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MACHINERY COSTS IN CROP BUDGETS

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ABSTRACT

Producers of specialized crops often have unique requirements for calculating their costs of production. This paper provides a description of how to include machinery cost in crop budgets. Costs of several tractors, combines and tillage implements are provided, a sample budget is developed. The need for and methods of including nonmarketable crops in the crop rotation are discussed.

MACHINERY COSTS IN PRODUCTION BUDGETS

Farmers producing alternative crops or traditional crops in specialized ways need to estimate costs of production for planning expenses or for contracting output. The North Dakota State University Extension Service "Farm Management Planning Guide" provides budgets for major crops using conventional production practices. Many direct cash costs like seed or property taxes are easily determined. Costs of machinery and field operations are not so easily determined. This paper provides guidance for developing a crop budget with particular attention to machinery cost calculation.[1] The paper is divided into the following sections: fuel, repair and labor costs; field operations; building a budget; and adjusting for crop rotation.

A complete crop budget is presented after the separate sections dealing with the parts of the budget. The concepts of cash costs and economic costs are introduced along with breakeven price calculation. The last portion of the paper explains the process of adjusting the enterprise budget for unmarketable crops within a cropping rotation.

Fuel, Repair, and Labor Costs

All tractors and combines listed are diesels. The price of diesel was $.80/gallon. Gasoline cost can be estimated by multiplying diesel fuel consumption by 1.36 times the price of gasoline. Repair expense was estimated by classifying the equipment into one of 14 categories and estimating the repair cost/acre based on the machine list price and the type of equipment

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[1]The University of Minnesota Extension Service publication "Minnesota Farm Machinery Economic Cost Estimates for 1989" was used as a guide in constructing the labor requirements and costs. Estimated acres/hour and the recommended size of power unit are from that publication. Another way of calculating costs is to use a computer package like the North Dakota State University Extension Service computer spreadsheet program called COMPBUD. That computer program uses the same method of calculation as is in this report.

(Hughes and Edwardson, 1988).[2] Labor costs were calculated by dividing the labor charge of $5/hour by the field capacity (acres/hour). Although $5/hour was used as a cost of labor, its value can vary significantly. For example, rocks are usually picked when all other jobs having a higher value per hour have been completed. The value of labor used for picking rock may be less than $5/hour. On the other hand, labor has a high value during calving, planting, and harvesting seasons because of the high value of the jobs competing for labor.

Field Operations

Tables 1 and 2 provide information for variable cost of field operations for the smaller 2-wheel-drive tractors (40 hp - 120 hp) and three different size combines. Each of the power units in Table 1 is numbered to correspond to the "Tractor Used" number listed in the variable cost summary (Table 2).

TABLE 1. SMALL TRACTORS AND COMBINES WITH FUEL USE AND LIST PRICES FOR 1990.

TRACTOR NO.	DESCRIPTION	FUEL USE (G/HR)	LIST PRICE
11	40 HP 2WD	2.4	$13,541
12	60 HP 2WD	3.6	$18,093
13	75 HP 2WD	4.5	$21,678
14	100 HP 2WD	6.0	$36,324
15	120 HP 2WD	7.2	$39,555
16	SM Combine	6.0	$57,780
17	Med Combine	7.2	$68,161
18	Lrg Combine	8.7	$84,015

[2]Repair cost per hour = (list price * total accumulated repairs as a percentage of list price)/hours of use over estimated machine life.

TABLE 2. VARIABLE COST BY TILLAGE OPERATION.

Machine No.	Description[a]	Size[b]	Tractor Used	Fld Cap (AC/HR)	Fuel Cost	Est. Repairs	Labor Charge	Total Cost
					----------$/Acre----------			
201	Moldboard plow	4	12	1.7	1.65	1.03	2.94	5.62
202	Moldboard plow	5.3	13	2.3	1.56	1.30	2.16	5.02
203	Moldboard plow	6.7	14	2.9	1.64	1.47	1.71	4.82
204	Moldboard plow	8	15	3.5	1.65	1.44	1.43	4.52
205	Chisel plow	10	13	4.4	0.83	0.47	1.15	2.45
206	Chisel plow	15	15	6.5	0.88	0.47	0.76	2.11
207	Field cult.	12	13	5.8	0.62	0.32	0.86	1.80
208	Field cult.	18	14	8.7	0.55	0.38	0.57	1.50
209	Tandem disk	10	12	4.8	0.59	0.46	1.04	2.09
210	Tandem disk	16	13	7.8	0.46	0.40	0.64	1.50
211	Tandem disk	20	14	9.7	0.50	0.53	0.50	1.53
212	Harrow	30	12	16.0	0.18	0.10	0.31	0.59
213	Harrow	48	13	27.9	0.13	0.07	0.18	0.38
214	Corn plntr.	12	11	3.7	0.52	1.49	1.34	3.35
215	Corn plntr.	18	12	5.6	0.52	1.57	0.90	2.99
216	Corn plntr.	15	12	4.8	0.60	1.70	1.04	3.34
217	Corn plntr.	20	13	6.8	0.53	1.60	0.74	2.87
218	Mintil.plnt.(4)	12	12	3.1	0.92	1.98	1.59	4.49
219	Mintil.plnt.(6)	18	13	4.7	0.76	1.87	1.06	3.69
220	Mintil.plnt.(6)	15	13	3.9	0.92	2.09	1.28	4.29
221	Mintil.plnt.(8)	20	14	5.2	0.92	2.30	0.96	4.18
222	Grain drill	12	11	4.7	0.41	0.96	1.06	2.43
223	Grain drill	14	11	5.4	0.35	0.91	0.71	1.46
224	Row cult.(4)	12	11	4.7	0.41	0.36	1.06	2.43
225	Row cult.(6)	18	12	7.0	0.41	0.34	0.71	1.46
226	Row cult.(6)	15	12	5.8	0.50	0.40	0.86	1.76
227	Row cult.(8)	20	13	7.8	0.46	0.32	0.64	1.42
228	Rotary hoe	16	11	10.9	0.18	0.14	0.46	0.78
229	Grain drill	20	13	7.8	0.46	1.08	0.64	2.18
230	Grain drill	24	13	9.3	0.39	1.11	0.54	2.04
231	Grain drill	28	14	11.1	0.43	1.10	0.45	1.98
232	Sprayer	30	11	14.5	0.13	0.17	0.34	0.64
233	Sprayer	50	12	24.2	0.12	0.13	0.21	0.46
234	Combine sm.gr.	14	18	6.3	1.10	3.12	0.79	5.01
235	Combine sm.gr.	14	16	4.1	1.18	3.40	1.23	5.81
236	Combine sm.gr.	16	16	4.8	1.01	2.98	0.92	4.91
237	Combine soybn.	16	16	3.5	1.36	4.13	1.43	6.92
238	Combine soybn.	20	17	4.0	1.43	4.19	1.25	6.87
239	Combine soybn.	20	17	4.7	1.24	3.69	1.07	6.00
240	Combine corn	12	17	3.1	1.86	5.81	1.61	9.28
241	Combine corn	10	17	2.8	2.06	6.40	1.79	10.25
242	Combine corn	15	18	3.9	1.79	5.77	1.29	8.85
243	Combine corn	20	18	4.8	1.44	4.93	1.03	7.40
244	Corn pick	6	11	1.5	1.32	3.71	3.44	8.47
245	Mower/condit.	9	11	4.1	0.47	0.57	1.22	2.26
246	Rotary mower	9	13	4.4	0.83	0.66	1.15	2.64
247	Loaf stack	3-Tons	13	4.8	0.74	1.10	1.03	2.87
248	Round bale	1500#	12	4.5	0.63	0.70	1.10	2.43
249	Round bale	1000#	12	2.9	0.99	1.32	1.72	4.03
250	Forage chop	6	14	1.6	3.09	4.06	3.22	10.37
251	Swather	20	-	7.8	0.31	0.77	0.64	1.72

[a]The number in parentheses following the description of some field operations is the number of rows for row crop implements.
[b]The "Size" column is the width of the tillage implement or the size of the bale or stack.

Table 3 lists the larger 2-wheel-drive tractors (120 hp - 190 hp) and the 225-hp, 4-wheel-drive tractor. Table 4 summarizes the variable costs of respective tillage activities according to implements.

Building a Budget

All costs are divided into two categories: cash costs and economic costs. Cash costs are out-of-pocket expenses; i.e., seed, fertilizer, fuel, property taxes, and interest on short-term debt. In this example, we use economic cost as a way to describe noncash costs that still must be covered in order to continue to operate. They result because capital tied up in buildings, equipment, and land ownership may not be used in alternative investments.

Many of the cash costs per acre can be calculated easily. The cost of seed and other materials put on the field can be calculated directly as can land tax. Fuel, lubrication, repairs, and labor costs are cash costs that often are not calculated directly on a per acre basis from farm records. The previous section allows comparisons to be made between different tillage and field operations; however, many other things need to be taken into account when calculating costs of production.

A good tool to aid farmers in calculating expected costs is the enterprise budget, which lists all items that contribute to the total cost of the enterprise.

TABLE 3. LARGE TRACTORS WITH FUEL USE AND LIST PRICES FOR 1990.

No.	Description	Fuel Use	List Price
		(g/hr)	
31	225 HP 4WD	13.5	$69,663
32	140 HP 2WD	8.4	$45,790
33	160 HP 2WD	9.6	$54,710
34	180 HP 2WD	10.8	$64,696
35	190 HP 2WD	11.4	$64,940
36	120 HP 2WD	7.2	$39,555

TABLE 4. VARIABLE COST FOR LARGE IMPLEMENTS BY FIELD OPERATION.

Machine No.	Description	Feet Wide	Tractor Used	Fld Cap	Fuel Cost	Est. Repairs	Labor Charge	Total Cost
				(ac/hr)	----------$/acre----------			
401	Moldboard plow	9.3	32	4.1	1.66	1.44	1.22	4.32
402	Moldboard plow	10.7	33	4.7	1.64	1.52	1.06	4.22
403	Moldboard plow	13.5	31	5.9	1.83	1.40	0.85	4.08
404	Moldboard plow	15	31	6.5	1.65	1.38	0.76	3.79
405	Chisel plow	17	32	7.4	0.91	0.48	0.68	2.07
406	Chisel plow	20	33	8.7	0.88	0.63	0.57	2.08
407	Chisel plow	24	31	10.5	1.03	0.35	0.48	1.86
408	Field cult.	28	33	13.6	0.57	0.41	0.37	1.35
409	Field cult.	37	31	17.9	0.60	0.36	0.28	1.24
410	Tandem disk	24	36	11.6	0.50	0.73	0.43	1.66
411	Tandem disk	28	32	13.6	0.50	0.65	0.37	1.52
412	Tandem disk	32	33	15.5	0.50	0.66	0.32	1.48
413	Offset disk	14	32	6.1	1.10	0.90	0.82	2.82
414	Offset disk	16	33	7.0	1.10	0.88	0.71	2.69
415	Offset disk	18	34	7.9	1.10	0.87	0.63	2.60
416	Offset disk	21	31	9.2	1.18	0.76	0.54	2.48
417	Sweep	25	33	10.9	0.70	0.64	0.46	1.80

Table 5 contains an example of a field operation sequence for hard red spring wheat. The tractors and tillage implements correspond to the tractors and implements listed in the previous tables. The 28-foot field cultivator pulled by the 160-horsepower tractor will cover approximately 13.6 acres per hour. This tillage operation will burn $.57 of fuel and accumulate $.41 and $.37 of repairs and labor cost, respectively. The total fuel, repairs, and labor cost are obtained by summing the cost for all field operations. These totals, from the Table 5 example, are reflected in the cash cost section of the hard red spring wheat enterprise budget (Table 6). Other costs found in the cash cost section are seed, lubrication, hauling and interest. Seed cost is 1.5 bushels per acre times $4.50 per bushel. Lubrication cost is 15 percent of the fuel costs. Labor costs equal machinery time multiplied by 110 percent times the labor charge per hour.

TABLE 5. 1990 VARIABLE COST ESTIMATES OF FIELD OPERATIONS FOR SPRING WHEAT

Op. No.	Description	Tractor Used	Machine No.	Fld Cap	Fuel	Repairs	Labor Charge
					---------$/acre---------		
1	Field cult.	33	408	13.6	0.57	0.41	0.37
2	Field cult.	33	408	13.6	0.57	0.41	0.37
3	Plant	13	230	9.3	0.39	1.11	0.54
4	Harrow	13	213	27.9	0.13	0.07	0.18
5	Swath	-	251	7.8	0.31	0.77	0.64
6	Combine	18	-	6.3	1.10	3.12	0.79
7	Sweep	33	417	10.9	0.70	0.64	0.46
	Total Cash Costs				3.77	6.53	3.35

Economic costs are split into categories according to the type of asset, equipment, and land. The farm used to calculate economic costs in Table 6 had 1,132 acres. A 7 percent interest rate multiplied by one-half the new value of the machine plus a 10 percent salvage value is used to calculate the ownership cost of the machinery complement. Seven percent was used because capital in machinery could be put into a savings account to earn a market rate of interest. One-half the new value of machinery plus 10 percent salvage value is used because this is the average value over the machine's lifetime.

Depreciation expense is another portion of economic costs. The depreciation is calculated using straight line depreciation, a 10 percent salvage value and a 10-year machine life. This is calculated by multiplying the new price of the machine times 9 percent. The economic cost of land ownership was calculated using a 7 percent interest rate and a land value of $263 per acre. The total cost per acre of $77.39 is found by summing all cash and economic costs.

TABLE 6. CROP BUDGET FOR HARD RED SPRING WHEAT, 1990

Production Costs	
	per acre
Cash Costs	
-Seed	$6.75
-Fuel	3.77
-Lubrication	0.58
-Repairs	6.53
-Hauling	2.00
-Labor charge (machine time + 10%)	3.69
-Land taxes	2.75
-Interest on operating: 6 MONTHS	1.47
TOTAL CASH COSTS	$27.54
Economic costs	
-Tractor investment	$ 3.83
-Self propelled imp. investment	3.62
-Pulled implement investment	1.97
-Depreciation on machinery	22.02
-Land investment	$18.41
TOTAL ECONOMIC COSTS	$49.85
TOTAL ALL COSTS	$77.39

* COSTS ON A PER BUSHEL BASIS * (assuming a 20 bushel per acre yield)	
-Cash costs	$1.38
-Economic costs	$2.49
-Cash and economic costs	$3.87

Adjusting for Nonmarketable Crops in the Rotation

In crop rotations with a fallow or green manure crop, costs are incurred even though no crop is marketed. These costs must be allocated to a marketable enterprise. For example, a 4-year rotation may include one year of a sweet clover green manure crop which costs $30.00 per acre. That $30.00 is a cost to the marketable crops in the rotation. If the benefits accrue equally to other marketable crops in the rotation, the cost of the sweet clover ($10/year) can be added equally to the production cost of the marketable crops. Alternatively, the cost could be assigned in proportion to the value of the other crops in the rotation. Either way, the important thing is to include all costs when calculating profitability.

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