• Water and Associated Costs in the
• Production of Cotton and Grain Sorghum,
• Texas High Plains, 1955

Figure 1. Specified production cost (power and machinery, labor, materials, water and harvesting cost) per pound of irrigated cotton related to yield per acre and to acres irrigated per well. Average cost on 160 and 320-acre sandy and heavy land farms.

In cooperation with the
UNITED STATES DEPARTMENT OF AGRICULTURE

TEXAS AGRICULTURAL EXPERIMENT STATION
R. D. LEWIS, DIRECTOR, COLLEGE STATION, TEXAS
SUMMARY AND CONCLUSION

Rising costs of water and machinery, along with higher rates of power, labor and water use, during the past 6 years have increased the cost of producing irrigated cotton and grain sorghum on the Texas High Plains.

The major part of the increase results from changes in the cost of water and from practices adopted to meet drouth-increased water demands with diminishing supplies of water. Based on 1955 price-cost conditions, preharvest costs of producing irrigated and dryland cotton and grain sorghum under high, medium and low water costs are:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Sandy land Cotton</th>
<th>Sandy land Grain sorghum</th>
<th>Heavy land Cotton</th>
<th>Heavy land Grain sorghum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dryland—cost per acre</td>
<td>10.38</td>
<td>5.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigated—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-cost water, 39 acres per well</td>
<td>65.00</td>
<td>41.00</td>
<td>53.00</td>
<td>31.00</td>
</tr>
<tr>
<td>Medium-cost water, 78 acres per well</td>
<td>54.00</td>
<td>29.00</td>
<td>47.00</td>
<td>26.00</td>
</tr>
<tr>
<td>Low-cost water, 156 acres per well</td>
<td>48.00</td>
<td>24.00</td>
<td>47.00</td>
<td>26.00</td>
</tr>
</tbody>
</table>

Unit costs are affected materially by variations in yield. Specified costs—power, labor, material, water and harvesting—per pound of lint cotton vary with differences in water cost and yield level. With high-cost water, the specified cost per pound of lint ranges from 25 to 19 cents at the 400 and 650-pound-per-acre yield levels, respectively. With medium-cost water, the range is 22 to 17 cents, respectively, for yields of 400 and 650 pounds per acre. With low-cost water, the specified cost per pound is 21 to 16 cents for yields of 400 and 650 pounds per acre, respectively.

Similar unit costs on dryland cotton range from 21 to 10.5 cents per pound of lint, respectively, for yields of 75 and 325 pounds per acre.

The specified cost per hundredweight of irrigated grain sorghum also is affected by different water costs and by variations in yield. At 1955 prices, power, labor, material, water and harvesting costs per hundredweight, under the high-cost water situation, range from $2.25 to 93 cents, respectively, for yields of 2,000 to 5,000 pounds per acre. With medium-cost water, the range is from $1.71 to 72 cents, respectively, for yields of 2,000 and 5,000 pounds per acre. With low-cost water, the specified costs per hundredweight range from $1.45 to 62 cents for yields of 2,000 and 5,000 pounds per acre, respectively.

Specified costs per hundredweight of dryland grain sorghum range from $1.48 to 41 cents, respectively, for yields of 500 and 2,000 pounds per acre.

CONTENTS

Summary and Conclusion ................................................. 2
Introduction .................................................................... 3
Crop Production Costs .................................................... 3
Conditions Assumed for Cost Analysis ............................... 3
Preharvest Production Practices ....................................... 4
  Irrigated Cotton .......................................................... 4
  Dryland Cotton ................................................................ 4
  Irrigated Grain Sorghum .................................................. 4
  Dryland Grain Sorghum .................................................... 4
Preharvest Production Requirements ................................. 5
Preharvest Production Costs ............................................. 5
  Preharvest Production Cost Comparison ........................... 7
Harvesting and Associated Costs ...................................... 7
Unit Production Cost ....................................................... 8
  Cotton ...................................................................... 8
  Grain Sorghum ............................................................ 9
Tenant Operator’s Cost .................................................... 10
Possible Cost Reductions .................................................. 11
Literature Cited ............................................................. 15
Water and Associated Costs in the Production of Cotton and Grain Sorghum, Texas High Plains, 1955

WILLIAM F. HUGHES and A. C. MAGEE*

Sharp reductions in the income from irrigated farming are being experienced on the High Plains. Reduction of cotton acreage and lower prices for grain sorghum have lowered gross farm income at a time when rising farm equipment and water costs have increased production costs.

The progressive decline in water levels indicates that future water supplies will be smaller and more expensive to obtain. Because of this, the adjustment in the present rates of water will be required to prolong the economic life of the water supply. The prospect of less water and the lack of suitable alternative cash crops test that adjustments toward more effective use of the available water supply will involve larger quantities of water than are now applied to the production of cotton and grain sorghum.

Information regarding production requirements and costs and the yields of individual crops from various amounts of water is a basic requirement for adjusting present practices. Information of this kind helps individual farmers appraise the risks and possible consequences of alternative adjustments. It is basic to the formulation of policies and to the institution of water conservation programs by state agencies.

This report presents estimates of production requirements and certain per-acre and per-unit costs of producing cotton and grain sorghum on typical irrigated and dryland farms of the Texas High Plains.

Land and management costs are not included in this report, but the amount available for these purposes is shown in Figures 3, 4, 7 and 8.

This is the second in a series of reports on a study concerning the most economical use of water in the agriculture of the High Plains. It is based partly on information developed in variously published studies adjusted to reflect 1955 production practices and prices.¹

CROP PRODUCTION COSTS

Except for the practices associated with the application of water, there is much similarity in the production and harvesting practices on irrigated and dryland crops. Crop production is highly mechanized and most farms are equipped with 4-row machinery. Cotton harvesting is the only major production practice that is not commonly mechanized. With a few exceptions, both irrigated and dryland farms are equipped with the same size and type of farm machinery. Because the practices are more intensive, irrigated farms require a greater amount of farm machinery.

Many changes were made in the practices used on irrigated farms during the shift from dryland farming. In recent years, however, most of the production practices have become more stable and standardized than they were when irrigation was first developed. Practices differ somewhat between farms on sandy soils and on heavy soils. They differ also within these groups, but most of the difference among farms on the same soil type consists mainly of differences in the amount of water applied and in minor cultural practices.

Water-use practices and investment in irrigation equipment and facilities are changing as farmers cope with the problem of supplying drouth-increased water demands from a constantly diminishing water supply.²

Moisture conditions govern production practices on dryland, consequently, these practices vary widely from year to year. Practices on partly irrigated farms combine the production practices of both irrigated and dryland farms. As the acreage to be irrigated on partly irrigated farms depends to a great extent on the amount of precipitation received, practices on the irrigated portions of these farms generally are less intensive than those on wholly irrigated farms.

CONDITIONS ASSUMED FOR COST ANALYSIS

Each combination of farm resources and methods of farm operation results in a differing cost of production figure. To be meaningful, therefore, estimates of production cost must be related to a specific set of conditions that represent the widest number of farms.

Cost estimates presented in this report are based on the cost of producing cotton and grain sorghum with the production practices commonly applied on typical 160 and 320-acre sandy and heavy land wholly irrigated farms, and on a 320-acre dryland farm located on sandy land.
Land use and crop acreages are based on 1954 conditions, when 97 percent of the farm was in cultivation, 42 percent in cotton and 58 percent in grain sorghum, or crops with similar production requirements. Machinery costs are based on the 1955 price of the amount of 4-row farm machinery commonly used to perform prevailing cultural practices. Labor costs are based on the reported 1955 wage rate paid per 10-hour day, without board. Costs of seed, insecticides, fuel and oil are based on 1955 prices. Water costs are based on the cost of water from butane-fueled pumping plants serving 39, 78 and 156 acres per plant. Harvesting costs are based on custom combine rates for grain sorghum and the cotton snapping and ginning rates in effect during 1955.

In conformity with earlier reports on this area, data for “sandy soils” pertain to production requirements and costs in Lubbock, Hockley, Lamb, Bailey and southern Parmer counties. Data for “heavy soils” reflect production requirements and costs in Crosby, Floyd, Hale, Swisher and Castro counties.

**PREHARVEST PRODUCTION PRACTICES**

**Irrigated Cotton**

A detailed account of irrigated crop production practices in 1947-49 is given in TAES Bulletin 763. According to this bulletin, practices used in the preparation of seedbeds were much the same for both cotton and grain sorghum. Irrigation practices differed between crops and major soil types. For example, most of the cotton land on sandy soils was irrigated before planting, but only about 50 percent of the cotton land on heavy soils was given a preplanting irrigation.

Since 1949, changes in seedbed preparation practices, heavier rates of water application and increased insect and weed-control practices have increased labor and power requirements by 26 and 29 percent, respectively.

Flat breaking, which requires a large amount of labor and power, has become a general practice. It is not as intensively practiced on sandy soils as on heavy soils. Generally, only half of the cotton land on sandy soils is flat broken each year, but flat breaking with a disc or moldboard plow is a standard practice on heavy soils.

Cotton land on heavy soils is irrigated at least once before planting. On sandy soils, cotton usually received two preplanting irrigations. This represents an intensification of irrigation practices on both soil types.

The amount of insect control practices varies considerably, particularly in late or mid-season. Reported practices ranged from no late poisoning to five applications during 1955. Insect control is increasing in both intensity and areas affected. Hoeing also has increased in intensity.

Pump operating time increased from an average of 930 hours per season during 1947-49 to an average of 2,200 hours during 1954-55.

**Dryland Cotton**

Dryland production practices depend largely on the amount of precipitation received before and after planting; thus, they vary widely from year to year. They range from a minimum of listing, planting and one or two cultivations with a light hoeing to an intensity of practices approaching that on irrigated lands. TAES-Bulletin 652 and Miscellaneous Publication 37 show the dryland practices during 1930-35 and 1947, respectively.

These two publications reflect practices during periods with more favorable moisture conditions than have prevailed in the past 5 years.

The dryland practices on which this study is based are somewhat less intensive than those reported for 1930-35 where only a small amount of 4-row machinery was used, and slightly more intensive than those reported for 1947 when 4-row equipment was in general use. Year-to-year variation in dryland production practices do not affect preharvest production costs materially. Most of the preharvest cost of producing a dryland crop stems from the ownership cost of machinery. Variations in the rate of production practices affect labor and fuel costs, however, since these costs are proportional to the hours of machinery use.

Dryland practices adopted for this study are those used on sandy soils. Dryland crop production practices used on heavy soils are not included, since a substantial acreage of wheat usually is planted on these farms.

**Irrigated Grain Sorghum**

Preharvest production practices for grain sorghum, although somewhat less intensive in their application, are similar to those for irrigated cotton. As with cotton, there has been an increase in the labor and power requirements and in the amount of water used per acre in producing grain sorghum since 1949. The increase in per-acre water use is similar on both soil types, although labor and power requirements have increased more on heavy soils where flat breaking at least half of the sorghum land is a common practice. Control of weeds in grain sorghum grown on heavy soils also requires more labor and greater use of machinery.

**Dryland Grain Sorghum**

Preharvest production practices for dryland grain sorghum are almost identical to those used for dryland cotton. The principal difference prior to planting consists of fewer wind-erosion control measures on sorghum land, and because sorghum is commonly planted later than cotton, there is more preplanting knifing of sorghum land.
higher than actually are required with reduced machinery investment in cotton were not unusual. Present machinery by this study commonly were planted to cotton. The amount and kinds of machinery required be- fore acreage-control programs reduced the cotton irrigated farms with acreage. The results of irrigation well and pumping plant costs are not included. Machines, exclusive of water, shown in Table 1 is affected by farm size. Although more equipment is required on large farms, the larger acreage involved permits a fuller use of some items of equipment and re- sults in a lower annual ownership cost of machinery per acre.

TABLE 1. PREHARVEST REQUIREMENTS FOR PRODUCING IRRIGATED AND DRYLAND COTTON AND GRAIN SORGHUM BY MAJOR SOIL TYPES, TEXAS HIGH PLAINS, 1955

<table>
<thead>
<tr>
<th>Type of farm</th>
<th>Man-hour requirements per acre</th>
<th>Tractor fuel, gallons per acre</th>
<th>Seed, pounds per acre</th>
<th>Number of insecticide applications per acre</th>
<th>Number of irrigations per season</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Machine</td>
<td>Tractor operator</td>
<td>Hoe</td>
<td>Irrigation</td>
<td>Total</td>
</tr>
<tr>
<td>Sandy soils</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigated cotton</td>
<td>4.16</td>
<td>4.16</td>
<td>5.20</td>
<td>2.08</td>
<td>11.44</td>
</tr>
<tr>
<td>Dryland cotton</td>
<td>1.55</td>
<td>1.55</td>
<td>3.20</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Irrigated grain sorghum</td>
<td>2.90</td>
<td>2.90</td>
<td>1.86</td>
<td>4.76</td>
<td>11.6</td>
</tr>
<tr>
<td>Dryland grain sorghum</td>
<td>1.55</td>
<td>1.55</td>
<td>—</td>
<td>1.55</td>
<td>6.2</td>
</tr>
<tr>
<td>Heavy soils</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigated cotton</td>
<td>4.75</td>
<td>4.75</td>
<td>5.40</td>
<td>1.62</td>
<td>11.77</td>
</tr>
<tr>
<td>Irrigated grain sorghum</td>
<td>3.02</td>
<td>3.02</td>
<td>2.00</td>
<td>1.73</td>
<td>6.75</td>
</tr>
</tbody>
</table>

1Butane.
2Seeding rates per planting: irrigated cotton, 32 lb.; dryland cotton, 20 lb.; irrigated grain sorghum, 7 lb.; dryland grain sorghum, 4 lb.
3Weight of seed before delinting.
4An average rate of 2 early applications and 1 1/2 late-season applications.
5Depends on rainfall. With rainfall, 1 or 2 early applications; without rainfall, no application.

PREHARVEST PRODUCTION REQUIREMENTS

The labor, machine hours and materials re- quired to conduct preharvest irrigated and dry- land production practices are shown in Table 1. Water requirements, other than the number of irrigations, are not included. For this study, the amount of water is held at a constant of 17 acre-inches, gross pumpage, per acre irrigated. Because of variations in the materials the quantities of insecticides used are not reported. Instead, the more common number of insecticide applications per acre is reported, regardless of the type or quantity of materials used.

PREHARVEST PRODUCTION COSTS

Cost of the preharvest production items and practices, exclusive of water, shown in Table 1 is presented in a later section of this report. Some of the cost items shown in Table 1 are affected by farm size. Although more equipment is required on large farms, the larger acreage involved permits a fuller use of some items of equipment and re- sults in a lower annual ownership cost of machinery per acre.

The annual cost of machinery is governed by the amount of machinery required to equip a farm. Both the amount and age of machinery vary widely; consequently, there is a wide range in the cost of machinery on High Plains farms. Most wholly irrigated farms are equipped with the amount and kinds of machinery required be- fore acreage-control programs reduced the cotton acreage. Before acreage control, some 70 to 80 percent of the irrigated lands in the area covered by this study commonly were planted to cotton. Irrigated farms with 100 percent of the cropland in cotton were not unusual. Present machinery inventories, therefore, are likely to be somewhat higher than actually are required with reduced cotton acreages. In this study, the amount of the investment in farm machinery is standardized. Machinery costs are based on the 1955 price of machinery items, combine and cotton strippers excepted, commonly found on wholly irrigated cotton and grain sorghum farms, Table 2.

Data are not available to indicate the age of equipment now on farms in this general area. Since these farms have been fully mechanized for some time, it may be assumed that present ma- chinery inventories reflect purchases over several years. Considering the fact that 1955 prices reflect a 17 to 20-percent increase in farm machinery prices since 1950, the depreciated value of present machinery inventories is probably about half that shown in Table 2.

The farm machinery investment on a 320-acre irrigated farm is nearly three times that on a similar dryland farm. Because of a heavier requirement and more intensive practices, the annual power and machinery cost for irrigated cotton is 3.5 times greater than the corresponding costs on dryland cotton. Annual power and machinery cost for irrigated grain sorghum pro- duction is double that on dryland sorghum, Table 2.

Labor costs, Table 3, are based on the pre- vailing 1955 wage paid for the type of labor involved—hoe or tractor operator or general
Material
Includes cost of machinery, fuel, oil, grease repair, labor, seed and insecticides.

In addition to the cost of machinery, fuel, oil, and grease repair, labor, seed, and insecticides, the costs of preharvest labor, power, and materials other than water are required to produce cotton and grain sorghum in the Texas High Plains at 1955 prices. These costs are presented for a 320-acre farm with heavy soils and for a 320-acre farm with sandy soils, and for a 160-acre farm with heavy soils.

Table 3 shows the preharvest costs for labor, power, and materials other than water required to produce cotton and grain sorghum in the Texas High Plains at 1955 prices. The costs are presented for a 320-acre farm with heavy soils and for a 320-acre farm with sandy soils, and for a 160-acre farm with heavy soils. The table includes the costs of machinery, fuel, oil, grease repair, labor, seed, and insecticides.

Water costs are governed by the investment in a pumping plant, size and type of power unit, fuel type and cost, mechanical condition of pumping equipment, pumping lift, rate of well yield, and total seasonal pumpage.

As this suggests, water costs differ considerably between wells, depending on how the factors listed combine at a particular well. High-yielding wells produce water at a lower cost per unit than low-yielding wells, and less labor is required to apply a given amount of water when larger irrigation heads are available. Well yield affects water costs significantly regardless of how other conditions combine at a particular pumping plant.

Although management practices provide some leeway for differences in the acreage that can be irrigated with a given head of water (g.p.m.), the acreage irrigated from a particular well is an indication of the yield of that well. Thus, declines in well yield are reflected by the reduction in the acreage irrigated per well. The acreage irrigated per well is related to the amount of water pumped for cotton and grain sorghum.

To appraise the effects of current and prospective changes in water supply, water costs are developed for typical high, medium, and low-cost water supply situations found in a field survey conducted in 1955. Water costs are based on the cost of providing water with butane-fueled pumping plants serving 39, 78, and 156 acres per well. Table 4 presents the water costs for pumping plants serving 39, 78, and 156 acres per well for the Texas High Plains.

Reasons for the higher costs of water from plants irrigating small acreages are apparent from Table 4. The per-acre investment in well and pumping equipment is $97, $57, and $39 for plants serving 39, 78, and 156 acres, respectively. Since overhead costs are proportional to the investment, the per-acre overhead costs on a well serving 39 acres is 2.5 times larger than on the plant that serves 156 acres. Operating costs per acre also are 2.5 times greater on the plant serving 39 acres than they are on the plant that serves 156 acres.

Cost estimates presented in Table 3, plus the water costs shown in Table 4, equal the total preharvest cost of machinery, labor, fuel, seed,
insecticides and water used to produce cotton and grain sorghum. Preharvest costs of cotton and grain sorghum production are related in Table 5 to the various combinations of acres irrigated per well, soil type and farm size.

**Preharvest Production Cost Comparison**

Preharvest production costs by the component groups (labor, power, materials and water) are shown in Table 5. Although production practices and requirements differ between heavy and sandy soils, these differences tend to cancel out and where water costs are comparable, there is no significant difference between the per-acre preharvest costs of producing irrigated cotton on sandy and heavy soils. Preharvest production costs for irrigated grain sorghum are approximately $2 per acre higher on heavy soils than on sandy soils. Preharvest production costs for cotton are $3.80 and $2.70 per acre lower on 320-acre sandy and heavy land farms than on 160-acre sandy and heavy land farms, respectively. These per-acre differences are lower with grain sorghum. Preharvest costs on grain sorghum are $1.70 and $1.80 per acre lower on 320-acre sandy and heavy land farms, respectively.

To facilitate a comparison, preharvest costs of producing dryland cotton and grain sorghum are repeated under each of the three water-cost situations in Table 5. On 320-acre farms, the preharvest costs per acre for irrigated cotton are 4.5 to 6 times greater than similar costs on dryland cotton, and the preharvest costs of irrigated grain sorghum is about 5 to almost 8 times greater than equivalent dryland costs, depending on water costs. For 160-acre farms, the difference between dryland and irrigated preharvest production costs is somewhat greater than those on 320-acre farms, particularly for cotton.

### TABLE 5. PREHARVEST LABOR, POWER, MATERIAL AND WATER COSTS RELATED TO ACRES IRRIGATED PER WELL, FARM SIZE AND MAJOR LAND TYPES, TEXAS HIGH PLAINS, 1955 PRICES

<table>
<thead>
<tr>
<th>Size and type of farm</th>
<th>320-acre dryland</th>
<th>320-acre irrigated</th>
<th>160-acre irrigated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>Grain sorghum</td>
<td>Cotton</td>
<td>Grain sorghum</td>
</tr>
<tr>
<td>Wells serving 39 acres</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>$3.55</td>
<td>$1.47</td>
<td>$9.31</td>
</tr>
<tr>
<td>Power &amp; machinery</td>
<td>$4.88</td>
<td>$3.22</td>
<td>$17.82</td>
</tr>
<tr>
<td>Materials &amp; supplies</td>
<td>$1.95</td>
<td>$0.42</td>
<td>$7.87</td>
</tr>
<tr>
<td>Water</td>
<td>0</td>
<td>0</td>
<td>28.10</td>
</tr>
<tr>
<td>Total</td>
<td>10.38</td>
<td>5.11</td>
<td>63.10</td>
</tr>
<tr>
<td>Wells serving 78 acres</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>$3.55</td>
<td>$1.47</td>
<td>$9.31</td>
</tr>
<tr>
<td>Power &amp; machinery</td>
<td>$4.88</td>
<td>$3.22</td>
<td>$17.82</td>
</tr>
<tr>
<td>Materials &amp; supplies</td>
<td>$1.95</td>
<td>$0.42</td>
<td>$7.87</td>
</tr>
<tr>
<td>Water</td>
<td>0</td>
<td>0</td>
<td>16.75</td>
</tr>
<tr>
<td>Total</td>
<td>10.38</td>
<td>5.11</td>
<td>51.75</td>
</tr>
<tr>
<td>Wells serving 156 acres</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>$3.55</td>
<td>$1.47</td>
<td>$9.31</td>
</tr>
<tr>
<td>Power &amp; machinery</td>
<td>$4.88</td>
<td>$3.22</td>
<td>$17.82</td>
</tr>
<tr>
<td>Materials &amp; supplies</td>
<td>$1.95</td>
<td>$0.42</td>
<td>$7.87</td>
</tr>
<tr>
<td>Water</td>
<td>0</td>
<td>0</td>
<td>11.25</td>
</tr>
<tr>
<td>Total</td>
<td>10.38</td>
<td>5.11</td>
<td>46.25</td>
</tr>
</tbody>
</table>

1Situation not typical on heavy land farms.

### HARVESTING AND ASSOCIATED COSTS

A high percentage of dryland cotton is machine-stripped, and a high percentage of irrigated cotton is hand-snapped once or twice, then the harvest is completed with a stripper.

Differences between hand-snapping and machine-stripping costs per hundred-weight of seed cotton affect the harvesting cost per unit. Associated costs, particularly ginning costs, also are affected by the method of harvest. Harvesting and ginning costs are based on the hundred-weight of seed cotton; consequently, they are not affected particularly by the yield per acre. The yield is likely to influence the proportion of the crop that is hand-snapped, and to that extent it will affect unit costs.

For this study, harvesting costs are based on 80 percent hand-snapping and 20 percent machine-stripping of irrigated cotton, and 20 percent hand-snapping and 80 percent machine-stripping of dryland cotton. A hand-snapping rate of $1.75 and a machine-stripping rate of 75 cents per hundredweight of seed cotton delivered to the gin were used to compute harvesting costs. Ginning costs are based on a rate of 50 cents per hundredweight for a seasonal average of 1,900 pounds of hand-snapped and 2,400 pounds of machine-stripped seed cotton per 500-pound bale of lint. Associated costs include a charge of $3.50 per bale for bagging and ties and 50 cents per bale for hauling to the compress.

Harvesting and associated costs, at these rates, average $44.20 per bale for irrigated cotton and $36.55 per bale for dryland cotton, or 8.84 and 7.31 cents, respectively, per pound of lint. The per-acre cost of harvesting cotton, therefore, is determined by the yield multiplied by the appropriate unit cost.
Cotton quality considerations are not included in this analysis. Previous studies have indicated no significant difference in quality between hand-snap and machine-stripped cotton, provided the cotton is harvested under comparable conditions.

Grain sorghum is harvested by combines. The most common custom combine rate during 1955 was $3 per acre for irrigated and $2 per acre for dryland grain sorghum, regardless of the yield per acre. In this study, grain sorghum combining costs are based on the 1955 custom harvesting rate. The only variable cost involved in harvesting grain sorghum is the cost of hauling from the combine to the elevator. The hauling charge is 5 to 10 cents per hundredweight, depending on the distance to market. In this analysis, the cost of hauling is based on a charge of 6 cents per hundredweight. As the variable cost is only 6 cents per hundredweight, harvesting costs per acre for grain sorghum are not affected materially by a variation in yield.

UNIT PRODUCTION COST

Generally, the higher the yield, the lower the unit cost. Preharvest labor, power, material and water costs shown in Table 5 are not affected particularly by variations in yields. Although these preharvest costs are somewhat fixed, a higher yield distributes them over more units. The same principle applies to harvesting costs for grain sorghum, which are based on a flat charge per acre except for the small hauling cost. With cotton harvesting and associated costs, both per-acre and per-unit costs vary directly with yield. Thus, the unit cost of producing either cotton or grain sorghum is governed largely by the yield per acre.

| Table 6. Total Labor, Power, Material, Water and Harvesting Cost, Per Acre and Per Pound, of Producing Irrigated and Dryland Cotton, by Major Soil Types and Size of Farm, Texas High Plains, 1955 Prices |
|---------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Yield in pounds of lint per acre | 400 | 450 | 500 | 550 | 600 | 650 |
| Cost per acre, $ | Cost per lb., c | Cost per acre, $ | Cost per lb., c | Cost per acre, $ | Cost per lb., c | Cost per acre, $ | Cost per lb., c | Cost per acre, $ | Cost per lb., c | Cost per acre, $ | Cost per lb., c |
| Irrigated farm |
| With wells serving 39 acres | 102.26 | 25.56 | 106.58 | 23.70 | 111.10 | 22.22 | 115.52 | 21.00 | 119.94 | 19.99 | 124.36 | 19.13 |
| 160-acre sandy land farm | 98.46 | 24.61 | 102.88 | 22.86 | 107.30 | 21.46 | 111.72 | 20.31 | 116.14 | 19.35 | 120.56 | 18.54 |
| 320-acre sandy land farm | 90.91 | 22.72 | 95.33 | 21.22 | 99.75 | 19.95 | 104.17 | 18.94 | 108.59 | 18.09 | 113.01 | 17.38 |
| With wells serving 78 acres | 89.32 | 22.31 | 93.74 | 20.83 | 98.16 | 19.63 | 102.58 | 18.65 | 107.00 | 17.85 | 111.42 | 17.14 |
| 160-acre sandy land farm | 87.11 | 21.77 | 91.53 | 20.34 | 95.95 | 19.19 | 100.37 | 18.24 | 104.79 | 17.46 | 109.21 | 16.80 |
| 320-acre sandy land farm | 87.18 | 21.79 | 91.60 | 20.35 | 96.02 | 19.19 | 100.44 | 18.26 | 104.84 | 17.47 | 109.24 | 16.80 |
| With wells serving 156 acres | 85.41 | 21.35 | 88.83 | 19.96 | 94.25 | 18.85 | 98.67 | 17.94 | 103.09 | 17.18 | 107.51 | 16.44 |
| 160-acre sandy land farm | 83.82 | 20.93 | 88.24 | 19.60 | 92.66 | 18.53 | 97.08 | 17.65 | 101.50 | 16.91 | 105.92 | 16.29 |
| 320-acre sandy land farm | 81.61 | 20.40 | 86.03 | 19.11 | 90.45 | 18.08 | 94.87 | 17.24 | 99.29 | 16.54 | 103.71 | 15.95 |
| 320-acre heavy land farm | 81.68 | 20.42 | 86.10 | 19.13 | 90.52 | 18.10 | 94.94 | 17.26 | 99.36 | 16.56 | 103.78 | 15.96 |
| Dryland farm |
Although irrigation increased both the per-acre and per-unit costs of cotton production, the higher yield obtained provides a larger return, as shown in Figures 3 and 5. For example, although the unit production costs of dryland and irrigated cotton at the cheapest water rate (156 acres per well) are comparable at the 75-pound dryland and 400-pound irrigated yield levels, the gross value of the 75-pound dryland lint and seed crop is $22.60 per acre, while the 400-pound irrigated crop grosses $128.60. The net return to land and management from dryland cotton at the 75-pound yield level is only $6.74 per acre, whereas with the cheapest water, an irrigated crop must yield 400 pounds per acre to provide a net return equivalent to that of a 400-pound-per-acre irrigated cotton yield.

Because the value of grain sorghum is low compared with the increased production costs for an irrigated crop, the returns from irrigated grain sorghum are considerably lower than those from irrigated cotton. At 1955 prices, a grain sorghum yield of 5,000 pounds per acre was required to provide a net return equivalent to that of a 400-pound-per-acre irrigated cotton yield.

### Grain Sorghum

Figures 5 to 8 present the specified cost per acre and per unit of producing irrigated and dryland grain sorghum. The unit cost of producing dryland grain sorghum at 500 pounds per acre, Figure 6, is approximately the same as the unit cost of a 2,000-pound per acre irrigated crop grown with the cheapest water, Figure 5. With more expensive water, the unit costs of irrigated grain sorghum production are 55 to 85 cents greater per hundredweight than dryland costs. A dryland yield of 750 pounds per acre can be produced at a cost of $1 per hundredweight, land and management costs excluded, whereas with the cheapest water, an irrigated crop must yield at least 2,900 pounds per acre to be produced at a similar cost.

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**Table 7. Total Labor, Power, Material, Water and Harvesting Cost, Per Acre and Per Hundredweight, of Producing Irrigated and Dryland Grain Sorghum by Major Soil Types and Size of Farm, Texas High Plains, 1955 Prices**

<table>
<thead>
<tr>
<th>Yield in pounds per acre</th>
<th>2000</th>
<th>2500</th>
<th>3000</th>
<th>3500</th>
<th>4000</th>
<th>4500</th>
<th>5000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost per acre</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per cwt.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Cost per pound</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per hundredweight</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dryland**

- 320-acre sandy land farm: $28.91 1.44 28.21 1.17 28.51 .98 28.81 .85 30.11 .75 30.41 .67 30.71 .61

**Irrigated**

**With wells serving 39 acres**

- 160-acre sandy land farm: $45.76 2.29 46.06 1.84 46.36 1.54 46.66 1.33 46.96 1.17 47.26 1.05 47.56 .95

**With wells serving 78 acres**

- 160-acre heavy land farm: $34.11 1.72 34.71 1.39 35.01 1.17 35.31 1.01 35.61 .89 35.91 .78 36.21 .67

**With wells serving 156 acres**

- 160-acre heavy land farm: $31.05 1.55 31.35 1.25 31.65 1.05 31.95 .89 32.25 .71 32.55 .53 32.85 .35

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**Graph: Dryland Cotton**

**Figure 2.** Specified production cost (power and machinery, materials and harvesting cost) per pound of dryland cotton related to yield per acre.
TABLE 8. TENANT’S PREHARVEST COST FOR LABOR, POWER, WATER AND OTHER MATERIALS REQUIRED TO PRODUCE IRRIGATED AND DRYLAND COTTON AND GRAIN SORGHUM BY MAJOR SOIL TYPES AND SIZE OF FARM RELATED TO ACRES IRRIGATED PER WELL, TEXAS HIGH PLAINS, 1955 PRICES

<table>
<thead>
<tr>
<th>Size and type of farm</th>
<th>Preharvest costs per acre (exclusive of water cost)</th>
<th>Preharvest costs per acre including water costs at 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cotton</td>
<td>Grain sorghum</td>
</tr>
<tr>
<td>39 acres per well</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dryland crops</td>
<td>10.38</td>
<td>5.11</td>
</tr>
<tr>
<td>Irrigated crops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78 acres per well</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dryland crops</td>
<td>38.80</td>
<td>13.46</td>
</tr>
<tr>
<td>Irrigated crops</td>
<td></td>
<td></td>
</tr>
<tr>
<td>156 acres per well</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dryland crops</td>
<td>34.51</td>
<td>13.80</td>
</tr>
<tr>
<td>Irrigated crops</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Entries from last column, Table 3.
2. Water cost based on typical rental agreement: landlord furnishes and maintains well and pump; tenant provides engine, fuel tank and oil, fuel and engine repair costs.
3. Few farms in this category.

The spread between the “total specified cost per acre” and “value of production” lines on Figures 7 and 8 indicates the per-acre returns from irrigated and dryland grain sorghum at 1954 and 1955 prices for grain. The price reduction of 50 cents per hundredweight in 1955 removed most of the profit from sorghum production, Figure 7.

TENANT OPERATOR’S COST

According to the 1954 Census of Agriculture, about 50 percent of the irrigated farms on the High Plains were tenant-operated. With this proportion of the farms operated principally under some form of agreement wherein both costs and returns are shared, the tenant operator’s cost merit some special consideration. Minor details of the rental agreements may differ considerably. Typically, however, the landlord provides land, buildings, well and pump, and pays well and pump repair costs. The tenant provides the pump power unit and all labor, machinery, fuel, oil, insecticide, seed and repairs required to produce and harvest the crop. The landlord receives one-third of the sorghum grain delivered to the elevator and one-fourth of the seed cotton delivered to the gin. The landlord usually pays the ginning costs on his portion of the cotton crop.
The tenant's specified per-acre costs and returns under the typical leasing agreement, are shown in Table 8 and in Figures 9 to 12. These cost estimates are based on the same requirements used in Tables 5 and 7. The data in Table 8 have been adjusted to reflect only the tenant's share of specified costs.

The amount of money available to cover risk, management and other unallocated costs is shown by the spread between the per-acre cost of production and the per-acre value of yield lines, Figures 9 to 12. The landlord's share of the crop, which is equivalent to the market value of the rental payment by the tenant, has been deducted from the yield value per acre so that the “value of production” lines represent the tenant’s per acre total return from crop sales.

For irrigated cotton grown with the most expensive water—39 acres per well—the tenant must produce 420 pounds of lint per acre to earn the equivalent of wages for his efforts, Figure 9. At the 400-pound level, he recovers his cash and overhead costs and $2.44 per acre for his labor: 39 cents per hour compared with a 1955 wage rate of 95 cents per hour. With 1954 average cotton yields on sandy soils, a tenant who uses water from a well serving 39 acres has a management income of $17.22 per acre.

At 1955 prices, average or better-than-average yields of irrigated grain sorghum are required to pay rent, labor, production, overhead and prime costs, Figure 10.

The situation is much the same with dryland cotton and grain sorghum production, Figures 11 and 12. A comparison of cost and returns in Figures 4 and 8 with those in Figures 11 and 12 shows that although the tenant recovers his specified cost at the lower yield, he receives a very low price for his labor.

**POSSIBLE COST REDUCTIONS**

Water constitutes one of the largest items of expense in preharvest costs, but substantial reductions in water cost seem unlikely. One prospect is to reduce fuel costs by a shift to natural gas. Natural gas lines cost about $1,000 per well; consequently, the shift is advisable only if the annual fuel requirements are large. For large wells, a shift to natural gas would reduce annual costs of fuel substantially, and the savings would be sufficient to amortize the cost of the gas line.

For small wells, the shift is inadvisable since the engines that power small wells require rela-
Figure 8. Specified production cost (power and machinery, labor, materials and harvesting cost) and value of production per acre, dryland grain sorghum, related to yield per acre.

Irrigation research and general experience show that higher rates of water application will increase crop yields. However, the regional decline in water levels indicates that the water resources will not support even the present rate of water use. Relief through increased water use, therefore, would be at the expense of production in future years.

Another possibility for reducing the costs of crop production on irrigated farms on the High Plains lies in the mechanization of the cotton harvest. Farm operations in this area are conducted on medium-size to large, highly mechanized farms; consequently, most of the savings from mechanized, large-scale farm operations have been realized already. The one notable exception on irrigated farms is cotton harvesting. Most of the cotton still is hand-snapped.

The proportion of specified costs attributable to preharvest operations is shown in Table 5 as labor, power and machinery, materials and water costs. Under the system now followed on the High Plains, a reduction in wage rates would not necessarily add to profits since the farm operator supplies most of the preharvest labor himself. Machine and power costs include expenditures for fuel, oil, repairs and machinery overhead—depreciation, interest and taxes. Material costs include expenditures for seed and insecticides. Since the farm operator has little control over the cost of power and production materials, the only way he can reduce preharvest costs is to use fewer of the items involved.

One prospect for reducing power costs is the more effective use of less farm machinery. Power and machinery constitute the largest item of expense, excluding water, in the preharvest cost of producing either cotton or grain sorghum. Tables 3 and 5. In fact, the ownership costs of machinery constitute almost half the preharvest cost, excluding water. The amount of equipment now used meets satisfactorily the physical requirements of producing crops under the weather conditions of the High Plains. However, under
the present cost-price situation and acreage con-
trols, a lower investment in machinery may be
required to reduce costs.

Prospects for reducing machinery costs are
much greater on the 320-acre irrigated farm,
where three tractors commonly are used, than on
the 160-acre farm equipped with one field and one
utility tractor. Reducing the number of tractors
to two on 320-acre farms may alter the timeliness
of operation, but the prospects of a reduction
in yield because of a delay of 1 or 2 days in most
critical farm operations appears to be remote.
Eliminating one 4-row field tractor and its attach-
ments would reduce the annual cost of owning
farm machinery by $750.

On 160-acre farms, machinery costs could be
reduced by greater use of 2-row farm machinery.
Both a utility and a 2-row field tractor could be
used, or they could be replaced by one of the
larger 2-row utility tractors with the newly
adopted fast-hitch equipment. The use of 2-row
equipment would increase the hours of labor
required to perform those operations that are
now performed with 4-row machinery. Possible
savings through a fuller use of 2-row equipment
and a reduction in the machinery investment per
farm should be balanced against the increase in
labor requirements.

A return to less intensive cultural practices
offers another prospect for reducing costs. Cot-
ton yields obtained on some of the partly irrigated
farms, where the intensity of cultural practices
is similar to those applied on dryland, suggests
that some practices adopted in recent years may
be eliminated or reduced in frequency. For
example, “flat breaking” and “deep plowing” in-
creases the labor and power requirements sub-
stantially for irrigated crops, but they are seldom
practiced on the partly irrigated farm. A return
to the less intensive cultural practices followed
in the late 1940’s probably would not reduce
yields greatly. It would, however, eliminate a
substantial amount of the labor and power re-
quired to produce irrigated crops. It also would
facilitate the use of fewer and perhaps smaller
tractors, with a consequent reduction in the farm
machinery investment.

Increasing per-acre yields is the most direct
way to lower unit production costs, but several
conditions on the High Plains limit the possibili-
ties of this method. The length of the frost-
free growing season restricts cotton yields com-
pared with yields in other areas. Fertilizer trials
at the Lubbock Experiment Station (sandy land)
and at the Ewen farm near Tulia (heavy land),
reveal no significant difference between the yield
of fertilized and unfertilized cotton. Significant
yield increases, however, have been obtained by
fertilizing cotton on the fine sand soils in Terry
county. The acreage of this type of soil under
irrigation is relatively minor, and this study does
not include production requirements and costs on
soils of this nature.
Although inorganic fertilizers have not proved beneficial on the "sandy" and "heavy" land areas included in this study, some significant increases in cotton yields have been obtained through the use of organic materials. Annual application of 2 tons of cotton burs during a 3-year period increased cotton yields approximately 20 percent. A slightly larger increase was obtained through the use of Madrid clover in a sorghum-clover-cotton rotation.

Research to date indicates that organic, rather than inorganic materials, affords the best prospect for increasing yields. There are several limitations, however, to the widespread use of either of the organics—cotton burs or Madrid clover. Unless there is a substantial residual or carryover effect from the use of cotton burs, the quantities of burs required to effect the increase is so great that only a small proportion of the cotton acreage can be treated each year. Work to determine the residual effects of cotton bur application is now underway at the Lubbock station.

The use of Madrid clover, or other cover crops as a green manure crop, entails considerable additional expense and the use of 6 to 9-acre inches of additional water. Unless an operator has a well of better-than-average capacity, the water demands of the cover crop will prevent or curtail the amount of preseasonal irrigation.

The quantities of burs required and possible conflict in demands for water may limit sharply the widespread use of organic materials. For the individual, however, who has access to a sufficient quantity of cotton burs, or who has a well of sufficient capacity to meet the water demands of a cover crop and preseasonal irrigation at the same time, organic materials provide an opportunity for increasing cotton yield.

In certain situations, the adoption of contour or short, level furrow irrigation practice will reduce the irrigation requirements. Adoption of these practices does not necessarily reduce production costs since possible savings in water cost or gains resulting from more efficient water use will be offset, at least in part, by the added costs involved. Generally, the prospects of reducing either the per-acre or per-unit production costs through these methods depends, as with the use of organic materials, on conditions on the individual farm.

Use of the newly developed grain sorghum hybrids may lower the unit cost for sorghum, but would not necessarily improve its competitive position with cotton. The increased production resulting from widespread adoption of sorghum hybrids could depress prices still more.

Of the three costs that might be lowered—harvesting, preharvest and unit—only mechanization of the cotton harvest provides an opportunity for substantially lower production costs. Some lower preharvest costs can be obtained by using less farm machinery and by using fewer practices that require a large amount of time and power.
LITERATURE CITED


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