	2,750	$2.28	$6,277.17	4.70%	$5,990.38	$2.18

[a] *Expected per unit machinery cost*

[b] *Expected crop machinery cost for each operation*

[c] *Field operation percentages*

[d] *Prorated actual whole-farm machinery costs to each operation*

[e] *Actual per unit machinery cost*

mentioned, there are rational economic reasons that producers choose to perform operations for less than their true cost to own and operate that machinery, or why producers hiring these services do not pay the full cost. However, if a farm is going to perform custom operations as an enterprise, it should consider the long term consequences of not covering all ownership and operating costs.

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Worksheet for estimating farm machinery costs

A. Scale Factor Coefficients	
Constant	1.241
1 ÷ harvested acres	33.026
B. Harvested Acres	
C. Scale Factor = 1.241 + 33.026 × (1 ÷ harvested acres)	
I. Step 3 – Expected whole-farm crop machinery costs (Sum of Column H)	
K. Step 5 – Actual whole-farm crop machinery costs	
N. Relative crop machinery cost coefficient (K ÷ I)	

Worksheet for estimating farm machinery costs (continued)

D Operations (required units)	E Estimated Coefficients	F Units	G Step 1 (C × E)	H Step 2 (F × G)	J Step 4 (H ÷ I)	L Step 6 (J × K)	M Step 7 (L ÷ F)
Field cultivate without fertilizer (acres)	$5.55						
Field cultivate with fertilizer (acres)	$6.24						
Sweep/undercut without fertilizer (acres)	$5.39						
Sweep/undercut with fertilizer (acres)	$6.06						
Disk (acres)	$6.33						
Chisel less than 12 inches deep (acres)	$7.88						
Chisel greater than 12 inches deep (acres)	$9.42						
Disk-chisel/disk deep-chisel (acres)	$9.27						
Moldboard plow (acres)	$8.96						
Row crop cultivate (acres)	$6.30						
Drill/air-seed no-till without fertilizer (acres)	$10.03						
Drill/air-seed no-till with fertilizer (acres)	$11.28						
Drill/air-seed conventional till without fertilizer (acres)	$5.88						
Drill/air-seed conventional till with fertilizer (acres)	$6.61						
Plant no-till without fertilizer (acres)	$9.79						
Plant no-till with fertilizer (acres)	$11.00						
Plant conventional till without fertilizer (acres)	$8.11						
Plant conventional till with fertilizer (acres)	$9.11						
Spray chemical (acres)	$3.63						
Spray fertilizer (acres)	$3.73						
Spray chemical and fertilizer (acres)	$3.74						
Anhydrous ammonia application (acres)	$5.50						
Broadcast dry fertilizer (acres)	$3.41						
Inject liquid fertilizer (acres)	$3.51						
Harvest wheat (acres)	$13.64						
Wheat yield above 20 bu/ac (bushels)	$0.130						
Harvest corn (acres)	$20.08						
Corn yield above 48 bu/ac (bushels)	$0.126						
Harvest grain sorghum (acres)	$14.14						
Grain sorghum yield above 35 bu/ac (bushels)	$0.128						
Harvest soybeans (acres)	$18.99						
Soybean yield above 24 bu/ac (bushels)	$0.127						
Harvest sunflowers (acres)	$17.99						
Swath (acres)	$8.36						
Rake hay (acres)	$2.93						
Round bales less than 1,500 lbs (bales)	$7.36						
Round bales greater than 1,500 lbs (bales)	$7.99						
Large square bales (bales)	$12.08						
Small square bales (bales)	$0.533						
Chop silage (no hauling or ensiling) tons	$3.07						
Rotary mow (acres)	$7.83						
Miles on farm pickups (miles)	$0.336						
Miles on grain/hay trucks (miles)	$1.80						

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Helpful comments of Martin Albright are greatly appreciated.

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