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BUYING AND SELLING SHELLED AND EAR CORN AT VARIOUS MOISTURE LEVELS

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BUYING AND SELLING SHELLED AND EAR CORN AT VARIOUS MOISTURE LEVELS 1/

Contents

1/ See also a companion publication A.E. Ext. 573 "Shelled Corn Drying and Storage Considerations," Charles H. Cuykendall and George L. Casler, 1970.

Note: A publication "High Moisture Corn Pricing" Ag. Eng. Ext. 390, Joseph K. Campbell, contains constant dry matter price data for intermediate moisture levels. The data for equivalent moisture levels in the last column in that publication differs slightly from comparable data in Table 4 because of the method of calculation.

Introduction

The material in this booklet has been prepared to aid corn growers and vestock feeders in the purchase and sale of wet shelled corn and wet ear corn.

Tables have been prepared showing the equivalent value of shelled and ear orn at several moisture levels under varying assumptions. Tables 1 and 3 efer to shelled corn; Tables 2 and 4 refer to ear corn.

Tables 1 and 2 have been prepared to help the grower decide whether he hould sell wet corn directly to a livestock feeder rather than paying the rying charge, taking the shrink (mostly water) and selling the corn to a lealer (at various prices per bushel).

Tables 3 and 4 have been prepared to help the livestock feeder (particularly a dairyman) decide whether wet corn (shelled or ear) is a good buy in relation to dry shelled corn. Table 3 prices dry matter at constant levels regardless of moisture content. Table 4 assumes that for feeding dairy cattle, dry ear corn is worth 90% as much as dry shelled corn. Then the dry matter in ear corn is priced at constant levels regardless of the moisture content.

Each of the Tables 1-4 has been prepared for kernel moisture levels of 20, 25, and 30%. Equivalent values for other moisture levels can be calculated by using the procedures outlined on pages 10 through 12. Approximate values for moisture levels between 20 and 30% can be found by interpolation.

Representative shrink and drying charges used in preparing Tables 1 and 2 are given in Table 6. Tables 1 and 2 are valid only when using these shrink and drying charges. However, values for other shrink and drying charges could be calculated by following the same method of calculation.

It should be kept in mind that many other factors affect corn buying and selling decisions. Some of these are: harvesting costs for shelled vs. ear; labor involved in handling; shelled vs. ear transportation costs to another farm vs. to a dealer; storage costs for wet corn vs. dry corn; interest on the money invested in corn in storage; risk and uncertainty; and storage losses.

A Formula for Converting Wet Corn to Dry Corn Weight

$$\text{Weight of wet corn} \times \frac{(100 - \text{initial moisture \%})}{(100 - \text{final moisture \%})} = \text{dry corn weight}$$

Example: How many pounds of 15.5% moisture shelled corn are there in 1 ton (2,000 lbs.) of 30% moisture shelled corn?

$$2{,}000 \times \frac{(100 - 30)}{(100 - 15.5)} = 2{,}000 \times \frac{70}{84.5} = 2{,}000 \times 0.828 = 1{,}656 \text{ lbs.}$$

Thus 344 lbs. of water would be lost and 1656 pounds of corn at 15.5% moisture would remain.

Note: The actual shrink in drying corn is somewhat greater than the loss in water. Usually, there is a dry matter loss of about $\frac{1}{2}$% in addition to the weight loss due to water removed. Thus, in the example above, there would be 1646 lbs. of 15.5% shelled corn left after the corn was artificially dried (2,000 x 0.823, using a shrink factor of 17.7%; see Table 6).

Table 1 is designed to show the break-even price a corn grower could receive for wet shelled corn compared to paying for drying and taking the shrinkage. At prices above the break-even values in the table the grower would be better off selling wet shelled corn compared to drying and vice versa. One should also consider the factors listed on page 2 before completing his decision.

Table 1: Equivalent Values of Wet Shelled Corn and Dry Shelled Corn 1/

Price/bu. of dry corn (15.5%)	Price/ton of dry corn (15.5%)	Equivalent Value Per Ton of Wet Shelled C		
		20% mois. 5.8% shrink 7¢ drying	25% mois. 11.7% shrink 12¢ drying	30% mois. 17.7% shrir 17¢ dryir
$ .90	$32.10	$27.80	$24.10	$20.40
.95	33.90	29.50	25.70	21.90
1.00	35.70	31.10	27.20	23.30
1.05	37.50	32.80	28.80	24.80
1.10	39.30	34.50	30.40	26.30
1.15	41.10	36.20	32.00	27.70
1.20	42.90	37.90	33.60	29.20
1.25	44.60	39.60	35.10	30.70
1.30	46.40	41.20	36.70	32.10
1.35	48.20	42.90	38.30	33.60
1.40	50.00	44.60	39.90	35.10
1.45	51.80	46.30	41.30	36.50
1.50	53.60	48.00	43.00	38.00

1/ Drying charges and shrinkage deducted (based on Table 6). All values rounded to nearest 10 cents. Equivalent values for moisture levels other than 20, 25, and 30 percent can be calculated by using the procedure on page 10.

2/ Individual buyers may use different drying charges and shrink factors based upon their own experience and buying policy.

Table 2 is designed to show the break-even price a grower could receive : wet ear corn compared to selling wet shelled corn and paying for drying i taking the shrinkage. Shelling cost would have to be deducted from these ices. The grower would also need to consider other factors listed on ge 2.

Value of wet ear corn (from table) $_____

Your shelling cost $_____

Value of ear corn sold as dry shelled corn $_____

Table 2: Equivalent Values of Dry Shelled, Dry Ear and Wet Ear Corn 1/

Price/bu. of Dry Corn (15.5%)	Equivalent Value/Ton of Dry (16%) Ear Corn	Equivalent Value Per Ton of Wet Ear Corn 2/		
		20% Kernel	25% Kernel	30% Kernel
$ .90	$26.30	$22.30	$18.80	$15.70
.95	27.80	23.70	20.00	16.80
1.00	29.20	25.00	21.30	17.90
1.05	30.70	26.40	22.50	19.10
1.10	32.20	27.70	23.70	20.20
1.15	33.60	29.10	25.00	21.30
1.20	35.10	30.40	26.20	22.40
1.25	36.60	31.80	27.40	23.60
1.30	38.00	33.10	28.70	24.70
1.35	39.50	34.50	29.90	25.80
1.40	40.90	35.80	31.10	27.00
1.45	42.40	37.20	32.40	28.10
1.50	43.90	38.50	33.60	29.20

1/ See page 11 for method of calculation. All values rounded to nearest 10 cents.

2/ Calculated on the basis of the value of the dry shelled corn contained in one ton of wet ear corn less drying charge for the shelled corn using the data in Tables 5 and 6.

Table 3 is designed to show the price that a dairyman could pay for wet shelled corn at various prices for dry shelled corn. A dairyman comparing the purchase of either shelled or ear corn at harvest time with the frequent purchase of dairy ration or ration ingredients must also consider the cost of storing and grinding and the interest on the money invested in corn.

Table 3: Equivalent Values of Shelled Corn at Various Moisture Levels for Constant Dry Matter Prices 1/

Price/bu. of Dry Corn (15.5%)	Price/ton of Dry Corn (15.5%)	Equivalent Value Per Ton of Wet Shelled Corn 2/		
		20%	25%	30%
$ .90	$32.10	$30.40	$28.50	$26.60
.95	33.90	32.10	30.10	28.10
1.00	35.70	33.80	31.70	29.60
1.05	37.50	35.50	33.30	31.10
1.10	39.30	37.20	34.90	32.50
1.15	41.10	38.90	36.50	34.00
1.20	42.90	40.60	38.10	35.50
1.25	44.60	42.30	39.60	37.00
1.30	46.40	44.00	41.20	38.40
1.35	48.20	45.70	42.80	39.90
1.40	50.00	47.30	44.40	41.40
1.45	51.80	49.00	46.00	42.90
1.50	53.60	50.70	47.60	44.30

1/ See page 12 for method of calculation. All values rounded to the nearest 10 cents.

2/ No charge for drying and no adjustment for storage costs.

NOTE: Shelled corn is worth more in terms of feed value (Table 3) than in terms of selling as dry corn (Table 1), mostly because of drying costs. For example, when dry corn is worth $1.10 per bushel, 25% moisture shelled corn is worth $34.90 per ton in terms of feed value but only $30.40 to the grower who must pay the drying charge. The difference of $4.50 per ton should provide a basis for selling corn directly from the grower to the feeder who can use high moisture corn. However, the feeder must have storage and feeding facilities to handle high moisture corn.

Table 4 is designed to show the price that a dairyman could pay for ear orn at various prices for dry shelled corn. A dairyman comparing the purhase of either shelled or ear corn at harvest time with the frequent purchase of dairy ration or ration ingredients must also consider the cost of storing and grinding and the interest on the money invested in corn.

Table 4: Equivalent Values of Ear Corn at Various Moisture Levels for Constant Dry Matter Prices 1/

Price/bu. of Dry Corn (15.5%)	Equivalent Value/Ton of Dry Ear Corn 3/	Equivalent Value Per Ton of Wet Ear Corn 2/		
		20% Kernel 22.6% ear	25% Kernel 29.2% ear	30% Kernel 34.6% ear
$ .90	$28.90	$26.70	$24.40	$22.40
.95	30.50	28.20	25.70	23.60
1.00	32.10	29.70	27.10	24.80
1.05	33.70	31.20	28.40	26.10
1.10	35.40	32.70	29.80	27.30
1.15	37.00	34.20	31.10	28.60
1.20	38.60	35.60	32.50	29.80
1.25	40.20	37.10	33.80	31.10
1.30	41.80	38.60	35.20	32.30
1.35	43.40	40.10	36.50	33.50
1.40	45.00	41.60	37.90	34.80
1.45	46.60	43.10	39.20	36.00
1.50	48.20	44.50	40.60	37.30

1/ See page 12 for method of calculation. All values rounded to the nearest 10 cents.

2/ No charge for drying and no adjustment for storage costs.

3/ Calculated on the basis that for feeding dairy cows dry ear corn is worth 90 percent as much as dry shelled corn.

NOTE: Ear corn is worth more in terms of feed value (Table 4) than in terms of selling as dry shelled corn (Table 2) because of drying costs and feed value in cobs. For example, when dry shelled corn is worth $1.10 per bushel, ear corn with 25% kernel moisture (29.2% ear moisture) is worth $29.80 per ton in terms of feed value but only $23.70 to the grower who must pay the drying charge. The difference of $6.10 per ton should provide a basis for selling corn directly from grower to feeder who can use high moisture ear corn. However, the feeder (or possibly the grower) must have storage (cribs or silos) for wet ear corn.

Table 5: Relationships of Kernel and Ear Moisture and Wet Ear Bushel Weight Required for 1 Bushel of Dry Shelled Corn 1/

Percent Moisture in Kernel	Percent Moisture in Ear 2/	Lbs. of Ear Corn Required to Equal 56 lbs. of Shelled Corn at 15.5% Kernel Moisture 3/
12.0		
13.0	11.9	
14.0	13.0	65.1
15.0	14.2	66.0
15.5	15.3	66.9
	16.0	67.9
16.0		68.4
17.0	16.6	
18.0	18.0	68.9
19.0	19.7	70.1
20.0	21.2	71.3
	22.6	72.6
21.0		74.0
22.0	23.9	
23.0	25.2	75.4
24.0	26.6	76.8
25.0	27.9	78.2
	29.2	79.8
26.0		81.2
27.0	30.4	
28.0	31.5	82.8
29.0	32.6	84.2
30.0	33.6	85.6
	34.6	87.0
31.0		88.5
32.0	35.5	
33.0	36.4	89.9
34.0	37.4	91.4
35.0	38.3	92.8
	39.3	94.3
36.0		95.7
37.0	40.3	
38.0	41.2	--
39.0	42.1	--
40.0	43.1	--
	44.1	--
		--

1/The relationships between ear moisture and kernel moisture will vary with hybrid and season. The values given in this table are averages based on the best available data and are for corn dried in the field. Corn dried in a crib usually will have a lower ear moisture relative to kernel moisture. Therefore the information in Table 5 and 7 is more accurate for corn sold at harvest time than for corn sold after drying in cribs.

2/From "Relations of Kernel, Cob, and Ear Moisture in Dent Corn," Purdue University Station Bulletin 599, S. R. Miles and E. E. Remmenga, July 1953.

3/From Iowa State College Publication, Agron. 205.

Table 6: Reference Table on Wet and Dry Bushel Drying Costs and Shrink

Moisture in Shelled Corn 1/	Drying Charge Per Wet Bushel 2/	Equivalent Drying Charge Per Dry Bushel	Shrink (to 15.5%) 3/ Deducted From Wet Weight
- percent -	- cents -	- cents -	- percent -
15.5	0	0	0
16	3	3.0	1.1
17	4	4.1	2.3
18	5	5.2	3.5
19	6	6.3	4.6
20	7	7.4	5.8
21	8	8.6	7.0
22	9	9.8	8.2
23	10	11.0	9.4
24	11	12.3	10.6
25	12	13.6	11.7
26	13	14.9	12.9
27	14	16.3	14.1
28	15	17.7	15.3
29	16	19.2	16.5
30	17	20.7	17.7
31	18	22.2	18.8
32	19	23.8	20.0
33	20	25.4	21.2
34	21	27.1	22.4
35	22	28.8	23.6

1/ If .1% over base, use the next bracket for calculating costs.

2/ A commercial drying schedule obtained from western New York.

3/ Including 1/2% invisible loss.

Table 7: Number of Pounds of Corn Required to Equal A Bushel of Shelled Corn at 15.5% Moisture (47.32 lbs. Dry Matter) 1/

Percent Moisture in Kernel	Pounds of Shelled Corn Required to Equal 1 Bu. No. 2 Corn at 15.5% 2/	Component Weights of Bushel		
		# Pounds of Dry Matter	Water	
			Pounds	Quarts 3/
12	53.77	47.32	6.45	3.1
13	54.39	47.32	7.07	3.4
14	55.02	47.32	7.70	3.7
15	55.67	47.32	8.35	4.0
15.5	56.00	47.32	8.68	4.2
16	56.33	47.32	9.01	4.3
17	57.01	47.32	9.69	4.6
18	57.71	47.32	10.39	5.0
19	58.42	47.32	11.10	5.3
20	59.15	47.32	11.83	5.7
21	59.90	47.32	12.58	6.0
22	60.67	47.32	13.35	6.4
23	61.45	47.32	14.13	6.8
24	62.26	47.32	14.94	7.2
25	63.09	47.32	15.77	7.6
26	63.94	47.32	16.62	8.0
27	64.82	47.32	17.50	8.4
28	65.72	47.32	18.40	8.8
29	66.65	47.32	19.33	9.3
30	67.60	47.32	20.28	9.7
31	68.58	47.32	21.26	10.2
32	69.59	47.32	22.27	10.7
33	70.63	47.32	23.31	11.2
34	71.70	47.32	24.38	11.7
35	72.80	47.32	25.48	12.2
40	78.86	47.32	31.54	15.1

1/Source FM-126, Univ. of Minnesota, C. Cuykendall and L. Christenson, 1969.

2/Does not include 1/2% invisible loss.

3/8.34 pounds of water = 4 quarts = 1 gallon.

Method of Calculation--Table 1

Column 2: Bushels per ton x price per bushel = price per ton

35.71 x $1.10 = $39.28 ($39.30)

Column 3: 20% moisture
5.8% shrink
7 cents per wet bushel drying charge

2,000 lbs. x 0.942 (5.8% shrink) = 1,884 lbs. dry corn

1,884 ÷ 56 = 33.64 bu. of dry shelled corn in 1 ton of 20% moisture shelled corn

Drying charge: 35.71 bu. wet corn x 7 cents = $2.50 per ton of wet corn

Value per wet ton: 33.64 bu. at $1.10 = $37.00
Drying charge 2.50
$34.50

Thus the grower would obtain equal return from selling the 20% moisture corn for $34.50 as from taking 5.8% shrink, paying 7 cents per wet bushel for drying, and selling dry corn for $1.10 per bushel.

Columns 4 and 5: Calculated in the same way as column 3 using the appropriate shrink factor and drying charge.

Method of Calculation -- Table 2

Column 2: 68.4 lbs. of dry ear corn are required to yield one bushel (56 lbs.) of 15.5% moisture shelled corn (see Table 5).

One ton of dry ear corn (16% moisture) will yield 29.24 bushels of dry (15.5%) shelled corn (2000/68.4 = 29.24).

Example: 29.24 x $1.10 = $32.16 ($32.20) = the value of one ton of dry ear corn when dry shelled corn is worth $1.10 per bushel (no shelling charge and no value for cobs.)

Column 3: 20% moisture kernel (22.6% moisture ear)

With 20% kernel moisture, 74.0 lbs. of ear corn are required to yield 56 lbs. of dry (15.5%) shelled corn.

2000/74.0 = 27.03 bu. dry shelled corn

Example: 27.03 x $1.10 = $29.73

Drying
Charge = 27.03 x $.074*= 2.00
$27.73 ($27.70)

Shelling charge (your cost) $_____

Value of ear corn sold as dry shelled corn $_____

The grower would obtain the same return from selling ear corn with 20% kernel moisture for $27.70 (less shelling charge) per ton as from paying the drying charge of 7.4¢ (per dry bu.) and selling the shelled corn for $1.10 per dry (15.5%) bu.

*27.03 is a dry bushel basis therefore use dry bushel drying charge.

Columns 4 and 5: Calculated in the same way as column 3 using the appropriate shrink factor and drying charge.

Method of Calculation -- Table 3

Column 2: Bushels per ton x price per bushel = price per ton

Example: $35.71 x $1.10 = $39.28 ($39.30)

Column 3: 20% moisture shelled corn

$$\frac{(100 - \text{initial moisture})}{(100 - \text{final moisture})} = \frac{(100 - 20)}{(100 - 15.5)} = \frac{80}{84.5} = 0.947$$

Therefore, 1 ton of 20% shelled corn contains 0.947 tons of 15.5% shelled corn.

Value of dry shelled corn x 0.947 = feed value of wet shelled corn

Example: $39.28 x 0.947 = $37.20 = feed value of 1 ton of 20% shelled corn when dry shelled corn is worth $1.10 per bushel.

Columns 4 and 5: Calculated in the same way as column 3 using the appropriate shrink factor.

Method of Calculation -- Table 4

Column 2: Price of dry shelled corn x 90% = feed value of dry ear corn

Example: 35.71 bu. of dry shelled corn per ton
35.71 x $1.10/bu. = $39.28 per ton of shelled corn
$39.28 x 90% = $35.35 = feed value per ton of dry ear corn

Column 3: 20% kernel moisture

74.0 lbs. of 20% kernel moisture ear corn is required to yield 68.4 lbs. of ear corn with 15.5% kernel moisture.

$\frac{68.4}{74.0} = 0.924$ = adjustment factor to reduce wet ear corn (20%) to dry ear corn (15.5%)

$35.35 = Value per ton of dry ear corn when dry shelled corn is $1.10

$35.35 x 0.924 = $32.66 ($32.70) = feed value of one ton of ear corn with 20% kernel moisture when dry shelled corn is worth $1.10 per bu.

Columns 4 and 5: Calculated in the same way as column 3 using the appropriate shrink factor.

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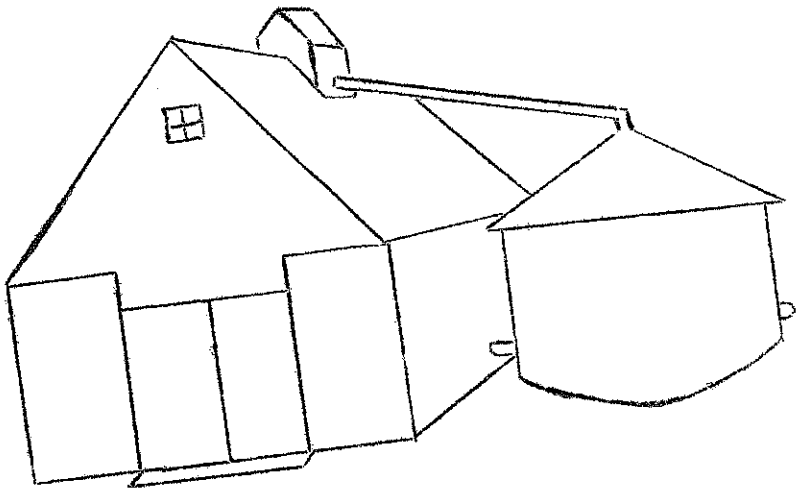
SHELLED CORN DRYING AND STORAGE CONSIDERATIONS



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Shelled Corn Drying and Storage Considerations

The tables and calculations in this booklet are to assist corn buyers and sellers in their corn drying, storing and marketing decisions. 1/

CONTENTS

TABLES

1/ See also a companion publication A.E. Ext. 572 "Buying and Selling Shelled And Ear Corn At Various Moisture Levels", G. L. Casler and C. H. Cuykendall, 1970.

alculation of Grain Shrinkage

In a kernel of corn only the dry matter has economic value. To make comparisons between different moistures in corn kernels, calculations are made to put all corn on an equivalent 15.5% kernel moisture.

When a quantity of grain is dried, some of the water is evaporated and some fines are lost. This loss is expressed as shrinkage. The amount of shrink depends on these factors:

a) The beginning kernel moisture

b) The final kernel moisture after drying

c) The dry matter loss (fines) in drying expressed as invisible loss

To calculate the amount of shrink as a percent, the following formula is used:

$$\% \text{ Grain Shrink} = \left[100\% - \left(\frac{100 - \% \text{ kernel moisture in wet corn}}{100 - \% \text{ kernel moisture after drying}} \times 100\% \right) \right] + \underbrace{.5\%}_{\text{invisible loss}}$$

$$\text{e.g. } \% \text{ Grain Shrink} = \left[100\% - \left(\frac{100 - 24}{100 - 15.5} \times 100\% \right) \right] + .5\%$$

$$= \left[100\% - 89.4\% \right] + .5\%$$

$$= 10.56\%$$

Using the above equation and any beginning or final moisture the resultant shrinkage can be calculated. Table 1 is a grain shrinkage table based upon this mathematical relationship and can be used directly to determine percent shrinkage. One should note that a 10 percentage point change in moisture is equal to more than a 10% shrink. For example 25.5% to 15.5% equals 12.33% shrink.

After you have determined the shrinkage as a percentage, multiply this by the quantity of wet grain in any units: bushels, tons, or pounds.

e.g. 2000 pounds wet grain (25.5%) x 12.33% = 246.6 pounds shrinkage to 15.5%

1 ton wet grain (25.5%) x 12.33% = .1233 tons shrinkage to 15.5%

35.71 bushels wet grain (25.5%) x 12.33% = 4.40 bushels shrinkage to 15.5%

Calculation of Net Dry Grain

To obtain the percent net dry grain subtract the shrinkage from 100%. e.g. 25.5% initial moisture to 15.5% dry = 12.33% shrinkage: 100% -12.33% = 87.67% net dry grain. Rather than calculate the amount of shrinkage you can calculate the tons, pounds, or bushels remaining after the moisture change by multiplying the wet quantity times the appropriate net dry grain percentage. e.g. 35.71 bushels wet grain (25.5%) x 87.67% = 31.31 bushels net dry grain at 15.5%. The net dry grain figures can be found on table 2 or by subtraction of the shrinkage from 100%.

Table 1.

Grain Shrinkage Table 1/

Beginning Moisture Percent	Shrinkage When Grain is Dried to These Levels					
	12.0	13.0	14.0	15.0	15.5	16.0
15.5	4.48	3.37	2.24	1.09	--	--
18.0	7.32	6.25	5.15	4.03	3.46	2.8
20.0	9.59	8.55	7.48	6.38	5.83	5.2
21.0	10.73	9.70	8.64	7.56	7.01	6.45
22.0	11.86	10.84	9.80	8.74	8.19	7.64
23.0	13.00	11.99	10.97	9.91	9.38	8.83
24.0	14.14	13.14	12.13	11.09	10.56	10.02
25.0	15.27	14.29	13.29	12.26	11.74	11.21
25.5	15.84	14.87	13.87	12.85	12.33	11.81
26.0	16.41	15.44	14.45	13.44	12.93	12.40
27.0	17.55	16.59	15.62	14.62	14.11	13.60
28.0	18.68	17.74	16.78	15.79	15.29	14.79
29.0	19.82	18.89	17.94	16.97	16.48	15.98
30.0	20.95	20.04	19.10	18.15	17.66	17.17
31.0	22.09	21.19	20.27	19.32	18.84	18.36
32.0	23.23	22.34	21.43	20.50	20.03	19.55
33.0	24.36	23.49	22.59	21.68	21.21	20.74
34.0	25.50	24.64	23.76	22.85	22.39	21.93
35.0	26.64	25.79	24.92	24.03	23.58	23.12

1/ Including an invisible loss of 1/2 %.

able 2 . Net Dry Grain 1/

eginning loisture ercent	When Dried to These Moisture Levels					
	12.0	13.0	14.0	15.0	15.5	16.0
15.5	95.52	96.63	97.76	98.91	--	--
18.0	92.68	93.75	94.85	95.97	96.54	97.12
20.0	90.41	91.45	92.52	93.62	94.17	94.74
21.0	89.27	90.30	91.36	92.44	92.99	93.55
22.0	88.14	89.16	90.20	91.26	91.81	92.36
23.0	87.00	88.01	89.03	90.09	90.62	91.17
24.0	85.86	86.86	87.87	88.91	89.44	89.98
25.0	84.73	85.71	86.71	87.74	88.26	88.79
25.5	84.16	85.13	86.13	87.15	87.67	88.19
26.0	83.59	84.56	85.55	86.56	87.07	87.60
27.0	82.45	83.41	84.38	85.38	85.89	86.40
28.0	81.32	82.26	83.22	84.21	84.71	85.21
29.0	80.18	81.11	82.06	83.03	83.52	84.02
30.0	79.05	79.96	80.90	81.85	82.34	82.83
31.0	77.91	78.81	79.73	80.68	81.16	81.64
32.0	76.77	77.66	78.57	79.50	79.97	80.45
33.0	75.64	76.51	77.41	78.32	78.79	79.26
34.0	74.50	75.36	76.24	77.15	77.61	78.07
35.0	73.36	74.21	75.08	75.97	76.42	76.88

1/ Including an invisible loss of 1/2%

Market Losses From Overdried Corn

Corn is bought and sold based upon 56.0 pounds being an equivalent bushe and containing 47.32 pounds of dry matter. If a grower has corn below 15.5% moisture he is marketing more pounds of dry matter in a 56.0 pound unit then is required. Most often he is not paid for the extra dry matter. The value of this extra dry matter that is in place of the water driven off is given in table 3. The lower the dried moisture level the greater the dry matter loss when sold based on 56.0 pound bushel weight. If this corn is fed to livestock they will get the full value of this extra dry matter as it is of no concern whether livestock obtain their water from a tank or in the corn. People who feed overdried corn should reduce the amount fed in relation to a standard bushel the same as they increase the amount fed when feeding high moisture cor

It requires more fuel (energy and the resulting cost) to dry corn from 12% to 11% kernel moisture than from 20% to 19%. A farm manager that overdrie will find his drying charges higher from overdrying not only from removing more water but also from having to remove additional internal moisture which comes out harder.

One must recognize that corn needs to be overdried to be safely stored. The 15.5% moisture kernel is marketable corn but 13 to 14% moisture kernels are needed if it is to be stored during the following spring warm up. For longer term storage of 2 or more years most people recommend 11 to 12% moisture levels as insurance that the corn will not go out of condition. Anyone drying corn will find that the final moisture level is one of safety first yet recognizing that lower levels are more costly in terms of drying cost and dry matter penalties if marketed without a premium.

Table 3 gives the market losses from overdrying corn. With number 2 corn (15.5%) priced at $1.10 per bushel every bushel dried to 10% moisture would have 7¢ worth additional dry matter in it than the standard bushel. The extra water driven off is replaced by valuable dry matter when 56 pounds of corn are sold. The table only includes the value of the additional dry matter marketed when overdried and not the additional fuel cost to get the kernel moisture down to overdried levels. This overdrying fuel charge would be from 1 to 3¢ additional. So one might expect the losses on the above overdried example to be 7¢ dry matter loss plus at least a 2¢ additional fuel cost. The 9¢ loss (when marketed) from mismanagement in addition to other normal drying costs would make costs of the system more expensive when compared to commercial drying charges. In some isolated cases livestock feeders are willing to pay a partial premium over number 2 corn price to get this corn of higher dry matter content.

Table 3. Marketing Losses From Drying Corn Below 15.5% Moisture 1/

Final Dried Kernel Moisture (Percent)	Market Receipts Paid to Farmers Per 56 lbs.	Dry Matter Value Per 56 lbs.	Loss From Overdrying 2/ Cents/Bushel
	Number 2 corn priced at $1.00/bushel		
9.0	$1.00	$1.08	8¢
10.0	1.00	1.07	7
11.0	1.00	1.05	5
12.0	1.00	1.04	4
13.0	1.00	1.03	3
14.0	1.00	1.02	2
15.5	1.00	1.00	0
	Number 2 corn priced at $1.10/bushel		
9.0	$1.10	$1.18	8¢
10.0	1.10	1.17	7
11.0	1.10	1.16	6
12.0	1.10	1.15	5
13.0	1.10	1.13	3
14.0	1.10	1.12	2
15.5	1.10	1.10	0
	Number 2 corn priced at $1.20/bushel		
9.0	$1.20	$1.29	9¢
10.0	1.20	1.28	8
11.0	1.20	1.26	6
12.0	1.20	1.25	5
13.0	1.20	1.24	4
14.0	1.20	1.22	2
15.5	1.20	1.20	0
	Number 2 corn priced at $1.30/bushel		
9.0	$1.30	$1.40	10¢
10.0	1.30	1.38	8
11.0	1.30	1.37	7
12.0	1.30	1.35	5
13.0	1.30	1.34	4
14.0	1.30	1.32	2
15.5	1.30	1.30	0
	Number 2 corn priced at $1.40/bushel		
9.0	$1.40	$1.51	11¢
10.0	1.40	1.49	9
11.0	1.40	1.47	7
12.0	1.40	1.46	6
13.0	1.40	1.44	4
14.0	1.40	1.42	2
15.5	1.40	1.40	0
	Number 2 corn priced at $1.50/bushel		
9.0	$1.50	$1.62	12¢
10.0	1.50	1.60	10
11.0	1.50	1.58	8
12.0	1.50	1.56	6
13.0	1.50	1.54	4
14.0	1.50	1.53	3
15.5	1.50	1.50	0

1/ Source: FM-122 University of Minnesota, C. Cuykendall & L. Christenson, 1967.

2/ This does not include any fuel costs required to get to this moisture level.

How Much Can You Afford for a Grain Drying System?

Many producers are faced with the question, "How many dollars can I aff to invest in a new drying and handling system for shelled corn?" The answer this depends on alternatives available and volume to be dried annually. One might design a drying system because of show or pride, speed of handling, la of alternatives, etc. and other growers want to set up a system only if it re sults in lower cost than their alternatives. This worksheet is designed to d termine the break-even investment which will make a corn grower equally well dollarwise as the commercial alternative. After working your case through yo will have to shop for the system to meet your needs and compare it to see if will result in a higher or lower cost, than commercial drying.

Worksheet to Calculate Investment in Drying Equipment Compared to Alternative Drying Charge

1. Shrinkage: You can not avoid the shrink no matter where or when grain is dried. Therefore make all comparison of costs on a net dry grain basis (15.5% kernel moisture for corn).

	Example Based on Shelled Corn (15.5%)	Your Farm
	--cents per dry bushel--	
2. Commercial or Alternative Drying Costs: Use a harvested average moisture level for selection of the specific alternative drying charge (e.g. 25% moisture). This is the alternative amount you would have per dry bushel to cover your drying, handling and risk costs.	13.6¢	_____
3. Less your estimated drying gas and electricity costs on a dried bushel basis. (Also add costs of any additional labor need as a result of drying operation). For this cost use your past records or those of neighbors with similar drying systems. This cost often is between 4 and 7¢ per dry bushel depending upon points removed and weather factors.	5.6¢	_____
4. Amount remaining to cover ownership costs of the system (2-3). This is the amount that can be capitalized into your complete drying system.	8.0¢	_____
5. Bushels of corn (15.5% basis) to be dried annually with the system.	20,000	_____
6. Break-even annual ownership costs - (Multiply line 4 times line 5) This amount could be applied annually on the fixed costs of ownership of the system.	$1600.00	_____

	Example Based on Shelled Corn (15.5%)	Your Farm
7. Estimation of annual ownership costs of the drying system based on a percent of purchase price.		
Overhead Item	Percent	
Depreciation (8 yrs.)	12.5	_____
Interest ($\frac{\text{annual rate}}{2}$)	4.0	_____
Repairs	4.0	_____
Insurance	.5	_____
Total	21.0%	_____
8. Line 6 divided by line 7 expressed as a decimal.		
Break-even Annual Ownership Costs / Annual Ownership Costs as a Percent of Purchase Price	$\frac{1600}{.21}$	_____
9. The answer equals break-even investment for drying and handling equipment.	$7,600	_____

10. Other Considerations: The above method gives an investment figure based on the data you supply. It does not include risk of grain going out of condition; fixed costs of present equipment nor the availability of labor or commercial drying at harvest time. Each of these items should be considered in deciding the best alternative. If the price you must pay for a system is more than the break-even investment maximum it is highly likely your business is not large enough to justify that system. Alternatives are to continue selling wet and pay the drying, or consider joint ownership or custom work to put more bushels through the system annually. By mismanagement and overdrying the potential profits gained by on the farm drying can sometimes be lost. Therefore, alternative use of management and capital must be considered after any budgeted change in the farm business.

Table 4 shows the break-even investment possibilities under varying returns to overhead costs and increasing quantities of grain dried. 1/ You can use the worksheet for your farm or if your fixed cost percentages are the same as the example (21% of purchase price) you may go directly to the table to obtain investment figure to adjust for your farm situation. For example if you overdry and fuel costs are increased by 2¢ under the preceding assumption this leaves only 6¢ per bushel to be capitalized over the 20,000 bushels or a break-even investment of $5700 rather than $7600.

1/ For a general discussion:selecting grain drying methods, performance relationships and estimated costs under Midwest conditions see "Selecting a Grain Drying Method" AE-67, Coop. Ext. Service, Purdue University, October 1966.

Table 4. Break-even Investment for Drying and Handling Equipment 1/

Cents Per Bushel (15.5%) For Overhead Costs	Annual Bushels to Dry (15.5% Basis)					
	5,000	10,000	15,000	20,000	30,000	40,000
4¢	$1000	$1900	$2900	$3800	$5700	$7600
5	1200	2400	3600	4800	7100	9500
6	1400	2900	4300	5700	8600	11400
7	1700	3300	5000	6700	10000	13300
8	1900	3800	5700	7600	11400	15200
9	2100	4300	6400	8600	12900	17100
10	2400	4800	7100	9500	14300	19000

1/ Based upon annual overhead costs of 21% of purchase price. Investments rounded to the nearest $100.

at Does It Cost To Store Shelled Corn 1/

The purpose of this section is to help to determine the relative costs of
elled corn storage. Your first decision is to determine whether to store or
ell at harvest. Your decision to store should be based upon: (a) availability
nd convenience of home or commercial facilities, (b) harvest price and discounts
r premiums, (c) your costs of storage vs. outlook for seasonal price change,
d) additional requirements of artificial drying, labor, and cash availability.
ou will then have to weigh the economics of home vs. elevator storage which is a
unction of all the above considerations and length of storage. If you store,
hen you should consider the merits and costs of the government grain seal program.
astly, what potential price rise would be required for you to store through 2, 4,
3 months, etc. The example in Table 5 has been worked through on the basis of 9
months of storage. You should consider this only as one example period of time and
calculate your approximate costs for your period of storage in the blanks.

Table 5. Costs Incurred When Storing Shelled Corn

Months of Storage -	Approx. Costs For Storing Shelled Corn: Typical Farm Bin 9 Months	Typical Elevator 9 Months	Your Costs Months
	---------- cents per bushel ----------		
Items			
1 - Bin Use Cost	3.5¢	--	____
2 - Elevator Storage (1¢ per 20 days per bu.)	--	13.5¢	____
3 - Extra Handling	2.5	--	____
4 - Losses and Damage	2.0	--	____
5 - Interest on Commodity Investment 8% on price of $1.10 per bu. (use cost). Use a lower percent if sealed under governmental loan.	6.3	6.3	____
6 - Commodity Insurance (41¢ per $100 insured)	.4	--	____
7 - Total Storage Cost	14.7¢	19.8¢	____

1/ Source FM-125R University of Minnesota, C. Cuykendall & L. Christenson, 1968

Data and Judgments to Assist You to Determine Your Storage Costs 1/

Column 1: ON THE FARM - Not Under Government Chattel

1. Bin Use Cost. Multiply purchase price per bushel times annua use cost (depreciation, interest, repair and maintenance, in- surance, and taxes).

   e.g. 30¢ per bushel times 11.7%

3. Extra Handling. This is the charge for the in and out labor a power plus the year around sampling and checking on condition quality. Estimated at 2.0 to 2.5¢ per bushel.

4. Losses and Damage. Corn loses weight as a result of handling, terioration, rodent and insect damage. Depending upon the sto: structure add up to a 2¢ per bushel for losses.

5a. Interest On Commodity Investment. The producer with a stored commodity has no rate of return on the corn which represents capital invested. To compare alternatives he must charge again the practice a rate of return he would expect to pay for the us of additional funds.

$$110¢ \times .08 \times \frac{1}{12} \text{ year} = .7¢ \text{ per bushel per month}$$

Multiply the monthly rate times months stored to determine per bushel charge.

5b. Sealed Under Government Chattel. An interest bearing chattel is an expense until commodity is bought back. Per bushel monthly charges equal county loan rate times interest rate times period of the loan. Assuming you retained control of the commodity and bought back July 31 the loan interest would be:

$$110¢ \times .036 \times \frac{1}{12} \text{ year} = .33¢ \text{ per bushel per month}$$

Use Cost on Corn Not Eligible For Loan Collateral. Usual practic to protect producer and loaner is to seal the bin at 90% of esti- mated volume. Thus 10% of the crop cannot be used as collateral for the chattel mortgage. Use cost on the balance is calculated at:

$$110¢ \times .08 \times \frac{1}{12} \text{ year} \times .10 = .07¢ \text{ per bushel per month}$$

$.33 + .07 = .4¢$ per month x 9 months = $3.6¢$ instead of non-sealed use cost of $6.3¢$

6. Commodity Insurance. Add in the insurance premium of the stored crop. e.g. 41¢ per $100 insured resulting in an annual charge of 0.4¢ per bushel.

Column 2: TYPICAL ELEVATOR STORAGE - Not Under Government Chattel

2. Elevator storage is often 1.5¢ per bushel per month. Multiply monthly rate times months stored to determine storage cost.

5a. Same as in A.

1/ Numbers refer to items on page 9.

Graphical Analysis

The attached graph shows accumulated costs by months based upon the preceding example.

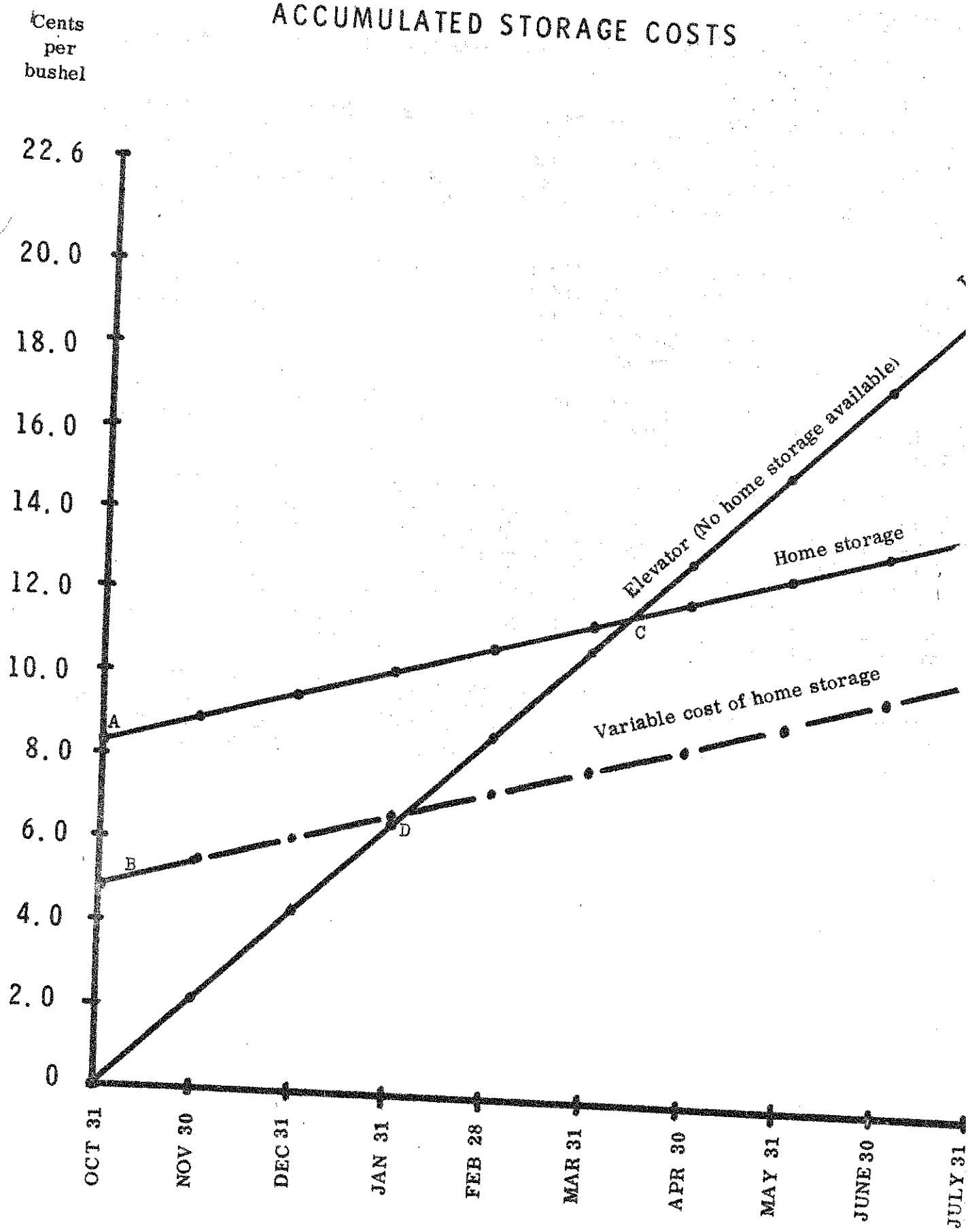
Line I represents the total costs of home storage for any individual month. The slope of the line or the amount if increase from one month to the next is the amount of the opportunity cost of funds tied up. e.g. .7¢ per bushel per month. At point A one has incurred all the in and out charges and the decision to storage one additional month should be based upon the marginal cost marginal revenues principle.

Line III represents the variable costs of home storage (total costs minus fixed bin costs). Point B is determined by total costs at: A (8.4¢) minus fixed bin cost (3.5¢). After one has the bin and if there is no other use for it this 3.5¢ is a sunk cost and the decision to store or sell should be made using this line. The slope is the same as line I.

Line II represents the costs of elevator storage. It is a uniform cost of 1.5¢ per bushel per month plus the opportunity cost of funds tied up .7¢ per bushel per month.

Point C represents the break-even point between covering all costs of home storage vs. commercial storage. When considering buying a storage unit one would choose purchase if the storage period was later than the break-even date of mid-April. If one were considering new storage both the fixed and variable costs are relevant. Line I assumes use of the storage every year for 15 years to get the average fixed costs down to 3.5¢ per bushel. Years in which the structure is not used still incurs a fixed cost of the same amount. If one was desiring short time storage the commercial facilities are more attractive.

Point D represents the break-even point when the fixed costs of the bin are ignored. Decisions to store at home or commercially now have a break-even date of mid-February. Storage up to that date would be less expensive commercially and longer term home storage cheaper than commercial if carried beyond that date.


ACCUMULATED STORAGE COSTS
Cents per bushel
22.6
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0
Elevator (No home storage available)
Home storage
Variable cost of home storage
A
B
C
D
OCT 31
NOV 30
DEC 31
JAN 31
FEB 28
MAR 31
APR 30
MAY 31
JUNE 30
JULY 31

Storage Costs Vs. Storage Returns

Cash grain farmers who hold dry shelled corn do so with the expectation that the stored price will exceed the harvest time price by more than the additional costs incurred. They must have an estimation of the costs of storage in order to compare this with the monthly price change of corn.

The 10 year historical average data for the state can be used only as a lesson in history. Tables 6A and 6B represent what has happened to corn prices over the last 10 years.

Table 6A shows the 10 year average monthly corn price changed 8 cents between November and the following May. This would represent the average expected return for holding that period of time. Local conditions of surplus and deficit feed areas cause these figures to move up or down and local prices should be used to make your marketing decisions.

The price change from November to May is shown annually in Table 6B. One can see little variation in the 1960-64 period and more variability in the 1965-69 period. Two years, in this latter period, the price change from harvest to May was not enough to cover the variable costs of storage.

In retrospect one can look back at the historical outcome of selling during the high month whenever it occurred. This shows a similar uniform price pattern in the 1960-64 period but the peak occurred sporadically in each of 5 different months.

The latter 5 years finds even more price variability and the high month tends towards the latter part of the crop year. The 1969 crop which was marketed in 1970 shows an abnormally high return to storage because of the uncertain effects of southern corn leaf blight.

After once deciding to put corn into storage you incur a 7 to 9¢ fixed cost whether storing for 1 week or 50 weeks. Your decision to continue storing or sell now is one of how much additional cost will be incurred vs. the change in market price. The previous graph and calculations indicate that the cost of storing 1 additional month (corn $1.10) would be around .7¢ per bushel. Any price change in excess of this added cost would be profitable.

From this historical glance one can see there are many price marketing factors to be considered and no "pat" answer can be used in one's marketing decision. The price changing forces of locality, exports, feed requirements, carryover, forthcoming production and all other utilization factors affect the cycle of stored corn prices.

Table 6A.

Corn Prices Received by Farmers, New York Mid-Month Average 1960-1969 1/

November	$1.24	May	$1.32
December	1.27	June	1.32
January	1.28	July	1.32
February	1.30	August	1.31
March	1.31	September	1.31
April	1.31	October	1.27

Table 6B.

Corn Prices Received by Farmers, New York Mid-Month Average Price Change From November to Following May and From November to Highest Month Thereafter 1/

Crop Year	Price Change (cents per bushel) November to Following May	November to Following High Month	
1960-61			
1961-62	$.08	$.11	March
1962-63	.07	.10	June
1963-64	.09	.13	August
1964-65	.10	.11	September
5-yr. average (60-64)	.08	.09	February
	$.08	$.11	
1965-66			
1966-67	$.13	$.23	September
1967-68	.01	.03	February
1968-69	.03	.06	March
1969-70	.17	.17	May
5-yr. average (65-69)	.09	.27	September
	$.09	$.15	
10-yr. average (60-69)	$.08	$.13	

1/ Agricultural Statistics, New York Crop Reporting Service; AMA Release No. 115, 119; 1968, 1969; N.Y.S. Agricultural Prices AMA Release No. 79, 1964.