Profits and Losses from On-Farm Drying and Storage of Grain Sorghum in Central Texas and the Coastal Bend

TEXAS AGRICULTURAL EXPERIMENT STATION
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in cooperation with the
UNITED STATES DEPARTMENT OF AGRICULTURE
The cost of owning and operating round bins and drying equipment when used at capacity for on-farm drying and storage of grain sorghum in the Coastal Bend area was 34 cents per hundredweight and 30 cents per hundredweight in the Central Texas area. These costs were based on a study of 91 units over two drying and storage seasons, 1954-55 and 1955-56. The costs with a building were slightly higher.

The seasonal price spread cannot be compared directly with the cost per hundredweight of on-farm drying and storage since grain is sold on a 15 percent moisture content basis at harvest. Grain stored on-farm should be dried to 12 percent moisture. The value of the loss in weight as well as other incidental costs and benefits, such as interest charges and discounts for high moisture grain, should be considered in the purchase of an on-farm unit.

The average seasonal price spread between harvest price in July and selling price in March was 42 cents per hundredweight for the 10-year period 1946-47 through 1955-56. The price spread was slightly larger for grain harvested in August.

Considering only the average price spread over the past 10-year period, this study indicates that it would not pay the average farmer to purchase an on-farm unit to dry and store and sell later in the season or put the grain in loan. For example, the total cost, 49 cents, of drying and storage of 16 percent moisture grain in Central Texas consists of a basic cost of 30 cents; value of weight loss in drying from 16 to 12 percent moisture, 10 cents; and interest on grain during storage, 9 cents. This total cost of 49 cents compares with total benefits of 47 cents—the price spread between July and March and the discount on grain above 15 percent moisture level, 5 cents. As the moisture level increases, the total benefits increase more rapidly than the total costs.

Where the farmer dries and stores to feed livestock or poultry, the purchase of a unit may be profitable. If the production of grain sorghum in the near future remains at present high levels or increases, the price spread may widen, making the purchase of the unit profitable both for feeding and for storage for cash sale.
On-Farm Drying and Storage of Grain Sorghum
in Central Texas and the Coastal Bend

R. J. HILDRETH and C. A. MOORE*

Grain sorghum combined in the Coastal Bend and Central Texas areas usually has a moisture content too high for safe storage. The grain must be dried artificially before it can be stored. Farmers must sell the grain at the time volume is greatest and prices usually lowest unless on-farm or commercial storage facilities are available. If the crop is left in the field until the grain is dry enough for immediate storage, heavy losses may occur from storm, bird or insect damage and from shattering when combined.

A number of on-farm drying and storage installations for grain sorghum, using unheated air, have recently been constructed in the Coastal Bend and Central Texas areas. The design and recommended operating procedure for these units are based on the results of tests conducted at Substation No. 1 at Beeville. There has been considerable interest in on-farm drying and storage units with the expansion of government facility loans for storage and conditioning equipment and the continuance of the commodity credit loan program.

This report answers questions farmers have raised about the economics of on-farm drying and storage of grain sorghum. These questions concern the costs of owning and operating on-farm drying and storage units, the benefits from owning on-farm units as opposed to selling at harvest time, the ability of the farmer to maintain quality of the stored grain sorghum, and the size of the unit to purchase.

This report is based on information obtained over two drying and storage seasons (1954-55 and 1955-56). Operating practices and cost information were obtained on 21 units during the 1954-55 season and 77 units during the 1955-56 season. Figure 1 shows the counties in which these installations were located. Quality information was obtained from farmers and from samples of grain sorghum taken from the units. Overhead cost information was obtained from farmers and building equipment dealers.

Figure 1. Location of counties included in study.

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COSTS OF ON-FARM DRYING AND STORAGE

Operating Costs

Operating cost information was obtained on the operation of 21 units during the 1954-55 season and 32 units during the 1955-56 season in the Coastal Bend area. The operation of 45 units was studied in Central Texas during the 1955-56 season.

The operating costs per hundredweight (100 pounds) for the two areas are presented in Table 1. The combined costs for the 1954-55 and 1955-56 season represent a weighted average for the 2-year period in the case of units in the Coastal Bend.

The total costs in Table 1 do not represent an average of actual farmer costs. They are made up of totals for the individual cost items. The individual cost items are averages of farmer experience. However, certain items may not be experienced by all farmers; for example, insect control measures were not needed each year by...
all farmers. Thus the total costs for an individual farmer may tend to be lower than those indicated.

Two major types of units were used: round bins and quonset-type buildings, Figures 2 and 3. An analysis of the operation cost for each type of unit indicated only slight differences in costs. Thus, no distinction is made between the two types of units in Table 1.

The costs presented are for a season of 7 to 8 months, July or August to March. Most costs do not vary with the length of the storage period. Only the grain insurance and the insect control costs would vary slightly with the length of the storage period.

Cleaning Bins

During the 1954-55 season few farmers incurred this cost since the buildings were new. The costs for this season were based on operations at the Substation No. 1, Beeville. The costs during the 1955-56 year were based on farmer experience and did not vary much from the estimated cost during the 1954-55 season.

<table>
<thead>
<tr>
<th>Item</th>
<th>Coastal Bend</th>
<th>Central Texas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of units</td>
<td>21</td>
<td>32</td>
</tr>
<tr>
<td>Cleaning bins</td>
<td>0.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Labor</td>
<td>2.6</td>
<td>2.8</td>
</tr>
<tr>
<td>Extra hauling</td>
<td>5.3</td>
<td>8.1</td>
</tr>
<tr>
<td>Electricity</td>
<td>1.9</td>
<td>2.0</td>
</tr>
<tr>
<td>Insect control</td>
<td>4.6</td>
<td>3.6</td>
</tr>
<tr>
<td>Value of loss due to shrinkage and handling during storage</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>Grain insurance</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Total</td>
<td>17.8</td>
<td>21.0</td>
</tr>
</tbody>
</table>

Labor

This item includes the cost of labor used in loading the grain into the drying unit from trucks at harvest time and loading it into trucks to be taken to market. Most of the labor used was hired; even if it were not hired the operation ties up labor that could be used in other parts of the farm. The labor charge is based on an average of the time necessary to perform the jobs as estimated by farmers, and an assumed wage rate of 75 cents per hour.

There was little difference in cost between seasons in the Coastal Bend area. The charge per hundredweight was higher in Central Texas than the Coastal Bend, probably because of less efficient utilization of crews with the smaller units.

Extra Hauling Cost

Grain dried and stored on the farm involves an extra hauling charge. It was assumed that the cost of hauling grain from the building to market (distance A, Figure 4) was approximately equal to that which would be incurred at harvest time if the grain were hauled directly from the field to market or to commercial drying and stor-
age facilities (distance B, Figure 4). Hauling
the grain from the field to the bin (distance C,
Figure 4) then is an extra cost incurred with the
use of on-farm drying and storage.

There is considerable variation among individ-
ual farm units in the hauling cost. In many local-
ities a normal charge for this operation is 10 cents
per hundredweight if a hired trucker is used.
Where the farmer uses his own trucks or trailers
to bring the grain from the field to the building,
the cost is considerably less. The cost presented
in Table 1 is an average of the two methods. The
average cost of hauling was higher during 1955-
56 than during 1954-55 for the Coastal Bend area.
The cost for the Central Texas area is less be-
cause of shorter hauls with smaller farms and
more use of farmer equipment.

A number of farmers expressed the opinion
that hauling grain from the combine to market
involves more expense than hauling the grain from
the on-farm units to market. They felt the need
to keep the harvesting operation in progress
tended to tie up more equipment during harvesting
than in moving the grain from the unit after har-
vest when the pressure of harvest is off. Also
many farmers sold the grain in the bin with de-
layed expense borne by the grain buyer. Under
these conditions, depending on whether the price
offered is reduced by the full transportation
charge, this cost may be less or eliminated. Thus,
the charge per hundredweight given here may
overstate the extra hauling cost.

Electricity

Electricity was used to dry, aerate and, in
most cases, to load and unload the grain. The cost
of electricity mainly depends on the amount
of moisture removed from the grain during the dry-
ing. The moisture of the grain as it went into the bins ranged from 13 to 25 percent with most of
it below 15 percent; usually the grain was dried
to at least 12 percent moisture. However, it was
impossible to relate this cost to the amount of
moisture removed since many farmers operated
their fans longer than necessary or when climatic
conditions prevented effective drying. The costs
during the two seasons for the Coastal Bend were
similar, with the cost in Central Texas lower.
This lower cost for Central Texas probably was
caused by the lower moisture of the grain when it
went into the bin.

Insect Control

Almost all units had insect infestations large
enough to warrant control practices. The costs
shown in Table 1 are for material and labor.

Grain Insurance

Grain insurance for fire and lightning and ex-
tended coverage was obtained by 5 of the 21 farm-
ers during 1954-55 and 2 of the 32 farmers dur-
ing 1955-56 in the Coastal Bend. It was obtained
by 7 of the 45 units in Central Texas. Grain in-
surance is a legitimate operating charge for all
units. Those not insured are undertaking a risk
similar to the insurance charge. The charge is
based on insurance rates in the area.

Shrinkage During Storage

Grain is sold at harvest time on a basis of 15
percent moisture. The reduction in weight that
usually occurs during storage represents an extra
cost. This loss in weight is caused mainly by
decreases in moisture content, which may not oc-
cur with high humidity during aeration of the
stored grain.

The loss in weight during storage was com-
puted on the basis of 6 years’ experience at the
Substation No. 1, Beeville; a reduction of 1 per-
cent of the dry weight (12 percent moisture) of
the grain, and the average July price of 2.22 per
hundredweight during 1946-47 through 1955-56.

Overhead Costs

Overhead costs are the annual cost of owner-
ship. A summary of overhead costs for different
types of structures and handling equipment is
shown in Table 2. The figures in this table were
obtained on commercially constructed units from
farmers with on-farm drying and storage facil-
ities and from building and equipment dealers.
They do not represent an average of farmer ex-
perience but represent the overhead cost of units
of specific size and type. The overhead cost in-
f ormation was based on commercially construct-
ed units equipped with drying systems that would
supply the minimum airflow rates recommended
by the Texas Agricultural Experiment Station.

The farmer contemplating investing in on-
farm drying and storage equipment should check
with his local dealers to determine the actual
prices of the various units. Building and fan
costs vary. Also, differences in location might
mean different freight rates to the dealers and
thus different prices to the farmers.

TABLE 2. ANNUAL OVERHEAD COSTS OF ON-FARM DRY-
ING AND STORAGE OF GRAIN SORGHUM FOR
UNITS OF SELECTED SIZE AND TYPE

<table>
<thead>
<tr>
<th>Item</th>
<th>Round bin</th>
<th>Quonset type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity*</td>
<td>2—2,200 bushel</td>
<td>1—3 x 60</td>
</tr>
<tr>
<td>Annual costs</td>
<td>2,274 cwt.</td>
<td>7,815 cwt.</td>
</tr>
<tr>
<td>Depreciation on structure, fans, grain moving and other equipment</td>
<td>180</td>
<td>613</td>
</tr>
<tr>
<td>Interest on investment at 6 percent</td>
<td>110</td>
<td>430</td>
</tr>
<tr>
<td>Taxes</td>
<td>8</td>
<td>41</td>
</tr>
<tr>
<td>Insurance on structure</td>
<td>13</td>
<td>58</td>
</tr>
<tr>
<td>Repairs</td>
<td>17</td>
<td>69</td>
</tr>
<tr>
<td>Total</td>
<td>329</td>
<td>1,211</td>
</tr>
<tr>
<td>Annual per cwt. overhead cost at capacity</td>
<td>14.5</td>
<td>15.5</td>
</tr>
<tr>
<td>Three-fourths capacity</td>
<td>19.3</td>
<td>20.7</td>
</tr>
<tr>
<td>One-half capacity</td>
<td>28.9</td>
<td>31.0</td>
</tr>
</tbody>
</table>

*Capacity at a 10-foot depth.
Depreciation

Depreciation expresses the original cost of the building, fans, drying and aeration equipment and grain moving and other equipment as an annual cost over the life of the item. The assumption is made that the building would have a life of 25 years and the fans and motors, 15 years. The portable auger is assumed to have a life of 10 years. These assumptions as to length of life are based on estimates of farmers and the Department of Agricultural Engineering. The length of life assumption for the building is the same as that listed for metal grain tanks in Bulletin "F" published by the Internal Revenue Service. In figuring depreciation charges, provisions were made for salvage values of the units.

Interest on Investment

When the farmer's money is tied up in a drying and storage unit, it cannot be used for other investments. The costs of missing these opportunities are represented by this figure, which is generally a noncash cost; that is, the farmer does not actually pay interest unless he has borrowed money. The rate of interest used was 6 percent.

Taxes

Property taxes had not been assessed because most of the units studied were new. The assumption was made that the buildings would be valued at 20 percent of one-half of the original cost. The tax cost was computed by applying the average rates of the various taxing agencies in certain counties in the grain sorghum production area to the assumed valuation.

Insurance

Insurance provides fire and extended coverage on the structure and equipment. The charge is computed from information on insurance rates for the types of structure studied.

Annual Repairs and Upkeep

The cost of annual repairs on the structure, fans, motors and grain-handling equipment was computed since most of the units have not been in use long enough to determine accurately what actual experience will be. Necessary repairs were based on estimates by the Department of Agricultural Engineering. It was assumed that 0.5 percent of the initial cost of the buildings and equipment will be spent for repair each year.

Annual Overhead Costs

The annual overhead costs are presented in Table 2. These costs are constant each year, thus, the cost per hundredweight depends on the level of utilization.

Capacity of the units is defined at the 10-foot depth. If the grain to be dried has a moisture content above 15 percent, it is recommended that an 8-foot depth be used, below 15 percent, 10 feet. However, even if the moisture content of the grain is above 15 percent, a 10-foot capacity can be utilized. The first grain harvested can be placed in the bin below an 8-foot depth and dried to 15 percent or less. Then additional grain can be placed on top of the relatively dry grain to a 10-foot depth. (For detailed operation recommendations, see Texas Agricultural Experiment Station Bulletin 885, "Research on Farm Drying and Storage of Sorghum Grain," J. W. Sorenson, Jr., et. al.)

Costs not Included

Interest on the value of the grain during the storage period was not included in the operating costs. It is included in the evaluation presented in a later section.

A charge for deterioration in quality during drying and storage has not been included. Most farmers maintained grade and suffered no economic loss. However, there is a risk that quality deterioration may occur as well as a risk that a price decline may occur. It is extremely difficult to put a value on this risk. The cost of management also is very hard to evaluate and was not included. The farmer will have to balance the benefits against the value he places on his management.

Total Costs

There is no one definite answer to the question: "What does it cost to dry and store grain on the farm?" The total cost per hundredweight depends mainly on the extent to which drying and storage facilities are used. Overhead costs are the same regardless of how much grain is dried and stored. The overhead cost per hundredweight and the total cost per hundredweight decrease as the amount of grain dried and stored increases. The cost will be less at capacity than if half of capacity is used.

Total costs per hundredweight at capacity, three-fourths capacity and one-half capacity are presented in Table 3 for the round-bin unit. These costs were obtained by dividing the constant overhead cost by the number of hundredweight dried and stored and adding the operation cost per hundredweight. The decrease in cost as the level of utilization increases for the bin unit in Central Texas is shown in Figure 5.

<table>
<thead>
<tr>
<th>Level of Utilization</th>
<th>Coastal Bend</th>
<th>Central Texas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity'</td>
<td>34.3</td>
<td>30.3</td>
</tr>
<tr>
<td>Three-fourths capacity</td>
<td>38.1</td>
<td>35.1</td>
</tr>
<tr>
<td>One-half capacity</td>
<td>40.7</td>
<td>44.7</td>
</tr>
<tr>
<td>Ten-foot depth</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE 3. ANNUAL TOTAL COST PER HUNDREDWEIGHT OF ON-FARM DRYING AND STORAGE OF GRAIN SORGHUM AT VARIOUS UTILIZATION LEVELS FOR ROUND-BIN UNITS, COASTAL BEND AND CENTRAL TEXAS
EFFECT OF ON-FARM DRYING AND STORAGE ON QUALITY

A major consideration in using on-farm drying and storage for grain sorghum is the effect this method has on quality. Quality in this study was measured by the grade of the grain sorghum. Although the cost for on-farm drying and storage may be low and less than the gain from the seasonal price spread, the farmer may suffer a loss in income unless grade can be maintained.

During 1954-55, the study of quality maintenance consisted of farmers’ reports of the grade at which they sold the grain. Grade information was obtained on 45 different bins of grain dried and stored by the 21 farmers surveyed. The grain in 55 of the bins, 78 percent, graded No. 1 at the time of sale. The grain in 10 bins, 22 percent, graded No. 2. All of these units were located in the Coastal Bend area.

An intensive study of the drying and storage operation of 16 farmers with 38 bins of grain sorghum was made during 1955-56. Samples of the grain were taken during the unloading process (check sample). This grain was dried in thin layers in the open air and then graded by grain inspectors of the USDA. A second sample was taken from the farmer’s bin after the grain was dry (dry sample). A third sample was taken from the bin before sale (sale sample), in the cases where the grain was stored. Deep bin probes were used to take the samples at various levels in the bin.

The percentage of the units with increases, decreases and no change in grade during the drying period and storage period is given in Table 4. Few bins of grain sorghum had a decrease in grade during either drying or storage, and a few showed an increase during storage. The decrease in those bins showing a decrease was only 1 grade. Most of the changes probably were caused by sampling error in the bins. At the time of sale, only 2 out of the 38 bins were No. 3 grain. None of the bins were below No. 3.

The economic importance of the effect of this method of drying and storage on grade is indicated by the lack of a price differential between No. 1 and No. 2 grade. Thus, it appears that farmers can maintain quality with on-farm units. With reasonable management and proper equipment, the farmer should suffer little economic loss from quality deterioration.

TABLE 4. CHANGE IN GRADE OF GRAIN SORGHUM DURING DRYING AND STORAGE, 1955-56

<table>
<thead>
<tr>
<th>Time period</th>
<th>Increase</th>
<th>No change</th>
<th>Decrease</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drying period</td>
<td>0</td>
<td>92</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>(Check sample to dry sample)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage period</td>
<td>14</td>
<td>77</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>(Dry sample to sale sample)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GROSS RETURNS TO ON-FARM DRYING AND STORAGE

When the producer harvests his grain, he may sell the grain at harvest or hold it in storage for later sale or for use in a feeding program. If he holds it for later sale or for feeding, he must pay storage and handling expenses until it is sold.

Whether it pays the farmer to store his grain for later sale depends on an increase in price after harvest large enough to more than cover the costs of storing and holding the grain.

The difference between harvest prices and prices later in the season may be determined by studying the seasonal price pattern of grain sorghum. This difference in seasonal price provides the farmer his gross returns to the storage oper-

TABLE 5. SEASONAL CHANGE IN GRAIN SORGHUM PRICE FROM JULY AND AUGUST BY PERIODS, 1946-47 THROUGH 1955-56

<table>
<thead>
<tr>
<th>Months</th>
<th>Difference between July and later prices</th>
<th>Difference between August and later prices</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First 5-year period¹</td>
<td>Second 5-year period¹</td>
</tr>
<tr>
<td>September</td>
<td>-1</td>
<td>18</td>
</tr>
<tr>
<td>October</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>November</td>
<td>14</td>
<td>26</td>
</tr>
<tr>
<td>December</td>
<td>16</td>
<td>36</td>
</tr>
<tr>
<td>January</td>
<td>28</td>
<td>35</td>
</tr>
<tr>
<td>February</td>
<td>14</td>
<td>37</td>
</tr>
<tr>
<td>March</td>
<td>38</td>
<td>45</td>
</tr>
<tr>
<td>April</td>
<td>37</td>
<td>40</td>
</tr>
<tr>
<td>May</td>
<td>38</td>
<td>50</td>
</tr>
</tbody>
</table>

¹Five-year period. 1946-47 through 1950-51.
²Five-year period. 1951-52 through 1955-56.
³Ten-year period. 1946-47 through 1955-56.
Table 5 shows the gross returns to grain sorghum storage in the form of price margins between harvest (July and August) and later prices, for the 10-year period 1946-47 through 1955-56 in Crop Reporting District Eight of Texas. The data are based on reported but unpublished mid-month farm prices in the District supplied by the division of Agricultural Estimates of the United States Department of Agriculture.

There was no discernible upward or downward trend in grain sorghum price over the 10-year period studied, indicating that the results drawn from the seasonal behavior of price over the period could not be affected materially by trend. The prices used in this study are not adjusted for trend.

Grain is sold on a 15 percent moisture content basis at harvest. Storage, to take advantage of possible price increases later, involved the cost of drying the grain to a 12 percent moisture content as well as a weight loss due to drying—100 pounds of 15 percent grain becomes only about 96.6 pounds when dried to 12 percent. These costs of storage are included along with other costs in the following section, so no adjustment is made in the harvest price in this section.

The largest returns to storage of July grain over the 10-year period averaged 42 and 44 cents per 100 pounds of sales from storage in March and May, respectively. Returns to storage of August grain were somewhat higher since August is the lowest price month. The 10-year average March and May prices were 45 and 47 cents, respectively, above the average August price.

Since the behavior of prices is uncertain, the farmer who stores is interested in determining the period when prices are usually at a seasonal peak and whether he can profit by consistently storing and selling in that period. March, April and May had higher average prices over the 10 years than other months.

**Table 6. Difference between Harvest and March, April and May Grain Sorghum Prices by Seasons, 1946-47 through 1955-56**

<table>
<thead>
<tr>
<th>Season</th>
<th>July grain stored and sold in</th>
<th>August grain stored and sold in</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>March</td>
<td>April</td>
</tr>
<tr>
<td></td>
<td>1946-47</td>
<td>-48</td>
</tr>
<tr>
<td></td>
<td>1947-48</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>1948-49</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>1949-50</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>1950-51</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>1951-52</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>1952-53</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>1953-54</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>1954-55</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>1955-56</td>
<td>28</td>
</tr>
<tr>
<td>10-year average</td>
<td>42</td>
<td>39</td>
</tr>
</tbody>
</table>

Table 6 shows the annual difference between harvest price and prices in those three, usually "peak" price, months. For example, annual returns on July grain sold from storage in March varied from a 48 cent loss to a 99 cent gain, but averaged 42 cents over the 10-year period. The table shows the considerable variation in annual returns from grain sorghum storage.

Since the farmer has little basis for correctly predicting what will happen to prices each year, consistent action over a period of years appears the better policy in deciding whether to sell at harvest or store. The 10-year average returns are a better guide for consistent action.

**COMPARISON OF COSTS AND BENEFITS**

The comparison of costs of on-farm drying and storage to benefits is made for three situations the farmer may face. The three situations are: (1) farmer dries and stores grain for later sale rather than sell at harvest, (2) farmer dries and puts grain in Commodity Credit Corporation (CCC) loan and forfeits grain rather than sell at harvest and (3) farmer dries and stores grain and feeds out rather than sell at harvest and buy back during feeding period. The third situation applies only to the farmer with livestock or poultry and the possibility of feeding the grain.

The benefits computed in this study depend to a large extent upon the seasonal spread in the Eighth District prices. This spread may not represent the exact situation faced by certain farmers. The prices for each month in any particular year represent an average of prices quoted at various locations. Certain farmers may expect a larger or smaller spread than shown in the prices used in this study. For example, the 21 farmers contacted during the 1954-55 season reported an average harvest price of $1.66 per hundredweight and an average selling price of $2.50 per hundredweight, a spread of 86 cents per hundredweight. This compares with the reported spread between July and March prices of 44 cents in Eighth District prices. Part of the difference between farmer experience and the reported prices may be caused by quoting of harvest prices by the farmers on the basis of offers received at the "turn-row" where the buyer bears the transportation cost. If this were true, it would tend to explain part of the difference between the two spreads. However, the only reliable price data available over a period of years are those used in this study.

**Drying and Storage for Later Sale**

In the analysis of the first situation, drying and storing for later sale rather than selling at harvest, the results depend on the moisture level at which the farmer harvests the grain. Grain can be sold with up to 15 percent moisture at harvest time at no discount. However, if the
grain is above 15 percent moisture, there is a general discount of 5 cents per 1 percent of moisture above 15 percent.

The items of cost and benefit used in evaluating this situation at various moisture levels for the Coastal Bend and Central Texas area using round bins are shown in Table 7. The basic cost is taken from Table 3 when the farmer uses his round bins at capacity. It is assumed that little or no additional costs are involved in drying 18 to 16 percent moisture grain than when drying 15 percent grain. There is also a loss in weight involved in drying and storing for later sale since the farmer could sell the grain at a 15 percent level at harvest time, but in order to store safely, he must bring the grain down to 12 percent. The value of this difference in weight was computed by using the average July price discounted for the various moisture levels and the actual loss in weight. There is also the possibility of an interest cost. The farmer has his funds tied up in grain and may have to borrow funds to keep it in storage or he cannot use the funds for paying off the cost of producing the grain. The interest cost is figured on the basis of storing the grain until March at an annual rate of 6 percent. This interest cost per hundredweight was computed by considering the price received at harvest time times the interest rate for the period from July through March.

As an example, the total cost with 17 percent grain in the Coastal Bend is 54 cents per hundredweight, Table 7. This cost is made up of a basic cost of 34 cents, weight loss of 12 cents and interest of 8 cents.

The price of grain sorghum tends to rise later in the storage season, but the highest price does not occur during the same month each year. There was considerable variability in the highest month during the 10-year period, 1946-47 through 1955-56. Thus, this situation has been analyzed under two assumptions. First, that the farmer will always sell the grain in March, the next to the highest month in terms of average price. March is used rather than May, the highest price on an average basis, on the basis that there will probably be more time available to move the grain out during March and that the advantage of the extra few cents per hundredweight gained by holding until May will be more than offset by the availability of labor in March. The second assumption made is that the farmer is able each year with perfect certainty to pick the highest month, which ranges from September through May. The average spread between July and the highest month over the 10-year period is used. (The interest charge will be slightly less when the highest month is picked since the grain is sold before March some years and the total costs for both the Coastal Bend and Central Texas will be 1 cent less than that shown in the total cost column.) Analysis under this assumption sets the upper limit of benefits.

The basic benefits or the spread between July and March and July and the highest month each year is shown in Table 7. A further benefit from on-farm drying and storage is the amount of the discount on the grain due to moisture levels above 15 percent.

A comparison of the total cost columns and the total benefits columns indicates that only at the 17 and 18 percent moisture levels do the benefits exceed the costs when the grain is sold in March. However, in both areas the benefits are equal to the costs at the 15 percent moisture level, assuming the farmer is able to pick the highest month.

In conclusion, on the basis of past prices, it is somewhat doubtful if on-farm drying and storage of grain for sale later rather than at harvest time would be a sufficient basis for the purchase of an on-farm unit. It is doubtful that the typical or average farmer will be able to realize enough return above his cost to pay for the management and risk bearing necessary to hold the grain for later sale. However, insofar as local facilities for buying the grain are not available in certain areas and harvest prices were below the Eighth District average, there may be more justification than is shown in this analysis. Also, if the grain is harvested in August rather than July, a slightly higher price spread occurs. If a substantial number of farmers started storing grain sorghum on-farm and withheld their grain at harvest, the seasonal spread would be lower.

<p>| TABLE 7. COMPARISON OF COSTS PER HUNDREDWEIGHT OF ON-FARM DRYING AND STORAGE OF GRAIN SORGHUM TO BENEFITS OF SELLING IN MARCH AND THE HIGHEST MONTH |
|---------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|</p>
<table>
<thead>
<tr>
<th>Moisture level</th>
<th>Basic costs1</th>
<th>Value of weight loss during drying2</th>
<th>Interest1</th>
<th>Total costs</th>
<th>Price spread</th>
<th>Discount</th>
<th>Total benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal Bend</td>
<td>Central Texas</td>
<td>Coastal Bend</td>
<td>Central Texas</td>
<td>March</td>
<td>Highest month</td>
<td>March</td>
<td>Highest month</td>
</tr>
<tr>
<td>Percent</td>
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<td>34</td>
<td>30</td>
<td>8</td>
<td>9</td>
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<td>47</td>
</tr>
<tr>
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<td>34</td>
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<td>30</td>
<td>14</td>
<td>8</td>
<td>56</td>
<td>52</td>
</tr>
</tbody>
</table>

Costs taken from Table 3 assuming use at capacity of round bins.
1. Computed on the basis of weight loss between moisture level and 12 percent grain and July price less any discount.
2. Computed on the basis of an annual rate of 8 percent and discounted July price. Interest charge for highest month is 1 cent less due to selling of grain before March.
According to the 1957 season, the acreage and production of grain sorghum increased in both Texas and the nation. With grain sorghum a major alternative for acres diverted from cotton, the future holds prospects for continued high production. This will put pressure on the price at harvest time and may lead to a higher spread in prices than in the past.

### Drying and Storage with Grain in CCC Loan

The second situation analyzed is where the farmer puts the grain in CCC loan and forfeits it, Table 8. The cost factors considered are the basic cost factors from Table 7 less the grain insurance, approximately 1 cent; the Agricultural Stabilization Conservation (ASC) service charge, 2 cents per hundredweight; and the value of the weight lost. Interest is not computed as a cost since the farmer will receive his cash for the grain very soon after it is put in loan. The benefits are figured on the basis of the average July price for the Eighth District and the loan rate in two counties, Burleson (Central Texas) and Calhoun (Coastal Bend). The benefits were determined by taking the average loan rate for the 9-year-period 1947-48 through 1955-56 for these two counties. The basic benefits from these two counties are less than the usual or average spread in price for the related 10-year period.

Comparison of the benefits to the cost for both the Coastal Bend and the Central Texas region indicates that the benefits do not exceed the cost at any of the moisture levels. Other counties with other loan rates may show slightly different results from this analysis, but they will not differ greatly. This analysis does not indicate it would not ever pay to put grain sorghum under loan. In certain years on-farm storage, if available, would pay. However, the purchase of a unit based only on the difference of loan price and harvest price may not be wise.

### Drying and Storage for Feeding

The third situation analyzed was where the farmer would dry and store his grain on the farm for feeding out later in the year rather than selling at harvest time and then buying back for feeding purposes, Table 9. The basic cost is that shown in Table 7 less 2 cents since the grain will not have to be loaded out of the building except during the feeding operation; this cost should be charged to the feeding operation. If grain is bought and fed to the cattle, this feeding operation will take place also. The other cost items are the weight loss and the interest for the average feeding period, July through December. The benefits in this situation are considered to be the price spread, the discount for high moisture grain, and a transportation charge to and from market. It was assumed that the total transportation charge would be 20 cents per hundred (10 cents each way). The total benefits are equal to or greater than the total costs in both the Coastal Bend area and Central Texas area with 15 per-

### Table 8. Comparison of Costs per Hundredweight of On-Farm Drying and Storage of Grain to Benefits of Putting Grain in CCC Loan

<table>
<thead>
<tr>
<th>Moisture level</th>
<th>Basic costs</th>
<th>Value of weight loss during drying</th>
<th>ASC service charge</th>
<th>Total costs</th>
<th>Average spread between July price and loan rate</th>
<th>Discount</th>
<th>Total benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coastal Bend</td>
<td>Central Texas</td>
<td></td>
<td>Coastal Bend</td>
<td>Central Texas</td>
<td></td>
<td>Coastal Bend</td>
</tr>
<tr>
<td>Percent</td>
<td></td>
<td></td>
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</tr>
<tr>
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<td>29</td>
<td>14</td>
<td>2</td>
<td>49</td>
<td>45</td>
<td>21</td>
</tr>
</tbody>
</table>

1. Costs taken from Table 3 assuming use at capacity of round bins less grain insurance.
2. Burleson county.
3. Calhoun county.

### Table 9. Comparison of Costs per Hundredweight of On-Farm Drying and Storage of Grain Sorghum to Benefits of Being Able to Store Rather Than Sell at Harvest and Buy Back for Feeding

<table>
<thead>
<tr>
<th>Moisture level</th>
<th>Basic costs</th>
<th>Value of weight loss during drying</th>
<th>Interest</th>
<th>Total costs</th>
<th>Price spread</th>
<th>Discount</th>
<th>Transportation</th>
<th>Total benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coastal Bend</td>
<td>Central Texas</td>
<td></td>
<td>Coastal Bend</td>
<td>Central Texas</td>
<td></td>
<td>Coastal Bend</td>
<td>Central Texas</td>
</tr>
<tr>
<td>Percent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>5</td>
<td>51</td>
<td>47</td>
<td>27</td>
<td>15</td>
</tr>
</tbody>
</table>

1. Costs taken from Table 3 assuming use at capacity of round bins less 2 cents per hundredweight for unloading.
2. Interest at 6 percent annually for 5 months, the average length of storage.
4. Assuming cost of hauling to or from market, 10 cents per hundredweight.
cent moisture. As the moisture level increases, the benefits become greater than the cost by a widening margin. This would indicate a long-run profitability for this type of operation. This is a conservative analysis in the sense that if the farmer were to feed out he would still need some storage since it is doubtful that less than truck loads of grain would be delivered and he would not necessarily be assured of getting the grain when and in the condition he wanted it. There is also some risk associated with the change in price levels of buying the grain later in the year.

**NON-MEASURABLE RETURNS AND COSTS**

The returns and costs of owning on-farm drying and storage equipment are relatively easy to put in dollars and cents. However, there are other costs and benefits that are hard to evaluate in dollars and cents, but which may outweigh measurable costs and benefits.

**Non-measurable Costs**

The management and operation of on-farm drying and storage equipment is time consuming. The farmer has to spend time to operate the fans, make moisture tests and check for insects.

There are risks involved to the farmer from falling prices or deterioration of quality. Although good management may reduce these risks of quality deterioration the farmer must bear them.

If insect control is necessary, the use of fumigants involves some danger.

**Non-measurable Benefits**

Grain sorghum can be harvested at the most convenient time with on-farm drying and storage equipment. Many areas have adequate commercial facilities for drying and storing grain, but during certain periods much grain may be cut in a short time, and it may be impossible to dry all the grain. Thus, the farmer would either have to sell wet grain or let it dry in the field and stand the chance of damage.

On-farm drying and storage installations, such as the quonset type or straight-sidewall building, may be used in off-season periods or in low-yield years for machinery and supply storage. The round bins can be used to store other grains and seed.

**PLANNING SPACE REQUIREMENTS**

Many types and sizes of on-farm drying and storage units are available. One or several bins may be purchased. The quonset-type building or the straight-sidewall building also may be purchased in different sizes and with different bin arrangements.

There are probably two main factors to consider in deciding on the size unit. The first of these factors is the relationship between degree of utilization and cost per hundredweight. Figure 5 shows that the cost per hundredweight increases with a decrease in the degree of utilization. Drying capacity is the second factor. Grain sorghum should not be dried above a 10-foot depth with most of the present types of equipment. If too small a unit is purchased and the attempt is made to dry above a 10-foot depth, there is a danger of loss in quality. If too large a building is purchased, the overhead costs lead to a large total cost per hundredweight.

The size of the unit should be based on the expected future acreage of grain sorghum. Once the basic acreage has been determined, there are at least two different ways to determine the size of the unit. One is on the basis of average yields. For example, with an expected acreage of 100 acres and an average yield of 3,000 pounds to the acre, the farmer should buy a unit with a 3,000-hundredweight capacity. The second alternative is to base the capacity on maximum yields. For example, assuming 100 acres of grain sorghum and a maximum yield of 4,000 pounds to the acre, a building or unit with 4,000-hundredweight capacity should be purchased. This alternative will lead to higher costs per hundredweight during average and below-average yield years. With capacity based on maximum yields, the farmer also would have an extra drying space available as a “turning bin” which could be used in case of high moisture grain sorghum and difficulty in drying.

**REDUCING COSTS**

Various steps can be taken in the operation and management of an on-farm drying and storage unit to cut costs.

**Insect Control**

A good clean-up program before storing grain will help in effective insect control during storage and the reduction of insect control costs. The bin walls and the areas around the building in which the grain is to be stored should be cleaned thoroughly and sprayed with a residual spray. A careful checking for insects, at least once a month during storage, will enable the farmer to get a head start on the insects and thus reduce insect control costs.

**Hauling From Field to Bin**

Careful planning as to the means of transportation from the field to the building may reduce this cost. Many farmers reduced this cost by using their own or neighbor’s truck in bringing the grain sorghum from the field to the bin. Planning as to the number of trucks and men to operate them will reduce confusion and expense.
Increased Utilization of Equipment

It is possible for the farmer to reduce his costs below the drying capacity costs. If the harvesting dates for the grain sorghum are spread out over a period of time, he can utilize the entire space to a depth of less than 8 feet. The grain sorghum that comes in later can be piled above the 8-foot depth and in this manner the unit utilized beyond the drying capacity.

Labor Utilization

Good planning in the use of labor for loading the grain sorghum into the bins and moving out is a source of potential cost reduction. Having three men to do the job of two is costly. Care and attention in planning labor use can reduce this cost considerably.

Following Recommended Operating Procedure

The cost involved when quality is not maintained is very great. Most quality losses can be prevented with good management and by following recommended operating procedures for drying and storage.

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