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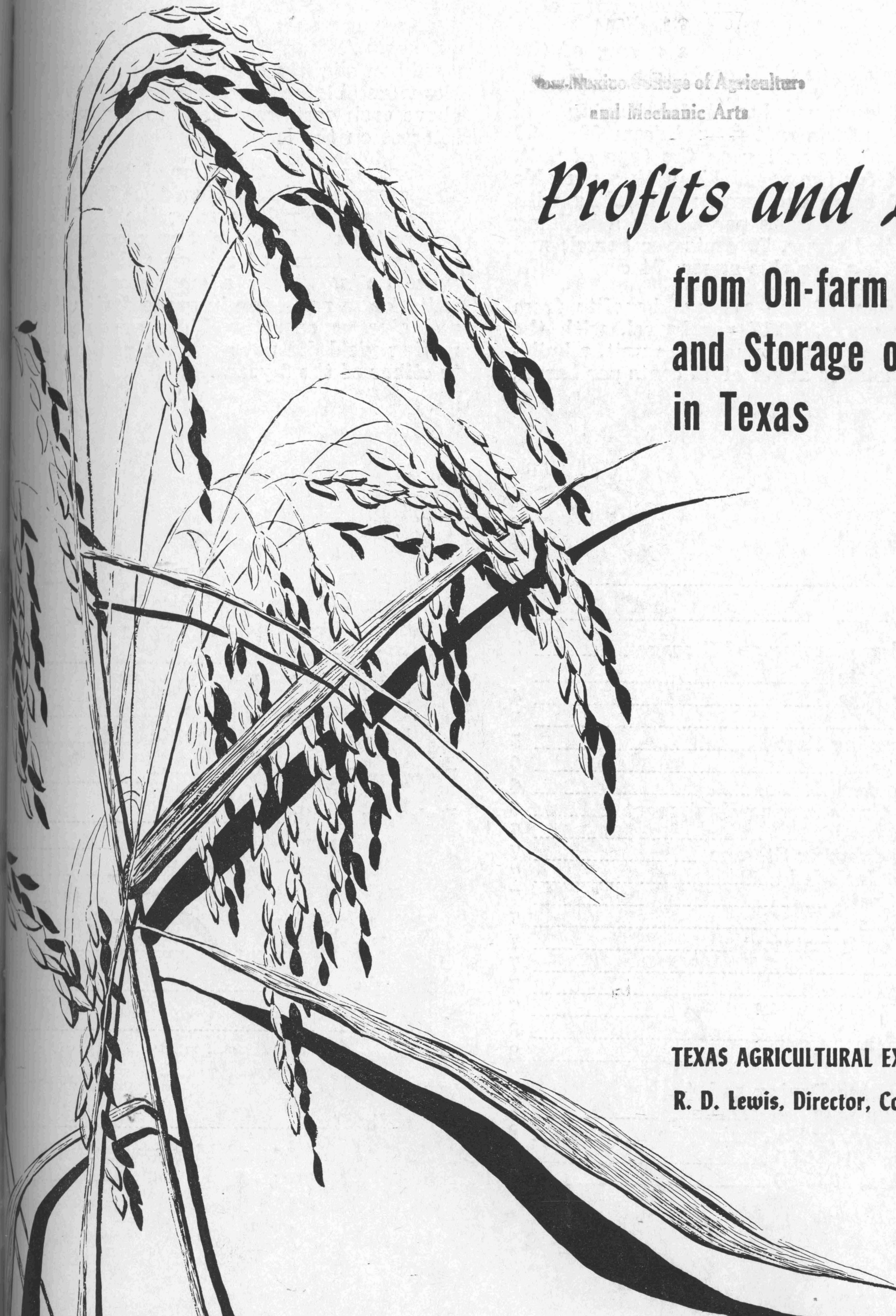
Bulletin 865

Profits and Loss

from On-farm Drying and Storage of Rice in Texas



TEXAS AGRICULTURAL EXPERIMENT STATION

R. D. Lewis, Director, College Station, Texas

SUMMARY

The gross benefits to a Texas rice grower from drying and storing his rice on-farm as compared with selling at harvest averaged $2.17 per barrel (162 pounds) for the 10 seasons, 1945-46 through 1954-55. This benefit consisted of a seasonal price spread of $1.67 per barrel between September and February, plus a saving of the normal drying charge of 50 cents per barrel.

The total cost per barrel for owning and operating an on-farm unit ranged from 66 to 90 cents per barrel, depending on the type of unit. The total cost for the round bin with a portable auger was 66 cents per barrel; a building with an air conveyor, 90 cents per barrel; a building with an installed auger, 79 cents per barrel; and a building with a portable auger, 74 cents.

A comparison of the average benefits from drying and storage, $2.17 per barrel, with the total cost of the most common type unit, a building with an installed auger of 79 cents per barrel, indicates a profit of $1.38 per barrel from the ownership of the on-farm unit. A comparison of the cost for drying and storing on the farm with the benefits received for the seasons of 1945-46 through 1954-55 indicates the benefits were smaller than the costs in only 1 out of 10 seasons. A loan to purchase a unit could be repaid in slightly over 3 years if average benefits were obtained each year and all the benefits above cash cost were used to pay principal and interest on the loan.

A study of the operation of 29 on-farm drying and storage units during the 1954-55 storage season and 10 units during the 1955-56 storage season indicated that rice growers can maintain quality in terms of milling yield in grain with these units. Only a small percentage of the units had a reduction in grade during the drying and storage operation. The average change in milling yield did not show a significant decrease in either of the 2 years.

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On-farm Drying and Storage of Rice in Texas

R. J. HILDRETH and J. W. SORENSON, JR.*

RICE GROWING IN TEXAS is concentrated in 15 counties on the Gulf Coast Prairie where rice is the main cash crop. Rice harvesting became fully mechanized with the introduction of the combine in the 1940's.

In general, rice should be harvested when the moisture content of the rice grains is between 18 and 25 percent. Kernels with this moisture content are fully developed and mill well. Rice harvested before this stage is likely to have a high percentage of light, chalky kernels which do not mill well. If harvested after this stage, there may be considerable loss in yield from shattering and from inferior milling quality because of checking of the grains.

As rice comes from the combine, it usually has a moisture content too high for safe storage. Rice should not contain more than 12 or 13 percent moisture for safe storage; consequently, rice must be dried artificially before it can be stored or moved into trade channels.

A number of on-farm drying and storage installations for rice, using unheated air, recently have been constructed in the Gulf Coast area. The design and recommended operating procedure for these units are based on results of tests conducted at the Rice-Pasture Experiment Station near Beaumont. There has been considerable interest in on-farm drying and storage units as the Commodity Credit Corporation loan program and the government facility loans for storage and conditioning equipment have been expanded.

This bulletin discusses 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 rice growers to maintain quality and the size of unit to purchase.

The report is based on information collected over two drying and storage seasons (1954-55 and 1955-56). Operating practices and costs were obtained from the majority of rice growers operating on-farm units. The installations studied were located in Jefferson, Chambers, Liberty, Harris, Wharton, Jackson, Colorado, Orange and Newton counties (Figure 1). Information on quality was obtained from samples of rice taken in the units. Overhead cost information was obtained from rice growers and building and equipment dealers.

The cost and quality information represents the situation during 1954 through 1956. As rice growers obtain more experience with the units and the design of the equipment is improved, costs probably will be lowered and the probability of a reduction in quality may be lessened.

COSTS OF ON-FARM DRYING AND STORAGE

Costs of on-farm drying and storage vary from farm to farm. The costs presented here represent the best estimates for "typical" situations that can be obtained from rice grower experience, from building and equipment dealers and from personnel of the Texas Station.

Two types of structures were used, a round metal bin or a building (Figure 2). The buildings were the straight-sidewall type or quonset type (Figure 3). Most of the buildings were commercial metal structures; however, a few were wood buildings constructed by the rice grower. The three main types of grain-moving equipment used with the buildings were portable augers (Figure 4), air conveyors (Figure 5) and in-

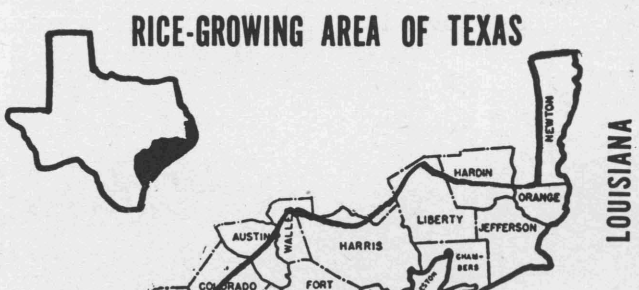

Figure 1. The principal rice-growing area of Texas, from the Louisiana line southeast along the Gulf Coast through Victoria county. The heavy black lines show the north and south boundaries of the rice area.

*Respectively, associate professor, Department of Agricultural Economics and Sociology; and professor, Department of Agricultural Engineering.

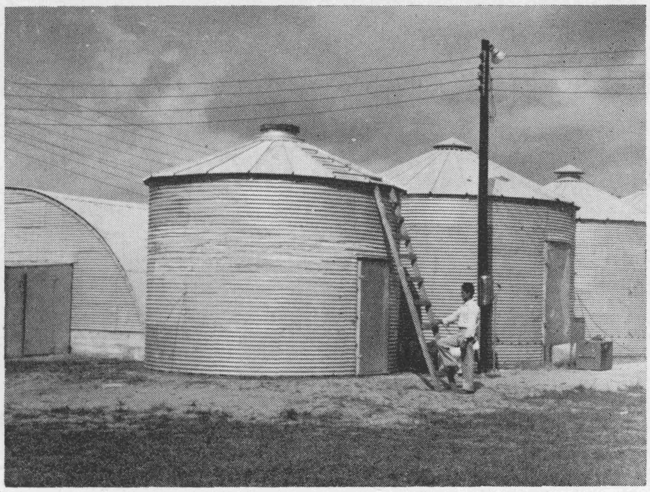

Figure 2. Typical round steel bins used for drying and storing rice on the farm in Texas.

stalled augers (Figure 6); all of the round-bin units used portable augers.

Costs of on-farm drying and storage are divided into two types, operating and overhead. Operating costs are associated with the volume or amount of rice dried and stored. Overhead costs do not vary with volume, but to a large extent, remain fixed regardless of the amount of rice dried and stored.

The costs presented in this bulletin can be compared with the seasonal spread in prices between harvest time and later in the year and the usual drying charges. This comparison indicates the benefits of drying and storage in on-farm units, as opposed to selling at harvest time.

Operating Costs

Operating cost information was obtained on the operation of 29 units during the 1954-55 season and 43 units during the 1955-56 season. In each drying and storage season these units accounted for over two-thirds of the total number

TABLE 1. AVERAGE OPERATING COST PER BARREL OF ON-FARM DRYING AND STORAGE OF RICE 1954-55

Item	Building			Bins
	Portable auger	Installed auger	Air conveyor	Portable auger
Number of units	10	5	7	7
	Cents			
Cleaning bins	00.6	00.7	00.6	00.8
Labor	04.5	07.4	05.6	06.4
Hauling to bin	07.9	07.9	07.9	07.9
Electricity	06.6	07.0	06.5	05.3
Insect control[1]	03.5	03.5	03.5	03.5
Fuel for grain-moving equipment			01.3	
Grain insurance	03.7	03.7	03.7	03.7
Shrinkage during storage	09.0	09.0	09.0	09.0
Total	35.8	39.2	38.1	36.6

[1]Based on 15 observations.

in operation during that season. Units not included in the study were largely those wth small amounts of rice dried and stored or with the responsibility for operation divided among a number of persons, making it difficult to obtain accurate information.

The operating costs per barrel (162 pounds) for 1954-55 and 1955-56 are presented in Tables 1 and 2, respectively. A summary of costs for the two seasons is given in Table 3. The costs for the various items in Table 3 represent a weighted average for the 2-year period.

The total costs in Tables 1, 2 and 3 do not represent an average of actual rice grower costs. They are totals of the individual cost items. Certain items may not be experienced by all rice growers; for example, insect control measures were not needed each year by all rice growers. The total costs for an individual rice grower may tend to be lower than those indicated.

Cleaning Bins

During the 1954-55 season few farmers incurred this cost since the buildings were new.

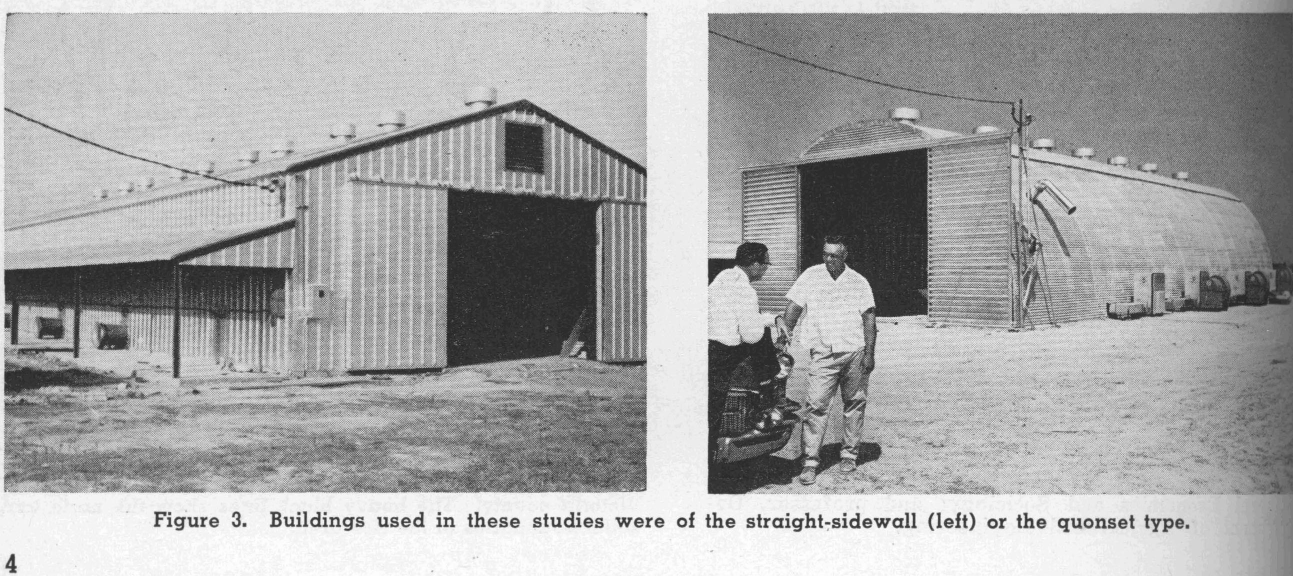

Figure 3. Buildings used in these studies were of the straight-sidewall (left) or the quonset type.

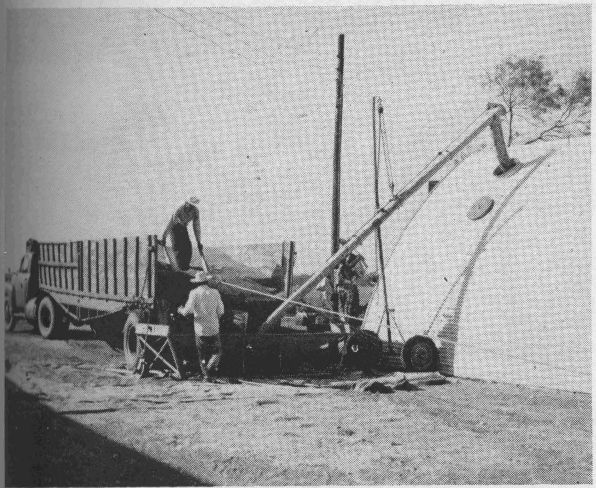

Figure 4. Portable auger.

Figure 5. Air conveyor.

The costs for this season were based on operations at the Rice-Pasture Experiment Station. The costs during the 1955-56 year were based on farmer experience and did not vary much from the estimated cost during 1954-55. The 1955-56 costs were used in Table 3.

Labor

This item includes the cost of labor used in loading the rice into the drying unit from trucks at harvest time, moving the rice from bin to bin during the drying operation and loading it into trucks to be taken to market. The labor charge is based on an average of the time necessary to perform the jobs as estimated by rice growers, and an assumed wage rate of 75 cents per hour. The labor costs during 1955-56 were somewhat higher than during 1954-55 because more rice was moved from bin to bin during the drying period. Muddy fields made conditions unfavorable for harvesting operations during 1955-56, thus tieing up more labor during the operation of loading the rice into the bin.

TABLE 2. AVERAGE OPERATING COST PER BARREL OF ON-FARM DRYING AND STORAGE OF RICE, 1955-56

Item	Building			Bins
	Portable auger	Installed auger	Air conveyor	Portable auger
Number of units	8	26	5	4
	Cents			
Cleaning bins	00.5	01.4	01.7	00.9
Labor	07.7	07.5	11.3	08.5
Hauling to bin	04.7	04.7	04.7	04.7
Electricity	07.7	07.2	08.0	06.4
Insect control[1]	01.9	01.9	01.9	01.9
Fuel for grain-moving equipment			00.8	
Grain insurance	03.7	03.7	03.7	03.7
Shrinkage during storage	09.0	09.0	09.0	09.0
Total	35.2	35.4	41.1	35.1

[1]Based on 20 observations.

During 1954-55 the installed auger units had the highest labor cost. It changed little from the 1954-55 season to the 1955-56 season while the labor charges increased considerably for other units. These differences in the labor cost may not be significant since only a small number of the units were studied.

Extra Hauling Cost

Rice dried and stored on the farm involves an extra hauling charge. It was assumed that the cost of hauling rice from the building to market (distance A, Figure 7) was approximately equal to that which would be incurred at harvest time if the rice were hauled directly from the field

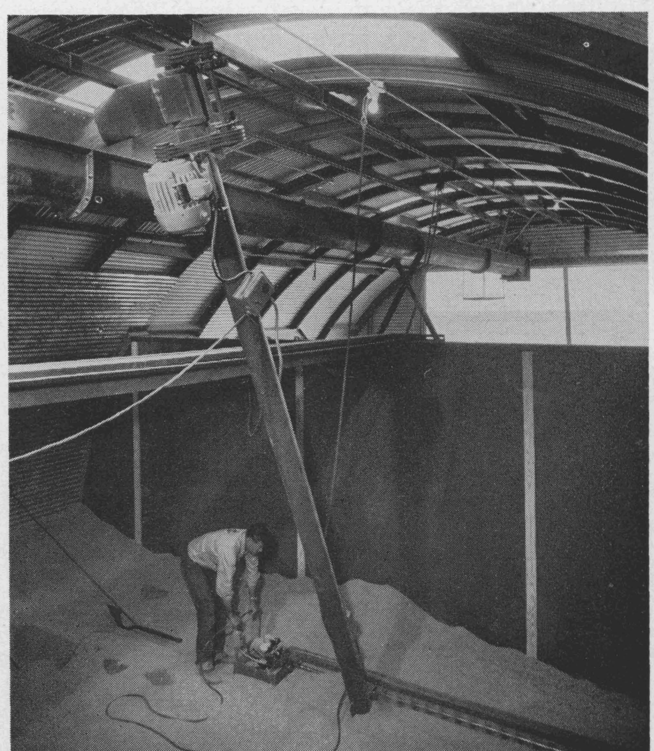

Figure 6. Installed auger.

TABLE 3. WEIGHTED AVERAGE OPERATING COSTS PER BARREL, 1954-55 AND 1955-56 SEASONS

Item	Building			Bins
	Portable auger	Installed auger	Air conveyor	Portable auger
Number of units	18	31	12	11
	— — — —	Cents	— — — —	
Cleaning bins	00.5	01.4	01.7	00.9
Labor	05.9	07.5	08.0	07.2
Hauling to bin	06.3	06.3	06.3	06.3
Electricity	07.1	07.7	07.1	05.7
Insect control[1]	02.7	02.7	02.7	02.7
Fuel for grain-moving equipment			01.1	
Grain insurance[1]	03.7	03.7	03.7	03.7
Shrinkage during storage	09.0	09.0	09.0	09.0
Total	35.2	38.3	39.6	35.3

[1]In many cases insect control costs can be reduced or eliminated. Some rice growers may not wish to obtain grain insurance. The elimination of these items will reduce operating costs by 06.4 cents per barrel.

to market or to commercial drying and storage facilities (distance B, Figure 7). Hauling the rice from the field to the bin (distance C, Figure 7) then is an extra cost incurred with the use of on-farm drying and storage.

There is considerable variation among individual farm units in the hauling cost. In many localities a normal charge for this operation is 10 cents per barrel if a hired trucker is used. Where the rice grower uses his own trucks or auger carts to bring the rice from the field to the building, the cost is considerably less. The average cost of hauling was lower during 1955-56 than during 1954-55 because more rice growers used their own trucks or carts rather than hired trucks to bring the grain in from the field.

A number of rice growers expressed the opinion that hauling rice from the combine to market costs more than hauling rice from the on-farm units. They felt the need to keep the harvesting operation in progress tended to tie up more equipment during harvesting than in moving the rice from the unit, thus the charge per barrel was higher during harvesting. Where this is the case, the extra hauling cost can be reduced.

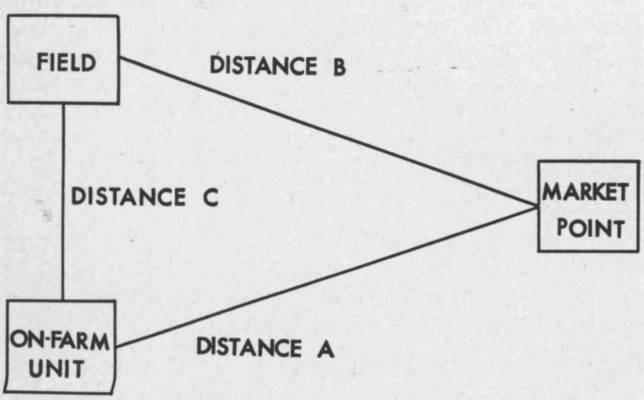

Figure 7. Extra hauling distance due to on-farm drying and storage unit.

Electricity

Electricity was used to dry, aerate and, in most cases, to load and unload the rice. The cost of electricity depends on the amount of moisture removed from the rice during the drying and the number of times the rice is transferred from one bin to another. The moisture of the rice as it went into the bins ranged from 13 to 25 percent; usually the grain was dried to at least 12 percent moisture. The costs during the two seasons were similar, with the cost during 1955-56 slightly higher. The 1955-56 season had unfavorable weather conditions, with many days of rain and high humidity, compared with the 1954-55 season and required more fan operation time.

Insect Control

Fifteen of the 29 units studied during 1954-55 had insect infestations large enough to warrent control practices, Table 1. Twenty of the 43 units had an insect infestation large enough to warrant control measures during 1955-56. This cost during 1955-56 was less than during 1954-55. With good management, the cost may continue to decline.

Fuel for Grain-moving Equipment

This item was incurred by the farmers using an air conveyor, which is operated by a gasoline engine.

Grain Insurance

Grain insurance was obtained by 9 of the 29 farmers during 1954-55. It was obtained by 25 of 43 farmers during 1955-56. Grain insurance 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, 7 months of storage and the average February price received by

TABLE 4. ANNUAL OVERHEAD COSTS OF ON-FARM DRYING AND STORAGE OF RICE FOR SELECTED UNITS

Item	Building			Bins
	Portable auger	Installed auger	Air conveyor	Portable auger
	— — — —	Barrels	— — — —	
Drying capacity[1]	4,400	7,700	4,400	2,300
	— — — —	Dollars	— — — —	
Depreciation on structure, fan, grain moving and other equipment	869	1,563	1,233	363
Interest on investment at 6 percent	591	1,098	642	249
Taxes	60	115	64	32
Insurance on structure	82	157	82	33
Annual repairs	98	191	194	42
Total	1,700	3,124	2,215	719
Cost per barrel at drying capacity	*0.39*	*0.41*	*0.50*	*0.31*

[1]Recommended depth for drying with unheated air is 8 feet.

farmers for rice, $9.19 per barrel, over the 10 seasons, 1945-46 through 1954-55.

Shrinkage during Storage

Rice is sold at harvest time on a dry-weight basis. 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 occur with high humidity during aeration of the stored rice.

The loss in weight was computed on the basis of a reduction of 1 percent for the dry weight of the rice. The value of the loss was based on the average February price received by farmers for rice, $9.19 per barrel, over the 10 seasons 1945-46 through 1954-55.

Costs not Included

Interest on the value of the grain during the storage period was not included in the operating costs. Most stored rice is placed in "government loan" and the rice grower receives payment soon after it is stored.

A charge for deterioration in quality during drying and storage has not been included. Most rice growers maintained grade and milling yield and suffered no economic loss. 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.

Overhead Costs

Overhead costs are the annual cost of ownership. A summary of overhead costs for different types of structures and handling equipment is shown in Table 4. The figures in this table were obtained on commercially constructed units from farmers with on-farm drying and storage facilities and from building and equipment dealers. They do not represent an average of rice grower experience but represent the overhead cost of units of specific size and type. The overhead cost information was based on equipment which would give the minimum airflow rates recommended by the Texas Agricultural Experiment Station.

TABLE 5. TOTAL COST PER BARREL OF ON-FARM DRYING AND STORAGE OF RICE AT VARIOUS UTILIZATION LEVELS

Level of utilization	Building: Portable auger	Building: Installed auger	Building: Air conveyor	Bins: Portable auger
	— — — — Dollars — — — —			
Storage capacity[1]	0.67	0.72	0.81	0.65
Drying capacity	0.74	0.79	0.90	0.66
Three-fourths drying capacity	0.87	0.92	1.06	0.77
One-half drying capacity	1.12	1.19	1.39	0.98

[1]Ten-foot depth for the building and 9-foot depth for the round bin.

The overhead costs for units built by rice growers were lower than those on the commercially constructed units. Only the costs of commercially constructed units are reported since few rice growers have the necessary engineering skill to construct their own units.

The rice grower 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 rice growers.

Depreciation

Depreciation expresses the original cost of the building, fans, aeration equipment and grain moving and other equipment as an annual cost over the life of the building. The assumption is made that the building would have a life of 25 years and the fans and motors, 15 years. The installed auger is assumed to have a life of 25 years; the portable auger, 10 years and the air conveyor, 5 years. These assumptions as to length of life, except for the air conveyor, are based on estimates of rice growers and the Department of Agricultural Engineering. A high level of repairs, upkeep and management was assumed in making these estimates. The length of life assumption for the building and bins is the same as that listed for metal grain tanks in Bulletin "F" published by the Internal Revenue Service. Air conveyors have been used on farms for 4 years and rice growers estimate they will be good for only 1 more year. 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 the original cost. The tax cost was computed by applying the average rates of the various taxing agencies in certain counties in the rice 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

TABLE 6. VARIATION OF TOTAL COST PER BARREL AT DRYING CAPACITY FOR INSTALLED AUGER UNIT, 1955-56 SEASON

Range of total cost, cents	Number of units
67 - 71	7
72 - 76	12
77 - 81	2
82 - 80	3
Over 87	2
	Total 26

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, except for the air conveyor where actual data is available. It was assumed repairs would amount to 0.5 percent of the first cost of the building, grain-moving equipment, fans and motors. Actual repair cost was used for the air conveyor.

Total Costs

The total cost per barrel for drying and storing rice on the farm depends mainly on the extent to which drying and storage facilities are used. Overhead costs are the same regardless of how much rice is dried and stored. The overhead cost per barrel and the total cost per barrel decrease as the amount of rice dried and stored increases. The cost will be less at capacity than if half of capacity is used.

Total cost per barrel for storage capacity, drying capacity, three-fourths drying capacity and one-half drying capacity is presented in Table 5. These costs were obtained by dividing the constant overhead cost by the number of barrels dried and stored and adding the operation cost per barrel. Figure 8 shows the cost at various levels of utilization for the building with an installed auger.

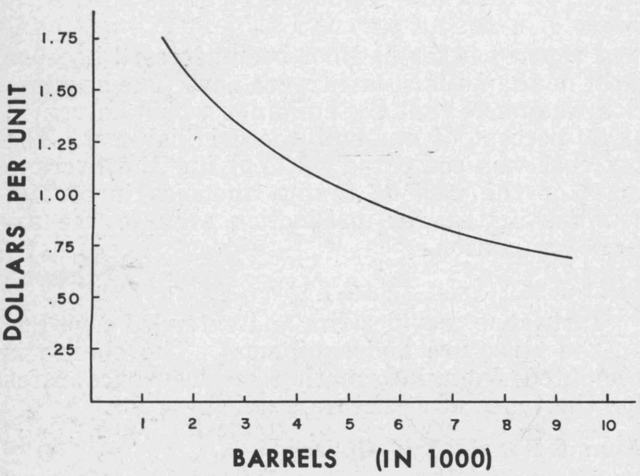

Figure 8. Total cost per barrel of on-farm drying and storing rice in a building with installed auger.

Variation in Costs

The costs presented in the preceding sections represent a typical situation. Individual costs vary about these figures. The variation in total cost for 26 rice growers in 1955-56 is presented in Table 6. The costs ranged from 68 cents to 92 cents per barrel. The distribution of costs is concentrated in the lower range; that is, over 50 percent of the rice growers had costs less than average.

EFFECT OF ON-FARM DRYING AND STORAGE ON QUALITY

A major consideration in using on-farm drying and storage for rice is the effect this method has on quality. Although the cost for on-farm drying and storage may be very low, the rice grower will suffer a loss in income unless quality can be maintained.

The price of rough rice is affected by variety, milling yield and grade. On-farm drying and storage affect the value of rice only in terms of its effect on milling yield and grade. Grade is determined by such factors as red rice, chalky kernels, field-damaged kernels, objectional seed and heat-damaged kernels. Drying and storage affect grade mainly in terms of heat-damaged kernels, since the other factors are present before the drying and storage operation. Thus, results of on-farm drying and storage on quality are reported in terms of grade changes due to heat-damaged kernels and milling yield.

Tests conducted at the Rice-Pasture Experiment Station show that drying rice with unheated air in farm-type bins is feasible and the milling yield and grade can be maintained during the drying and storage period.

Method of Quality Determination

A study was made of the effect of on-farm drying and storage under farm conditions on grade and milling yield for 1954-55 and 1955-56. The general procedure used in obtaining information in this part of the study follows. As the rice was unloaded from trucks into the bins, samples were drawn. These samples were dried at the Rice-Pasture Experiment Station to 13 percent moisture or less in a dehumidified room or by spreading the rice out in thin layers in the open air. These were considered check samples.

After the rice was dried a second sample was taken from the bin. This was called the dry sample. The usual drying period for the units studied was approximately 3 weeks.

Information was obtained on milling yield and grade at the time of sale or at the end of the storage period. The usual storage period was approximately 6 months. During the 1954-55 storage year, this information was obtained on each bin from the rice grower's sale data. These sale data were considered accurate since most of the rice was in loan and thus graded by official grain inspectors of the United States Department of Agriculture at the time of delivery to the CCC. During 1955-56, samples were taken from the bin shortly before sale. These were called the sale sample.

The samples were taken from the bins with "deep-bin" probes (Figure 9). Each sample consisted of probings from several locations over the bins and was graded by official grain inspectors of the USDA.

Storage Year, 1954-55

The operation of 29 on-farm drying units was studied during 1954-55. About 41 units were in use in Texas during that year and weather conditions generally were favorable for drying. Samples were drawn at various locations and depths in the 95 bins checked.

Little reduction in grade because of heat damage occurred during the drying operation. An analysis of the change in grade between the check samples and dry samples indicates that 92 percent of the bins did not have any reduction in grade due to heat-damaged kernels, Table 7. Only 1 percent of the bins had heat-damaged kernels which caused a reduction of more than two grades.

Although 95 bins were checked for heat damage, complete milling yield information was obtained on only 80 bins, mainly because some bins were combined during the storage period.

There appeared to be little difference between milling yield of the check samples versus the dry and sale samples. The largest change in head rice yields occurred during the drying period. Table 8 shows there was an average decrease of 0.8 pound of head rice per 100 pounds of rough rice. The average change in total rice was a decrease of 0.4 pound of milled rice per 100 pounds of rough rice.

Storage Year, 1955-56

The operation of 10 drying and storage units was studied during the 1955-56 storage year. These units were located in Liberty and Jefferson counties. More complete information on the

TABLE 7. REDUCTION IN GRADE DUE TO OCCURRENCE OF HEAT-DAMAGED KERNELS DURING DRYING OPERATION, 1954-55 STORAGE YEAR

Number of grades reduced	Percent of bins
0	92
1	1
2	6
3	
4	1
5	

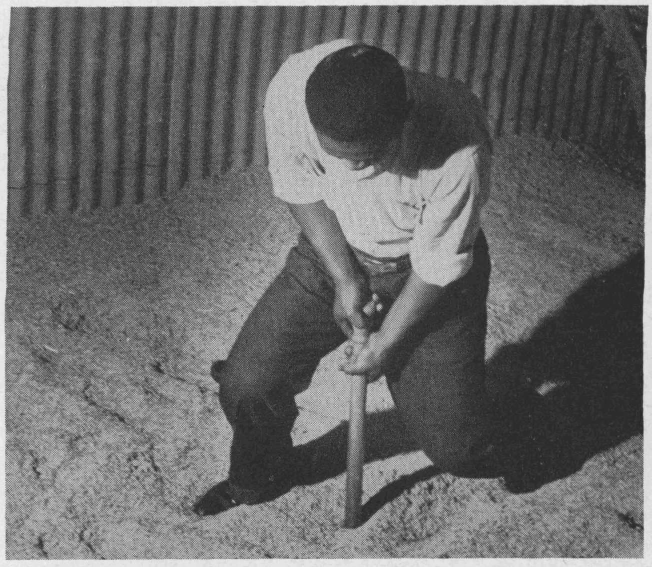

Figure 9. A grain probe was used to obtain samples of rice for moisture tests and for determining the effect of on-farm drying and storage of the milling quality.

operating procedure was obtained during 1955-56 than 1954-55. Most of the days during October and November in 1955 were rainy with high relative humidity, which is unfavorable weather for drying.

A total of 41 bins or lots of rice was included in the survey. Samples were drawn at different locations at three levels in most bins, from the top foot, the bottom foot and the middle foot. Separate checks on milling yield and grade were made at each level.

Although there were 103 levels in the study, complete milling yield data were obtained on only 97 levels; two bins were sold shortly after the drying operation was completed, reducing the total by six levels.

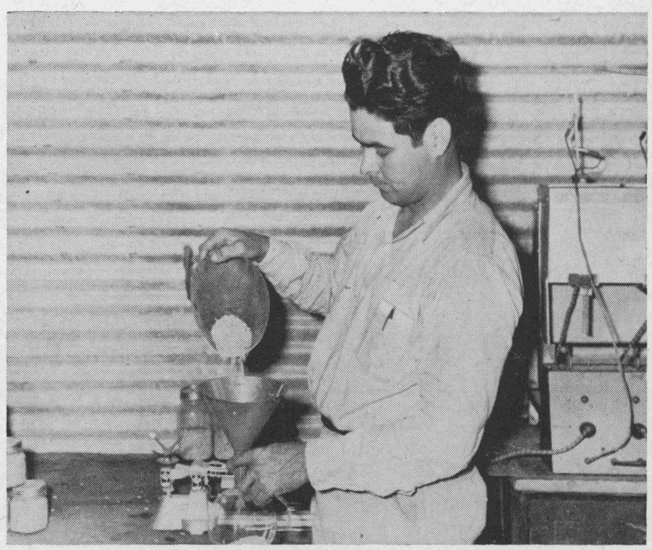

Figure 10. A Brown-Duvel moisture tester was used to determine the moisture content of rice samples. This man is preparing a sample for the moisture test.

TABLE 8. AVERAGE CHANGE IN MILLING YIELD, 1954-55 STORAGE YEAR

Time Period	Average Change[1]	
	Head rice	Total rice
Drying period (Check sample to dry sample)	—0.8[2]	—0.4
Storage period (Dry sample to sale sample)	+0.4	—0.2
Drying and storage period (Check sample to sale sample)	—0.4	—0.6[2]

[1]Pounds of milled rice per 100 pounds of rough rice.
[2]Change is larger than could be explained on pure chance basis if difference was zero at 5 percent probability level.

Eighty-nine percent of the levels did not show any reduction in grade due to heat-damaged kernels, Table 9. Four percent of the levels had a reduction of five grades. This largely resulted from improper operation of one unit. (A case history of this operation is given in Appendix B.)

The average milling yield and yield of head rice increased during all periods, Table 10. The increase in total rice during the storage period also was significant.

The average increase does not mean that all the levels increased. Some increased and some did not and the net effect was an average increase. Part of the average increase could be explained by sampling error in the bins.

Perhaps a major factor in the explanation of the increase is the change in moisture during the storage period. The moisture content of most of the levels was reduced from the storage sample to the sale sample, which may have caused the increase in milling yields.

COMPARISON OF COSTS AND BENEFITS

Whether to dry and store rice on-farm or to sell at harvest depends to a large extent on the costs of on-farm drying and storage and the seasonal movement in prices between harvest and later in the year. Other factors involved are difficult to evaluate in dollars and cents although they may outweigh the more direct costs and benefits.

Seasonal Movement of Rice Price

An analysis of the prices paid Texas rice growers for the seasons 1945-46 through 1954-55

TABLE 9. REDUCTION IN GRADE DUE TO OCCURRENCE OF HEAT-DAMAGED KERNELS DURING DRYING OPERATION, 1955-56 STORAGE YEAR

Number of grades reduced	Percent of observations
0	89
1	3
2	3
3	1
4	
5	4

TABLE 10. AVERAGE CHANGE IN MILLING YIELD, 1955-56 STORAGE YEAR

Time Period	Average Change[1]	
	Head rice	Total rice
Drying period (Check sample to dry sample)	+1.8[2]	+0.1
Storage period (Dry sample to sale sample)	+0.7[2]	+0.3[2]
Drying and storage period (Check sample to sale sample)	+2.5[2]	+0.4

[1]Pounds of milled rice per 100 pounds of rough rice.
[2]Change is larger than could be explained on pure chance basis if difference was zero at 5 percent probability level.

gives some indication of future seasonal movements for rice prices. The immediate past indicates a definite seasonal price movement with a good possibility for the same type of seasonal movement in the future.

The solid, heavy line in Figure 11 shows the average of the midmonthly prices received by Texas rice growers for rice from 1945-46 through 1954-55. September showed the lowest average price, $7.52 per barrel. Prices generally strengthen in October and subsequent months until about mid-winter. The highest monthly price received by farmers was $9.19 per barrel in February. The average of the February prices (the peak) was $1.67 greater per barrel than the average of the September prices (the low) during the 10-year period.

The difference in the seasonal behavior prices in the late Forties (1945-46 through 1949-50) in contrast to that in the early Fifties (1950-51 through 1954-55) is shown by the light, broken lines which depict the 5-year periods (Figure 11). TAES bulletin 848, *Seasonal Price Changes and Commercial Storage Costs,* by Clarence A. Moore and Howard S. Whitney, gives a complete analysis of these differences and seasonal price movements.

Returns from On-farm Drying and Storage

A comparison of the returns from drying and storing on the farm with selling at harvest time (September) indicates that drying and storing on the farm usually shows a clear profit. The total cost of drying and storing at drying capacity ranged from 66 to 90 cents per barrel depending on the type of unit, Table 5. The average seasonal price spread was $1.67 per barrel. However, this was the spread between dried rice at harvest time and in February. By having on-farm drying and storage, the farmer also saves drying costs, which generally amount to approximately 50 cents per barrel. The benefits of having on-farm drying and storage as opposed to selling at harvest time amount to $2.17 per barrel. The typical total costs of on-farm drying and storage for the installed auger unit, 79 cents, subtracted from the benefit of $2.17 indicates a profit of $1.38 per barrel from the ownership of an on-farm unit.

TABLE 11. BENEFITS OF DRYING AND STORAGE COMPARED WITH COSTS

Season	Price difference between September and February	Benefits difference plus drying costs	Benefits larger than cost (installed auger unit)
	— — — Dollars — — —		
1945-46	0.04	0.54	no
1946-47	1.34	1.84	yes
1947-48	3.49	3.99	yes
1948-49	1.94	2.44	yes
1949-50	0.90	1.40	yes
1950-51	2.11	2.61	yes
1951-52	2.51	3.01	yes
1952-53	2.27	2.77	yes
1953-54	1.46	1.96	yes
1954-55	0.73	1.23	yes

The costs of drying and storing on the farm were compared with the benefits received from drying and storing, during 1945-46 through 1954-55, Table 11. The benefits were smaller than the cost in only one of the seasons, 1945-46. This indicates that the average returns over the years are favorable to drying and storage on the farm as opposed to selling at harvest, and the odds are very good in any 1 year that drying and storage will pay a profit.

The past seasonal pattern would not be expected to continue if a substantial number of rice growers started storing their rice on the farm and withheld their rice from the market at harvest time. This action would tend to raise the price at harvest time and lower it later in the year, thus reducing the seasonal price spread.

Payoff Period

In evaluating the feasibility of owning on-farm drying and storage it is necessary to determine the number of years it would take to pay out the investment. In computing this period, it was assumed that the rice grower would have to pay cash costs each year. These cash costs include the operating costs and the allowances for taxes, insurance and repairs. Using the installed auger unit, as an example, and assuming that the drying capacity is utilized, the operation costs would amount to $2,926 (7,700 barrels times 38 cents per barrel). The taxes, insurance and repairs would amount to $463 per year, making the total cash costs $3,389 per year. The average benefit is $2.17 times 7,700 barrels or $16,709. Subtracting cash costs from the benefits indicates a surplus for repayment of the loan and interest of $13,320 per year.

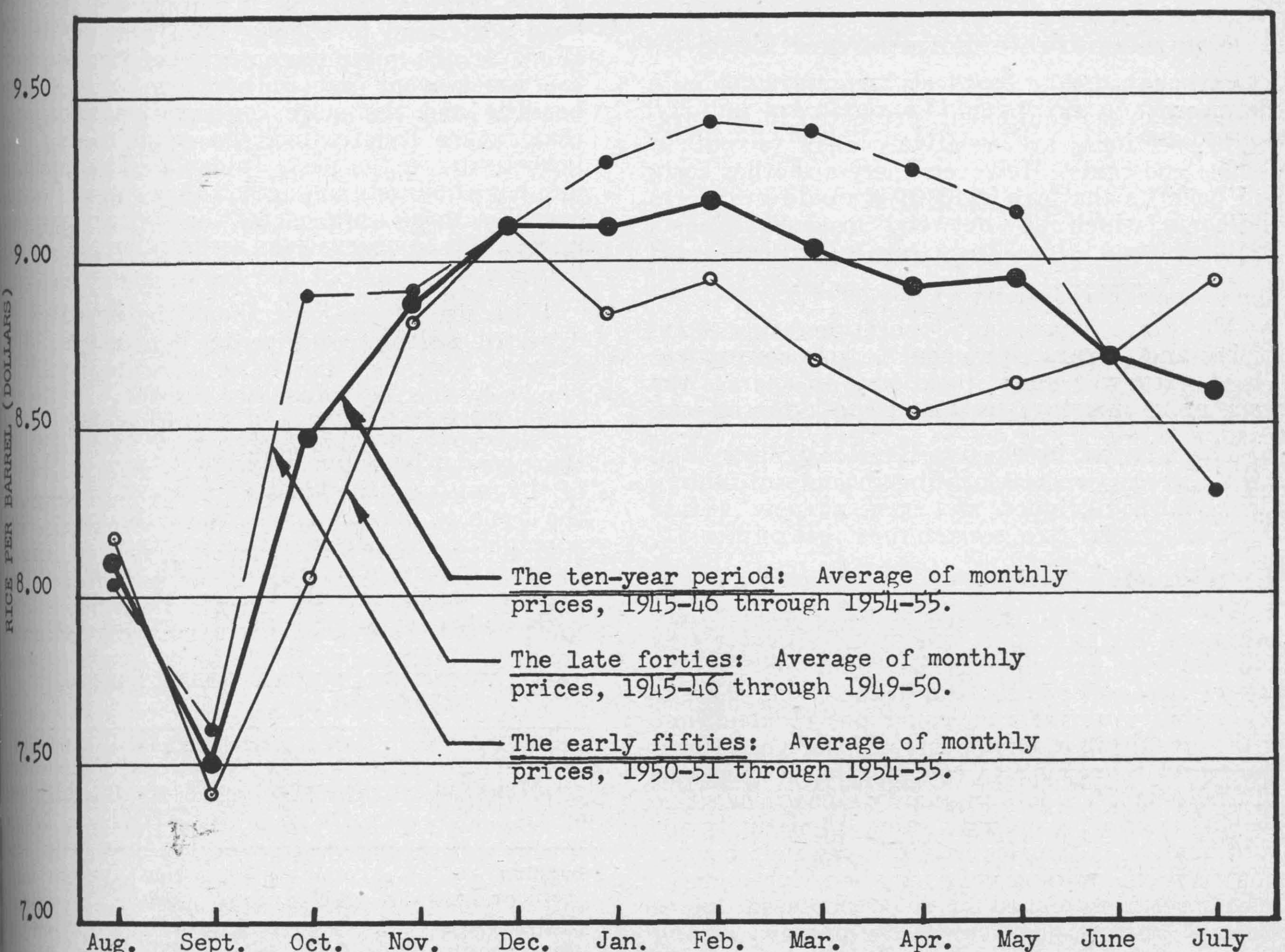

Figure 11. Seasonal price behavior of rice, Texas, 1945-55. Prices used in the bulletin are the midmonth Texas farm prices as reported by the Crop Reporting Service, U. S. Department of Agriculture.

Assuming a first cost of $36,245 for the building, fans, motor, grain moving and testing equipment and an interest rate of 6 percent, the farmer could payoff in a little over 3 years. For example, the first year the interest on the loan would be $2,174. After paying the interest and $11,145 on the principal, the balance the second year would be $25,100. The rice grower would have to pay a balance of $1,398 at the end of 3 years.

Even with the more conservative assumption that the future benefits would be equal to the third lowest year, $1.40 in 1949-50, Table 2, the rice grower could pay off the debt in a little over 5 years. Using this price or benefit assumption, the rice grower would have $7,381 to apply each year on the interest and the principal. At the end of 5 years a balance of $2,404 would exist.

In using the payoff to evaluate the feasibility of owning on-farm drying and storage units, no assumptions are made about the life of the building and equipment. When the overhead costs are computed, assumptions need to be made about the life of the building in order to compute the depreciation values. In both cases considered, the investment could be paid off in a shorter time than a very conservative estimated life of the units.

Non-measurable Returns and Costs

The returns and costs of owning on-farm drying and storage equipment, presented in the preceding sections, 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, 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 rice grower must spend time to operate the fans, make moisture tests and check for insects.

There is risk involved to the rice grower from falling prices or deteriorating grade and milling yield. Although good management may reduce these risks, the rice grower must bear them.

Non-measurable Benefits

During certain periods much rice may be harvested during a short time in a particular area and the rice grower may be "shut off" at the dryer. If the rice is cut and in the truck, there is *a possibility of the rice going out of condition*, with a resulting economic loss. If the rice grower has to wait too long to continue harvesting, the rice may suffer a loss in quality since it needs to be harvested at a definite stage of maturity for high quality. If the rice is left in the field beyond this stage, the milling yield may be reduced greatly and the risk of loss in yield increased due to storms. If rice is not cut at the proper stage of maturity, the price may be reduced two to three dollars a barrel for the rice grower. With on-farm drying and storage, the rice grower can harvest his rice at the proper stage of maturity without regard to other factors.

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

PLANNING SPACE REQUIREMENTS

Many types and sizes of units for on-farm drying and storage 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.

The two main factors to consider in deciding on the unit are the relationship between degree of utilization and costs and drying capacity. Figure 8 shows that the cost per barrel increases as utilization decreases. Rice should not be dried above an 8-foot depth with most types of equipment. If too small a unit is purchased, and the attempt is made to dry above an 8-foot depth, the danger of loss in milling yield and grade exists. If too large a building is purchased, the overhead costs lead to a large total cost per barrel. However, the minimum amounts of rice necessary to "break-even" are rather low with average benefits and the more conservative assumption that future benefits will be equal to the third lowest year in the past, Table 12. The minimum number of barrels is less that 50 percent of drying capacity for all units except the air conveyor even under the conservative assumption of future benefits.

The size of the unit should be based on the expected acreage of rice to be planted. With acreage controls, this basic acreage usually is known by the individual rice grower.

Once the basic acreage has been determined there are at least two ways to determine the size of the unit—on the basis of average yields or on the basis of maximum yields. With an expected acreage of 100 acres and an average yield of 20 barrels to the acre, a unit with a 2,000-barrel drying capacity should be bought. During years with above-average yields the excess rice could

TABLE 12. MINIMUM NUMBER BARRELS REQUIRED TO BREAK-EVEN

Type unit	Drying capacity, barrels	Minimum barrels with average benefit ($2.17)	Minimum barrels with third lowest year ($1.40)
Building			
Portable auger	4,400	934	1,619
Installed auger	7,700	1,745	3,063
Air conveyor	4,400	1,251	2,110
Round bin	2,300	395	685

be sold at harvest. This would involve some loss during the years with above-average yield, but during the years with below-average yields the cost per barrel would not be as large as if a unit with maximum capacity had been purchased. With an expected acreage of 100 acres of rice and a maximum yield of 25 barrels to the acre, a unit with a capacity of 2,500 barrels would be purchased. This alternative would lead to higher costs per barrel during average and below-average years. However, the loss incurred by selling at harvest in years with above-average yields with capacity based on average yield may be greater than the increased costs during years with average or below-average yields with capacity based on maximum yield. With capacity based on maximum yields, the rice grower would also have extra drying space available as a "turning bin" which could be used in case of high-moisture rice and difficulty in drying during most years.

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 the grain is stored helps control insects during storage and reduces insect control cost. The bin walls and the area around the buildings in which grain is to be stored should be cleaned throughly and sprayed with a residual spray. By checking carefully for insects, at least once a month during storage, the rice grower can get a head start on the insects and thus reduce insect control cost.

Hauling from Field to Bin

Careful planning may reduce the cost of transportation from the field to the building. Many farmers reduced this extra hauling cost by using their own or neighbors' trucks to bring the rice from the field to the bin. Auger carts probably would be cheaper than hired trucks. Although using auger carts involves more labor, careful planning as to the number of carts and men to operate them reduces confusion and expense. Some farmers do not have the opportunity to cut this cost, especially if considerable distance is involved in hauling.

Utilization of Equipment and Labor

The rice grower can reduce his cost below the drying capacity cost. If he has one variety of rice and planting dates permit harvesting over a period of time, all the bins can be utilized to dry the early rice. The later rice can be dried on top of the early rice, which utilizes the structure over the 8-foot depth (drying capacity if the bin is filled in a short period of time with wet rice). This procedure would not be possible if the rice grower had different varieties of early rice since varieties should not be mixed. Good planning in the use of labor for loading the rice into the bins, moving the rice from bin to bin and moving it out is a potential cost reduction.

Following Recommended Operating Procedure

When milling yield and grade are not maintained, the cost is very great. Most quality losses can be prevented by good management and following recommended operation procedures for drying and storage.

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Special acknowledgment is made to the rice growers who cooperated with the study.

Photographs of installed auger and quonset building are through the courtesy of the McRan Company, Houston, Texas.

APPENDIX A

Recommendations for Drying and Storing Rice in Farm Storage Bins

The following recommendations for drying rice with unheated air and for storing it when dry are based on results of tests conducted at the Rice-Pasture Experiment Station near Beaumont.

A tight structure is essential to protect stored rice from the weather, insects and rodents. Locate storage bins on well-drained areas to prevent leakage of moisture around the floor-wall joints.

Select drying equipment that will provide a minimum air-flow rate of 9.0 cubic feet per minute per barrel. The fan should be capable of delivering this much air uniformly through an 8-foot depth of rice.

A good clean-up campaign is necessary for effective insect control during storage. Before storing new rice, the bin walls and the area around the storage buildings should be cleaned thoroughly and sprayed with a residual spray.

Do not attempt to dry rice that contains excessive amounts of foreign material or "trash." This material accumulates in pockets, causes air to channel and results in musty and heat-damaged rice. Proper adjustment of combines at harvest will reduce the amount of trash.

Fill bins to a maximum depth of 4 feet if the initial moisture content of the rice is 20 to 22 percent, and to a maximum depth of 6 feet if the moisture content is 18 to 20 percent. Push air through the rice until the moisture content in the top foot is reduced to about 16 percent. Then, add more rice and continue pushing the air until the moisture content of the rice in all parts of the bin is reduced to 12.5 percent or less. If the moisture content is less than 18 percent, bins may be filled to a maximum depth of 8 feet.

Push air through the rice continuously until the moisture content of the top foot of rice is reduced to about 16 percent. After the moisture is reduced to this level, complete the drying to a maximum of 12.5 percent moisture by pushing air through the rice only when the outside relative humidity is 80 percent or less. Cut the fan off if it rains during the period of continuous fan operation. When rainy periods last longer than 24 hours, keep the rice cool by operating the fan 2 to 3 hours each day until the weather clears.

Take samples for a check on moisture content at least twice a week during the drying operation. The rice should be probed at 8-foot intervals over the surface of the rice and samples drawn from the bottom, center and top foot. The rice from each level should be mixed thoroughly and a moisture check made for each level.

After the rice is reduced to a moisture content considered safe for storage, the temperature of the rice is a good indication of its condition. When rice is checked for moisture content, "hot spots" usually can be detected by feeling the temperature of the probe as it is withdrawn from the rice; or a probe thermometer can be used. Aerate the rice to reduce any hot spots which may develop.

Aerate as often as necessary during the winter months to reduce average grain temperatures to 60°F. or less. Operate the fan when the outside air temperature is 10°F. or more below the temperature of the air leaving the bin. Fans should not be operated during periods of fog or rain.

Determine insect population monthly by taking full depth probes in all parts of the bin.

APPENDIX B

A Case History of Management of an On-farm Rice Dryer

Although most farmers have little difficulty in operating their on-farm dryers, a case history on the management for one bin of rice shows the difficulties that can occur. This case history points out the importance of management in successful on-farm drying and storage.

The bin was loaded with Century Patna rice to a depth of 4 feet on September 5. The moisture content of this rice was approximately 19 percent. The fans were started immediately. On September 8 more very high moisture rice was added to the bin, bringing the depth to 8½ feet. Some of this added rice had a moisture content of over 23 percent.

The rice in the top 3 feet of the bin stayed above 18 percent moisture from September 5 to October 1. On October 1 the top 4 feet were turned with shovels. This operation dropped the moisture to 16½ percent. On October 1 more rice was added to the bin, bringing the total depth to over 9 feet. The moisture content of this added rice was approximately 16 percent. The fans were operated day and night until October 17. At this time the top 3 feet had a moisture content of 15 percent. Thereafter, the fans were operated during the day only and the top 3 feet had dropped to slightly over 12 percent moisture on October 31. The top 3 feet were the highest in moisture since the fans were forcing air up through the rice, causing the rice to dry in layers from bottom to top.

This operation was mismanaged in a number of ways. First, very high moisture rice, over 23 percent, was put into the bin. It is not recommended that this high level of rice be used. Second, the bin was filled over 9 feet deep. The recommended depth is a maximum of 8 feet when the bin is filled in a short time. Increasing the depth to 9 feet reduced the air flow below the recommended rate. The air flow at 9 feet was 6.1 cubic feet per minute per barrel; the recommended rate is 9 cubic feet per minute per barrel. The addition of an extra foot of rice reduces the air-flow rate considerably. Also, during much of September and October the relative humidity was high and many rainy days occurred. The unfavorable drying weather combined with improper management did not yield good results for the rice grower.

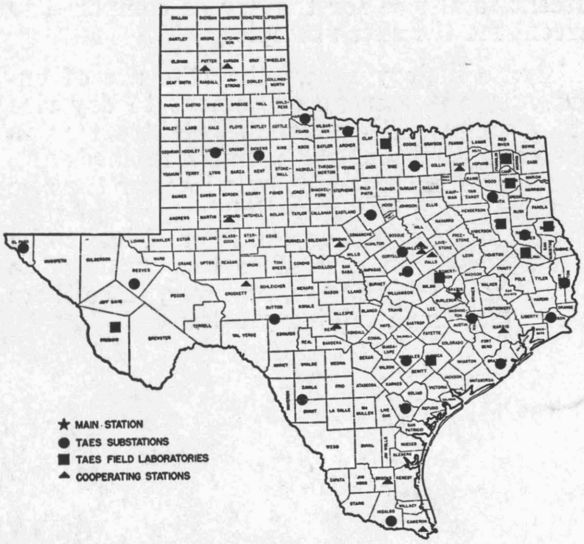
Samples of rice taken from the bin and dried in thin layers in the open air gave the following milling yields and grade. The top level was a grade of No. 2, with a milling yield of 56 percent head rice and 62 percent total rice. The middle level had a grade of No. 2, with a milling yield of 48 percent head rice and 57 percent total rice. The bottom level was a grade of No. 1, with a milling yield of 46 percent head rice and 56 percent total rice.

Samples taken from the bin after the rice was dried by the rice grower gave the following results. The top level was sample grade because there were 135 "heat damaged" kernels in 500 grams. Although the grade was lowered considerably, there was only a slight decrease in milling yield, 50 percent head rice in the dry sample compared with 56 percent in the check sample and 61 percent total rice as compared with 62 percent in the check sample.

The middle level also was sample grade because there were 144 "heat damaged" kernels in 500 grams. In the middle level milling yields were 55 percent head rice in the dry sample compared with 48 percent in the check sample. There was 62 percent total rice in the dry sample as compared with 48 percent in the check sample.

The bottom level graded No. 2, a reduction of one grade. There also was a slight increase in milling yield in this level. The milling yield of the dry sample was 50 percent head rice compared with 46 percent for the check sample and 59 percent total rice for the dry as compared to 56 percent for the check sample.

This case history shows that the use of on-farm drying and storage equipment to dry rice is not a "foolproof" operation. Slight errors in management combined with unfavorable drying conditions lead to some economic loss for the rice grower. This rice was not eligible for loan with the Commodity Credit Corporation and had to be sold on the open market. The loss was not as great as it might have been, however, since there was no reduction in milling yields.



Location of field research units in Texas maintained by the Texas Agricultural Experiment Station and cooperating agencies

State-wide Research

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The Texas Agricultural Experiment Station is the public agricultural research agency of the State of Texas, and is one of ten parts of the Texas A&M College System

IN THE MAIN STATION, with headquarters at College Station, are 16 subject-matter departments, 2 service departments, 3 regulatory services and the administrative staff. Located out in the major agricultural areas of Texas are 21 substations and 9 field laboratories. In addition, there are 14 cooperating stations owned by other agencies. Cooperating agencies include the Texas Forest Service, Game and Fish Commission of Texas, Texas Prison System, U. S. Department of Agriculture, University of Texas, Texas Technological College, Texas College of Arts and Industries and the King Ranch. Some experiments are conducted on farms and ranches and in rural homes.

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