Economics of FARM STORAGE BUILDINGS

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It is widely accepted that storing farm equipment under a shelter is better than storing it outside and that hay stored in a barn is better than hay stored in the field. But how can we determine just how much a farm storage building is worth? The answer is different for every individual operation, but there are some guidelines that will help you make an intelligent decision about whether or not you can afford a building (or afford not to have one).The following is a discussion of the costs and benefits of owning a building, along with some example calculations. In each example, you are given the opportunity to substitute your figures, which might more accurately reflect your local markets and conditions.

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COST OF OWNING A BUILDING

The cost of a building depends on many factors including the amount of side enclosure, type of floor, height, and type of construction. Costs also vary depending on steel and wood prices. For an example calculation, we will use a pre-engineered steel building 50 by 100 feet with 14 foot eave height (vertical clearance). The building is open-sided and has a dirt floor. It would be suitable for storing equipment or hay.

Example: 50′ by 100′ open shed.

			Your Figures
Cost - 5,000 ft^2 of storage @ \$6.00/ft^2.	=	\$30,000	________________
Salvage value after use	=	\$0	________________
Annual Costs:			
Depreciation (20 years) \$30,000 - 0 / 20 yrs	=	\$1,500	________________
Interest (8% of avg. value) \$15,000 x 0.08	=	\$1,200	________________
Taxes and Insurance (3%) \$30,000 x 0.03	=	\$900	________________
Annual Repairs (.5%) \$30,000 x .005	=	\$150	________________
Total Annual Cost		**\$3,750**	________________

Depreciation is calculated as the beginning value minus the ending value divided by the useful life. In this example, the structure is assumed to be worth \$0 after 20 years. In all likelihood, it will be worth something. In that case, the actual depreciation will be less. For instance, if the building were worth \$5,000 after 20 years, the actual depreciation would be \$1,250 per year (\$30,000-\$5,000/20 years).

Interest is calculated based on the average value, which is the beginning value plus the ending value divided by two. In this example, ending value is assumed to be \$0 so the average value is merely \$30,000/2. However, if the ending value were \$5,000, the average value would be \$17,500 (\$30,000+\$5,000/2).

Taxes and insurance are location dependent so readers should consult their local tax assessor.

Annual repairs will vary considerably. In many years, there will likely be no repairs. However, in other years repairs could be considerable. Readers are encouraged to calculate a realistic average annual repair estimate or consult with their builder and include that cost as part of the annual expenses.

Instead of using depreciation and interest, some producers may prefer to use annual principal and interest payments. In that case, Table A (found at the end of this publication) may be useful. To use this table, readers find the appropriate payback period and interest rate and multiply the corresponding value by the thousands of dollars financed. For instance, if \$30,000 is financed for 20 years at 8%, the annual payment would be \$3,055.50 (30 X \$101.85).

BENEFITS OF STORING MACHINERY INSIDE

In a nationwide survey (Meador, 1981), farmers were asked about the resale value of their farm equipment at trade-in and whether or not it was stored inside when not in use. The results in Table 1 show that farmers who traded their equipment after five years got significantly more for tractors and other equipment that were stored inside than for equipment stored outside.

Table 1. Increased value of stored equipment at resale after five years (% of resale price)

	5 years	Per year
Tractors	16.5%	3.3%
Planters	22.1%	4.4%
Harvesting Equipment	23.7%	4.7%
Tillage Equipment	10.0%	2.0%

A 3% savings per year on barn-stored equipment is a conservative estimate of storage benefits. Using a resale value of 50% of new cost after five years, we can expect the savings shown in Figure 1 from storing equipment.

Figure 1. Annual Savings for Storage of Selected Equipment

		Your Figures
Two 155-HP Tractors @ $100,000 each	$200,000	
Combine	$325,000	
Cotton Picker	$700,000	
Hay Baler (Round)	$35,000	
Total Equipment Value	**$1,260,000**	
Equipment value after 5 years ($1,260,000 x 50%)	**$630,000**	
Savings of 3% per year ($630,000 x 3%)	**$18,900**	
Net Annual Savings (Annual Savings less Annual Cost of Facilities) ($18,900 - $3,750)	**$15,150**	

The equipment described in the example in Figure 1would only require approximately **1,100** of the **5,000** ft^2 of available space. **Additional savings can be expected from reduced down time.** Deterioration of rubber and plastic parts due to exposure to the sun is a major contributor to breakdowns and increased maintenance time. It has been estimated that barn-stored equipment has less than half the down time of field-stored equipment.

BENEFITS OF BARN HAY STORAGE

A number of studies have been done comparing various storage methods for large round bales of hay. The results varied greatly depending on the weather during the storage period. The kind and quality of hay, tightness and size of bales, and the length of time stored also affect losses. In each test, though, it was clear that a significant amount of dry matter was lost in field-stored hay, and the quality (digestibility) of the remaining hay was lowered. Results of three of these tests (1. Ely, 1984; 2. Collins et al., 1987, and 3. Hoveland et al., 1997) are shown in Table 2. All of these tests were based on a storage period of seven months.

Size of the bale affects losses because typically the outer 4 to 6 inches of the bale is lost, and that outer layer represents a higher portion of a small bale than a large bale. The outer 6 inches of a 4-ft diameter bale represents about 44% of the bale while the same outer 6 inches of a 6-ft diameter bale represents 31% of the bale.

The effect of increased digestibility in barn-stored hay was studied in experiment 1 and shown at the bottom of Table 2. This effect is greater than it initially appears from the figures in Table 2. If we start with a 1,000-lb bale at 85% dry matter and 54% digestibility, we have (1000 x 85%) = 850 lb of dry matter and (850 x 54%) = 459 lb of digestible hay. If that bale is stored on the ground, losing 30% of its dry matter and lowering the digestibility to 45%, we now have (850 x 70%) = 595 lb of dry matter and (595 x 45%) = 268 lb of digestible hay. This represents a loss of 42% of digestible hay. The actual savings on hay storage depends on the value of the hay, the length of storage, and the weather during the storage period.

Table 2. Storage and handling losses for large round hay bales

Study	Ground Stored	Elevated on Pallets	Elevated & Tarped	Tarped Only	Barn Stored
Dry Matter and Handling Loss (%)					
1	65	38	14	n/a	4
2	50	32	14	n/a	4
3	30	n/a	n/a	10	0
Digestibility (%)					
1	45	49	52	n/a	54

Figure 2 shows a conservative example of the benefits of barn storage. The example does not include the benefits of using the building for other purposes when it's not needed for hay storage. Should you store all of your hay in a barn? Not necessarily. Hay harvested late in the season and fed early in the winter would have much lower loss than hay stored over a longer period. One strategy would be to store early hay in a barn, mid-summer hay under tarps, and late hay in the open (if barns and tarps are all full).

Figure 2. Benefits of Barn-Stored Hay

Use the following:	**Your Figures**
1. Hay valued at **$80/ton** of dry matter (equivalent to $34/1000-lb roll)	_________ ($/ton)
2. Dry matter losses reduced by **30%** over ground storage	_________ (% reduced dry matter loss)
3. Digestibility decreases from 54% to 45%, yielding a total effective loss of **42%** of digestible hay (see previous example).	_________ (% digestible hay loss)
4. Building is 50' by 100' with annual cost of $3,750.	_________ (Annual building cost)
5. Bales are 5' diameter by 4', weigh 1,000 lb, and are stacked 3 high (on end) so 500 bales or **250 tons** can be stored in the barn.	_________ (Total tons stored)
6. Hay stored at 85% moisture content	_________ (% moisture content)
Hay Storage Savings:	
7. Total dry matter stored 250 x 85% = 212 tons	_________ (#5 x #6)
8. Dry matter saved 212 tons x 30% = 64 tons	_________ (#7 x #2)
9. 64 tons @ $80/ton = $5,120	_________ (#8 x #1)
10. Net annual savings $4,800 - $3,750 = $1,050	_________ (#9 - #4)
If we include savings due to increased digestibility:	
11. 42% x 212 tons x $80/ton = $7,123	_________ (#3 x #7 x #1)
12. Net annual savings $6,678 – $3,750 = $2,928	_________ (#11 - #4)
If hay is worth $90/dry ton ($38/1,000-lb roll):	
13. 42% x 212 tons x $90/ton = **$8,014**	_________ (#3 x #7 x $90)
14. Net annual savings $8,014 - $3,750 = $4,264	_________ (#13 - #4)

GENERAL RECOMMENDATIONS

1. **Open-sided barns** should generally be oriented with the long axis east and west to minimize the amount of sun intrusion into the building.

2. **If only one side** of the barn is open, it should be facing away from prevailing wind (generally South), to minimize rain being blown into the barn.

3. **All buildings** should meet Southern Building Code requirements.

4. **Sidewalls add protection** to both equipment and hay, but add significantly to the cost of the building. You should get a bid on different types of buildings and do your own analysis using the guidelines in this publication.

5. **Buildings for hay storage** should be as open as possible in the gable ends (peak of the roof) to allow moisture to escape as the hay dries while in the barn. Other-wise, condensation and rust will occur on the inside of the roof. Ridge vents should also be considered in large barns. 100 tons of hay will give off about 5,000 lb of water during curing, and this must be removed by ventilation.

6. **More large round hay bales** can be stored in a barn by stacking the bales on their (flat) end rather than on their (round) side. This can be done with a 4-foot front-end-loader fork. It does, however, take a little more time and effort than storing on the side.

7. **Make sure the eave height** (vertical clearance) of your barn is high enough to fit your needs (usually at least 14 feet.) Nothing is more frustrating than realizing that one more foot of ceiling height would allow you to put another layer of hay bales in the barn or that your barn is one foot too short for the new combine.

Table A. Annual Payments per $1,000 Borrowed for Various Payback Periods and Interest Rates

Number of Years	Interest Rate				
	4.00%	6.00%	8.00%	10.00%	12.00%
1	$1,040.00	$1,060.00	$1,080.00	$1,100.00	$1,120.00
2	$530.20	$545.44	$560.77	$576.19	$591.70
3	$360.35	$374.11	$388.03	$402.11	$416.35
4	$275.49	$288.59	$301.92	$315.47	$329.23
5	$224.63	$237.40	$250.46	$263.80	$277.41
6	$190.76	$203.36	$216.32	$229.61	$243.23
7	$166.61	$179.14	$192.07	$205.41	$219.12
8	$148.53	$161.04	$174.01	$187.44	$201.30
9	$134.49	$147.02	$160.08	$173.64	$187.68
10	$123.29	$135.87	$149.03	$162.75	$176.98
11	$114.15	$126.79	$140.08	$153.96	$168.42
12	$106.55	$119.28	$132.70	$146.76	$161.44
13	$100.14	$112.96	$126.52	$140.78	$155.68
14	$94.67	$107.58	$121.30	$135.75	$150.87
15	$89.94	$102.96	$116.83	$131.47	$146.82
16	$85.82	$98.95	$112.98	$127.82	$143.39
17	$82.20	$95.44	$109.63	$124.66	$140.46
18	$78.99	$92.36	$106.70	$121.93	$137.94
19	$76.14	$89.62	$104.13	$119.55	$135.76
20	$73.58	$87.18	$101.85	$117.46	$133.88
25	$64.01	$78.23	$93.68	$110.17	$127.50
30	$57.83	$72.65	$88.83	$106.08	$124.14
35	$53.58	$68.97	$85.80	$103.69	$122.32
40	$50.52	$66.46	$83.86	$102.26	$121.30

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