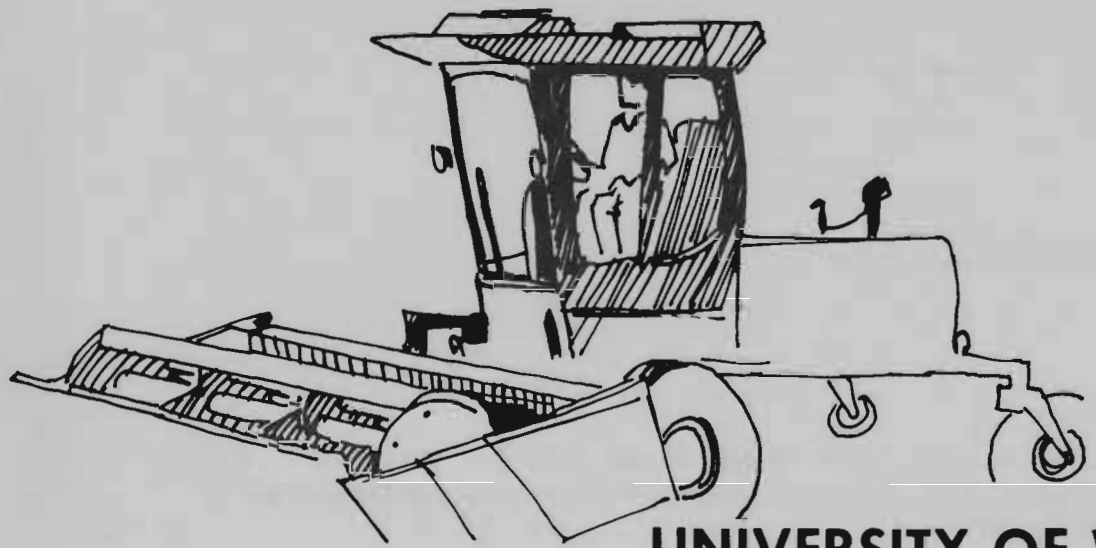
HARVESTING AND FEEDING HAY
A GUIDE FOR ESTIMATING LABOR REQUIREMENTS AND COSTS



Summary
see P. 21

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Harvesting and Feeding Hay
A Guide for Estimating Labor Requirements and Costs

by D. E. Agee[1/]

Introduction

Farmers and ranchers in Wyoming use various methods for harvesting and feeding hay. They have different reasons for choosing particular methods. Some of these are: personal preference, winter weather conditions, because the method is common to the area, availability of labor, availability of capital, costs, and perhaps other reasons. In some cases, the harvesting and feeding method used is influenced by the location of the hay meadows in relation to the feeding area. For example, if hay must be transported a long distance, it will generally be baled or otherwise "packaged" to facilitate hauling. When hay is fed near where produced, the "packaging process" may not be necessary.

Objective

The objective of this guide is to outline a step-by-step procedure that ranchers or farmers might follow in evaluating various hay harvesting and feeding methods. This procedure considers labor and machinery requirements and costs for the various methods.

Farmers and ranchers using this analysis procedure should be cautioned to use labor and machine data for their own operations. Labor and machinery data used in the following examples are mostly estimates based on a limited number of observations.

Case Situation

To evaluate costs and physical requirements for various hay harvest and feeding methods, the manager should first outline conditions for the specific hay enterprise and harvest-feeding options to be evaluated.

[1/] Extension Farm Management Specialist and Assistant Professor, Division of Agricultural Economics, University of Wyoming, May 1975.

Step 1. Basic assumptions for the hay enterprise and harvest-feeding methods to be analyzed.

Worksheet 1 is an example of how a manager might list enterprise and harvest-feeding assumptions. A brief description of the hay enterprise is listed at the top of the worksheet, i.e., 400 acres of alfalfa-grass hay, to be cut one time, average yield 1.5 tons/acre or 600 tons total production. Harvest-feeding conditions are also stated, i.e., the hay is to be stacked on or near the meadows where grown and is to be fed on the same meadows at a rate of about 3 tons/day.

The assumptions for the harvest-feeding methods are then listed in the appropriate columns. This example shows assumptions for 5 different methods. The information should include: the operations to be performed with the type and size of machines, the approximate performance rates and the number of men required. The example shows that the hay is swathed with a 12 ft., self-propelled swather at an estimated performance rate of 4 acres/hour, requiring one man. Requirements for other harvest operations are listed similarly.

The assumptions for feeding the hay are also listed in the appropriate columns. Note that machine and man hours required to feed 3 tons of hay are listed.

Worksheet 1. Basic assumptions for the hay enterprise and 5 harvest-feeding methods. (The hay enterprise: 400 acres of alfalfa-grass hay, cut one time, yield 1.5 tons/acre or 600 tons; hay to be stacked on or near the meadows where grown; to be fed on the meadows at a rate of 3 tons/day)

Method 1	Method 2	Method 3	Method 4	Method 5
Harvest: Swath: 12 ft, SP, 4 acres/hr, 1 man Stack: 80 hp tractor, front loader, 1 man, 2.5 tons/hr	Harvest: Swath: 12 ft, SP, 4 acres/hr, 1 man Bale: 60 hp tractor, 16x18 baler (twine), 1 man, 5 tons/hr Stack bales: 80 hp tractor, front loader, 1 man, 1 man on stack, 3 tons/hr	Harvest: Swath: 12 ft, SP, 4 acres/hr, 1 man Bale: 60 hp tractor, 16x18 baler (twine), 1 man, 5 tons/hr Stack bales: 80 hp tractor, 3 ton bale wagon, 1 man, 5 tons/hr	Harvest: Swath: 12 ft, SP, 4 acres/hr, 1 man Bale, large round bales: 60 hp tractor, large baler, 1 man, 6 tons/hr Stack large bales: 80 hp tractor, front loader, 1 man, 6 tons/hr	Harvest: Swath: 12 ft, SP, 4acres/hr, 1 man Stack: 80 hp tractor, 3 ton stackwagon, 1 man, 4 tons/hr
Feed: Load on wagon with 80 hp tr. and front loader, pitch off by hand	Feed: Load bales on wagon by hand, pitch off by hand	Feed: Load bales on wagon by hand, pitch off by hand	Feed: Load bales on wagon with 80 hp tractor and front loader, pitch off by hand	Feed: 80 hp tractor, stackmover-feeder, 1 man
To feed 3 tons: Tractor loader, 1 hr, wagon, 1 hr, labor, 2 men, 1 hr each	To feed 3 tons: 60 hp tractor, 1 hr, wagon, 1 hr, labor, 2 men, 1.5 hrs each	To feed 3 tons: 60 hp tractor, 1 hr, wagon, 1 hr labor, 2 men, 1.5 hrs each	To feed 3 tons: 80 hp tractor, 1.5 hrs front loader, .5 hr wagon, 1.5 hrs, labor, 2 men, 1.5 hrs each	To feed 3 tons: 80 hp tractor, 1 hr, stackmover feeder, 1 hr, labor, 1 man, 1 hr

Machinery Costs

One of the more difficult steps in developing costs of harvesting and feeding hay is that of estimating costs for owning and operating equipment. Where can farmers and ranchers get this type of information? Machinery investment and cost data can be obtained from dealers, from personal experiences, from neighbors, and from printed materials provided by the Extension Service and Experiment Stations. The person doing the analysis must be objective and rely on his best judgment and experience in developing the performance rates and machinery costs.

The task of developing machinery costs can be made easier by using "Worksheets for Estimating Ownership and Operating Costs for Machinery and Equipment."[1/] Again, persons using this worksheet should be reminded to develop costs fitting the situation being analyzed.

Step 2. Develop costs of owning and operating machinery.

Worksheet 2 shows estimated costs of owning and operating a 60 horsepower, 2-wheel drive, diesel tractor. Information at the top of the worksheet includes: the type of machine, size, new cost, annual use, useful life, trade in value, and average value. Average value, or investment, is calculated as follows:

$$\frac{\text{Cost + salvage}}{2} = \text{average value.}$$

Ownership or fixed costs are estimated as follows:

$$\text{Depreciation} = \frac{\text{New cost minus salvage}}{\text{Useful life}}$$

Interest = average value x interest rate

Taxes = average value x .01

Insurance (if any) = average value x .006

Housing (if any) = average value x .01

Total annual ownership cost divided by units of use equals ownership cost per unit. The example for the 60 hp tractor shows ownership cost at $2.03 per hour.

Operating or variable costs are estimated next. Annual fuel cost equals fuel consumption per hour x price per gallon x hours of annual use.[2/] The cost for engine oil equals gallons used annually x price per gallon. Cost for other lubricants, including filters, transmission and hydraulic oil is estimated.

1/ This worksheet is also illustrated in Using Farm Machinery Efficiently, Univ. of Wyo., Agric. Exp. Sta., Bull. 482, Dec. 1967 by Stevens and Agee. Also, references containing a great deal of information on costs to own and operate machinery are listed on page 27.

2/ Ibid. Bulletin 482 contains guidelines for estimating fuel use, repairs, etc. Or, see Nebraska Tractor Test Data or manufacturer specifications.

Worksheet 2. Estimating ownership and operating costs for machinery and equipment.

Machine Tractor, diesel 2-wheel dr. Size 60hp; New cost $8500; Annual use 500 (hours) acres miles, tons

Useful life 15 yrs.; Trade in value $1,700; Average value $ 5,100 (new cost plus trade in ÷ 2)

Interest rate 9 percent

OWNERSHIP OR FIXED COSTS:

1. DEPRECIATION: $8,500 (new cost) minus 1700 (trade in) ÷ 15 (useful life) $ 453
2. INTEREST: $ 5,100 (ave. value) X .09 (int. rate) 459
3. TAXES: $ 5,100 (ave. value) X .01 (1%) 51
4. INSURANCE: $ ~~5,100~~ (ave. value) X .006 —
5. HOUSING (if any): $ 5,100 (ave. value) X .01 (1%) 51
6. TOTAL ANNUAL OWNERSHIP COST..... $ 1,014
7. OWNERSHIP COST PER UNIT: (hour) acre, mile, ton..... $ 2.03
   (line 6 ÷ annual use)

OPERATING OR VARIABLE COSTS:

8. FUEL: 3.4 gal. per hr. X $.35 per gal. X 500 hrs. $ 595
9. ENGINE OIL: 10 gal. per yr. X $ 3.00 per gal. 30
   (use .0250 to .0625 gal. per hour)
10. OTHER LUBRICANTS: (estimated) 15
11. REPAIRS: $_____ (new cost) X _____ (fixed rate) (or estimated) 350
12. SERVICE LABOR: _____ (annual use) X .03 X $_____ (labor rate/hr.) 50 hrs @ $3 150
13. TOTAL ANNUAL OPERATING COSTS..... $ 1,140
14. OPERATING COSTS PER UNIT: (hour) acre, mile, ton..... $ 2.28
    (line 13 ÷ annual use)
15. TOTAL ANNUAL OWNERSHIP AND OPERATING COSTS..... $ 2,154
    (line 6 plus 13)
16. TOTAL ANNUAL OWNERSHIP AND OPERATING COSTS PER UNIT: (hour) acre mile, ton.... $ 4.31
    (line 7 plus 14)

Estimated repair cost for the total life of the machine is divided by years of use to get annual repair cost.[1/] Service cost equals service time per day x days of use plus extra time for installing repair parts x the labor rate/hour. Total annual operating cost divided by annual use gives operating cost per unit of use. The example for the 60 hp tractor shows operating cost at $2.28 per hour.

Worksheet 3 shows estimated costs of owning and operating a power-take-off driven, twine tie, hay baler. Here, ownership costs are estimated at $10.78/hour and operating costs (excluding twine) at $3.13/hour.

Similar worksheets should be developed for all machines necessary for the 5 harvest-feeding options to be evaluated. Worksheet data for all machines required for this example are summarized in Appendix Worksheets I, II and III (pages 24, 25, and 26).

The basic data developed and explained up to this point can now be summarized for meaningful analysis and comparisons.

[1/] Ibid.

Worksheet 3. Estimating ownership and operating costs for machinery and equipment

Machine Baler, PTO Size 16X18; New cost $ 6,140; Annual use 120 (hours) acres miles, tons

Useful life 6 yrs.; Trade in value $ 614; Average value $ 3,377 (new cost plus trade in ÷ 2)

Interest rate 9 percent

OWNERSHIP OR FIXED COSTS:

1. DEPRECIATION: $ 6,140 (new cost) minus 614 (trade in) ÷ 6 (useful life) $ 921
2. INTEREST: $ 3,377 (ave. value) X .09 (int. rate) 304
3. TAXES: $ 3,377 (ave. value) X .01 (1%) 34
4. INSURANCE: $ _____ (ave. value) X .006 (.6%) —
5. HOUSING (if any): $ 3,377 (ave. value) X .01 (1%) 34
6. TOTAL ANNUAL OWNERSHIP COST ..... $ 1,293
7. OWNERSHIP COST PER UNIT: (hour) acre, mile, ton ..... $ 10.78
   (line 6 ÷ annual use)

OPERATING OR VARIABLE COSTS:

8. FUEL: ____ gal. per hr. X $_____ per gal. X _____ hrs. $ —
9. ENGINE OIL: _____ gal. per yr. X $_____ per gal. —
   (use .0250 to .0625 gal. per hour)
10. OTHER LUBRICANTS: $_____ (new cost) X (annual charge) 15
11. REPAIRS: $_____ (new cost) X _____ (fixed rate) (or (estimated)) 307
12. SERVICE LABOR: _____ (annual use) X .03 X $_____ (labor rate/hr) 12X1+6X$3 = 54
13. TOTAL ANNUAL OPERATING COSTS ..... $ 376
14. OPERATING COSTS PER UNIT: (hour) acre, mile, ton ..... $ 3.13 (excludes twine)
    (line 13 ÷ annual use)
15. TOTAL ANNUAL OWNERSHIP AND OPERATING COSTS ..... $ 1,669
    (line 6 plus 13)
16. TOTAL ANNUAL OWNERSHIP AND OPERATING COSTS PER UNIT: (hour) acre, mile, ton ... $ 13.91
    (line 7 plus 14)

Machinery Investment Requirements

One of the first questions ranchers or farmers might ask concerning haying methods is, "How much will I have to invest to obtain the necessary machinery complement for each harvest-feeding method?" Investment data from the cost worksheets for each individual machine can be summarized to answer this question.

Step 3. Summarize machinery investment requirements.

Worksheet 4 shows a summary of investment requirements for the 5 harvest-feeding methods. Note that the two tractors are included for all methods. It is assumed that the two tractors would be on the farm or ranch irregardless of the haying method selected.

The investment requirement for the two tractors ($8,500 and $14,000) could be subtracted from the totals shown to get the investment needed in addition to tractors. This comparison shows the farmer or rancher that method 1 requires the lowest investment and method 5 requires the greatest investment. Farmers or ranchers might next ask, "How many man and machine days would be required to harvest and feed 600 tons of hay using the various methods?"

Worksheet 4. Machinery investment requirements, 5 methods of harvesting and feeding hay.

	Investment for method 1/					Estimates for your operation				
	1	2	3	4	5	1	2	3	4	5
60 hp tractor	$ 8,500	$ 8,500	$ 8,500	$ 8,500	$ 8,500					
80 hp tractor	14,000	14,000	14,000	14,000	14,000					
Swather	15,600	15,600	15,600	15,600	15,600					
Baler, 16"x18"	---	6,140	6,140	---	---					
Baler, large round	---	---	---	6,226	---					
Front end loader	3,820	3,820		3,820	---					
Bale stacker-wagon	---	---	6,490	---	---					
Stackwagon	---	---	---	---	11,600					
Stackmover-feeder	---	---	---	---	9,384					
Hay wagon	1,000	1,000	1,000	1,000	---					
Total	$42,920	$49,060	$51,730	$49,146	$59,084					

1/ Method 1. Swath, stack loose with front loader; feed with front loader and wagon.

Method 2. Swath, bale, stack bales with front loader; feed with wagon and tractor.

Method 3. Swath, bale, stack with bale wagon; feed with wagon and tractor.

Method 4. Swath, bale large round bales, stack with front loader; feed with front loader and wagon.

Method 5. Swath, stack with 3 ton stackwagon; feed with tractor and stackmover-feeder.

Labor and Machine Requirements

Total labor and machine requirement, in hours or days, can be an important consideration in choosing between alternative machinery complements. Some producers may give considerable weight to total labor requirement while others may give less emphasis to this factor.

Step 4. Summarize labor and machine requirements.

Worksheet 5 shows operations with crew and machinery requirements for the 5 harvest-feeding methods. The swathing operation for Method 1 requires one man and the swather. The performance rate is 4 acres per hour so 100 hours of man labor and swather time are required to cut 400 acres of hay. This would be equivalent to 10 working days of 10 hours each.

The second operation shown for Method 1 is to stack hay in loose stacks using a tractor with front-loader, no one on the stack. One man is required and it is estimated that he can sweep up and stack an average of 2.5 tons/hour. At that rate it would take 240 man and tractor hours or 24 days to stack 600 tons.

The total estimated labor requirement for Method 1, swathing and stacking, is 340 hours or .56 hr/ton.

Feeding operations for Method 1 include loading hay from loose stacks onto a wagon using the 80 hp tractor and front loader. This operation requires 2 men, ½ hour each. After loading the hay, one man drives the tractor and pulls the wagon to the feeding grounds where the other man pitches it off to the cattle.

Total requirements for feeding are: front loader 1 hour, 80 hp tractor 1 hour, wagon 1 hour, and 2 man hours/3 tons of hay. Requirements for feeding 600 tons are: loader 200 hours, tractor 200 hours, wagon 200 hours, and 400 hours of labor or .67 hr/ton. The total labor required for harvest-feeding Method 1 is 740 hours or 1.23 hrs/ton.

Labor and machine requirements for other methods were summarized similarly. Again, the budgeter should be reminded to use performance rates realistic for the situation being analyzed.

The next question operators might ask is, "What is the cost/ton for the various harvest-feeding methods?

Worksheet 5. Operations, crew, performance rates, labor and machine requirements, 5 hay harvest-feeding methods.

					Estimates for your operation			
	Crew	Performance rate	Labor requirements for 400 acres or 600 tons (hours)	(10 hr days)	Crew	Performance rate	Labor requirements for ____ acres or ____ tons	
Method 1.								
Harvest:								
Swath	1	4 acres/hr	100	10.0				
Stack loose, front loader	1	2.5 tons/hr	240	24.0				
Total harvest		.56 hr/ton	340	34.0				
Feed:								
Load on wagon	2	3 tons/.5 hr	200	20.0				
Unload wagon	2	3 tons/.5 hr	200	20.0				
Total feeding		.67 hr/ton	400	40.0				
Total harvest and feed		1.23 hrs/ton	740	74.0				
Method 2.								
Harvest:								
Swath	1	4 acres/hr	100	10.0				
Bale (rectangular bales)	1	5 tons/hr	120	12.0				
Stack bales, front loader	2	3 tons/hr	400	40.0				
Total harvest		1.03 hrs/ton	620	62.0				
Feed:								
Load on wagon	2	3 tons/hr	400	40.0				
Unload wagon	2	3 tons/.5 hr	200	20.0				
Total feeding		1.0 hr/ton	600	62.0				
Total harvest and feed		2.03 hrs/ton	1,220	122.0				
Method 3.								
Harvest:								
Swath	1	4 acres/hr	100	10.0				
Bale (rectangular bales)	1	5 tons/hr	120	12.0				
Stack, 3 T. bale wagon	1	5 tons/hr	120	12.0				
Total harvest		.56 hr/ton	340	34.0				
Feed:								
Load on wagon	2	3 tons/hr	400	40.0				
Unload wagon	2	3 tons/.5 hr	200	20.0				
Total feeding		1.0 hr/ton	600	60.0				
Total harvest and feed		1.56 hr/ton	940	94.0				

Worksheet 5. (cont.)

	Crew	Performance rate	Labor requirement for 600 tons or 400 acres (hours)	(10 hr days)	Estimates for your operation: Crew	Performance rate	Labor requirement for ____tons or ____acres	
Method 4.								
Harvest:								
Swath	1	4 acres/hr	100	10.0				
Bale, large round bales	1	6 tons/hr	100	10.0				
Stack, front end loader	1	6 tons/hr	100	10.0				
Total harvest		.5 hr/ton	300	30.0				
Feed:								
Load wagon, front loader	2	3 tons/.5 hr	200	20.0				
Unload wagon	2	3 tons/1.0 hr	400	40.0				
Total feeding		1.0 hr/ton	600	60.0				
Total harvest and feed		1.5 hrs/ton	900	90.0				
Method 5.								
Harvest:								
Swath	1	4 acres/hr	100	10.0				
Stack, 3 T. stack wagon	1	4 tons/hr	150	15.0				
Total harvest		.42 hr/ton	250	25.0				
Feed:								
Stackmover-feeder	1	3 tons/hr	200	20.0				
Total feeding		.33 hr/ton	200	20.0				
Total harvest and feed		.75 hr/ton	450	45.0				
Other methods								
Harvest:								
Feed:								
Total harvest and feed								

Hay Harvest and Feeding Costs

The performance rates and hourly costs of owning and operating each machine, as developed and explained previously, can now be used in determining estimated costs for various methods of harvesting and feeding hay.

Step 5. Develop costs for hay harvest-feeding methods. Worksheet 6 shows how the performance rates and hourly costs can be organized into a useful format. The haying method to be analyzed is listed at the top of the worksheet. The worksheet has a wide column on the left for listing operations and 3 columns on the right for costs. The first operation, swath and crimp, is listed in the left column with hourly costs for the swather opposite in the right hand columns. The cost data for machinery are brought forward from Appendix Worksheets II and III (pages 25 and 26). A charge for an operator is added to swather costs to get total cost/hour for swathing. In these examples, a rate of $3/hour is used for all man labor.

Cost/acre is found by dividing cost/hour by acres cut/hour. The cost/acre divided by tons/acre gives estimated cost/ton. If yield/acre varies, cost/ton would vary also. Costs for stacking loose hay are determined similarly. Hourly costs for the 80 hp tractor and front loader are brought forward from Appendix Worksheets II and III. Add $3/hour for the operator to get total cost/hour. Cost/hour divided by tons stacked/hour gives cost/ton for stacking. Note that performance rates from 2.5 to 3.5 tons/hour are shown. This illustrates that persons using the guide should choose performance rates fitting the situation being analyzed as cost/ton will vary with the performance rate.

Costs for harvest Method 1 are summarized by adding cost/ton for swathing and cost/ton for stacking loose hay to get total harvest cost/ton.

The procedure used to determine costs for feeding hay is slightly different from that used to determine costs for harvesting. Our original assumptions indicated that 3 tons of hay would be fed/day. The procedure is as follows:

The method of feeding is listed at the top.

Next, each machine to be used is listed in the left column along with the estimated time required for feeding 3 tons of hay. Then, hours to feed 3 tons of hay X the hourly rate for machinery equals costs to feed 3 tons. Costs for feeding 3 tons are listed in the right hand columns. Note that it might take more than one hour of machine time or labor to feed 3 tons of hay. The cost to feed 3 tons, divided by 3 gives the estimated cost/ton.

The harvest-feeding summary shows harvest cost plus feeding cost giving total estimated harvest-feeding cost/ton. Costs for Methods 2, 3, 4, and 5 are determined similarly.

Worksheet 6. Estimated costs for 5 methods of harvesting and feeding hay.

Method 1. Harvest hay - Self-propelled swather, stacked loose with 80 hp tractor and front loader, no one on the stack.

Operations	Costs Fixed	Costs Operating	Costs Total	Operations	Estimates for your operation Costs Fixed	Costs Operating	Costs Total
(1) Swath and crimp:							
Swather/hr	$11.39	$ 5.40	$16.79				
Operator/hr	--	3.00	3.00				
Total cost/hr	11.39	8.40	19.79				
Cost/acre @ 4 acres/hr	2.85	2.10	4.95				
Cost/ton at:							
1.5 tons/acre/cutting	1.90	1.40	3.30				
(2) Stack loose:							
80 hp tractor/hr	3.34	3.24	6.58				
Front loader/hr	2.11	1.00	3.11				
Operator/hr	--	3.00	3.00				
Cost/hr	5.45	7.24	12.69				
Cost/ton at:							
2.5 tons/hr	2.18	2.90	5.08				
3.0 tons/hr	1.82	2.41	4.23				
3.5 tons/hr	1.56	2.07	3.63				
(3) Summary, harvest costs:	Cost/ton						
Swath @ 1.5 tons/acre/cutting	1.90	1.40	3.30				
Stack @ 2.5 tons/hr	2.18	2.90	5.08				
Total cost/ton	$4.08	$4.30	$8.38				
Feed loose hay: Load onto wagon with front end loader, pitch off by hand, 2 men.							
(4) Load and feed hay (3 tons of hay):							
80 hp tractor, 1 hr	$3.34	$3.24	$6.58				
Front loader, 1 hr	2.11	1.00	3.11				
Wagon, 1 hr	.41	.11	.52				
Labor, load and unload, 2 man hrs	--	6.00	6.00				
Cost to feed 3 tons	5.86	10.35	16.21				
Cost to feed 1 ton	1.95	3.45	5.40				
(5) Summary, harvest and feed:	Cost/ton						
Method 1, harvest	4.08	4.30	8.38				
Method 1, feed hay	1.95	3.45	5.40				
Total, harvest and feed/ton	6.03	7.75	13.78				

Worksheet 6. Continued

Method 2. Harvest hay - Self-propelled swather, 60 hp tractor with 16"x18" baler, stack bales using 80 hp tractor with front end loader.

Operations	Costs Fixed	Costs Operating	Costs Total	Operations	Estimates for your operation Costs Fixed	Costs Operating	Costs Total
(1) Swath and crimp:							
Cost/ton @ 1.5 tons/acre/cutting	$1.90	$1.40	$3.30				
(2) Bale:							
60 hp tractor, cost/hr	2.03	2.28	4.31				
16"x18" baler, cost/hr	10.78	3.13	13.91				
Operator, cost/hr	--	3.00	3.00				
Total cost/hr	12.81	8.41	21.22				
Cost/ton @ 5 tons/hr	2.56	1.68	4.24				
Add: twine @ $2.50/ton	--	2.50	2.50				
Total cost/ton	2.56	4.18	6.74				
(3) Stack bales:							
80 hp tractor/hr	3.34	3.24	6.58				
Front loader/hr	2.11	1.00	3.11				
Operator/hr	--	3.00	3.00				
Man on stack/hr	--	3.00	3.00				
Total cost/hr	5.45	10.24	15.69				
Cost/ton @ 3.0 tons/hr	1.82	3.41	5.23				
(4) Summary, harvest costs:	Cost/ton						
Swath	1.90	1.40	3.30				
Bale @ 5 tons/hr	2.56	4.18	6.74				
Stack @ 3 tons/hr	1.82	3.41	5.23				
Total cost/ton	$6.28	$8.99	$15.27				
Feed baled hay: Load bales onto wagon and scatter by hand, 2 men.							
(5) Load and feed hay (3 tons of hay)							
60 hp tractor, 1 hr	$2.03	$2.28	$4.31				
Wagon, 1 hr	.41	.11	.52				
Labor, load and feed, 3 man hrs	--	9.00	9.00				
Cost to feed 3 tons	2.44	11.39	13.83				
Cost to feed 1 ton	.81	3.80	4.61				
(6) Summary: harvest and feed:							
Method 2, harvest	6.28	8.99	15.27				
Method 2, feed	.81	3.80	4.61				
Total, harvest and feed/ton	7.09	12.79	19.88				

Worksheet 6. Continued

Method 3. Harvest hay - Self-propelled swather, 60 hp tractor with 16"x18" baler, stack bales using 80 hp tractor and 3 ton bale wagon.

Operations	Costs			Operations	Estimates for your operation Costs		
	Fixed	Operating	Total		Fixed	Operating	Total
(1) Swath:							
Cost/ton @ 1.5 tons/acre/cutting	$1.90	$1.40	$3.30				
(2) Bale:							
Baling cost/ton @ 5 tons/hr	2.56	4.18	6.74				
(3) Stack bales:							
80 hp tractor/hr	3.34	3.24	6.58				
Bale wagon/hr	10.38	2.52	12.90				
Operator/hr	--	3.00	3.00				
Total cost/hr	13.72	8.76	22.48				
Cost/ton @ 5 tons/hr	2.74	1.75	4.49				
(4) Summary, harvest costs:							
Swath	1.90	1.40	3.30				
Bale	2.56	4.18	6.74				
Stack with bale wagon	2.74	1.75	4.49				
Total cost/ton	$7.20	$7.33	$14.53				
Feed baled hay: Load onto wagon and scatter by hand, 2 men.							
(5) Load and feed (3 tons of hay)							
60 hp tractor, 1 hr	$2.03	$2.28	$4.31				
Wagon, 1 hr	.41	.11	.52				
Labor, load and feed, 3 man hours	--	9.00	9.00				
Cost to feed 3 tons	2.44	11.39	13.83				
Cost to feed 1 ton	.81	3.80	4.61				
(6) Summary, harvest and feed:							
Method 3, harvest	7.20	7.33	14.53				
Method 3, feed	.81	3.80	4.61				
Total, harvest and feed/ton	8.01	11.13	19.14				

Worksheet 6. Continued

Method 4. Harvest hay - Self-propelled swather, 60 hp tractor with large baler (5'x6' bales), stack bales with 80 hp tractor and front end loader.

Operations	Costs Fixed	Costs Operating	Costs Total	Operations	Estimates for your operation Costs Fixed	Costs Operating	Costs Total
(1) Swath:							
Cost/ton @ 1.5 tons/acre/cutting	$1.90	$1.40	$3.30				
(2) Bale:							
60 hp tractor/hr	2.30	2.28	4.31				
Large baler/hr	13.77	3.95	17.72				
Operator/hr	--	3.00	3.00				
Total cost/hr	15.80	9.23	25.03				
Cost/ton @ 6 tons/hr (10 bales/hr)	2.63	1.54	4.17				
Add cost for twine/ton	--	.75	.75				
Cost/ton	2.63	2.29	4.92				
(3) Stack large round bales:							
80 hp tractor/hr	3.34	3.24	6.58				
Front loader/hr	2.11	1.00	3.11				
Operator/hr	--	3.00	3.00				
Total cost/hr	5.45	7.24	12.69				
Cost/ton @ 6 tons/hr	.91	1.21	2.12				
(4) Summary, harvest costs:							
Swath	1.90	1.40	3.30				
Bale, large round bales	2.63	2.29	4.92				
Stack, large round bales	.91	1.21	2.12				
Total cost/ton	$5.44	$4.90	$10.34				
Feed large round bales: Load onto wagon with front loader, scatter by hand, 2 men.							
(5) Load and feed (3 tons of hay)							
80 hp tractor, 1.5 hrs	$5.01	$4.86	$9.87				
Front loader, .5 hr	1.05	.50	1.55				
Wagon, 1.5 hr	.61	.17	.78				
Labor, load and feed, 3 man hrs	--	9.00	9.00				
Cost to feed 3 tons	6.67	14.53	21.20				
Cost to feed 1 ton	2.22	4.84	7.06				
(6) Summary, harvest and feed:							
Method 4, harvest	5.44	4.90	10.34				
Method 4, feed	2.22	4.84	7.06				
Total, harvest and feed/ton	7.66	9.74	17.40				

Worksheet 6. Continued

Method 5. Harvest hay - Self-propelled swather, stacked with 80 hp tractor and 3 ton stack wagon.

Operations	Costs Fixed	Costs Operating	Costs Total	Estimates for your operation Operations	Costs Fixed	Costs Operating	Costs Total
(1) Swath:							
Cost/ton @ 1.5 tons/acre/cutting	$1.90	$1.40	$3.30				
(2) Stack:							
80 hp tractor/hr	3.34	3.24	6.58				
3 ton stack wagon/hr	12.37	3.45	15.82				
Operator 1 hr	--	3.00	3.00				
Total cost/hr	15.71	9.69	25.40				
Cost/ton @ 4.0 tons/hr	3.93	2.42	6.35				
(3) Summary, harvest costs:							
Swath	1.90	1.40	3.30				
Stack with 3 T stack wagon	3.93	2.42	6.35				
Total cost/ton	$5.83	$3.82	$9.65				
(4) Load and feed (3 tons of hay)							
80 hp tractor, 1 hr	$3.34	$3.24	$6.58				
Stackmover-feeder, 1 hr	7.50	2.42	9.92				
Labor, 1 man hr	--	3.00	3.00				
Cost to feed 3 tons	10.84	8.66	19.50				
Cost to feed 1 ton	3.61	2.89	6.50				
(5) Summary, harvest and feed:	Cost/ton						
Method 5, harvest	5.83	3.82	9.65				
Method 5, feed	3.61	2.89	6.50				
Total, harvest and feed/ton	$9.44	$6.71	$16.15				

Compare and Evaluate the Results

After completing the cost analysis for each method, the results should be compared and evaluated.

Step 6. Compare and evaluate the results.

Worksheet 7 shows a summary-comparison of labor requirements and costs for the 5 harvest-feeding methods. The estimates show that method 5 requires the least amount of labor and is second to lowest in cost/ton. Method 2, swath, bale and stack bales with front loader and one man on the stack, requires the most labor and is the highest cost method.

Method 1, swath and stack with a front loader and no one on the stack, is the lowest cost option and second from lowest labor requirement method. Obviously, if a man is needed on the stack the cost/ton would be higher.

The cost for putting up hay in large round bales is competitive with methods 1 and 5, but the estimated cost for feeding the large bales is high. Why? Perhaps there is a more efficient method of feeding large bales than assumed here? Methods 2 and 3, regular baling, are apparently the highest cost methods. However, we should remember that baled hay is "packaged" for hauling if necessary. Also, the cost for twine at $2.50 per ton is a major factor for methods 2 and 3!

Important questions can be raised relating to the annual use of machinery for the haying methods analyzed. Are the machinery complements for the various methods adequate for harvesting and feeding more than the assumed 400 acres or 600 tons of hay? Are performance rates realistic? These and other questions can be raised.

If we refer back to Worksheet 5, it is shown that the self-propelled swather would be needed only 10 days to swath 400 acres of hay. Yet, in developing the unit costs for the swather, as summarized in Appendix Worksheets II and III, we assumed an annual use of 200 hours. Therefore, to get the annual fixed cost per hour for the swather

Worksheet 7. A comparison of labor requirements and costs, 5 methods of harvesting and feeding hay.

	Method[1/]					Estimates for your operation				
	1	2	3	4	5	1	2	3	4	5
Labor required:										
Harvest:										
Hours/600 tons	340	620	340	300	250					
Hours/ton	.56	1.03	.56	.50	.42					
Feed:										
Hours/600 tons	400	600	600	600	200					
Hours/ton	.67	1.0	1.0	1.0	.33					
Harvest and feed:										
Hours/600 tons	740	1,220	940	900	450					
Hours/ton	1.23	2.03	1.56	1.50	.75					
Cost/ton:										
Harvest	$ 8.38	$15.27	$14.53	$10.34	$ 9.65					
Feed	5.40	4.61	4.61	7.06	6.50					
Harvest and feed	$13.78	$19.88	$19.14	$17.40	$16.15					

loose — Regular bales — large round — loafstacks

1/ Method 1. Swath, stack loose with front loader; feed with front loader and wagon.

Method 2. Swath, bale, stack bales with front loader; feed with wagon and tractor.

Method 3. Swath, bale, stack with bale wagon; feed with wagon and tractor.

Method 4. Swath, bale large round bales, stack with front loader; feed with front loader and wagon.

Method 5. Swath, stack with 3 ton stack wagon, feed with tractor and stackmover-feeder.

For 400 acres of hay
cut 1 time
yield 1.5 tons/acre
or 600 tons total harvested + fed out

down to $11.39, we must use it an additional 100 hours. So, we assume the swather is used about 10 days doing custom work for neighbors. This assumption does not affect the cost comparison for the 5 harvest methods because swathing was charged to each method at the same rate.

The estimated time required for stacking 600 tons of hay in loose stacks with a tractor and front loader was 24 days (Worksheet 5). If the size of the hay enterprise was larger it would probably be desirable to add a sweep rake with operator to help gather the hay from windrows and bring it to the stack. This would change the performance rates, and costs, and would require analyzing another harvest method.

The estimated time required to stack 600 tons of baled hay with a front loader and one man on the stack, was 20 days (Worksheet 5). It might be desirable in this case also to add a sweep rake to help accumulate bales. This would be especially true if the size of the enterprise was larger.

The estimated time required to stack 600 tons of baled hay with a bale wagon, method 3, was about 12 days (Worksheet 5). Here, it is quite possible that the machinery complement is adequate for more than 400 acres or 600 tons of hay. Also, cost per ton would probably be lower as fixed costs would be spread over more tons.

The estimated time required to stack 600 tons of hay baled into large round bales was only 10 days, method 4 (Worksheet 5). Here also the machinery complement is probably adequate for more than 600 tons of hay and fixed costs per ton would be lower if more tons were harvested.

The estimated time required to stack 600 tons of hay with the 3 ton stackwagon, method 5, was 15 days (Worksheet 5). This machinery complement would also probably be adequate for somewhat more than 600 tons, say up to about 800 tons or 20 days for stacking. Here, too, fixed cost per ton would be lower if more tons were harvested. It might be desirable to have a larger sized stackwagon if more than 800 tons are involved.

Conclusions

Physical requirements and costs for various hay harvest and feeding methods can be estimated by using a step-by-step procedure as outlined in this guide. The analysis includes these steps:

1) List the basic assumptions for the specific hay enterprise and the harvest-feeding methods to be analyzed.

2) Develop costs of owning and operating machinery needed for all methods.

3) Summarize and compare machinery investment requirements for all methods.

4) Summarize labor and machine requirements for each method.

5) Develop costs for the various methods.

6) Compare and evaluate the results.

It is important that operators choose harvest and feeding methods that suit their needs. Some methods use more labor but require less capital investment than others. In general, the low labor requirement methods require higher capital investments. The machinery complement should fit the size of the hay enterprise. Otherwise, fixed costs per unit of hay may be higher than necessary.

The analysis procedure outlined can be used to test other methods of harvesting and feeding hay. Farmers and ranchers should use their own performance rates and unit machinery costs fitting the situation being analyzed.

Appendix Worksheet I. Machinery complement, various methods of harvesting and feeding hay.

Item	Size	Cost	Salvage	Average investment	Depreciable investment	Years used
		$	$	$	$	
Tractors:						
2-wheel drive, diesel	60 hp	8,500	1,700	5,100	6,800	15
2-wheel drive, diesel	80 hp	14,000	2,800	8,400	11,200	15
Harvest equipment:						
Swather, self-propelled, gas	12 ft	15,600	3,120	9,360	12,480	10
Baler, PTO, twine 1/ (rectangular bales)	16"x18'	6,140	614	3,377	5,526	6
Baler, PTO, twine 2/ (large round bales)	6'x5'	6,226	1,245	3,736	4,981	8
Front end loader	2 ton	3,820	764	2,292	3,056	8
Bale stacker-wagon	3 ton	6,490	1,298	3,894	5,192	8
Stackwagon	3 ton	11,600	2,320	6,960	9,280	8
Feeding equipment:						
Stackmover-feeder	3 ton	9,384	1,877	5,630	7,507	8
Hay wagon	4 ton	1,000	100	550	900	10

1/ Makes rectangular bales about 16x18x48 inches, twine tied, average about 65 to 70 pounds per bale.

2/ Makes large round bales about 5 feet x 6 feet which average about 1,100 to 1,500 pounds per bale.

Appendix Worksheet II. Estimated fixed costs for machinery, various methods of harvesting and feeding hay.

Item	Size	Annual use	Depreciation	Interest	Taxes	Housing	Total	Fixed cost
		hours	$	$	$	$	$	$/hour
Tractors:								
2-wheel drive, diesel	60 hp	500	453	459	51	51	1,014	2.03
2-wheel drive, diesel	80 hp	500	747	756	84	84	1,671	3.34
Harvest equipment:								
Swather, self-propelled, gas	12 ft	200	1,248	842	94	94	2,278	11.39
Baler, PTO, twine 1/ (rectangular bales)	16"x18"	120	921	304	34	34	1,293	10.78
Baler, PTO, twine 2/ (large round bales)	6'x5'	75	623	336	37	37	1,033	13.77
Front end loader	2 ton	300	382	206	23	23	634	2.11
Bale stacker-wagon	3 ton	100	649	350	39	--	1,038	10.38
Stackwagon	3 ton	150	1,160	626	70	--	1,856	12.37
Feeding equipment:								
Stackmover-feeder	3 ton	200	938	507	56	--	1,501	7.50
Hay wagon	4 ton	360	90	50	6	--	146	.41

1/ Makes rectangular bales about 16x18x48 inches, twine tied, average about 65 to 70 pounds per bale.

2/ Makes large round bales about 5 feet x 6 feet which average about 1,100 to 1,500 pounds per bale.

Appendix Worksheet III. Estimated operating costs for machinery, various methods of harvesting and feeding hay.

Item	Size	Annual use	Oil	Lube, filters	Repairs	Service labor	Fuel	Total	Operating cost
		hours	$	$	$	$	$	$	$/hour
Tractors:									
2-wheel drive, diesel	60 hp	500	30	15	350	150	595	1,140	2.28
2-wheel drive, diesel	80 hp	500	30	20	560	150	858	1,618	3.24
Harvest equipment:									
Swather, self-propelled, gas	12 ft	200	25	15	500	90	450	1,080	5.40
Baler, PTO, twine 1/ (rectangular bales)	16"x18"	120	--	15	307	54	---	376	3.13
Baler, PTO, twine 2/ (large round bales)	6'x5'	75	--	10	249	37	---	296	3.95
Front end loader	2 ton	300	--	25	229	45	---	299	1.00
Bale stacker-wagon	3 ton	100	--	15	195	42	---	252	2.52
Stackwagon	3 ton	150	--	15	440	63	---	518	3.45
Feeding equipment:									
Stackmover-feeder	3 ton	200	--	20	390	75	---	485	2.42
Hay wagon	4 ton	360	--	2	20	18	---	40	.11

1/ Makes rectangular bales about 16 x18x48 inches, twine tied, average about 65 to 70 pounds per bale.

2/ Makes large round bales about 5 feet x 6 feet which average about 1,100 to 1,500 pounds per bale.

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