OPTIMUM ORGANIZATION OF GINS AND WAREHOUSES
FOR MARKETING COTTON IN THE
OKLAHOMA-TEXAS PLAINS

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PREFACE

This research represents an analysis of raw cotton industry optimum market structures for the high plains of Texas and the rolling plains of Oklahoma and Texas. The primary objective is to determine the optimum size, number and location of cotton processing plants that would minimize total assembly, processing and distribution cost under alternative assumptions. A spatial equilibrium model is used and includes economies of size in gin and warehouse processing.

Many people contributed to the competition of this study. Foremost among these is Dr. Leo V. Blakley, the author's major adviser. For his guidance and assistance the author is deeply grateful. Appreciation is also due advisory committee members Drs. Paul D. Hummer, Daryll E. Ray, P. Leo Strickland and Michael R. Edgmand for the invaluable assistance in the preparation of the final manuscript. A note of appreciation is also extended to James S. Plaxico, Head of the Department of Agricultural Economics.

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CHAPTER I

INTRODUCTION

The United States cotton industry is characterized by a continuously changing economic environment. Economic change within the industry has resulted from technological advancement and from capital for labor substitution in the producing, marketing and milling sectors of the industry. Further change has resulted from shifts in geographical production areas and from the emergence of forward contracting.

Even though recent production levels are similar to early 1900 levels, marked increases in production occurred in the early 1950's and 1960's. However, since 1899 the number of active gins has decreased from 29,620 to 3,219. As the number of gins has decreased the average number of bales handled per gin has increased from 317 to 3519 (U. S. Dept. of Commerce, p. 2-18).

Major geographical shifts have occurred since the early 1900's. These shifts have been from the Southeast and East Texas to the plains of Oklahoma and Texas and the Imperial and San Joaquin Valleys of California. The Mississippi Delta has retained its historical position as a major producing area.

Oklahoma and West Texas' emergence as a major producing region was made possible by the development of new varities of cotton and technological advancement in field machinery and ginning equipment. Since becoming one of the major producing areas in the Cotton Belt, this area, often referred to as the machine stripped area, has become the primary innovator in the marketing sector of the industry. The first successful attempt to lengthen the ginning season by the practice of storing seed cotton as well as the first usage of modern high capacity universal density gins occurred in this region. However, these innovations have been accepted by only a very few members of the industry.

The declining competitive strength of the cotton industry has been a matter of increasing concern to industry members and public policy-makers for many years. The industry continues to face many complex economic adjustments arising from changes in government policies, technology, market conditions and exogenous shocks to an old and tradition-bound marketing system. The impact of these factors coupled with increasingly stiff competition of manmade fibers and foreign-grown cotton has been felt by all sectors of the industry.

Producers are faced with a series of problems that seriously affect their future. Chief among these is competition from synthetic fibers. Between 1960 and 1971, cotton's share of the fiber market decreased from 65 percent to 33 percent (USDA 1973, p. 27). Increasing costs of ginning and warehousing present other problems. Increasing production costs appear to be the area over which producers have the most control; however, it is generally acknowledged that significant reduction in production cost is limited. Greater opportunities exist for cost reduction in the marketing system of the industry.

Economic Environment

Few significant changes have been made in the cotton marketing system in the last half century. Cotton cannot be converted into cash until it is separated from the seed. Seed cotton is still hauled to the gin by the producers and gins and warehouses operate very much the same. The gin bale is about the same size and density and is wrapped in similar bagging. Bales are weighed and sampled as many as four times: (1) at the gin; (2) upon receipt at the warehouse; (3) after warehouse recompression and (4) prior to shipment to the mill.

Cotton gins press bales to several different weights and densities. As late as 1973 warehouses recompressed gin bales to two different densities, standard density for domestic shipment and high density for foreign shipment. In some instances gin bales have been recompressed to standard density and later to high density. Inefficiences of this nature can add as much as seven dollars to the per bale marketing cost.

There have been few attempts to eliminate duplication and inefficiency. One warehouse official remarked:

> Nearly all the waste, all of the mutilation, and a great portion of the unnecessary expense with which cotton is and has been made to bear the burden, can be eliminated at the point where the bale is originally packaged.
>
> A bale of cotton, originally compressed to a proper density at the gin, and a correct sample drawn from the original bale of cotton, properly supervised, and with sufficient financial guarantee as to the sample honesty and fairly representing the bale, would forever stop the unnecessary waste of cotton and insure a perfect package from origin to destination.

This statement, made in 1919, is applicable today (Turner, p. 57).

The estimated cost of marketing raw cotton in the Oklahoma and West Texas plains areas in 1974 is $88 per bale or $.18 per pound, Table 1. Ginning and merchandising are primary cost items being $33.20 and $32.38 per bale, respectively. Warehousing is $13.23 while farm assembly adds another $8.86 to the per bale cost. Estimated gin-warehouse transportation cost is $.75 per bale.

Table 1. Estimated Per Bale Cost of Marketing Raw Cotton, Oklahoma and West Texas Plains Areas, 1974

Activity	Cost	
	Dollars Per Bale	Cents Per Pound
Assembly[a]	8.860	1.8
Ginning	33.200	6.9
Gin-Warehouse Transportation	0.750	0.2
Warehousing[b]	13.230	2.8
Merchandising[c]	32.278	6.7
Total Cost[d]	88.318	18.4

[a]Estimated as $8.04 for trailer and $0.82 for transportation

[b]Includes compression

[c]Weighted average cost for Altus study area based on quantity shipped to each mill area; the weighted cost for Abilene and Lubbock study areas was estimated to be $32.254 and $32.444, respectively

[d]Total cost for Abilene and Lubbock study areas is $88.294 and $88.484, respectively.

Sources: (Chandler and Ghetti, p. 6)
(Looney, p. 2)
(Sandel, Smith and Fowler, pp. 25-33)

Few changes suggested over the years have been incorporated by the marketing sector of the cotton industry. Resistance by certain segments of the industry have prevented the adoption of some ideas. Others have been bypassed because of their high cost. In some cases, producers and others have felt that the existing system could not be improved.

The changing economic environment has been evidenced by rapidly rising production, transportation, ginning, warehousing and merchandising costs as well as unpredictable and erratic price changes.

A more recent and unfamiliar concern of cotton producers is the realization that government assistance may not continue. The push toward market orientation intensifies the need to find solutions to cotton marketing problems. Producers can no longer rely on government payments to fill the gap between costs and returns. Nor can they or other industry members ignore the lack of efficiency in the traditional marketing system.

Analysis of the industry indicates that the greatest impediment to its improvement may be the lack of coordination between various industry functions. The cotton gin has been viewed as a complete system, in and of itself, with no interest in the costs incurred after ginning and no direct responsibility for the quality of products processed.

As a result, the gin is considered as one of the many independent business centers through which cotton must move on its way to market. The cotton warehouse has been managed and operated as another separate business through which each bale is required to move. Lint merchandising operations have also been treated as a separate business with no control over the costs incurred in preparing the lint for market and no control over its quality or condition. To be efficient, these sectors much be coordinated and become sensitive to needs of the others.

In reality, these off-farm functions not only cost farmers, but the additional cost between farmer price and mill price decreases the quantity of cotton demanded or increases the competition from other fibers. The most efficient marketing system does not make money--it costs money: less efficient systems cost more.

The producer harvests his cotton and transports it to the gin. He cannot sell his crop until it is ginned; therefore, the system creates a conflict between his interests and those of the gin. He wants the shortest possible harvest season, the shortest possible trailer turnaround time, and rapid low-cost ginning with minimum physical damage and loss.

The ginner prefers a steady flow of cotton for the longest period of time possible. He needs a backlog to keep the gin operating during periods of bad weather when the producer cannot harvest. He is interested in packaging the bale and delivering it to the warehouse at the least possible cost to himself and the producer. There is no direct benefit to the gin after the bale has been placed in warehouse storage.

Similarly, the warehouseman and the merchant have conflicting interests. The warehouseman has no incentive to improve the product he handles. He attempts to maximize revenue from storage and handling fees. However, the merchant wants an attractive product to offer mills with the lowest possible storage and compression costs attached to the bale.

It is doubtful that costs of moving cotton from producers to mills can be reduced with fragmented industry interests. With separate business centers controlling sectors of the marketing system, chances are that at least one group will oppose potential cost reducing concepts simply because their individual position may not be improved.

However, all sectors of the industry have recently agreed to accept a standard size bale. Now a bale can be pressed to universal density at the gin and not have to be recompressed; thus, resulting in a savings of up to seven dollars per bale. Transportation costs are also lower for a universal density bale. Unfortunately, with the present industry structure, this savings will be slow to materalize. Most gins are fully depreciated, out-dated and lack the capacity required to operate a universal density press. Seed cotton storage through the use of cotton ricks or cotton modules has been suggested as a means of increasing the ginning season, thus, increasing gin and warehouse capacity. This method has been tested throughout the Cotton Belt and appears to be a desirable change.

The Problem

Industry experience and research indicates that serious overcapacity in both ginning and warehousing facilities exist in the machine stripped area. In 1974 the plains area of Texas and Oklahoma had the capacity to gin over 7 million bales and to warehouse 4.6 million bales. Production in 1974 for this area is estimated to be 2.8 million bales. The cost of ginning increased 30 percent between 1963 and 1973, an increase from $18.11 to $25.60 per bale. Warehousing costs per bale increased from $1.41 to $2.29 (Looney, p. 2).

The resulting increased costs are reflected in the price which textile mills have to pay for cotton and eventually result in increased consumer prices for textile products. As a result, producers suffer economic losses in two ways: (1) increasing costs of ginning and warehousing services tend to have a dampening effect on the net return to the producer and (2) the increased price of raw cotton to mills is an additional incentive for mills to turn to alternative fibers as a source of raw material, thus eroding the market for raw cotton.

Many studies have been made of the various sectors of the industry; however, none have attempted to consider all sectors of the marketing system. As a result the benefits of some studies have failed to materalize since effects on related sectors have not been understood. Research linking the various sectors of the marketing system could, for example, indicate the effects of changes in the size, number and location of cotton gins on the warehouse sector and related effects on the delivery of raw cotton to the mill.

The changing economic environment has resulted in significant changes in the industry alternatives with respect to size, number and location of ginning and warehousing facilities. An environment of change affecting the efficiency of the entire marketing sector exists. Changes within the marketing sector affect the behavior of the producing and milling sectors.

Efforts to specify an optimum organization of the marketing system in a dynamic economic environment may not succeed; however, a partial equilibrium analysis will provide the direction and magnitude for desirable changes. An analysis of the optimum marketing system should provide: (1) guidelines to firms to eliminate unnecessary inefficiencies in their existing organization, and (2) guidelines to public policymakers to facilitate the needs of producers and consumers.

Objectives of the Study

The purpose of this study is to evaluate alternative marketing structures and resulting performance of the ginning, warehousing and distribution sectors of the cotton marketing industry in the Oklahoma-Texas plains region. Two alternative ginning seasons are examined. The specific objectives of the study are to:

(1) Develop an operational model capable of analyzing the existing flow of cotton from the farm through the ginning, warehousing and merchandising sectors of the cotton marketing system.

(2) Describe the present operation of firms in the Oklahoma-West Texas cotton marketing system and estimate the total cost of farm assembly, ginning, warehousing, and merchandising.

(3) Determine the size, number and location of gins and warehouses that will minimize the total cost of farm assembly, ginning, warehousing and merchandising under two alternative ginning seasons and estimate the savings that would result from a relocation of gins and warehouses for each ginning season.

Both public and private decision makers will benefit from the results of such research: (1) ginners, warehousemen, and other middlemen, through the development of improved practices and the evaluation of potential industry adjustments on performance; (2) producers and consumers, through a more efficient cotton marketing sector and (3) policymakers, by having more complete and current data on the total system and the economic relationships.

The Study Area

The Smith-Doxey Cotton Classing Act of 1968 divided the Oklahoma-

Texas plains region into three classing territories; Altus, Lubbock, and Abilene, Figure 1. A multi-county area of each territory is selected and identified by classing terriroty name, Figure 2. The delineation of each study area is based on conditions prevalent in each classing territory. Ginning data are presented in Table 2. The Altus area includes the Oklahoma counties of Greer, Tillman, Kiowa, Jackson and Harmon and is characterized by large amounts of production in some counties and small amounts in other counties. This area accounts for over 50 percent of Oklahoma cotton production and had 39 gins and 7 warehouses operating in 1974.

The Lubbock study area includes the Texas counties of Lamb, Hale, Floyd, Crosby, Lubbock, Hockley, Terry, Lynn and Garza and is the center of production in West Texas. There were 217 gins and 16 warehouses operating in 1974. Over 30 percent of the cotton produced in Texas is grown in these nine counties.

The Texas counties of Taylor, Jones, Fisher and Nolan are included in the Abilene study area and had 33 gins and 8 warehouses operating in 1974. This area is representative of one declining in cotton production relative to other areas. Only 4 percent of the 1973 Texas crop was produced in this region.

The selection of these three areas to represent the machine stripped area was based on a number of factors. Factors of primary importance were:

1. The production in each area.
2. The expectation that the areas will maintain their competitive position in cotton production.
3. There is a minimum of seed cotton transported into and out of each area.

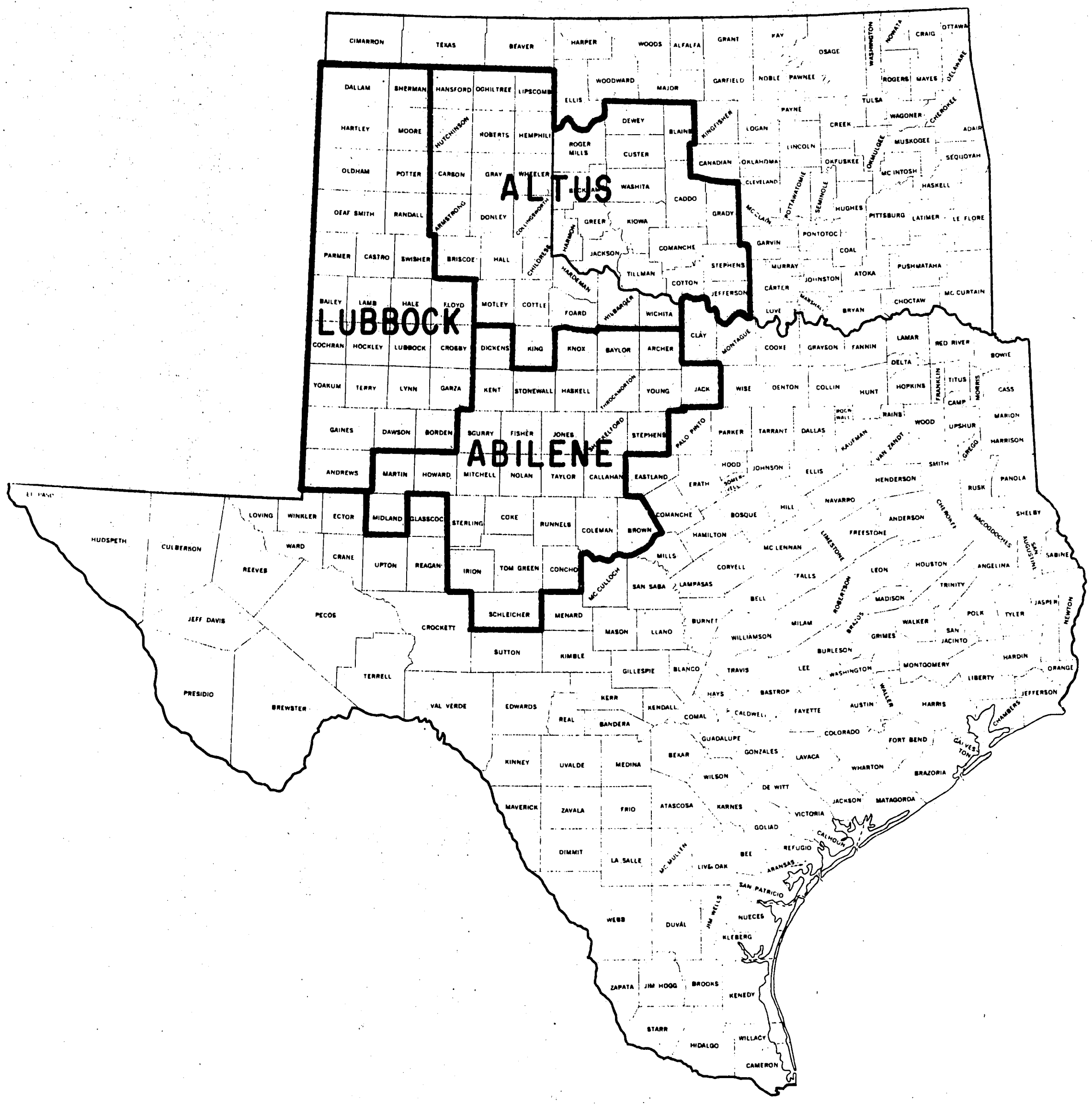

Figure 1. Cotton Classing Territories in Texas High Plains and Oklahoma and Texas Rolling Plains

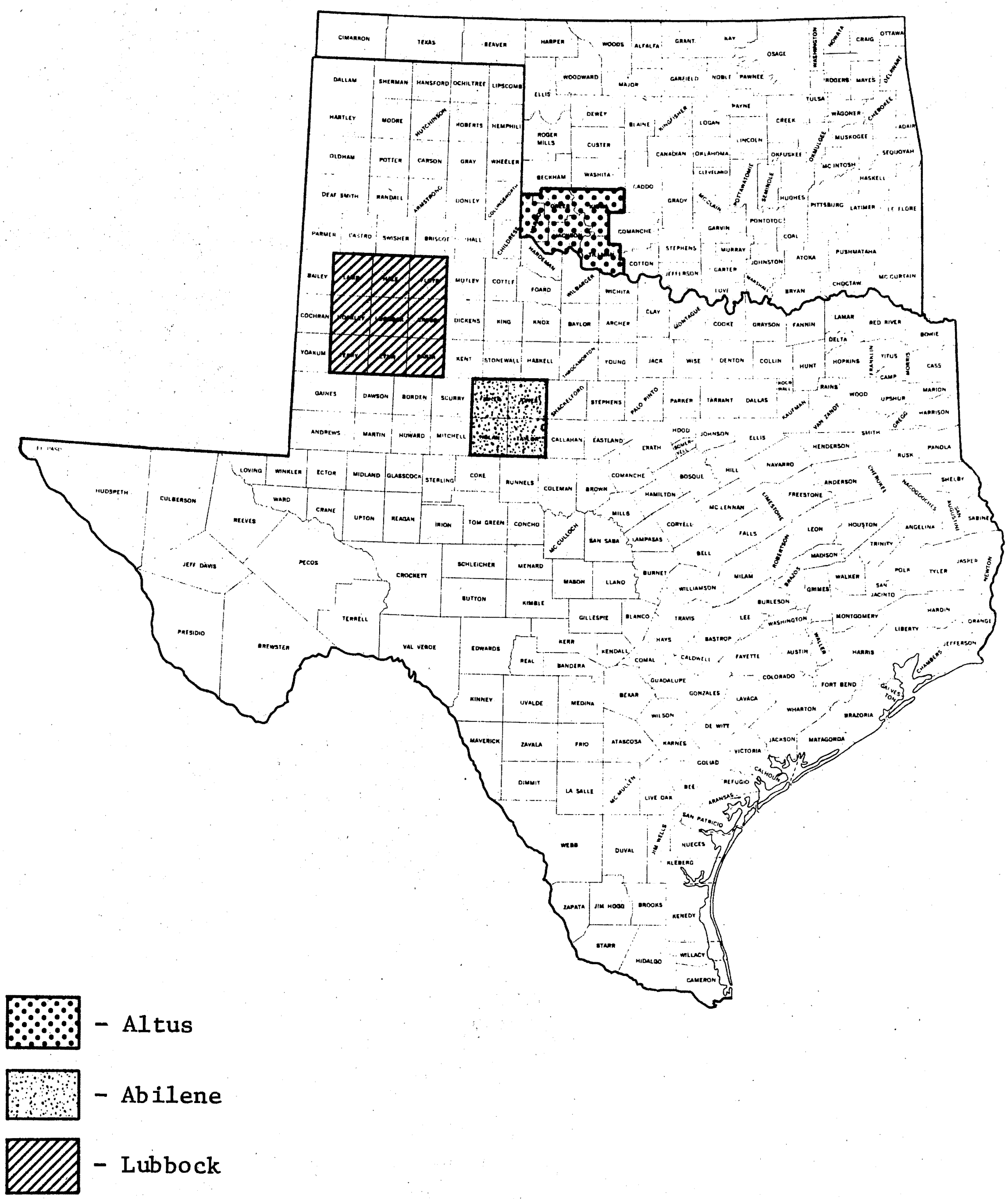

Figure 2. Altus, Abilene and Lubbock Study Areas

Table 2. Cotton Ginnings by Study Area and Classing Territory, 1968-1973

Study Area/County	GINNINGS					
	1968	1969	1970	1971	1972	1973
			BALES			
ALTUS						
Greer	14,932	14,802	8,482	10,223	18,977	26,982
Harmon	20,670	13,583	10,695	11,793	20,364	28,249
Jackson	31,545	29,893	28,881	16,325	38,910	59,943
Kiowa	20,852	26,927	13,524	23,199	26,900	43,121
Tillman	32,708	29,557	19,424	13,415	39,483	62,870
Study Area Total	120,707	114,762	81,006	74,954	144,634	221,165
Classing Territory Total	447,385	408,161	392,121	300,448	542,307	729,804
LUBBOCK						
Crosby	74,381	78,759	117,408	78,237	156,130	189,244
Floyd	40,502	62,802	77,748	44,195	113,971	131,386
Garza	21,717	15,901	17,640	11,283	28,198	34,612
Hale	68,297	79,073	140,178	89,869	143,406	157,797
Hockley	168,808	132,718	153,447	93,470	122,484	212,403
Lamb	106,707	67,754	119,966	84,747	106,069	141,567
Lynn	172,311	150,568	152,886	97,697	230,717	309,356
Lubbock	180,765	173,086	215,485	152,052	226,837	310,481
Terry	117,615	90,954	103,514	81,310	121,357	172,896
Study Area Total	951,103	851,615	1,098,272	732,860	1,121,069	1,541,542
Classing Territory Total	1,462,776	1,286,810	1,587,724	1,080,859	1,911,223	2,418,987
ABILENE						
Fisher	47,771	17,684	37,110	24,461	42,056	56,494
Jones	67,160	43,478	58,643	38,378	70,443	89,117
Nolan	26,286	16,323	21,326	9,113	25,353	28,980
Taylor	10,482	7,190	9,672	5,942	6,781	10,031
Study Area Total	108,699	84,675	126,751	77,894	166,832	184,622
Classing Territory Total	579,376	326,946	446,280	346,482	582,515	717,836

Source: (U. S. Department of Commerce, pp. 13-17)

4. The relative importance of each area as merchandising centers. Although the study areas are limited to a portion of the machine stripped region, the concepts employed could be applied to the entire region. The concepts are also applicable to other areas given minor modifications.

CHAPTER II

THE OKLAHOMA-WEST TEXAS COTTON MARKETING SYSTEM

The marketing system for raw cotton can be divided into four subsystems:

1. On farm assebly of seed cotton and transportation to the gin.
2. Seed cotton ginning and transportation to the warehouse.
3. Storage and recompression.
4. Merchandising services and market distribution.

An industry flow diagram, Figure 3, depicts the relationship of these subsystems.

Most producers in the Oklahoma-West Texas region haul seed cotton to gins in their own trailers as soon as it is harvested; however, some producers in West Texas utilize gin owned trailers. Regulations in Oklahoma prohibit gins from owning trailers. The trailers are transported in tandem by a farm tractor or pick-up truck. Producers haul from three to twelve bales of lint cotton per trailer depending on trailer size with six bale trailers being the most common size. Generally, producers demand that their cotton be ginned as soon as possible. Given the numerous gins located throughout the area, producers are seldom required to transport their crop more than five miles.

The ginning period is tied closely with the harvesting period, differing only by a few days at most. Consequently, ginning varies

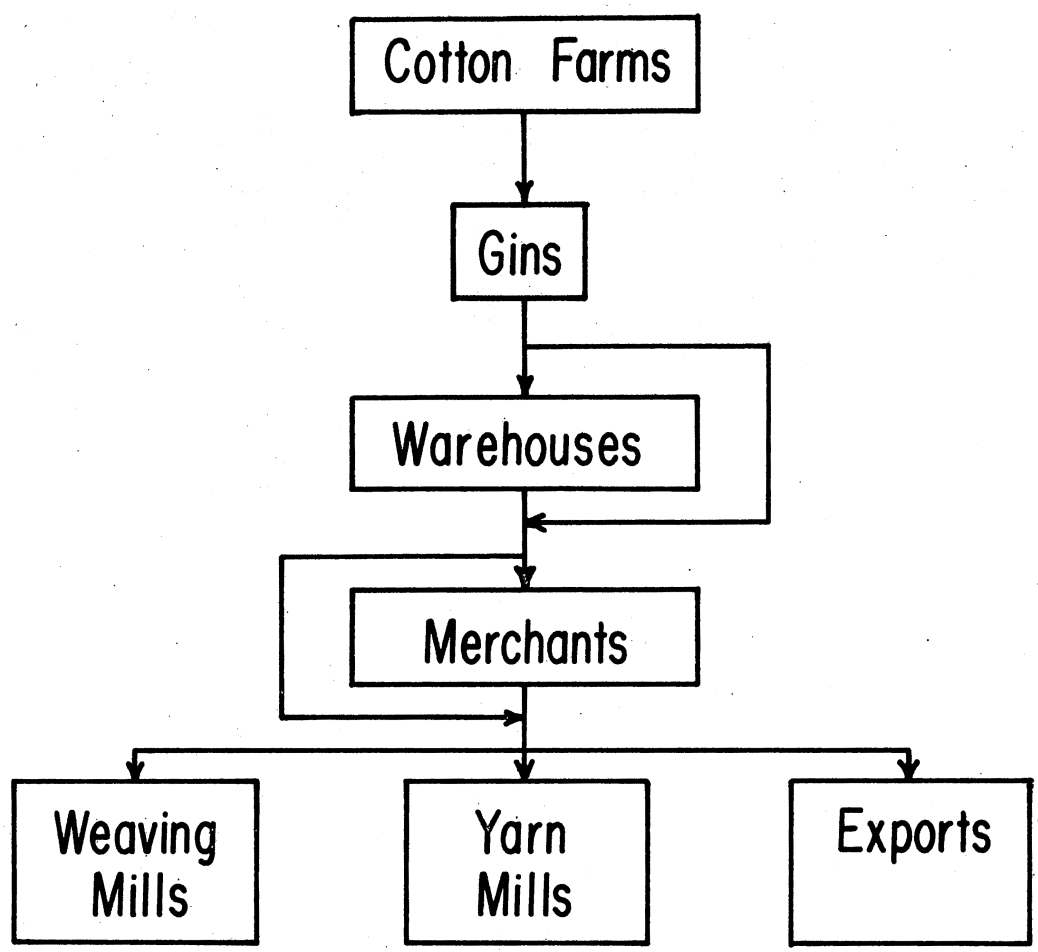

Figure 3. Raw Cotton Marketing System

with weather and crop conditions. The ginning season in the machine stripped area is between October 1 and March 1. However, most of the activity is concentrated between late October and early February. Gin facilities with insufficient capacity to meet demands lose customers to competing gins; therefore, most cotton is ginned and transported to a warehouse with a minimal delay. Producers expect fast ginning service for three reasons: (1) trailers must be emptied for immediate reuse; (2) the lint cotton sample taken after ginning is required before producers can sell their crop and (3) the government loan program is more attractive for lint cotton than seed cotton. The latter reasons make apparent why the demand for ginning parallels harvesting dates. However, gins seldom can handle cotton as rapidly as it is harvested, particularly during the peak of the harvest period, usually between November 10 and December 20. Gins often operate 24 hours a day during this peak period, but only sporadically during the remainder of the ginning season. Almost yearly decreases in machine harvest time have placed an increased burden on peak ginning capacity.

Most gins press "modified flat" bales, however, some have a universal density press. Shortly after being baled and wrapped at the gin, the bale is transported to a warehouse in a gin owned or commercial truck. Transportation is provided by the gin and usually paid by the producer as part of his ginning charges. Once at the warehouse most cotton is sampled, stored and a negotiable warehouse receipt issued. Modified flat bales are recompressed to universal density before being shipped to the mill-export point.

Nearly 72 percent of the machine stripped cotton is shipped by rail to the Houston-Galveston area for export. Cotton for domestic use is generally shipped by rail to five major mill areas: 1) western Carolina states hereafter referred to as Group 201 mills, 2) eastern Carolina states hereafter referred to as Group 200 mills, 3) New England mills, 4) Alabama-Georgia mills and 5) other domestic mills.

Problems Associated with Providing Marketing Services

A casual survey of facilities producing marketing services for agricultural products will likely reveal that the plant operates for only a portion of the year. Such is true of cotton gins. Gins have been established in the Oklahoma-West Texas region at relatively close intervals for three reasons: (1) producers prefer to haul seed cotton only a short distance; (2) producers want their trailers emptied and returned with a minimal delay and (3) producers feel that only the local community gin will provide the quality of service they demand. To ensure adequate labor and to prevent losing volume to competition, ginning crews are hired for the entire harvest season. However, adequate volume is available only during the peak harvesting season. This and the fact that gins are idle from March to September results in excess capacity for most of the year.

A primary problem confronting gin facilities is the need for increased volume. Higher annual volume provides the opportunity to spread annual fixed costs over a larger number of bales. Per bale costs of labor and other inputs to a lesser degree can be reduced through a more complete utilization of facilities.

Gins continue to be faced with intense competition in attempts to satisfy producers and succeed in obtaining higher volumes. This competition has forced many operations out of business and as a consequence only a very few modern gins have been built in recent years. For example, gin numbers in the Altus area have decreased 19 percent since 1970, from 48 to 39 plants. Gin numbers decreased 16 percent between 1960 and 1970, from 57 to 48 firms.

Warehouse facilities, unlike gin plants, operate throughout the year. However, their peak operation corresponds to the ginning season; therefore, complete utilization during the remainder of the year does not occur. Warehouse capacity must be large enough to store approximately 80 percent of the annual production. Physical storage capacity for 1974 in the Altus study area was 297,500 bales. This is the number of bales that could be stored in area warehouses at any given time. However, due to the inflow and outflow of monthly inventories throughout the ginning season, Altus area warehouses could store about 383,000 bales. The largest crop in this area over the last ten year period was 221,165 bales in 1973, 42 percent less than available storage capacity. With average production since 1968 of only 126,205 bales, the warehouse industry excess capacity problem is significant. This problem is also evident in the Lubbock and Abilene areas.

Like ginning facilities, the principal problem confronting warehouses is the need for increased annual volume per warehouse. Warehouse managers also face difficulty in finding skilled labor willing to work for the short period during peak warehouse operation.

Past research has pointed to the significant economies of size that could be realized through increased volume for both gins and warehouses. However, the present organization of gins as well as warehouses does not allow gin and warehouse managers to be assured of obtaining the necessary volume to reach these economies.

Alternative Solutions

Significant reductions in the per bale cost of ginning can be accomplished only by increasing the volume ginned per plant. Engineering specifications of equipment require that gins operate at a specific rate per hour and any deviation from this may cause fiber damage, thus resulting in a lower return to the producer. Therefore, increasing plant volume can be accomplished in two ways: (1) building modern high capacity gins or (2) increasing ginning hours or operation. Increasing volume by expanding the plant size allows high investment cost to be spread over a greater number of bales; therefore, taking advantage of size economies. The few modern gins constructed in the last few years have been able to achieve such economies. Modern high capacity operations offer other advantages such as automatic unloading, bale strapping and bale covering equipment. Further, these gins are equipped with a universal density press; therefore, the bale does not require further compression.

Increasing ginning hours within the present ginning season would require seed cotton to be stored when the harvesting rate exceeded the ginning rate. Stored cotton would then be ginned when machine stripping was delayed due to inclement weather or mechanical difficulties. However, this alternative has not proven to be feasible since it does not alleviate the ginners problem of employing suitable skilled labor for a short period of time. Actually many night crews presently receive two weeks extra pay as an incentive to work during the short ginning season. Further, the attractiveness of this alternative is lessened by the almost daily problem of gin down time. More importantly however, experience has shown that this method does not significantly increase plant volume. Another alternative would be to encourage producers to plant cotton varieties that mature throughout the ginning season, thus eliminating the peak capacity problem. However, late maturing varieties are subject to quality deterioration and production loss. Therefore, consistent with their risk management scheme, producers have opted for earlier maturing varieties.

Only a very few operations have taken advantage of reduced ginning costs via the extended ginning season. Increasing volume by lengthening the ginning season also makes possible for increased utilization of warehouse facilities by eliminating peak warehouse requirements. Significant increases in plant volume by this method would require extensive seed cotton storage. This method would allow ginning to be independent of harvesting, therefore eliminating problems created by peak capacity limitations of gins as well as warehouses. Increasing volume by extending the ginning season allows for a more intensive use of fixed factors. Spreading fixed costs over a larger volume would lower unit fixed cost. Coupled with constant unit variable cost the net effect would lower average total cost. Additionally, gin managers would find it easier to employ gin crews since crews could be offered employment over a longer period of time. Further, neither gin nor warehouse managers would need to employ additional crews since present peak operating conditions would no longer exist.

For purposes of this study, it is assumed that seed cotton can be stored for extended time periods. The importance of storage effects cannot be overemphasized. Decreases in quality during storage may offset reductions in costs obtained through seed storage. Most seed cotton storage research has considered the moisture, temperature and humidity levels at which seed cotton can be safely stored. Storage techniques studied have included free standing stacks on the ground or on pallets, in baskets, in large loose bale form and in buildings. Researchers have concluded that seed cotton can be stored for varying lengths of time without a price-decreasing effect provided moisture content, temperature and relative humidity are monitored. Most studies have reported a moisture content of 10 percent or less as necessary for safe storage. However, some studies have concluded that levels as high as 14 percent were acceptable. The density to which the seed cotton is compressed is also important with respect to seed quality.

Paxton and Roberts noted that seed cotton storage could enhance the timeliness of the harvest operation and result in a higher quality cotton available to mills. Smith, in 1970, and again in 1974, reported increases in lint value as a result of storage.

Additionally, seed cotton storage would enhance other changes in the present season. Seed cotton could be sampled when stored, thereby allowing individual producers cotton to be mixed, a practice that could increase ginning speed up to 5 percent (Campbell, p. 9). Further, harvesting costs could be decreased by as much as 30 percent if mechanical harvesters were not dependent upon trailer availability (Smith 1971, p. 8).

The tradition-bound cotton marketin system has been slow to accept the concept of seed cotton storage even though its feasibility was established as early as 1949 by Looney and Speaks. However, the fact that the U. S. Department of Agriculture has established a seed cotton loan program is evidence of its recent acceptability.

Sandel, Smith and Fowler; and Moore and Courtney indicated the cost of marketing raw cotton could be significantly reduced if the ginning season could be extended thus allowing for increased volumes per gin. Given that increased volume will come through a reduction in gin numbers rather than increased production, the supply area of each gin will be increased. The warehouse network would be similarly affected. However, such a method would increase farm assembly and transportation costs. Therefore, the gain through economies must be weighed against the possible diseconomies of assembly.

A long run solution to the high cost problem in the raw cotton marketing system is particularly important since most of the warehouse as well as gin facilities are fully depreciated. Such a solution encompasses a new set of processing operations and allows for modern high capacity gins and an extended ginning season.

CHAPTER III

THEORETICAL CONSIDERATIONS

The location of economic activity seldom occurs by chance, but rather is subject to locational choice. An analysis to determine the optimal size, number and location of cotton ginning and warehousing facilities must include the spatial aspects of location theory as well as the theory of the firm.[1] Hoover has noted that location theory is but a modification of the conventional theory of the firm (1948). This modification recognizes the existence of a set of factors which are external to the firm but influences the firm's cost-profit structure. However, each is presented separately. Optimality as used in this analysis refers to the size, number and location of economic units that will, with a given set of assumptions, minimize raw cotton transfer and processing costs.

Location Theory

Location theory had its beginning with the German agriculturalist, von Thunen. Primary extensions were made by Weber; Losch; and Palander. Present knowledge has been expanded by Hoover; Beckmann; Isard; and Lefeber.

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[1]Ginning and warehousing facilities will be referred to as processing facilities.

Von Thunen's analysis focused on the most efficient location for agricultural production with respect to transportation costs and land rent. He assumed a purely competitive farming sector, a uniformly fertile plain and a single mode of transportation. The sector operated within a closed economy he identified as "the isolated state". He emphasized the competition among various types of agriculture and the relative ability of each type to pay land rent, thus determining the pattern of land use. Von Thunen's application assumed location as given while the type of production was to be determined.

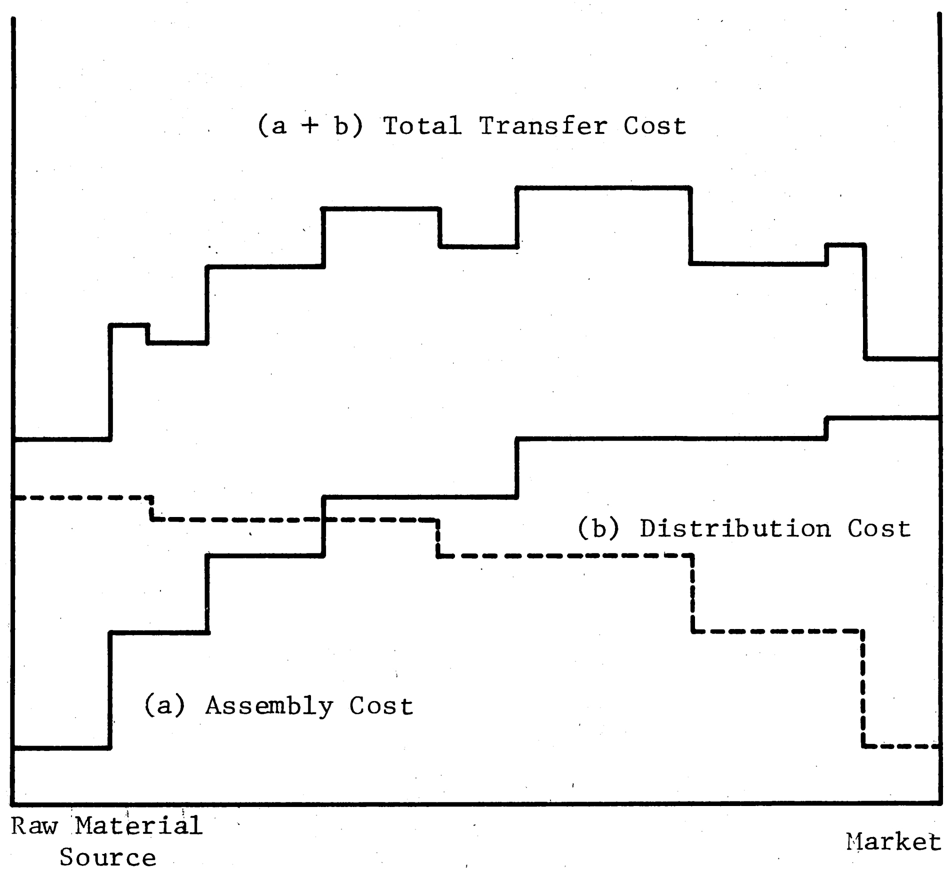
Alfred Weber's formulation was directed toward selecting the least cost location for an individual firm that produced a specific product. He assumed equal transportation rates, varying fertility rates and numerous consuming centers throughout the plain. It is important to note that varying fertilizer rates implies an uneven distribution of raw products, a significant departure from von Thunen's work. Unlike von Thunen's, his theory assumed that plant location is to be determined. He is credited with the first analysis of industry location in terms of transportation costs, labor costs and raw material prices. Before his work, transportation cost was the only variable considered important.

However, it was not until Tord Palander's 1935 study that the theories of location were meshed with the general economic theory of the firm. Edgar Hoover is also credited with combining the relevant Weberian analysis with economic notations of the theory of the firm and partial equilibrium analysis. However, his work, Location Theory and the Shoe Leather Industries, was not published until 1937. August Losch, who also published in the 1930's, was the first writer to present a general equilibrium system describing the interrelationships among locations. He analyzed the choice of location in terms of spatial interdependence and found the optimum shaped economic regions to be hexagons.

Louis Lefeber, drawing on the works of such noted authors as Koopmans; Beckmann; Samuelson; Isard; and Dantzig combined location theory into a general equilibrium model providing a programming framework for a spatial equilibrium analysis of production and location choice. This has allowed for the inclusion of relevant variables in determining optimal plant and industry location. His work resulted in a general equilibrium system in the Walrasian sense.

Transportation Costs and the Production Process

The question of location for a given gin or warehouse cannot be addressed until the parallel question of optimum location for each particular industry is resolved. Hoover's analysis refers to this question as industry orientation (1948, p. 31). The profit oriented industry responds to costs by seeking to reduce them. Assembly costs can be lessened by moving to a location with better access to materials, or distribution costs can be lessened by moving to a point with better access to markets. For example, consider an industry that uses one raw material from a given source and produces one product, sold at a single given market. The base line in Figure 4 measures the distance between raw material source and product destination. Gradients *a* and *b* illustrate the variation of assembly cost and distribution cost, respectively for the set of possible locations. The gradients exhibit the characteristic features of the respective costs, assembly costs rise in a steplike fashion as the distance from the raw material source increases,



Source: (Hoover 1948, p. 30)

Figure 4. Assembly Cost, Distribution Cost and Total Transfer Cost Per Unit of Product for Processing Locations Along a Route Between a Raw Material Source and a Market

while distribution costs increase similarly as production is farther from the market.

With assembly and distribution costs having this characteristic convexity, the total transfer cost schedule will dip at both ends with one end generally being lower than the other. Therefore, the general case will find the best industry location at either the raw material source or the product destination (Hoover 1948, p. 46). A firm facing a transfer cost structure as in Figure 4 will tend to locate near the raw material source.

Whether industries are attracted to the vicinity of either their raw materials source or market depends on the structure of their transfer costs and production process. Industries having a substantial weight loss in processing will likely locate near the source of their raw materials. Conversely, if the production process adds weight or bulk to the product, the industry will tend to locate nearer their markets. These tendencies hold provided transfer cost schedules for both the raw material and finished product are linear or increase at a decreasing rate with distance and are equal for equivalent units of the finished product. These general rules can be modified to account for the actual conditions of a given problem.[2]

The relative weights of the raw material and finished products are roughly equal in cotton processing. The raw material, seed cotton, is

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[2]Because of the nature of their transfer cost structure or production process, many industries are neither raw material nor market oriented. These industries, known as foot-loose industries find it advantageous to locate between their raw materials source and product destination. Intermediate points have special transfer advantages when they are transshipment points and the production process draws from several raw material sources or sells to several markets.

separated into two products by the ginning process, cotton lint and cottonseed.[3] These are transshipped to separate processing plants while the only discard is trash.[4] However, after ginning the bulkiness of seed cotton is reduced through compression and unit transfer costs are lower for the processed product. Thus, cotton gins are material oriented to the extent that the agents of production involved are divisible; their imperfect divisibility sets limits to the dispersion of the ginning industry (Hoover 1937, p. 44). Cotton gins are thus more economically located near their raw materials, which means they are scattered at fairly short intervals through the cotton belt.

The warehousing industry has historically served two primary functions, storage and recompression. Associated with the storage service, warehouses provide suitable facilities for buyers to assemble lots of similar quality cotton demanded by mills. Further, the production process of recompression reduces bulk. These first stages of processing generally involve bulk reduction, grading, preservation, standardization and heavy fuel consumption are therefore located nearer the raw material location (Hoover 1948, p. 36). As with ginning, cotton warehousing is within this category.

Once industry orientation is specified, individual plant location can be considered. Estimation of the optimal regional organization of cotton processing facilities, as with any productive enterprise, involves the consideration of three areas of cost:

1) Procurement: assembling cotton from scattered production points to the site of processing

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[3]The inclusion of cottonseed was not within the scope of this study.

[4]However, there does appear to be an economic use for gin trash generated in the machine-stripped area (Haskell).

2) Processing: the ginning and storage of cotton, and

3) Distribution: delivering lint cotton to the mill or export point.

Distribution cost for the finished product is not a factor in determining optimum plant location in this study since each study area is a single origin for shipping cotton to demand points.

Within the industry, cotton producers pay assembly costs at both the farm and gin level. However, to estimate the total marketing cost, assembly cost must be considered. Given a predetermined production density pattern assembly costs decline as the number of plants increase because the supply area for given plants and total distance required for assembly is reduced. Conversely, to increase plant volume requires a larger supply area and longer distances. Therefore, the determination of equilibrium plant size must include assembly costs.

Assembly Costs

Raw material assembly cost is contingent on loading equipment and procedure, travel distance and time as well as labor availability and cost. The combination of these variables is referred to as transfer cost and its function can be developed to express the relationship between length of haul and cost of transfer services.

Bressler and King point out that one consequence of alternative transport technologies is that there may be zones within which each will have the advantage of lowest cost. Long distance hauls may be more advantageous per unit if rail cars or large trucks are used, while shorter distance hauls may be cheaper if a small truck is used. Some combination of large and small vehicles often results in average transfer costs increasing at a decreasing rate as a result of economies of scale accruing to large capacity vehicles (Bressler and King, pp. 114-116).

French described a transportation cost function for the section line road network of Oklahoma and West Texas. The least costly area to haul from is a square tilted 45 degrees to the road net (French 1960, pp. 767-778). Given a set of assembly equipment and input prices the average variable cost of assembly from a single production site to a processing plant can be represented by:

1) A constant term, α, associated with loading, unloading, and average waiting time, and

2) A constant cost per unit of volume-distance traveled, β, associated with costs of labor, fuel, maintenance, etc.

Therefore, for any given supply source the total variable cost of hauling any given volume, S, can be expressed as:

$$TVC = S(\alpha + \beta\overline{D}) \tag{1}$$

where $\overline{D}$ = average length of haul

Where there are many geographically discrete supply sources the total variable assembly cost per season is the sum of the cost from each distance weighted by the volume shipped from that distance. This can be expressed as:[5]

$$TVC + \Sigma_{i}^{1}{}^{n} (\alpha S_i + \beta\ S_i\overline{D}_i) \tag{2}$$

where i = a given location within the supply area.

With the road system illustrated in Figure 5, road distance to any supply point is (x + y), where x and y are rectangular coordinates of the point. If production density (P) is uniform throughout the

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[5]The summation notation is read: the summation where i goes from 1 to n.

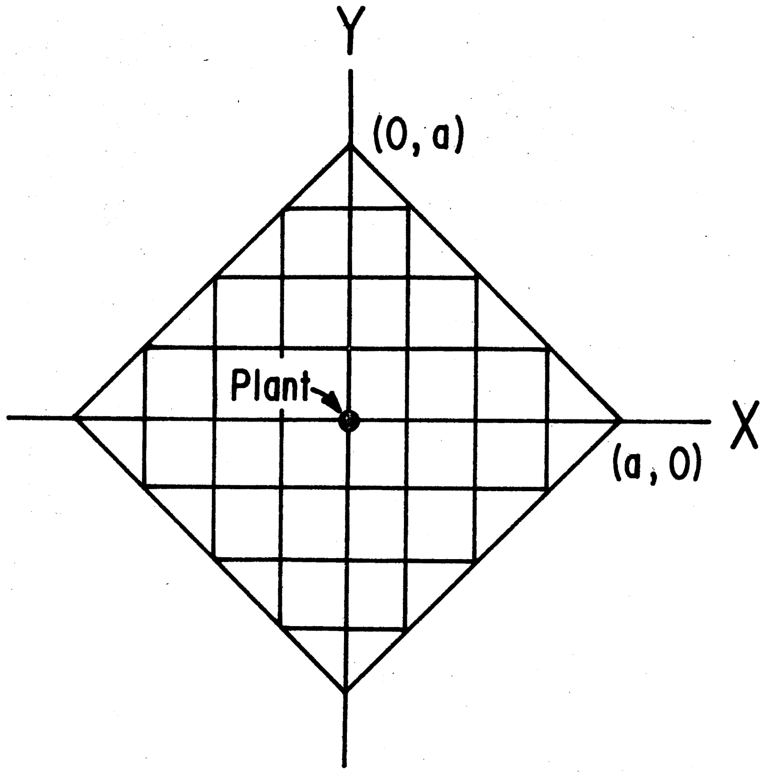

Figure 5. Supply Area for a Square Grid System of Roads

supply plain, the average travel distance for a square area with diagonal distance $2a$ is:

$$\overline{D} = \frac{4}{\text{area}} \int_0^a \int_0^{a-x} (x + y)\, dy\, dx \tag{3}$$

$$= \frac{4}{2a^2} \frac{a^3}{3}$$

$$= \frac{2}{3} a$$

In relation to a total supply is:

$$S = 2Pa^2 \tag{4}$$

therefore,

$$\overline{D} = \frac{2}{3} \frac{S^{\frac{1}{2}}}{2^{\frac{1}{2}} P^{\frac{1}{2}}} \tag{5}$$

$$= .4717 \frac{S^{\frac{1}{2}}}{P^{\frac{1}{2}}} .$$

Therefore, the relationship between assembly cost and plant volume can be expressed by substituting equation (5) in equation (1):

$$TVC = S \left[\alpha + .4714\beta \; \frac{S^{\frac{1}{2}}}{P^{\frac{1}{2}}} \right] \tag{6}$$

The first and second derivatives of equation (6) are positive, thus total variable assembly cost increases with volume at an increasing rate. Average variable assembly cost (AVC) expressed as a function of plant volume can be derived by dividing equation (6) by plant volume, S:

$$AVC = \alpha + .4714\beta \frac{S^{\frac{1}{2}}}{P^{\frac{1}{2}}} \tag{7}$$

Noting that the first derivative of equation (7) is positive and the second is negative we see that average variable assembly cost increases with plant volume at a decreasing rate.

Over the long run, fixed cost must be included in the assembly cost function. This cost can be defined as FN, where F is the fixed cost associated with a set of equipment and N is the total number of such sets employed. The general shape of the variable cost function will dominate the combined cost function.

The Theory of the Firm

The argument that there need be no special economic theory of marketing has been effective. With repect to production and marketing services, the essential guides for empirical analyses relating to efficiency in agricultural marketing should be provided by the general body of microeconomic theory. However, while accepting this view, marketing economists have found two major difficulties with the neoclassical theory of the firm. Much of the conventional firm theory centered on developing a base for explaining resource allocation, market price, total output and factor shares with rather less concern for the development of a base for empirical analysis. Perhaps more importantly, and in particular relation to this study, the conventional theory was expressed in single dimension--rates of output and rates of input. Marketing facilities, however, are concerned with other dimensions of time, length of operation, space, and form. The inclusion of these topics has until recently, been given little attention in general microeconomic literature (French in press, p. 7).

Economic theory of the firm has been presented by many writers including Boulding; Marshall; Stigler; Henderson and Quandt; and Leftwich. Many of the neoclassical theory elaborations providing a more suitable framework for studying marketing efficiency were formulated by Ferguson; Shepard; Naylor and Vernon; and French, Sammet and Bressler.

Equilibrium conditions can be established through cost minimization or profit maximization for a firm under pure competition (Allen, pp. 608-612). For short run analysis, durable factors of a firm are fixed and only variable factors enter into production decisions. The short run average cost curve is usually thought to be bowl-shaped. Its shape depends upon the efficiency with which both fixed and variable resources are used or: the decline in average fixed cost is eventually offset by increasing average variable costs, reflecting diminishing marginal productivity of variable factors.

In the long run the firm is free to find the least cost size of plant corresponding to its desired volume since all inputs are variable. The size of plant is determined by long run output. The possible plant sizes which a firm can build as long run undertaking usually are limited in number. Thus, the long run average cost curve is the envelope to the set of short run cost curves and is referred to as the economies of size or planning curve. The curve is comprised of the set of points representing least unit cost of producing any given output. When output level is determined, the firm selects the size of plant represented by the short run cost curve comprising the planning curve at that output level.

The planning curve is thought to be bowl shaped because of economies or diseconomies of size. This is the case if size of plant becomes successively more efficient up to some particular size or range of sizes, and if sizes of plants then become successively less efficient as the range of plant size from very small to very large is considered.

For a firm in pure competition long run equilibrium is attained where average total cost is lowest since the firm receives neither pure profit or incurs loss at this point. There is no incentive for other firms to enter the industry because the rate of return on investment is the same as in the next best alternative. Therefore, the number of firms is stabilized. All firms will produce their output with a size of plant represented by the tangency of the short run average cost curve and the long run average cost curve. Within the framework of pure competition, long run equilibrium will occur at the point of equality between price, short and long run average costs and short and long run marginal costs.

Conventional economic theory underlying both assembly and processing costs has benefited from several modifications (Moore and Courtney, pp. 11-15). Notable among these elaborations are plant stages, plant segmentation and the time dimension (French, Sammet and Bressler, pp. 543-579).

Processing activity within plants usually consists of several operating stages. A stage consists of all producting services, durable or nondurable, that cooperate in performing a single operation or a group of minor but closely related operations. To the extent of independence, individual stage cost functions can be considered separately and the total cost function of the plant is composed of individual functions plus overall cost components not associated with specific stages. With technology constant, minimum average cost results when operating at a rate of output which is a common denominator of the capacities of all processing stages.

It has been established that for a fixed plant size, output variation can be achieved either by increasing the intensity of fixed factor use per time period or by lengthening the time period the firm operates. Generally, microeconomic literature has considered only curvilinear cost functions resulting from output variation of the rate dimension. However, the variation of operation in the time dimension while holding the rate of operation fixed, results in a linear total cost function and therefore constant marginal cost. Average variable cost will also be constant. The linearity is due to the lack of intensification on fixed factors or changes in input proportions.

Since technical requirements of gin plants prohibit variations in ginning rates in the short run, any variation in output must accrue to the variation in operating hours per season. This time-rate dichotomy is therefore important in the study of gin plants.

Since increasing gin volume may occur only through an increase in operating hours per time period, the ginning total cost function will be linear. However, average total cost is nonlinear and declines until output increases to maximum capacity per plant size, Figure 6. The average total cost schedule is traced in the volume dimension through variation in gin operating hours. These plant cost relationships are illustrated in Figure 7. The decreasing average unit cost in Figure 7:B is brought about by the greater volume that can be ginned by increasing the number of hours ginned per time period, given a specified plant size.

With plant scale variable in the long run, the long run average cost curve for a set number of operating hours is derived from short run average total cost curves. It is necessary to determine the minimum cost combination of operating hours for processing a given volume when firms can operate in seasons of varying lengths. Long

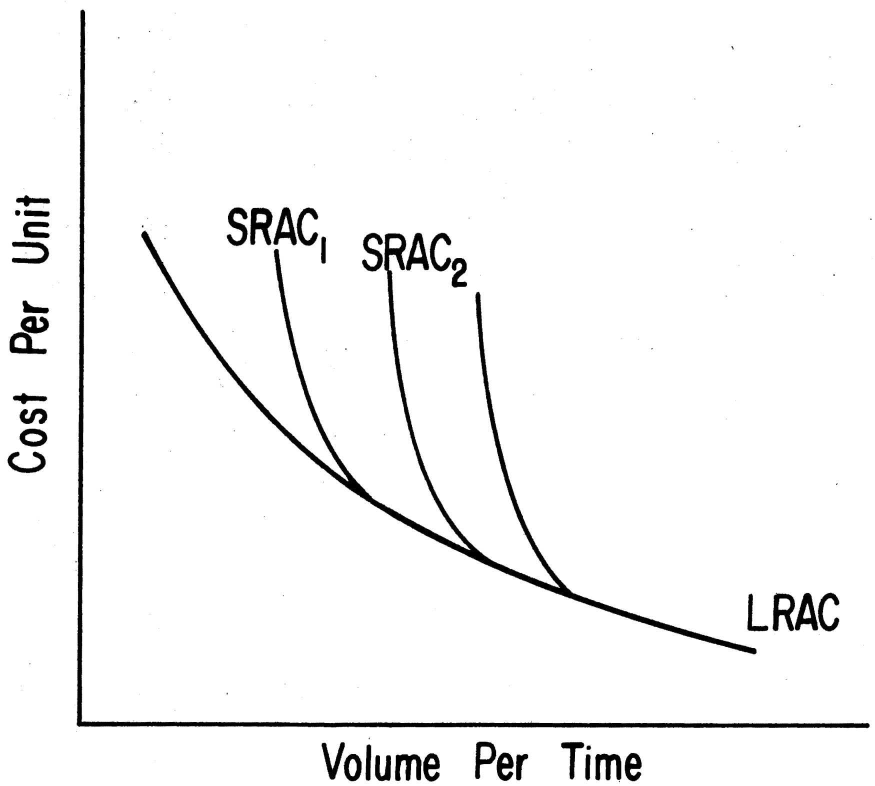

Figure 6. Average Costs for a Firm with Fixed Capacity in the Short Run

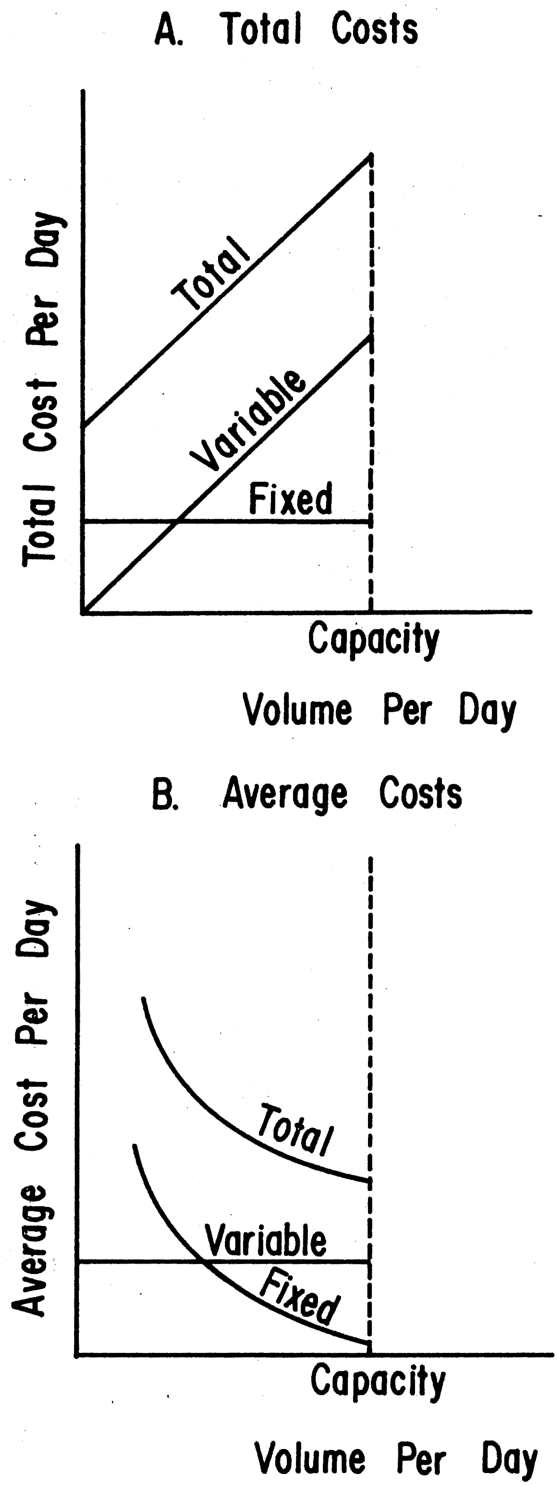

Figure 7. Firm Cost Relationships with Rate of Output Held Constant but Total Output Increases by Operating for Longer Time Periods

run average cost curves for varying operating seasons are presented in Figure 8. This is the situation faced by a firm building a new plant. Average costs decrease because of economies of size achieved as plant size increases and ginning season length remains fixed.

Storage Costs

Converting storage requirements to cost requires the consideration of three categories. These are the cost of moving products into and out of storage, the variable cost of storage operation and the fixed cost associated with storage buildings and equipment. Handling costs are primarly determined by the nature and volume of products stored, the variable cost is a function of the time-weighted average quantity of products in storage and fixed cost a function of maximum storage holdings.

Cotton warehousing provides an excellent illustration of plant stages; these being receiving, storage, breakout and shipping. The costs of receiving, breakout and shipping are largely variable costs with only materials handling equipment and storage areas being fixed factors. Most fixed assets are related to the storage function. Therefore, the first and latter stage costs are largely dependent on volume while storage cost is primarily determined by the size of the storage facility.

Relationships involving seed and lint cotton storage requirements are illustrated in Figure 9 and are based on the following assumption--only cotton produced in a 12 month time period is considered and consumption over this same period is uniform. The horizontal axis is divided into 12 one-month periods with the harvest season starting at

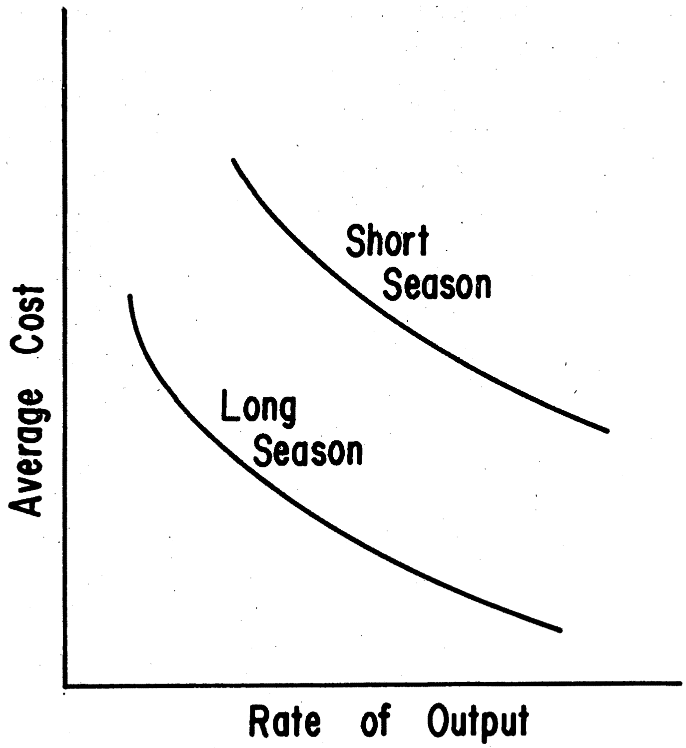

Figure 8. Long Run Average Cost Curves for a Firm with Varying Lengths of Seasonal Operation

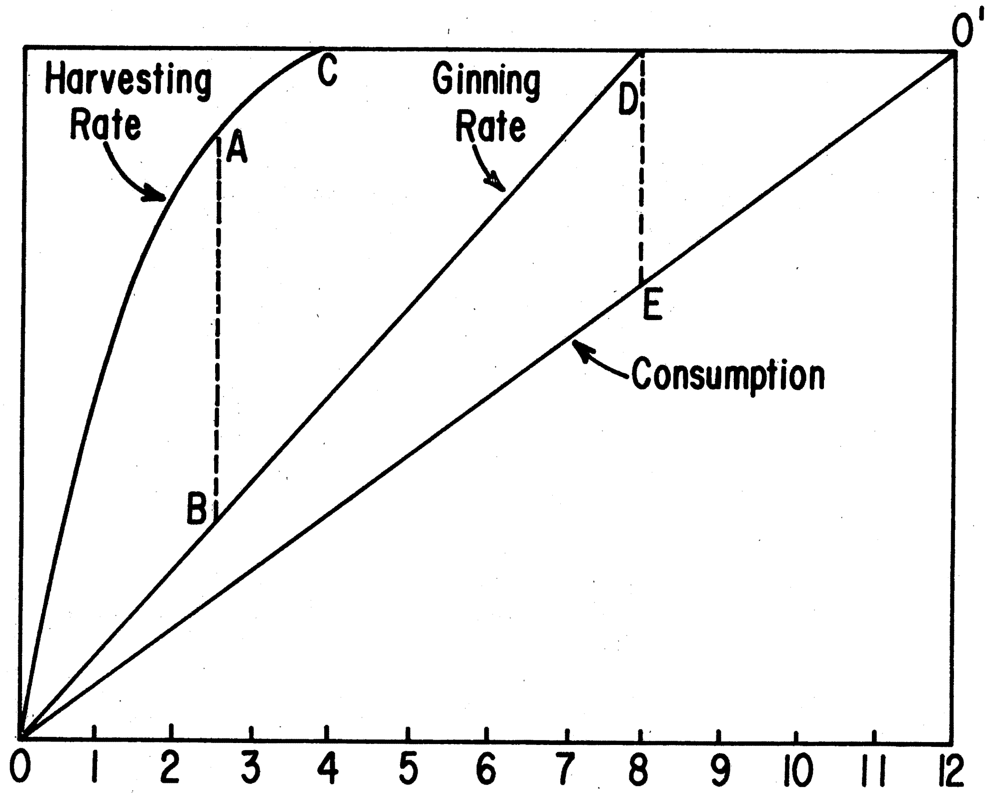

Figure 9. Storage Requirements for Seed and Lint Cotton

the beginning of the first month. Quantity harvested increases at a decreasing rate until the end of the fourth month when it is completed. The harvesting schedule is represented by OAC, a 32 week ginning season by OBD and consumption by OEO'. As illustrated, harvesting rate exceeds processing rate, thus requiring seed cotton storage. Further, since the ginning rate exceeds consumption lint storage is also required. The maximum amount of seed cotton storage is AB while peak lint storage is represented by DE.

Plant Equilibrium

Equilibrium plant size is based on the combination of assembly and processing costs. Assuming uniform production density and one raw material source, the processor's best supply area will tend to be circular. Equilibrium plant size determines the size of this supply area.

The combined assembly and processing unit cost previously described is given in Figure 10 for the purpose of illustrating the plant size representing lowest average assembly and processing cost. The combined average assembly and processing cost is given by CC' and indicates that a volume level of X is necessary to obtain minimum long run average cost. The increasing total assembly costs are exactly offset by economies of size in processing at this point. The short run average cost curve tangent to the long run average cost curve at point X represents the equilibrium plant size the processor should build, other things being equal.

However, in an area with competing processing plants, the spatial relationships of each competitor must be considered. It is only then

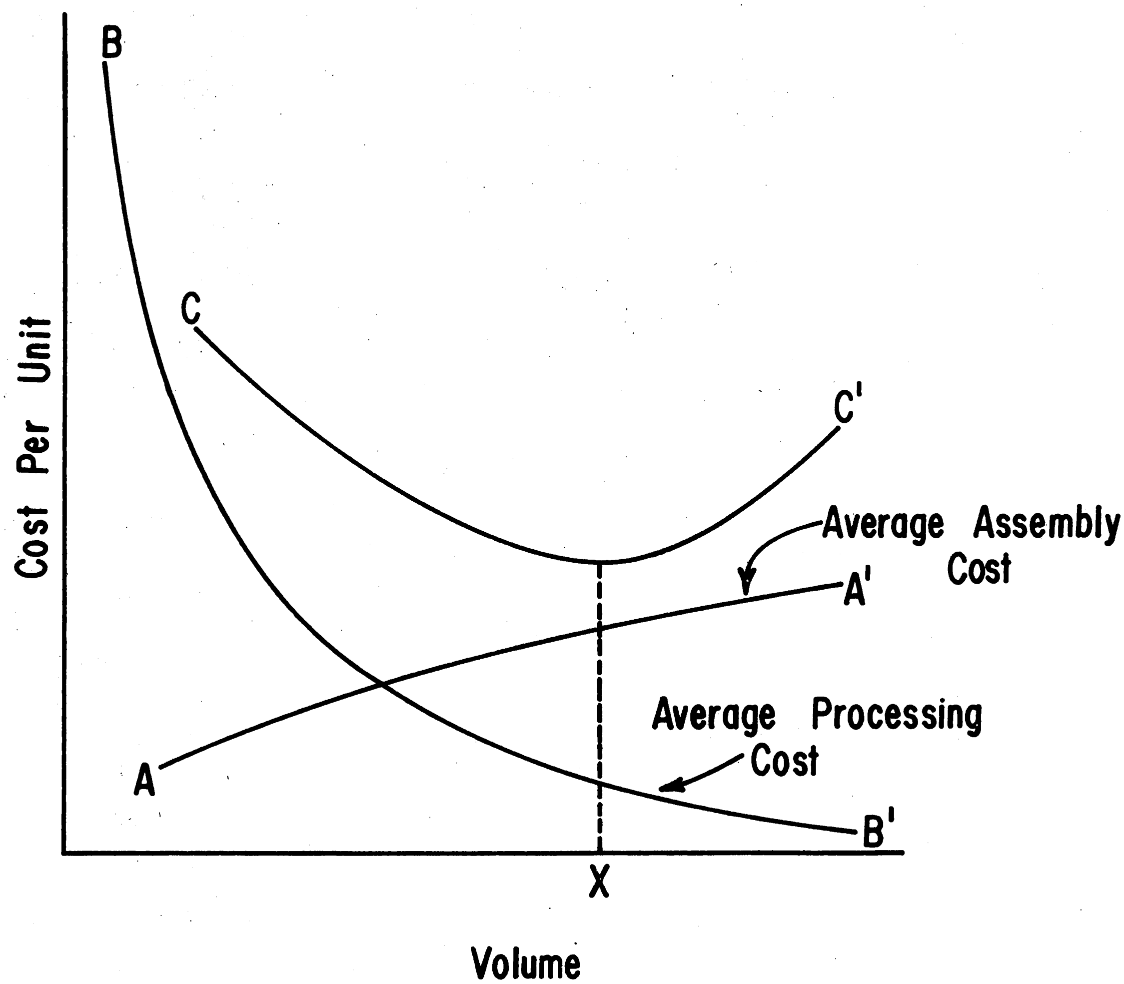

Figure 10. Long Run Average Costs and Plant Size Determination

that the equilibrium size, number and location of plants in the system will be determined. Assuming uniform production, an assembly cost function increasing with distance and identical cost functions facing each plant, the shape of the supply areas leading to the optimal regional organization of plants will be hexagonal as described by Losch. These hexagonal supply areas define market territories such that the size, number and location of plants minimizes the combined assembly and processing costs for the system (Bressler and King, pp. 144-145).

There are many consideration which may be included in studies of market structure; concentration, conditions of entry, price competition and the marginal efficiency of capital to name a few. However, descriptive studies of structure are of value only in so far as they explain performance. Cost efficiency is used in this study as the sole criterion in studying market performance. The purpose of the next two chapters will be to present the various data needed for the analysis and the model which will make use of this information in the search for an optimal solution.

CHAPTER IV

THE MODEL

Management is faced with problems of choice in determining the optimum size, number and location of processing facilities. Often these problems are simple and choices can be made through insight and experience. However, given the nature of the problem outlined in this study, the determination of an optimum market organization is too complex to be determined by experience.

If the objective of an economic activity can be expressed quantitatively, the solution may be computed by mathematical programming. Economic research has made extensive use of this technique in analyzing complex decision alternatives to determine optimal strategy. Mathematical programming is represented by the nonlinear programming model. Linear, integer, dynamic, transshipment, separable and reactive models represent special cases of the nonlinear model. The purpose of this chapter is to present a mixed integer programming model which may be used to determine the least cost marketing organization for raw cotton.

The Nonlinear Programming Model

The general nonlinear programming model may be described as follows: given a set of m nonlinear inequalities of n decision variables, the objective is to find non-negative values of these variables which satisfy the constraints and minimize (maximize) some function of the decision variables. Mathematically, the problem is to find $X_1, X_2, \cdots, X_n$ so as to: minimize

$$Z = f(X_1, \cdots, X_n)$$

subject to

$$\begin{aligned} g_1(X_1, \cdots, X_n) &\leq b_1 \\ g_2(X_1, \cdots, X_n) &\leq b_2 \\ &\vdots \\ g_m(X_1, \cdots, X_n) &\leq b_m \end{aligned}$$

and

$$X_j \geq 0, \text{ for } j = 1, \cdots, n.$$

where $f(X_1, \cdots, X_n)$ and the $g_i(X_1, \cdots, X_n)$ are given functions of the n decision variables.[1]

As with any model, mathematical formulations are accompanied by a set of assumptions. One assumption involves the necessity of additivity in the sense that when two or more processes are used, the total product must be the sum of their individual products. Also, factors can be used and production can occur in quantities of fractional units. In addition, there is a limit to the number of alternative processes and to input restrictions which need be considered.

If the assumption of linearity is imposed on all functions of the decision variables, the resulting model is known as the general linear programming model.

The Linear Programming Model

The linear programming formulation and the associated systematic

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[1]The $g_i(X_1, \cdots, X_n)$ functions are not restricted to be less than or equal to.

method of solution was first given by Dantzig (pp. 359-373). The linear programming (LP) model in summation notation is written: minimize[2]

$$Z = \Sigma^{1}_{j}{}^{n} C_j X_j \qquad (1)$$

subject to

$$\Sigma^{1}_{j}{}^{n} a_{ij} x_j \leq b_i, \text{ for } i = 1, \cdots, m \qquad (2)$$

and

$$X_j \geq 0, \text{ for } j = 1, \cdots, n \qquad (3)$$

where a_{ij}, b_i and C_j are given constants.

It follows that given n competing activities, the decision variables represent the levels of these activities and any solution satisfying the non negative restrictions is a feasible solution. In most problems an infinite number of feasible solutions exist. However, out of these solutions, only one will optimize the objective function, and this is the solution of interest (Hadley).

The Transportation Problem

One of the most fruitful applications of LP was the formulation and solution of the transportation problem as a linear programming problem. The basic transportation problem was originally stated by Hitchcock and later discussed in detail by Koopmans.

The general transportation problem is a special case of integer linear programming in which the objective is to minimize total transfer cost. Mathematically, it is written: minimize

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[2] The model is read: The summation of $C_j X_j$ as j goes from 1 to n.

$$Z = \sum_{j}^{n}\sum_{i}^{m} C_{ij} X_{ij} \tag{4}$$

subject to

$$\sum_{j}^{n} X_{ij} \leq a_i, \text{ for } i = 1, \cdots, m \tag{5}$$

$$\sum_{i}^{m} X_{ij} \leq b_j, \text{ for } j = 1, \cdots, n \tag{6}$$

and

$$X_{ij} \geq 0 \tag{7}$$

where a homogeneous product is to be shipped in amounts $a_1, \cdots, a_m$, respectively, from each of m origins and received in amounts $b_1, \cdots, b_n$, respectively, by each of n destinations. The unit cost of shipping from origin i to destination j is C_{ij} and is known for all combinations (i, j).

The LP problem has m + n equations in mn variables. It can be shown that one of the equations of the system (5) or (6) is redundant and can be eliminated (Gass, p. 195). Therefore, the transportation problem reduces to m + n - 1 independent equations in mn variables. Since all nonzero coefficients of X_{ij} are ones and any given X_{ij} appears in only two constraints, the constraints of transportation problems have a particularly simple form.

Integer Programming

Integer programming deals with the class of optimization problems in which some or all of the decision variables are required to be integers. Many practical problems such as assigning labor, machines and vehicles to activities make sense only if these resources are applied in integer units. The usual method to round off non integer values to represent integer solutions is often not adequate. The determination of an optimal location for processing plants is an excellent example. Integer restrictions have been difficult to handle mathematically, but some progress has been made in developing solution procedures for LP problems subjected to this additional restriction. Much of the success in developing solution procedures has been by Gormory (1958); however, most algorithms have lacked efficiency. Efficient routines for small integer and mixed integer problems have been developed by Hurt (1967). Recent research has led to the development of efficient suboptimal algorithms (Hiller and Lieberman 1967, p. 555).

The integer LP model can be represented as: minimize

$$Z = \Sigma_{j}{}^{1}_{n} C_j X_j \tag{8}$$

subject to

$$\Sigma_{j}{}^{1}_{n} a_{ij} X_j \leq b_i, \text{ for } i = 1,\cdots,m \tag{9}$$

and

$$X_j \geq 0 \text{ integer, for } j = 1,\cdots,n \tag{10}$$

This differs from the LP model, equations (1), (2) and (3), in equation (10) where X_j is required to be integer.

The typical average cost curves for processing reflects decreasing costs associated with economies of size and may be represented as a nonlinear function. Therefore, since an objective of this study involves the determination of optimum size, number and location of processing facilities, the integer LP model must be modified.

The concept of mixed integer programming offers a formulation in which both conventional LP constraints and fixed cost constraints may be used. This model can be stated as: minimize

$$Z = \Sigma_{j}{}^{1}_{n} C_j X_j + \Sigma_{\ell}{}^{1}_{g} C_\ell X_\ell \tag{11}$$

subject to

$$\Sigma_{j}^{1}{}_{n} a_{ij} X_j + \Sigma_{\ell}^{1}{}_{g} a_{i\ell} X_\ell \geq b_i, \text{ for } i = 1,\cdots,m \tag{12}$$

and

$$X_j \geq 0, \text{ for } j = 1,\cdots,n \tag{13}$$

$$X_\ell \geq 0 \text{ integer, for } \ell = 1,\cdots,g \tag{14}$$

where C_j, X_j, a_{ij} and b_i are as before: C_ℓ and $a_{i\ell}$ are given constants associated with X_g integer decision variables.

The total cost of processing represents the sum of the variable cost related to the level of processing and the fixed cost necessary to initiate production. Frequently, the variable cost will be at least approximately proportional to the level of the activity. Thus, if X_ℓ denotes the level of activity ℓ, the total cost of activity ℓ will be $(K_\ell + C_\ell X_\ell)$ if $X_\ell \geq 0$, and total cost will be zero if $X_\ell = 0$. The fixed cost, K_ℓ, suggests that an integer linear programming formulation would not be applicable; however, integer programming may be used to obtain a solution. The logic of this formulation is as follows, let:

$$Z = f_1(X_1) + \cdots + f_g(X_g)$$

where

$$\begin{aligned} f_\ell(X_\ell) &= K_\ell + C_\ell F_\ell, \text{ if } F_\ell > 0 \\ &= 0, \qquad\qquad \text{if } F_\ell = 0 \end{aligned}$$

and where X_ℓ is constrained to be non negative for $\ell = 1,\cdots,g$. If $K_\ell = 0$ the problem would be in LP formulation. Since negative fixed cost would be meaningless, assume $K_\ell \geq 0$ and that the problem is to minimize Z subject to the given LP constraints. Reformulating,

$$Z = \Sigma_{\ell}^{1}{}_{g}(C_\ell X_\ell + K_\ell Y_\ell)$$

where

$$Y_\ell = 1, \text{ if } X_\ell > 0$$
$$= 0, \text{ if } X_\ell = 0$$

Thus, it is only necessary to find linear or integer constraints which insure that Y_ℓ will take on the specified values. First it is necessary that the constraints include

$$Y_\ell \leq 1$$
$$Y_\ell \geq 0$$

and

$$Y_\ell \text{ is an integer, for } \ell = 1,\cdots,g.$$

Then let M be an extremely large number which exceeds the maximum feasible value of any X_ℓ. Thus the constraints,

$$X_\ell - MY_\ell \leq 0, \text{ for } \ell = 1,\cdots,n$$

insure that $Y_\ell = 1$ rather than zero whenever $X_\ell > 0$. These constraints must allow Y_ℓ to be either zero or one when $X_\ell = 0$. The nature of the objective function insures this. Because $K_\ell \geq 0$, the case where $K_\ell = 0$ can be ignored since Y_ℓ can then be deleted from the formulation. In the remaining case, $K_\ell > 0$, $Y_\ell = 0$ must yield a smaller value of Z than $Y_\ell = 1$ when $X_\ell = 0$ in order for the constraints to permit a choice between $Y_\ell = 0$ when $X_\ell = 0$ (Hiller and Lieberman, pp. 564-565).

Thus the mixed integer programming model for analysis involving economics of size may be presented as: minimize

$$Z = \sum_{j}{}_{n}^{1} C_j X_j + \sum_{\ell}{}_{g}^{1} (C_\ell X_\ell + K_\ell Y_\ell) \tag{15}$$

subject to

$$\sum_{j}{}_{n}^{1} a_{ij} X_j + \sum_{\ell}{}_{g}^{1} a_{i\ell} X_\ell \leq b_i, \text{ for } i = 1,\cdots,m \tag{16}$$

$$X_j \geq 0, \text{ for } j = 1,\cdots,n \tag{17}$$

$$X_\ell \geq 0 \text{ integer, for } \ell = 1,\cdots,g \tag{18}$$

$$X_\ell - MY_\ell \leq 0 \tag{19}$$

$$Y_\ell \leq 1 \tag{20}$$

$$Y_\ell \geq 0 \tag{21}$$

and

$$Y_\ell \text{ is integer valued, for } \ell = 1,\cdots,g. \tag{22}$$

The transportation and mixed integer techniques must by integrated into one model to consider economies of size in processing facilities while minimizing the assembly, processing and distribution costs. For such an integrated model to be operative, assumptions regarding the objective function and constraints must be made:

(1) supply of the resource from each production area is known,

(2) unit costs associated with assembly and distribution are known and independent of volume shipped,

(3) unit costs associated with processing are known for each potential plant location and size, and

(4) demand for each market is known.

Given the model and associated assumptions the objective is:

minimize

$$Z = \sum_{j=1}^{m}\sum_{i=1}^{n} C_{ij}Q_{ij} + \sum_{j=1}^{m}\sum_{i=1}^{n}\sum_{h=1}^{g} C_{jh}Q_{ijh} + \sum_{k=1}^{p}\sum_{j=1}^{m}\sum_{i=1}^{n} C_{jk}Q_{ijk} +$$

$$\sum_{k=1}^{p}\sum_{j=1}^{m}\sum_{i=1}^{n} C_{k}Q_{ijk} + \sum_{\ell=1}^{t}\sum_{k=1}^{p}\sum_{j=1}^{m}\sum_{i=1}^{n} C_{k\ell}Q_{ijk\ell}$$

where

Q_{ij} = quantity of seed cotton transported from supply area i to gin area j

C_{ij} = unit transfer cost from supply area i to gin area j

Q_{ijh} = quantity of seed cotton ginned at gin area j, gin size h

C_{jh} = unit cost of ginning seed cotton at gin area j, gin size h

Q_{ijk} = quantity of lint cotton transported from gin area j to warehouse area k for storage

C_{jk} = unit transfer cost from gin area j to warehouse area k

C_k = unit cost of warehousing lint cotton in warehouse area k

$Q_{ijk\ell}$ = quantity of lint cotton transported from warehouse area k to demand area ℓ.

The matrix format for the mixed integer model is presented in Table 3. The format represents a model with two supply areas, two gin areas each with two plant sizes, two warehouse areas and two demand areas.

Elements of the matrix are:

S_{ij} = quantity of cotton transported from supply area i to gin area j

G_jS_hV = quantity of cotton ginned at gin area j, gin size h

G_jS_hF = maximum quantity of cotton that can be ginned at gin size h, gin area j

G_jW_k = quantity of cotton transported from gin area j to warehouse area k

W_kF_1 = variable warehouse size

W_kV = quantity of cotton warehoused at warehouse area k

W_kM_1 = quantity of cotton transported from warehouse area k to mill area ℓ

W_kF = fixed cost associated with building any warehouse

D_h = gin size h

B = minimum warehouse size

C = maximum warehouse size

P = coefficient relating physical warehouse size to quantity warehoused

Y = quantity of cotton transported to mill two for each unit transported to mill one.

The elements in the objective function row represent per bale cost for the associated activities, except for F_h and U_k. F_h represents the level of fixed cost associated with gin size and U_k represents the fixed cost associated with warehouse size.

Table 3. Matrix for Mixed Integer Programming Model

RHS	R	S_{11}	S_{12}	S_{21}	S_{22}	G_1S_1V	G_1S_2V	G_2S_1V	G_2S_2V	G_1S_1F	G_1S_2F	G_2S_1F	G_2S_2F	G_1W_1	G_1W_2	G_2W_1	G_2W_2	W_1F_1	W_1V	W_2F_1	W_2V	W_1F	W_2F	W_1M_1	W_1M_2	W_2M_1	W_2M_2
0	=	-1	1	-1		1	1																				
0	=		-1	1	-1			1	1																		
Supply 1	=	1																									
Supply 2	=				1																						
0	≥					-1				D_1																	
0	≥						-1				D_2																
0	≥							-1				D_1															
0	≥								-1				D_2														
0	=					1	1							-1	-1												
0	=							1	1							-1	-1										
0	≤																	-1				B					
0	≥																	-1				C					
0	=																	1	-P								
0	≤																			-1			B				
0	≥																			-1			C				
0	=																			1	-P						
0	=													1		1			-1								
0	=														1		1				-1						
0	≥																		1					-1	-1		
0	≥																				1					-1	-1
Demand 1	≥																							1		1	
Demand 2	≥																								1		1
0	=																							-1	Y		
0	=																									-1	Y
OBJ	N	A_{11}	A_{12}	A_{21}	A_{22}	C_1	C_2	C_1	C_2	F_1	F_2	F_1	F_2	T_{11}	T_{12}	T_{21}	T_{22}	V_1	V_2	V_1	V_2	U_1	U_2	W_1	W_2	W_1	W_2

CHAPTER V

COST ESTIMATES FOR THE PROPOSED SYSTEMS

The marketing system for raw cotton was divided into four segments and the farm to mill flow of cotton was discussed in Chapter II. A spatial analysis of the industry and the validity of any conclusions from such analysis depends in part upon the accuracy of data selected. Data describing operations within each subsystem are required. The procedures for generating needed data for each of the two proposed systems are outlined in this chapter.

The primary distinction between the two systems concerns seed cotton storage. The first system considered involves seed cotton storage, a 32 week ginning season with modern high capacity gin equipment and a warehouse industry whose primary service is storage. The other proposal considers conventional seed cotton assembly and a 14 week ginning season as well as the remaining considerations of the first system. Since seed cotton storage is utilized in the first system, total warehouse capacity will vary between systems. Even though market area distribution cost is equivalent for all distribution points within a given study area, this cost is considered because it represents a portion of the marketing system. The distinction between the second system and the present is within the gin industry. In the proposed system cotton is compressed to universal density, thus not requiring further compression ar the warehouse.

Several alternative methods for field handling and assembly of cotton have been proposed. Previous research indicates that field ricks and modules are feasible alternatives to the present system. Sandel, Smith and Fowler proposed that seed cotton by stored in ricks in the field.

The idea of ricking cotton on the turnrow is not new, but the idea of mechanical ricking is. The rick compacter design with its flared sides allows for instant harvester dumping. The hydraulic compressor compacts seed cotton into a uniform dimension and density that allows for efficient use of a mechanical loader. Capital investment is low and its use blends well with the existing trailer system. One producer-gin owner noted that "...one of the nicest aspects..." of field storage was the ability to utilize his gin crew when adverse weather stopped harvesting. He further stated "...it was a real pleasure to work during that period without all the strains associated with peak season ginning" (Howington, p. 79).

Ricks are formed by dumping harvested seed cotton into a movable form known as a rick compacter. After mechanical compaction the form is moved away leaving a free standing rick. Since 1970 many engineering improvements have been made and the rick compacter is now commercially marketed by several firms.

The module building system, developed in 1971, utilizes a transport unit, pallets and a form in which seed cotton is compressed. The transport unit allows for cotton to be delivered to the gin with a minimum of handling, unlike the rick system where it is necessary to use trailers. However, the module system requires a fixed investment considerably higher than the mechanical rick compacter. Haskell and

Moore estimated per bale assembly cost of the module system was $2.21 if 400 bales were moduled and $15.49 if 100 bales were moduled, indicating the system is highly sensitive to volume. The per bale cost of ricking 400 bales was estimated to be $.66 (Haskell and Moore, pp. 11-16). The module system offers greater economies of transportation but due to its high initial investment its present use has been limited to large scale producers; those that can better afford the initial purchase and are able to handle a large volume of cotton with each machine. Because of this the number of rick units operating on the south plains of Texas has increased from one experimental unit in 1969 to 500-600 units operating in 1972 (Smith 1974, p. 1). A further advantage of the ricking system is that a savings of up to 30 percent in harvesting efficiency could be realized because harvesters would not have to wait until trailers became available. This increased efficiency would insure that all cotton could be harvested when mature since present harvesting stoppages due to trailer shortage would not be a factor. This is further significant in that cotton harvested after or during adverse weather is of lower quality than cotton stored in ricks.

For purposes of this study, interviews were conducted with producers, gin managers, and warehouse managers in the machine stripped area. Their ideas along with opinions of professional cotton marketing personnel are the basis for costs developed in this study.

Assembly Costs

The method presently used for assembly and transporting seed cotton to the gin requires the use of trailers and a pickup truck to position trailers in the field and to move them to the gin. Trailers of various sizes and construction are used in the area; however the four bale steel frame trailer is the most common. This size trailer costs $1,025 and is used as a basis for calculating seed cotton assembly costs under the present system. This trailer cost makes it desirable to obtain maximum utilization of trailers and one way to increase trailer utilization is to place full loads on the trailers. Although trailer loads are increased, some harvester time is lost due to difficulty experienced while dumping into nearly full trailers. Trailers can be partially loaded to eliminate long dump times but trailer utilization is decreased. Few producers have the capital necessary to maintain a trailer fleet capable of handling peak harvesting requirements. Since the harvesting rate exceeds the ginning rate, producers are forced between the decision of obtaining full trailer loads or bearing the risk of harvesting stoppages due to a shortage of trailers. Factors influencing the decision are labor cost, trailer cost and the pressure for getting mature cotton harvested as soon as possible.

Once cotton is dumped into a trailer it is distributed over the trailer area and compacted manually. Therefore, in addition to delaying harvest time, filling trailers to capacity requires more man-hours than does partial filling. As a result, most producers restrict trailer loads to three bales.

Annual trailer costs based on $1,025 purchase price and a 15 year estimated useful life are presented in Table 4. The estimated cost of $144.02 is relatively insensitive to the number of bales hauled each year; therefore, it is presented as a fixed cost. With annual trailer cost constant, per bale cost is a function of the number of bales carried per season. A survey conducted by the Farmer Cooperative

Table 4. Estimated Cost of Assemblying Seed Cotton in Trailers, Machine Stripped Area, Oklahoma and West Texas, 1974

Item	Cost
	Dollars
Fixed Cost:	
Depreciation[a]	68.37
Interest[b]	46.13
Repairs and Maintenance[c]	20.50
License and Tax[d]	9.02
Total Fixed Cost	144.02
Variable Cost: (Per Bale)	
Packing Labor[e]	1.13
Total Assembly Cost (Per Bale)[f]	7.39

[a]Based on 4-bale steel trailer purchase price of $1,025, 15 year life and no salvage value

[b]Calculated as 9 percent of average investment

[c]Estimated as 30 percent of initial investment spread over 15 years

[d]Estimated as .0088 percent of initial investment

[e]Based on hourly wage rate of $2.25

[f]Variable cost plus fixed cost per bale assuming 23 bales per trailer

Service, USDA, indicated the average trailer hauled 23 bales of seed cotton annually (Haskell, p. 19). Using this figure the seasonal trailer cost was estimated to be \$6.26 per bale. The labor cost associated with compacting seed cotton in the trailer was estimated to be \$1.13. Thus the total cost of assembling machine stripped seed cotton in trailers under the present handling system was estimated to be \$7.39 per bale.

Trailers are transported between farm and gin by a pickup truck pulling two trailers per trip. The truck is used primarily for this purpose during the harvesting season and is used for other activities during the remainder of the year. Fixed and variable costs associated with the vehicle operation are given in Table 5 and reflect an annual fixed cost of \$1,025.41, with one-third of this, \$341.80, allocated to the farm assembly function. The determination of vehicle fixed cost per bale requires the determination of the number of bales per truck carried to the gin during the season. Producer estimates indicate that one truck can handle 23 trailers per season. Then, with a trailer carrying 23 bales per season, a pickup truck may haul 529 bales per season, thus resulting in a per bale fixed cost of \$.65. Variable cost, Table 5, was estimated to be \$.077 per mile. The bale-mile variable cost based on 6 bales per trip was \$.0128.

Driver labor requirements were patterened after those reported by Sandel, Smith and Fowler. Labor cost for the transportation function of assembly includes fixed time activity and variable driving time. The fixed time per trip is comprised of activities such as spotting trailers, hooking and unhooking trailers, fuel stops and positioning of trailers at the gin and was estimated to be 1.33 hours. Assuming

Table 5. Estimated Truck Costs Associated with Transporting Seed Cotton in Trailers, Oklahoma and West Texas, 1974

Item	Cost
	Dollars
Fixed Cost:	
Depreciation[a]	590.00
Interest[b]	202.25
Insurance	193.00
Taxes and Licenses	42.55
Total Fixed Cost	1025.41
Total Fixed Cost Allocated to Transportation[c]	341.80
Variable Cost: (Per Mile)	
Gas[d]	.055
Oil	.005
Tires[e]	.008
Lubrication	.001
Repairs and Maintenance	.008
Total Variable Cost[f]	.077

[a]Purchase price of $3,700, 5 year life and $750 salvage value

[b]Calculated as 9 percent of average investment

[c]Truck used 33 percent of year for this purpose

[d]Assumes 10 mpg and $.30 per gallon

[e]One set every 20,000 miles and $160 per set

[f]Driver labor cost not included

average driving speed is 30 miles per hour, driving time would be .033 multiplied by round trip distance. Labor cost per trip may thus be expressed as LC = (1.33 + 0.33D)W, where D is round trip distance in miles and W represents hourly wage rate, assumed to be $2.50 for the driver. Estimated total transfer cost, Table 6, was $8.04 per bale plus $.0128 per bale mile for the pickup truck. This transfer cost is exclusive of driver labor cost.

Using the rick system proposed in this study would necessitate additional equipment needs. Among these are the rick compacter and front end loader. The rick compacter is capable of producing a free standing stack of seed cotton approximately six feet high and seven feet wide. The length of the stack may vary, with 80 to 150 feet being the most common. At one bale per 10 running feet this would be 8 to 15 bales. Cotton is dumped into the rick directly on the ground. The top of the rick siding is flared to prevent loose seed cotton from spilling over the side and end.

The process of forming a rick in the field begins with dumping seed cotton into the form until it is full. Then a mechanical tramper, operated by hydraulic power obtained from a tractor used to pull the rick compacter forces pressure on the loose cotton. The cotton is compacted against the ground and the form. After this first compaction the rear gate is opened and the unit pulled forward a few feet, thus creating a free standing stack. The rear gate is not closed and successive harvester dumps are compacted against one another. As the rick is formed and the rick compacter is pulled forward, polyethylene sheeting mounted on top of the rick compacter is pulled over the rick covering the top and sides. The edges of the sheeting are buried under

Table 6. Estimated Transfer Cost for Conventional Seed Cotton Assembly and Handling Method for Machine Stripped Cotton, Oklahoma and West Texas, 1974

Item	Cost
	Dollars Per Bale
Fixed Costs:	
Trailer	6.26
Pickup Truck	.65
Total Fixed Cost	6.91
Variable Cost:	
Labor	1.13
Total Variable Cost[a]	1.13
Total Transfer Cost[b]	8.04
Per Bale Mile Cost[c]	.0128

[a]Variable cost for pickup truck and driver labor are not included

[b]Does not include truck driver labor cost or truck variable cost

[c]Calculated as $\frac{\$.077 \text{ per mile}}{6 \text{ Bales}}$ for transporting to gin

dirt to anchor this covering in place. Covering is necessary to prevent water and wind damage.

The cost of a rick compacter having a capacity of 5 bales per hour was $2,495 in 1974. Costs for the ricking operation are shown in Table 7. Fixed cost per season amount to $265.28 for the ricking unit and $569.00 for a tractor to pull the unit. Given the limited time period a tractor would be used in this operation it was assumed that one used in other farm operations would be available for the ricking operation. Therefore, a used tractor costing $4,000 was used for purposes of cost estimation. Assuming one unit ricks 300 bales annually, fixed costs are estimated to be $.88 per bale for the ricker and $1.90 per bale for the tractor.

Variable costs associated with ricking included insurance, covering material, opportunity cost for storing cotton, labor, fuel, oil and maintenance. Since seed cotton stored in ricks will not be processed upon harvesting it is necessary for producers to protect against fire and theft losses. Ricking of seed cotton is a new practice and therefore insurance rate quotes vary widely. However, based on information provided by insurance agents, gin managers and producers, insurance cost was estimated at $.50 per bale.

Precipitation on uncovered ricks has the effect of reducing lint and seed qualities. Cotton stored in ricks not protected from adverse weather conditions has been subject to quality decreases due to wind blown sand and other debris. Further, unprotected seed cotton may be blown away by high winds. Therefore, the use of a protective covering material is necessary.

Ricks may be covered partially or completely. Covering material requirements for partial covering, known as cap covering, are less, but anchoring material such as rope, weights and stakes must also be used. Further, cap covering subjects the rick to an increased degree of weather damage compared with ricks that are completely covered.

Several materials have been used for covering ricked cotton. These include canvas, cross-laminated polyethylene (CLP) and fiber reinforced cross-laminated polyethylene. Any covering material must be capable of withstanding winds of at least 70 miles per hour. Canvas tarpaulin is capable of withstanding such winds and of providing protection from water damage; however, its cost is prohibitive as is that of fiber reinforced polyethylene. Light weight 2 mil CLP has proven to be an effective covering when anchored with dirt.

Several alternative means exist for anchoring CLP on the rick but the practice of burying the edges in dirt offers advantages. First, the rick is completely covered, thus preventing water damage and preventing sand from being blown into ricked cotton. Since dirt is used no anchoring materials need be purchased.

Assuming one lint bale per 10 running feet of rick and 200 square feet of 2 mil CLP required per bale, the method of complete covering costs $1.88 per bale. Labor for covering is supplied by the rick compacter operator and helper. Since the producer is unable to sell his crop until after it has been ginned, another economic cost must be recognized. That is, the lost interest he could have received if his crop was ginned and sold immediately after harvest. This cost was estimated to be $1.63 per bale, Table 7.

Labor required for the ricking operation includes a tractor driver and helper. Aside from driving the tractor that pulls the rick

Table 7. Estimated Costs for Ricking Machine Stripped Cotton, Oklahoma and West Texas, 1974

Item	Cost
	Dollars
Rick Compacter:	
Fixed Costs	
Depreciation[a]	153.00
Interest[b]	112.28
Total Fixed Cost	265.28
Variable Costs (Per Bale)	
Labor[c]	.95
Repairs and Maintenance	.07
Ricked Cotton Insurance	.50
Rick Covering	1.88
Interest[d]	1.63
Total Variable Cost	4.08
Tractor:	
Fixed Costs	
Depreciation[e]	380.00
Interest[f]	189.00
Total Fixed Cost	569.00
Variable Costs (Per 100 Hours)	
Fuel[g]	33.30
Oil[h]	1.80
Repairs and Maintenance	15.00
Total Variable Cost	50.10

[a]Purchase price of $2,495. 15 year life and $200 salvage value

[b]Calculated as 9 percent of average investment

[c]Tractor driver and helper at $2.50 and $2.25, respectively

[d]Based on 480 pound bale, $0.40 per pound, 5 percent interest for 2 months

[e]Based on use of used tractor, $4,000 investment, 10 year life and $200 salvage value

[f]Calculated as 9 percent of average investment

[g]Estimated consumption rate of .74 gallons per hour and $.45 per gallon

[h]Based on 3 quarts per 100 hours and $.60 per quart

compacter their functions include picking up any cotton that may spill from the harvester when dumping into the rick unit and anchoring the rick covering. Assuming five bales are ricked per hour, labor cost was estimated to be \$.95 per bale. Estimated total variable cost associated with the rick compacter was \$4.08.

Variable costs for the power unit pulling the rick compacter are also given in Table 7. Total variable cost was estimated to be \$50.10 per 100 hours of operation. Sixty hours of operation are required to rick 300 bales; therefore, total variable operating cost was estimated to be \$30.06 or \$.10 per bale.

When stored seed cotton is to be ginned it is loaded on conventional cotton trailers by a front end loader and hauled to the gin with a pickup truck. Specially designed loaders are used for loading seed cotton ricks. Tests indicate the loaders do an excellent job of picking up ricks because of their speed, ease of operation and flexibility. The loader has a capacity of 20 bales per hour, but due to its high investment cost, \$23,295, it was assumed the gin would own and operate this equipment. A rick loading team consists of a loader operator and helper and are equipped with a loader and a pickup truck. The loader helper will assist in the loading operation and also help pack trailers. Total fixed cost for the loader, Table 8, is \$5,706.70. Truck costs presented in Table 5 are applicable to this operation and show total fixed cost to be \$1,025.41.

It was estimated that one loader would be required for every 10,500 bales. Based on this, fixed cost per bale would be \$.54 and truck fixed cost would be \$.10 per bale. Total variable cost for the loading operation consists of fuel, oil, hydraulic fluid and repairs

Table 8. Estimated Cost of Loading Ricked Cotton on Trailers, Oklahoma and West Texas, 1974

Item	Cost
	Dollars
Loader:	
Fixed Costs	
Depreciation[a]	4,159.00
Interest[b]	1,160.78
Insurance[c]	137.44
Taxes[d]	249.48
Total Fixed Cost	5,706.70
Variable Costs (Per 100 Hours)	
Fuel[e]	108.50
Oil[f]	8.00
Hydraulic Fluid	5.80
Repairs and Maintenance	46.59
Total Variable Cost[g]	165.89
Variable Labor Costs (Per Bale)[h]	
Gin Loading Crew	.32
Packer	.15
Total Variable Labor Cost	.47

[a]Based on purchase price of \$23,295, 5 year life and \$2,500 salvage value

[b]Calculated as 9 percent of average investment

[c]Insurance rate of \$.59 per \$100

[d]Estimated as .0138 percent of 20 percent plus .0159 percent of 50 percent of initial investment

[e]Consumption rate of 2.411 gallons per hour and \$.45 per gallon

[f]Filter and 6 quarts of oil every 100 hours

[g]Excluding labor costs

[h]Loader operator at \$2.50 per hour and helpers at \$2.25 per hour

and was estimated to be $165.89 per 100 hours of operation. Assuming a loading rate of 15 bales per hour, variable cost per bale was estimated to be $.11. Truck variable costs are the same as presented in the conventional system and were estimated at $.077 per mile. Over an eight hour work day 120 bales could be loaded, thus, the variable cost of operating the truck was estimated to be $.0006 per bale mile.

Additional labor is required to help compact seed cotton loaded onto trailers and is furnished by the producer. It was estimated that the operator and two helpers load 15 bales per hour assuming an adequate volume of ricked cotton. The loader capacity, 20 bales per hour, is not realized due to the time required to fill trailers to capacity. Labor costs for the loading operation amount to $.47 per bale.

Trailers are moved to the gin by a producer owned pickup truck pulling 2 four-bale trailers or 8 bales per trip. The driver is also responsible for spotting trailers for the loading operation.

Implementation of this sytem will modify conventional system costs previously presented as trailer and truck utilization rates will change. Since seed cotton will be stored, harvesting will be independent of trailer availability, thus resulting in an increase in trailer and truck utilization. Since a complete ricking system of this type has not been practiced, no actual cost data were available. However, it was possible to synthesize these costs based on the partial ricking system presently in use and information obtained from producers and gin managers.

Annual trailer and truck costs presented in Tables 4 and 5 are not expected to change using the complete ricking system. However, fixed and variable costs per bale would decrease due to increased utilization. It was estimated that a trailer could carry 184 bales per season. This results from an increase in bales carried per trip to the gin and from extending the ginning season. Thus, trailer cost was estimated to be \$.78 per bale. It was also expected that one truck could handle 23 trailers throughout the season or 4,232 bales. Since the truck would have to be available for the eight month ginning season, the annual fixed cost of \$1,025.41 was allocated over this volume resulting in an estimated fixed cost of \$.24 per bale.

Variable costs of this operation includes vehicle operating cost and driver labor cost. Truck variable costs in Table 5 are \$.077 per mile. Assuming an 8 bale load per trip, variable cost was estimated to be \$.0096 per bale mile. Driver labor cost was patterned after that presented earlier. Fixed time was estimated to be .82 hours and driver labor cost was estimated to be (.82 + .033D)W where D and W represent round trip mileage to the gin and hourly wage rate, respectively. A wage rate of \$2.50 per hour was assumed.

Estimated total transfer cost exclusive of driver labor cost for the proposed ricking system presented in Table 9 indicates per bale cost is \$10.15 plus \$.0102 per bale mile. The conventional system cost, Table 6, was estimated to be \$8.04 per bale plus \$.0128 per bale mile. The higher per bale cost of the ricking system is due to additional equipment requirements. Associated bale mile cost is lower than the conventional system because of increased utilization of the pickup truck used to transport seed cotton to the gin. Driver labor cost for hauling seed cotton to the gin was estimated to be (.82 + .033D)W for the ricking system and (1.33 + 0.33D)W for the conventional system, where D and W are as previously defined.

Table 9. Estimated Farm to Gin Transfer Cost for Machine Stripped Ricked Cotton, Oklahoma and West Texas, 1974

Item	Cost	
	Dollars Per Bale	
Ricking:		
Fixed Costs		
Ricker	.88	
Tractor	1.90	
Total Fixed Cost	2.78	
Variable Costs		
Ricking	4.08	
Tractor	.10	
Labor	.95	
Total Variable Cost	5.13	
Total Ricking Cost		7.91
Loading:		
Fixed Costs		
Loader	.54	
Pickup Truck	.10	
Total Fixed Cost	.64	
Variable Costs[a]		
Loader	.11	
Labor	.47	
Total Variable Cost	.58	
Total Loading Cost		1.22
Transportation to Gin:		
Fixed Costs		
Trailer	.78	
Pickup Truck	.24	
Total Fixed Cost	1.02	
Total Transportation Cost[b]		1.02
Total Transfer Cost		10.15
Per Bale Mile Costs		
Pickup Truck[c]	.0102	

[a]Variable cost for pickup truck not included

[b]Variable cost for pickup truck and labor cost for transporting cotton to gin are not included

[c]Truck for loading crew; estimated as $\frac{.077 \text{ per mile}}{120 \text{ bales}}$ plus truck to pull trailers; estimated as $\frac{.077 \text{ per mile}}{8 \text{ bales}}$

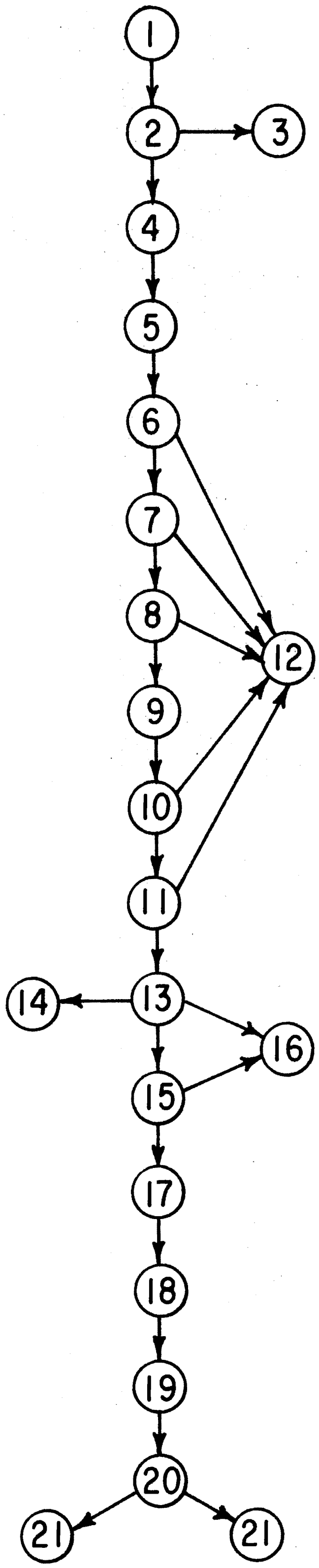
Ginning

Cotton ginning equipment remained relatively unchanged for many years. The relatively recent development of the high capacity gin stand was the first milestone reached in the quest for faster ginning rates. The conventional 12-inch gin saw was used by all manufacturers until the late 1950's. Up to the mid-1950's gin stands were capable of ginning only one to two bales an hour. The development of the high capacity gin has led to ginning rates of up to 42-bales per hour.

Gin presses also remained unchanged for many years. Prior to the development of the high capacity gin, the press had not been considered as a major bottleneck in the ginning process. With the development of a more efficient gin, limitations of the press became an immediate problem. The development and incorporation of larger press pumps, faster traveling rams, automatic bale tying equipment and automatic packaging provided by the heat-shrink tunnel have resulted in presses with capacities twice those resulting from earlier innovations. At the same time press crew labor requirements have been cut in half.

The ginning production process consists of a set of separate but related operations. The integrated processing and materials handling line consists of a standardized array of machines and equipment. The sequential order of the major operational items is presented in Figure 11.

The traditional system of unloading seed cotton is to raise it pneumatically with suction to the top of the gin. This method has been found to be inefficient in both energy and labor utilization. Designing, developing and testing of alternative methods have resulted in the adoption of automatic unloading techniques. The most efficient



1. Unloading
2. Airline cleaner
3. Green boll trap
4. Feed control
5. First stage drying
6. First stage cleaning
7. First stage stick machine
8. Bur machine
9. Second stage drying
10. Second stage cleaning
11. Second stage stick machine
12. Trash collection
13. Feeder and gin stands
14. Cotton seed collection
15. Lint cleaners
16. Mote collection
17. Automatic sample
18. Press
19. Automatic tying and weighing
20. Heat shrink tunnel
21. Load out to warehouse

Figure 11. Ginning Operations

technology for unloading ricked seed cotton is to raise the trailer and dump the seed cotton onto a moving belt system. A series of feed control cylinders moves the cotton into a hot air line. Seed cotton, seed and lint are moved through the gin by large quantities of air. Stages 2, 3, and 11 in Figure 11 are necessary only in the machine stripped area. The mechanical stripper literally strips the plant through the use of rotating brushes. As a result, leaves, branches, pieces of bark, stems, sticks and some sand are collected with the cotton. The additional extracting equipment is required to handle this extra foreign matter reaching the gin. The feed control unit provides for an even flow of seed cotton to driers and cleaners. The conditioning process removes foreign matter by air to a trash collection center. After seed cotton has been properly conditioned it flows to the feeder unit above the gin stands. The size and number of gin stands as well as this overhead equipment are the primary determinants of gin capacity. The sizes and number of overhead equipment for gin capacities considered in this study are in Appendix Table 1. Equipment in latter stages must process at the same capacity as this equipment.

Lint and seed are separated at the gin stand. Seed is collected and later transferred to oil mill facilities. Next, cotton is forced through lint cleaners where most of any remaining trash is removed. From this stage lint cotton flows toward the bale pressbox, going there immediately or either passing through an automatic sampler. Modern gins are equipped with an automatic sampler which collects, and packages a series of random subsamples extracted at intervals while any given bale is being pressed. In gins not equipped with this equipment the lint flows to the pressbox where it is compressed into bales. Most gins press either a modified flat bale, a standard density bale or a universal density bale. After compression the bale is wrapped and tied either by hand or automatically. Bales that have not been sampled are done so by using a saw to cut a small section from each bale. The bale is then moved to a platform area for almost immediate transportation the warehouse.

The gin models considered in this study assume automatic unloading equipment, universal density press, automatic sampling, and automatic packaging equipment. These represent the latest technologies in the ginning industry and insure the finished bale to be a neat clean package that can be shipped to foreign or domestic mills without further compression.

In this study six gin models were considered. The manufacturer's rating of these sizes ranges from 7-to 42-bales per hour, in seven bale increments and represent equipment being installed in modern high capacity gins. However, industry experience has shown that the manufacturer's rating can be maintained only for short periods of time and that 85 percent of this rating represents the productive capacity of the equipment.

Costs for the model gins were developed for the conventional 14 week season and an extended 32 week season. Plant costs were based on the estimated seasonal distribution of hourly labor requirements given in Table 10 and Table 11 for the 14 week and 32 week operating season, respectively. In the present season the gin operates from 8 to 12 hours per day and from 12 to 14 days over any two week period. During this 14 week season the gin operates for approximately six weeks. Night operation involves a 12 hour shift and varies from 6 to

Table 10. Estimated Distribution of Hourly Gin Crew Requirements by Two Week Periods for 14 Week Ginning Season, Oklahoma and West Texas, 1974

Item	2-Week Periods							Season
	1	2	3	4	5	6	7	Total
Day Crew:								
Days Worked	12	12	12	12	12	12	12	84
Hours Per Day	8	12	12	12	12	8	8	--
Day-Hours	96	144	144	144	144	96	96	864
Night Crew:[a]								
Nights Worked	--	6	14	12	6	--	--	38
Hours Per Night	--	12	12	12	12	--	--	--
Night-Hours	--	72	168	144	72	--	--	456
Total Hours	96	216	312	288	216	96	96	1,320[b]

[a]For construction of overtime hours see Appendix Table 5

[b]Number of duty hours for which crew is paid, exceeds actual processing hours by 414: assumes first 2-week ginning period to train new crewmen and to make final repairs and adjustments; 6 night shifts during the second period to train new crewmen and also to make jobs sufficiently appealing to attract necessary laborers; 6 night shifts during fifth period to handle departure from normal ginning and to make jobs financially attractive; one-half hour per shift for clean up and 76 non-productive hours of gin down time

Source: (Looney and Wilmot, p. 16)

Table 11. Estimated Distribution of Hourly Gin Crew Requirements by Two Week Periods for 32 Week Ginning Season, Oklahoma and West Texas, 1974

Item	2-Week Periods 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Season Total
Day Crew:																	
Days Worked	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	160
Hours Per Day	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Day-Hours	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	1,280
Night Crew:																	
Nights Worked	10	10	10	10	10	10	10	10	10	10	10	10	10	10	4	--	144
Hours Per Night	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	--	8
Night-Hours	80	80	80	80	80	80	80	80	80	80	80	80	80	80	32	--	1,152
Total Hours	160	160	160	160	160	160	160	160	160	160	160	160	160	160	112	80	2,432[a]

[a]Number of duty hours for which crew is paid, exceeds actual processing hours by 620: assumes first two week ginning period to train new crewmen and to make final repairs and adjustments; 4 night shifts during period 15 to handle departure from normal ginning; one hour per shift for clean up, preventive maintenance and crew break time and 176 hours of non-productive time including gin down time

14 nights per two week period. The 32 week season is basically a five day week operation with two 8 hour shifts per day. As shown in Table 11 the night crew works 16 less shifts than the day crew.

Some gin plants may be capable of operating without interruption for indefinite periods of time. However, most gin managers have found it advisable to shut down for a short time during each shift for crew rest, clean up operations and to perform preventive maintenance. Based on information supplied by USDA ginning economists, Stoneville, Mississippi, one-half hour was so allocated from each shift in the 14 week season and one hour for the 32 week season. Thus, crews were on duty for 1320 hours during the 14 week season and 2431 hours during the 32 week season, while actual processing hours for each season were reduced to 906 and 1812, respectively. The actual hours of processing multiplied by the estimated hourly processing rate provided the seasonal capacity estimate for the six gin models and two seasonal lengths, Table 12. Using these assumptions the annual volume for each gin model and season ranged between 5,391 and 64,688 bales.

The cost of erecting new gin plants has risen considerably the last few years. A decade ago an expenditure of $250,000 for construction of a single-battery gin was considered excessive. In 1974, the smallest of gins could not be constructed for that cost. In fact, larger and more elaborate plants costing over 1.5 million dollars are in existence. The increase in gin construction costs has been due not only to the upward trend of the general price level but also to the increased sophistication of ginning machinery which resulted from producer demands for faster ginning rates. Since ginning affects lint value through sample grade and quality, producers have also demanded more efficient equipment.

Table 12. Volume of Cotton Processed by Model Ginning Plans and Length of Season, Oklahoma and West Texas, 1974

Gin Capacity	Ginning Season 14 Weeks	32 Weeks
Bales Per Hour	Bales	
7	5,391	10,782
14	10,781	21,562
21	16,172	32,344
28	21,563	43,126
35	26,954	53,908
42	32,344	64,688
Hours of Operation	1,320	2,432
Actual Ginning Hours[a]	906	1,812

[a]Actual processing time does not include clean-up time, crew rest, gin down time and time required for preventive maintenance

Gin machinery is the single largest cost item. In capital cost estimates developed for the six model gin plants, Table 13, machinery cost ranged between 0.3 and 1.0 million dollars or 60 to 75 percent of the total plant investment. Gin buildings represent 12 to 29 percent of total capital outlay. Much of this cost is for the concrete foundation which must be sufficiently strong to withstand the vibrational stress induced by heavy ginning equipment operating at high speeds.

Other cost items include land, outside equipment, tools, gin office and office equipment. Investment requirements for the six gin plant models were estimated to range between $418,600 to $1,677,600.

Annual Investment Costs

Fixed costs accrue regardless of volume ginned. Annual fixed costs include depreciation allowances, interest on investment, insurance, property taxes, management costs and costs of permanent labor personnel. Annual estimated fixed costs for each ginning season are listed in Tables 14 and 15.

The most important items were depreciation and interest. Ginning firms frequently depreciate their machinery over 10 to 15 years. However, the useful life of this equipment is usually 20 years. The cost of capital invested in the ginning operation was set at 9 percent of land investment and 9 percent of one-half the remaining investment. The depreciation schedule for major items is listed in Appendix Table 2. The fire and comprehensive insurance rate used for the ginning cost function was $.64 per $100 of capital investment in buildings and equipment. The costs of real estate and personal property taxes, including gin owned trucks and automobiles is also considered an annual

Table 13. Estimated Capital Requirements for Model Gins Equipped to Handle Machine Stripped Cotton, by Rated Capacity, Oklahoma and West Texas, 1974

Capital Item	Bale Capacity Per Hour					
	7	14	21	28	35	42
			Dollars			
Land	12,000	14,000	18,000	20,000	30,000	40,000
Gin Buildings[a]	50,000	153,000	210,000	258,000	435,000	485,000
Gin Machinery	317,200	530,000	700,500	896,000	941,000	998,000
Outside Equipment[b]	25,600	45,000	60,000	75,000	100,000	115,000
Tools	2,000	3,000	3,000	4,000	5,000	6,000
Office and Equipment[c]	12,000	12,000	16,800	16,800	28,000	33,600
Total	418,600	757,000	1,008,300	1,270,300	1,539,000	1,677,600

[a]Includes building, foundation, wiring and erection

[b]Includes cyclones, piping, seed hopper, auto and truck

[c]Includes furniture, fixtures and scales

Table 14. Estimated Annual Fixed Costs for Model Gins Equipped to Handle Machine Stripped Cotton, by Rated Capacity and Major Cost Items, 14 Week Season, Oklahoma and West Texas, 1974

Item	Bale Capacity Per Hour					
	7	14	21	28	35	42
	Dollars					
Depreciation[a]	20,340	37,150	49,515	62,490	75,450	81,880
Interest[a]	19,386	34,695	46,184	58,064	70,605	77,292
Insurance[b]	2,602	4,755	6,338	8,002	9,658	10,481
Taxes[c]	4,186	7,570	10,083	12,703	15,390	16,776
Management[d]	9,616	11,753	23,377	26,457	31,525	36,594
Permanent Gin Labor[d]	--	9,232	9,232	9,232	9,232	9,232
Permanent Office Labor[d]	6,402	6,859	6,859	13,261	13,261	13,261
Total	62,532	112,014	151,588	190,209	225,121	245,516

[a]Appendix Table 2

[b]64 cents per $100 of capital investment excluding land

[c]1 percent of capital investment

[d]Includes fringe benefits; Appendix Tables 3 and 4

Table 15. Estimated Annual Fixed Costs for Model Gins Equipped to Handle Machine Stripped Cotton, by Rated Capacity and Major Cost Items, 32 Week Season, Oklahoma and West Texas

Item	Bale Capacity Per Hour					
	7	14	21	28	35	42
			Dollars			
Depreciation, Interest Insurance, Taxes and Management[a]	56,130	95,923	135,497	167,716	202,628	223,023
Permanent Gin Labor[b]	15,634	15,634	22,035	22,035	22,035	22,035
Permanent Office Labor[b]	6,859	13,261	13,261	13,261	19,815	19,815
Total	78,623	124,818	170,793	203,012	244,478	264,873

[a]Table 13

[b]Appendix Table 3; includes fringe benefits

fixed cost. The tax rate used here was one percent of capital investment.

It could be argued that management is not truly a fixed cost. However, during the span of one ginning season, presumably managers are retained regardless of seasonal ginning volume as are other permanent personnel. Management personnel consist of a gin manager and in the case of the larger plants an assistant manager. Other permanent personnel ranged between one and six depending on gin size and operating season length. Personnel requirements and salaries are included in Appendix Tables 3 and 4, respectively.

Total fixed cost for the 14 week season ranged between $62,535 for the 7-bale per hour plant to $245,516 for the 42-bale per hour plant, Table 14. Table 15 shows a listing by gin size of all fixed cost items required for each model gin operating for a 32 week season. The range is between $78,623 and $264,873. In both seasonal ginning lengths the primary cost items were depreciation, interest and management.

Variable Costs

Primary variable cost items are labor, electrical energy, bagging and ties and repairs. Of lesser importance is a miscellaneous group consisting of natural gas for drying, office supplies, advertising and promotion, and travel expenses.

Two categories comprise total labor variable cost, gin labor and office help of which gin labor is the more important. Crew size and consequent cost of gin labor are determined by the rated hourly capacity of the gin. Increases in capacity do not result in proportionate increases in crew size and in fact the ratio of labor to gin size decreases as hourly capacity increases. The number of employees for each crew is based on observations made at gins during normal operation. Gins processing machine stripped cotton require from 7 to 14 crew members depending on capacity. Crew size is invariant between seasonal operating length; however, some crew members are considered to be permanent rather than seasonal employees in the 32 week season.

The ginning operation may be divided into three separate crew functions: receiving, conditioning and ginning, and bale packaging. It was estimated that the gin crew works 84 days and 38 nights in the present 14 week ginning season, Table 10. Both day and night crews work 12 hour shifts except during the very early and very late stages of the season when volume received was light. The crews work 6 day weeks except during the peak season when they work 7 day weeks. This is in contrast to the proposed 32 week season with seed cotton storage where crews are split into two 8 hour shifts each day and work 5 day weeks, Table 11. In this system the day crew would work 160 days and the night crew 144. This allows for greater utilization of the fixed factors and eliminates the overtime pay requirements of the present system. Furthermore, since the job would be for 8 months, gin managers will be able to attract suitable labor.

Crew size requirements listed by gin size and crew function in Table 16 show labor requirements for ginning to range between 7 for the 7-bale per hour gin and 14 for the 42-bale per hour gin. The receiving crew is responsible for positioning trailers as they arrive at the gin yard, dumping seed cotton into the ginning stream and yard cleanup.

The conditioning and ginning crew is responsible for regulating the

Table 16. Crew Size and Function for Model Gins Equipped to Handle Machine Stripped Cotton, Oklahoma and West Texas, 1974

Gin Crew Function	Bale Capacity Per Hour					
	7	14	21	28	35	42
	Number of Personnel					
Receiving	3	3	4	4	5	6
Conditioning and Ginning	2	3	4	4	4	4
Bale Packaging	2	3	4	4	4	4
Total Gin Crew	7	9	12	12	13	14

dryers, cleaners and gin stands so that the seed cotton is properly conditioned before ginning and that gin stands operate at the desired speed. This crew is further responsible for preventive maintenance and minor repair work.

Functions of the bale packaging crew include operation of automatic sampler, gin press, automatic strapping equipment, bale weighing and heat shrink tunnel.[1] The bale packaging crew also assists the yard crew in loading cotton on trucks for transportation to the warehouse. They also perform necessary minor repair work on equipment they operate.

Hourly wage rates for the ginning crew were estimated to be \$4.00 for the ginner, \$3.00 for ginner helper, \$2.75 for head pressman and \$2.25 for all other crew members. Social security, and workmen's compensation were added in calculating total labor cost. Some crew members were considered as permanent employees and thus their salary was included in the fixed cost of operation. Wages paid to the ginner were treated as a variable cost only in the smallest gin size operating for a 14 week season. However, the ginner was the only employee considered to be permanent in other gin sizes operating for 14 weeks. For plants operating 32 weeks, the ginner was considered to be a permanent employee as was one other crew member for the two smallest plants and two crew members for the remaining plants. These data are given in Appendix Table 3. Total plant labor costs for the 7-bale per hour gin are shown in Table 17. Associated costs for other gin sizes are listed in Appendix Tables 6-10.

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[1]A heat shrink tunnel is not specified for the 7-bale per hour gin; therefore, the crew is responsible for dressing the press.

Table 17. Estimated Annual Fixed and Variable Costs for a 7-Bale Per Hour Model Gin Equipped to Handle Machine Stripped Cotton, by Length of Season, Oklahoma and West Texas, 1974

Cost Item	Season 14 Weeks	Season 32 Weeks
	Dollars	
Fixed Costs:		
Depreciation	20,340	20,340
Interest	19,386	19,386
Insurance	2,602	2,602
Taxes	4,186	4,186
Management	9,616	9,616
Permanent Gin Labor	--	15,634
Permanent Office Help	6,402	6,859
Total Fixed Cost	62,532	78,623
Variable Costs:		
Office Help	1,867	3,342
Plant Labor	25,842	36,847
Electrical Energy	8,124	16,966
Bagging and Ties	20,108	40,217
Repairs	19,666	29,500
Miscellaneous	11,213	21,995
Total Variable Cost	86,820	148,867
Total Fixed and Variable Cost	149,352	227,490
Seasonal Volume (Bales)	5,391	10,782
Fixed Cost Per Bale	11.60	7.29
Variable Cost Per Bale	16.10	13.81
Total Cost Per Bale	27.70	21.10

Office help was invariant with respect to season, but did vary some between gin sizes. One employee working an 8 hour day, 5 day week for 18 weeks was included for the 7-to 28-bale per hour gins operating for the 14 week season. For the longer season a similar work schedule was assumed but for 32 weeks. Operation of 35-and 42-bale per hour gins required one additional office employee, but working only 4 hours a day. Wage rates for these employees were estimated to be $2.45 per hour plus social security benefits. Total per bale cost of this activity for the 7-bale per hour gin is contained in Table 17. Cost for other gins are in Appendix Tables 6-10.

Electrical energy cost was estimated from horsepower requirements presented in Appendix Table 1 and utility company rate schedules. Table 18 contains per bale cost of electricity for the various gin models. Lower unit costs are reflected for the gins operating at capacity in the present 14 week season. Since operation is more concentrated during this season the energy rate structure is more favorable. Energy costs for both ginning seasons are given in Table 17 for the smallest gin and in Appendix Tables 6-10 for the remaining gins.

The cost of bagging, ties and bale packaging material, varies with the types used. Jute bagging was specified for the 7-bale per hour gin and polyethylene for all other gin sizes. In addition, the larger gins use automatic strapping while strapping is done manually in the smallest gin. Packaging material was estimated to be $3.73 per bale for jute bagging and steel bands. In larger gins, after the bale is banded it moves along a conveyor belt and into a polyethylene bag. The bale then moves through a heat tunnel causing the polyethylene to shrink; therefore providing an air tight package. The cost for

Table 18. Estimated Annual Electrical Energy Inputs and Unit Costs for Model Gins Equipped to Handle Machine Stripped Cotton, by Rated Capacity and Length of Ginning Season, Oklahoma and West Texas, 1974

Item and Ginning Season	Unit	Bale Capacity Per Hour 7	14	21	28	35	42
14 Week Season:							
Total Energy	KWH	276,322	537,781	765,460	1,010,704	1,232,302	1,405,257
Energy Per Bale	KWH	51.25	49.88	47.33	46.87	45.72	43.45
Cost per KWH[a]	Cents	2.94	2.93	2.93	2.91	2.91	2.91
32 Week Season:							
Total Energy	KWH	552,644	1,075,562	1,530,919	2,021,407	2,464,604	2,810,469
Energy Per Bale	KWH	51.25	49.88	47.33	46.87	45.72	43.45
Cost per KWH[a]	Cents	3.07	3.06	3.05	3.04	3.04	3.04

[a]Season average cost based on monthly energy use and rate schedule

bagging and ties used in this system was estimated to be \$2.25 per bale.

Repair costs are higher in machine stripped areas because of the additional trash that must be removed from lint. Further, these costs vary with gin size and volume. Assuming all plants operated at their seasonal capacity, repair costs per bale ranged between \$1.39 in a 42-bale per hour gin operating 32 weeks and \$3.22 in a 7-bale per hour gin operating 14 weeks, Table 17 and Appendix Tables 6-10. These estimates were based on gin machinery investment and are developed in Appendix Table 11.

Other variable costs of operating a cotton gin include natural gas for drying, supplies, office utilities, advertising and items of lesser importance. The per bale cost of these individual items comprise a relatively minor part of total cost; however, their combined cost represents a major item. Miscellaneous cost per bale decreases as gin size increases and was estimated from data provided by gin managers. These data are shown in Table 17 and Appendix Tables 6-10.

The cost of bagging and ties was the largest variable cost item in the 35-and 42-bale per hour gin plants operating for 14 weeks. Labor was the highest variable item in the small plant while repair cost was the highest variable item in the 14-, 21-and 28-bale per hour gins. For gins operating in the extended season, labor was the largest variable item in the two smallest gins. Bagging and ties represented the greatest variable cost in the four largest plants, Table 17 and Appendix Tables 6-10. Repair and miscellaneous costs, especially the latter, increased in importance with gin capacity in both operating season. Electrical energy was also a noticeable cost for 28-, 35-and 42-bale capacity plants operating for 32 weeks. Total variable cost ranged between $86,820 in the conventional season 7-bale per hour gin and $778,656 in the 42-bale per hour gin operating for 32 weeks.

Total cost of gin operation is presented in Table 17 for the 7-bale per hour gin and in Appendix Tables 6-10 for the remaining plants. Total cost for gins operating for 14 weeks ranged between $149,352 and $529,787 while the range for the 32 week ginning season was between $227,490 and $778,656.

Per bale costs by item are presented in Tables 19 to 24 for the various gin sizes and operating seasons. These estimates show cost declines as gin size and operating season increases. Unit costs for the conventional season were $27.70 for the 7-bale capacity operation and $16.38 for 42-bale per hour operation. The Tables show the 32 week season average cost ranged between $21.10 for the smallest gin and $12.04 for the largest gin.

These data indicate that cost savings in the ginning operation exist for larger gins. More importantly, however, the estimates indicate that a more substantial savings could be achieved if gins could be assured the volume necessary to operate for a longer period of time than they presently do. This is a result of greater utilization of gin machinery and equipment as well as management and labor skills. Average costs are lower for the extended season operation because fixed costs are invariant with respect to seasonal length and therefore their cost may be spread over a greater volume.

Warehouse Cost

Transportation

Once cotton has been ginned it is loaded onto trucks by gin labor

Table 19. Estimated Annual Fixed and Variable Costs Per Bale for a 7-Bale Per Hour Model Gin Equipped to Handle Machine Stripped Cotton by Length of Season, Oklahoma and West Texas, 1974

Cost Item	Season	
	14 Weeks	32 Weeks
	Dollars Per Bale	
Fixed Costs:		
Depreciation	3.77	1.88
Interest	3.60	1.80
Insurance	.48	.24
Taxes	.78	.39
Management	1.78	.89
Permanent Plant Labor	--	1.45
Permanent Office Personnel	1.19	.64
Total Fixed Cost	11.60	7.29
Variable Costs:		
Office Help	.34	.31
Plant Labor	4.79	3.42
Electrical Energy	1.51	1.57
Bagging and Ties	3.73	3.73
Repairs	3.65	2.74
Miscellaneous	2.08	2.04
Total Variable Cost	16.10	13.81
Total Fixed and Variable Cost	27.70	21.10
Seasonal Volume (Bales)	5,391	10,782

Table 20. Estimated Annual Fixed and Variable Costs Per Bale for a 14-Bale Per Hour Model Gin Equipped to Handle Machine Stripped Cotton, by Length of Season, Oklahoma and West Texas, 1974

Cost Item	Season 14 Weeks	Season 32 Weeks
	Dollars Per Bale	
Fixed Costs:		
Depreciation	3.45	1.72
Interest	3.22	1.61
Insurance	.44	.22
Taxes	.70	.35
Management	1.09	.55
Permanent Plant Labor	.86	.72
Permanent Office Personnel	.63	.62
Total Fixed Cost	10.39	5.79
Variable Costs:		
Office Help	.17	.08
Plant Labor	2.83	2.40
Electrical Energy	1.46	1.53
Bagging and Ties	2.25	2.25
Repairs	3.00	2.25
Miscellaneous	2.04	1.96
Total Variable Cost	11.75	10.47
Total Fixed and Variable Cost	22.14	16.26
Seasonal Volume (Bales)	10,781	21,562

Table 21. Estimated Annual Fixed and Variable Costs Per Bale for a 21-Bale Per Hour Model Gin Equipped to Handle Machine Stripped Cotton, by Length of Season, Oklahoma and West Texas, 1974

Cost Item	Season	
	14 Weeks	32 Weeks
	Dollars Per Bale	
Fixed Costs:		
Depreciation	3.06	1.53
Interest	2.86	1.43
Insurance	.39	.20
Taxes	.62	.31
Management	1.45	.72
Permanent Plant Labor	.57	.68
Permanent Office Personnel	.42	.41
Total Fixed Cost	9.37	5.28
Variable Costs:		
Office Help	.12	.10
Plant Labor	2.50	2.05
Electrical Energy	1.39	1.45
Bagging and Ties	2.25	2.25
Repairs	2.64	1.98
Miscellaneous	2.00	1.88
Total Variable Cost	10.90	9.71
Total Fixed and Variable Cost	20.27	14.99
Seasonal Volume (Bales)	16,172	32,344

Table 22. Estimated Annual Fixed and Variable Costs Per Bale for a 28-Bale Per Hour Model Gin Equipped to Handle Machine Stripped Cotton, by Length of Season, Oklahoma and West Texas, 1974

Cost Item	Season	
	14 Weeks	32 Weeks
	Dollars Per Bale	
Fixed Costs:		
Depreciation	2.90	1.45
Interest	2.69	1.35
Insurance	.37	.19
Taxes	.59	.29
Management	1.23	.61
Permanent Plant Labor	.43	.51
Permanent Office Personnel	.61	.31
Total Fixed Cost	8.82	4.71
Variable Costs:		
Office Help	.09	.08
Plant Labor	1.88	1.54
Electrical Energy	1.36	1.42
Bagging and Ties	2.25	2.25
Repairs	2.49	1.87
Miscellaneous	1.96	1.82
Total Variable Cost	10.03	8.98
Total Fixed and Variable Cost	18.85	13.69
Seasonal Volume (Bales)	21,563	43,126

Table 23. Estimated Annual Fixed and Variable Costs Per Bale for a 35-Bale Per Hour Model Gin Equipped to Handle Machine Stripped Cotton, by Length of Season, Oklahoma and West Texas, 1974

Cost Item	Season	
	14 Weeks	32 Weeks
	Dollars Per Bale	
Fixed Costs:		
Depreciation	2.80	1.40
Interest	2.62	1.31
Insurance	.36	.18
Taxes	.57	.29
Management	1.17	.58
Permanent Plant Labor	.34	.41
Permanent Office Personnel	.49	.37
Total Fixed Cost	8.35	4.54
Variable Costs:		
Office Help	.10	.09
Plant Labor	1.62	1.34
Electrical Energy	1.33	1.39
Bagging and Ties	2.25	2.25
Repairs	2.09	1.57
Miscellaneous	1.92	1.76
Total Variable Cost	9.32	8.40
Total Fixed and Variable Cost	17.67	12.94
Seasonal Volume (Bales)	26,954	53,908

Table 24. Estimated Annual Fixed and Variable Costs Per Bale for a 42-Bale Per Hour Model Gin Equipped to Handle Machine Stripped Cotton, by Length of Season, Oklahoma and West Texas, 1974

Cost Item	Season: 14 Weeks	Season: 32 Weeks
	Dollars Per Bale	
Fixed Costs:		
Depreciation	2.53	1.26
Interest	2.39	1.19
Insurance	.32	.16
Taxes	.52	.26
Management	1.13	.57
Permanent Plant Labor	.29	.34
Permanent Office Personnel	.41	.31
Total Fixed Cost	7.59	4.09
Variable Costs:		
Office Help	.09	.08
Plant Labor	1.45	1.21
Electrical Energy	1.27	1.32
Bagging and Ties	2.25	2.25
Repairs	1.85	1.39
Miscellaneous	1.88	1.70
Total Variable Cost	8.79	7.95
Total Fixed and Variable Cost	16.38	12.04
Seasonal Volume (Bales)	32,344	64,688

and transported to a warehouse for storage. The most common equipment used is a semi-tractor trailer unit; however, many small gins utilize smaller trucks. During the peak ginning season, plants of 21-bales per hour and greater maintain two units operating twenty-four hours a day.

However, due to the erratic seasonal volume and the difficulty of attracting and holding suitably skilled labor, gin managers have identified this operation to be very inefficient. Gins have historically charged their patrons $1.00 per bale for this service. Data provided by gin managers indicated actual gin cost ranged from $.96 to nearly $2.50 per bale. Sandel, Smith and Fowler did report the cost to one gin to be $.368 (pp. 33-35).

The past few years has seen more and more gin managers rely on commercial trucking lines to either assist them in this function or to provide it completely. In fact, some trucking operations have purchased special loading equipment which they leave at gin sites; thus, loading the cotton as well as transporting it to the warehouse. Since this method has become increasingly more popular and because many gins not presently using it have expressed a desire to do so, transportation rates used in this study pertain to the commercial contract system. Cost estimates were developed from data provided by four commercial trucking firms and are listed in Table 25. The estimates relate to the transportation process only; that is, gin managers retain the responsibility of loading cotton onto trucks.

Storage and Handling

The cotton warehouse industry occupies a major position in the

Table 25. Estimated Rate Schedule for Transporting Cotton Between Gin and Warehouse, Machine Stripped Areas, Oklahoma and West Texas, 1974

Distance	Cost
Miles	Dollars Per Bale
0.1 - 10.0	.65
10.1 - 20.0	.75
20.1 - 30.0	.90
30.1 - 40.0	1.00
40.1 - 50.0	1.10
50.1 - 65.0	1.25
65.1 - 80.0	1.40
80.1 - 100.0	1.50
100.1 - 125.0	1.60
125.1 - 150.0	1.70
> 150.0	1.80

cotton marketing system of Oklahoma and West Texas. Commodity characteristics, quality differences between individual bales and the exacting specifications of mills requires concentration of cotton into warehouses after ginning in order to provide effective merchandising. Since cotton merchants seldom if ever see the product they buy and sell, they rely on the warehouse industry to provide the services associated with the physical handling of cotton between the warehouse and the mill.

Warehouse managers have traditionally received their revenue from both private and government sources with the latter being the largest single source. However, since 1967 the government has disposed of most of its stocks and is no longer the primary buyer of warehouse services. In fact, government demand for warehouse space is negligible, CCC stocks being 218,000 bales in 1974 as compared with a high of 12,304,000 bales in 1966 (USDA 1974, p. 10). As a result, the industry must now depend upon the private sector for its revenues. Therefore, submarginal firms unable to become more efficient are being forced out of business.

Services provided by the warehouse industry operating under the present marketing system may be delineated into five stages: receiving, storage, breakout, recompression and shipping. An important requirement in each stage is preservation of bale identity.

The receiving function includes unloading bales upon arrival, tagging, reweighing and resampling as required, issuing a negotiable warehouse receipt and moving bales to temporary storage locations. Services pertaining to the storage function are moving bales to specific storage areas, stacking bales in tiers, maintaining stacks and other custodial operations as necessary. Warehouse personnel also record storage location by compartment row and bale number. The breakout operation includes identifying bales ordered for shipment and moving such bales to either the shipping area or the compression room if recompression is necessary. In the present cotton marketing system, recompression to universal density is necessary for nearly all cotton. After recompression the bale is moved to the shipping area or to storage, depending on specification of the recompression order. In the proposed system gins compress bales to universal density; therefore eliminating the necessity of warehouse recompression. The shipping operation generally includes segregating bales into lots, checking and rechecking bale numbers for accuracy and loading the cotton onto trucks or into railcars.

A U. S. Department of Agriculture study provided the basis of warehouse cost estimates used in this study (Ghetti, et al.).[2] Data for the USDA study were collected from 18 Oklahoma and West Texas warehouses operating in 1969.[3] This random sample was composed of 29 percent of the warehouses and accounted for 47 percent of the total cotton storage capacity in the machine stripped area. These same percentages were applicable in 1974, but require qualification. While the number of warehouses has remained unchanged, a minor portion of storage capacity has been diverted to commercial storage.

Data requirements of the Ghetti study included monthly quantity of cotton handled and stored, plant and equipment inventory, structure types and the proportional uses made of buildings and equipment in the performance of each service function. Data pertaining to labor crew

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[2]The connotation of warehouse as used in this study is the same as compress warehouse in the USDA study.

[3]The study included other areas of the cotton belt, however a separate analysis was made for each region.

organization and makeup, quantity of bales handled per hour as well as number and types of equipment used by service function were obtained. Further, cost data relating to warehouse operation, including taxes, salaries, wages, operating supplies, energy requirements, insurance and other pertinent costs were collected. Cost items were allocated between handling and storage functions based on information given by warehouse managers participating in the survey.

Since wide variation existed between warehouses with respect to depreciation schedules, interest rates and acquisition cost, these costs were standardized. These data provided the basis used by Ghetti to estimate warehouse handling and storage functions.

Alternative regression models were developed for each stage of warehouse operation; however, only one estimating equation per stage was reported. The functional forms of estimating equations used in the USDA study were

Receiving:

Total Cost $Y = b_0 + b_1X_1 + e$

Storage:

Fixed Cost $Y_1 = b_0 + b_2X_2 + e$

Variable Cost $Y_2 = b_0 + b_2X_2 + b_3X_3 + e$

Breakout:

Total Cost $Y = b_0 + b_1X_1 + e$

Shipping:

Total Cost $Y = b_0 + b_1X_1 + e$

where Y represents the total cost of the associated operation except for storage where total cost is the summation of Y_1 and Y_2. Independent variable X_1 represents the number of bales handled within each stage,

X_2 represents warehouse capacity and X_3 is warehouse percent occupancy and is defined as the ratio of the sum of the twelve monthly ending inventories plus one-half of the annual receipts to twelve times capacity (available bale-months of storage). The error term is defined as e.

The estimating equations and reported statistical information are given in Table 26. Standard errors were not reported; however, the authors indicated all coefficients were significant at the 99 percent level.

Since these models reflected 1969 price relationships, modifications were necessary in order to estimate 1974 costs associated with the storage and handling operations. The models were modified through the use of price inflators. Intercept coefficients of the receiving, break-out and shipping functions were inflated by the ratio of the 1974 Wholesale Price Index (WPI) to the 1969 WPI. Coefficients associated with the slope terms in these three functions were inflated in a similar manner; however, the index of labor cost for marketing farm-food products was used. The inflators used in this study are given in Appendix Table 12. The estimation of storage cost consisted of two functions, one each for fixed and variable costs. The intercept of the fixed cost expression was inflated by the WPI ratio while the intercept of the variable cost estimation equation was inflated by the labor cost index ration.

The resulting cost equations were

Receiving:

$$\hat{Y} = 15.68469 + 1.20130\ X_1$$

Table 26. Cost Relationships of Handling and Storing Cotton in Oklahoma and West Texas Warehouses, 1969

Stage	Coefficient b_0	b_1	b_2	b_3	R^2
Receiving	10.36723	0.78521*			98.4
Storage:					
Fixed Cost	-16.20694		0.93809*		98.6
Variable Cost	-24.33897		0.52911*	1.65218*	97.3
Breakout	1.76956	0.51144*			82.4
Shipping	9.57704	0.30831*			94.1

*Significant at the 99 percent level

Source: (Ghetti, et al., pp. 13-30)

Storage:

Fixed Cost $\hat{Y} = -7.89424 + 0.93809\ X_2$

Variable Cost $\hat{Y}_2 = -11.44151 + 0.52911\ X_2 + 1.65218\ X_3$

Breakout:

$$\hat{Y} = 2.67718 + 0.78245\ X_1$$

Shipping:

$$\hat{Y} = 14.48920 + 0.47168\ X_1$$

where all variables are defined as before.

In synthesizing total warehouse cost for 1974 a further assumption was made: the quantity of cotton moving thru each stage was equal. This implies all cotton receipts are stored, broken-out and shipped. Cost estimates obtained from these equations were found to be similar to actual costs incurred by area warehouses; however, a further modification was made.

First, using the previous assumption of equating the number of bales handled in each operation, warehouse total cost was expressed as the summation of the individual equations:

$$TC = 13.51532 + 2.45543\ X_1 + 1.46720\ X_2 + 1.65218\ X_3 \qquad (1)$$

where TC is total cost of handling and storage and X_1, X_2 and X_3 are as previously defined.

The additional modification pertains to specifying percentage occupancy as defined in the work of Ghetti et al. The determination of percentage occupancy requires estimates of monthly receiving and shipping distributions. These estimates were developed from 1973 and 1974 data obtained from 40 of the 74 firms operating in the machine stripped area. This was supplemented with the percentage of the total Oklahoma crop ginned during each two-week period of the 1970 to 1973 ginning seasons (U. S. Department of Commerce, p. 4). These distributions, associated with the 14 week ginning season are contained in Table 27 and indicate warehouses receive 50 percent of their annual volume in December and that the distribution tends to be bell shaped. Distributions for the extended ginning season are in Appendix Table 13.

Further, using 1972-1974 information obtained from firms accounting for 79 percent of area capacity the average carryover of stocks was estimated to be 15 percent of capacity. Therefore, at the beginning of each year any warehouse was estimated to be 15 percent utilized.

Using these distributions, the percentage of receipts in storage during each month was developed by subtracting shipments from receipts, Table 27. Since January is the last month in which more cotton is received than shipped, the monthly ending inventory for January will be at the highest level. Allowing the January ending inventory to equal plant capacity established maximum receipts to be 128.78 percent of capacity. This was based on maximum receipts on hand (66 percent) and annual carryover (15 percent of capacity). By requiring plant capacity to be equal to 66 percent of receipts plus 15 percent of capacity, maximum receipts can be determined by defining

$$X = \text{annual receipts}$$

$$Y = 100 \text{ percent of capacity}$$

therefore,

$$Y = .66X + .15Y$$

$$.66X = .85Y$$

$$X = 1.28787Y$$

or annual receipts equal 1.28787 times capacity.

Monthly ending inventories may then be expressed in percentages

Table 27. Estimated Monthly Receiving and Shipping Distribution for Warehouses Receiving Cotton Ginned over a 14 Week Ginning Season, Oklahoma and West Texas

Month	Receipts	Shipments	Receipts In Storage	Warehouse Utilization
		Percent of Receipts		Percent of Capacity
August		4	-4	10
September		1	-5	9
October	6	2	-1	14
November	20	4	15	34
December	50	7	58	90
January	19	11	66	100
February	5	10	61	94
March		11	50	79
April		11	39	65
May		14	25	47
June		13	12	30
July		12	0	15

of capacity by adding 15 percent to the multiplication of monthly receipts in storage and the linear transformation factor 1.28787. The monthly ending inventories are presented in Table 27. Percentage occupancy was estimated to be 51 percent and substituting this into equation (1)

$$TC = 14.35793 + 2.45543X_1 + 1.46720X_2 \qquad (2)$$

This equation was used in estimating warehouse cost associated with the 14 week ginning season. Estimates obtained from this equation were found to approximate costs reported by area warehouses.

Appendix Table 13 contains the distributions for the 32 week season. Ending inventory is at the highest level in April and is assumed to be equal to warehouse capacity and establishes maximum receipts to be 265.62 percent of capacity. Estimated percentage occupancy, independent variable X_3, was estimated to be 59 percent. Substituting this into equation (1), warehouse total cost of storage and handling associated with the long ginning season may be expressed as

$$TC = 14.4901 + 2.45543X_1 + 1.46720X_2 \qquad (3)$$

Merchandising

A vital link between the cotton producer and textile mill is merchandising and the cotton shipper is the primary supplier of this service. Shippers purchase cotton from various sources in performing their function; the delivery of required cotton where and when needed. Such purchases are direct from farmers either before or after entering the warehouse, from ginners, other shippers or local buyers and from spot brokers (Chandler and Glade, p. 8).

In merchandising cotton a shipper furnishes several specific services, these being, obtaining the cotton, quantity selection, storage and insurance until delivered, transportation to the textile mill and financing until delivery is made and payment received.

All cost estimates except for mill transportation were developed similar to 1973 estimates reported by Chandler and Glade. Their survey accounted for 49.8 percent of machine stripped production and included individual firm data relating to shipper cost and volume on both domestic and foreign shipments. Additionally, they obtained information from each firm as to methods of purchasing and selling. Estimates used in this study were based on their 1973 estimates and supplemental 1974 data collected by Chandler. These estimates are presented in Table 28 and 1973 base estimates are contained in Appendix Table 14.

Two sets of data were used in determining the warehouse to mill transportation cost of lint cotton. The percentage of cotton moving by truck and rail to the various mill areas was calculated from data collected in a 1971 survey by USDA. It was expected that these data would be applicable because similar information pertaining to 1962 showed like percentages (Ghetti, Looney and Holder). This distribution of shipments by mode of transportation and destination was determined from data obtained from 57 of the 74 warehouses in the area.[4] The cost of rail transportation was obtained from applicable tariff sheets while trucking costs were estimated from data provided by firms operating in the area. The weighted average cost of mill shipments is given in Table 29 while the distribution of shipments by mode and associated costs are contained in Appendix Tables 15 and 16. Total merchandising

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[4] Appreciation is expressed to Joseph Ghetti, Agricultural Economist, USDA-ERS, Stoneville, Mississippi for making the schedules available.

Table 28. Cost of Merchandising Cotton by Major Cost Item, Origin and Destination, Oklahoma and West Texas, 1974

Item	Mill Area					
	201	200	New England	Alabama Georgia	Other Domestic	Foreign
	Dollars Per Bale					
Buying and Local Delivery	.63	.52	1.04	.86	.60	.80
Cotton Insurance	.21	.22	.15	.18	.31	2.58
Financing	3.55	2.44	4.42	5.17	3.00	5.61
Selling	.65	.55	1.00	.74	.56	1.62
Overhead	2.82	2.75	4.24	2.60	.41	.35
Miscellaneous	.39	.37	.41	.83	2.47	2.62
Total Cost[a]	8.25	6.85	11.26	10.38	7.35	13.58

[a]Excluding transportation cost

Table 29. Cost of Shipping Cotton from Warehouses by Origin, Destination and Mode of Transportation, Oklahoma and West Texas, 1974[a]

Destination	Study Area		
	Altus	Abilene	Lubbock
		Dollars Per Bale	
Group 201 Mills	7.76	7.89	8.32
Group 200 Mills	8.17	8.36	8.82
New England Mills	10.94	10.98	11.38
Alabama-Georgia Mills	7.35	7.01	8.06
Other Domestic Mills	5.89	5.16	5.67
Foreign Mills	24.80	24.80	24.80

[a]Appendix Tables 14 and 15

costs presented in Table 30 show only small variations between areas of origin, but range between $12.51 and $38.38 per bale for destinations.

Supply and Market Areas

The areas of study for the analysis were previously identified in Figure 2 as the five southwestern Oklahoma Counties around Altus, the four county Abilene area and the nine county area whose center is Lubbock, Texas. These areas are referred to as the Altus, Abilene and Lubbock study areas, respectively. Alternative gin and warehouse sites were limited to that set of locations having established firms. Production regions supplying seed cotton to gins were established based on present gin locations and are sub-county regions. The center of each sub-county supply region was assumed to be a gin location. Therefore, for each alternative gin location within a county there exists a supply region where it was assumed seed cotton would be assembled and ginned or would be transferred and ginned at another alternative gin location. For every alternative gin location in a county there is a supply area. Production was assumed to be unifrom throughout a county and was equal for supply sources within the same county.

Production estimates for each county unit within the three study areas were based on average county production of the past four years and are contained in Table 31. Alternative gin locations, the number of gins at each location in 1974 and estimated production of the associated supply regions are contained in Tables 32 through 34 for the Altus, Abilene and Lubbock study areas, respectively. Alternative warehouse locations for the above corresponding study area are presented in Table 35. Gin-warehouse shipping costs for each area are in Appendix Tables 17-19.

Table 30. Cost of Merchandising Cotton by Origin and Destination, Oklahoma and West Texas, 1974

Mill Area	Study Area		
	Altus	Abilene	Lubbock
		Dollars Per Bale	
Group 201	16.01	16.14	16.57
Group 200	15.02	15.21	15.67
New England	22.20	22.24	22.64
Alabama-Georgia	17.33	17.39	18.44
Other Domestic	13.24	12.51	13.02
Foreign	38.38	38.38	38.38

Table 31. Cotton Production by County and Study Area, 1970-1973 and Average Production

County	Production				
	1970	1971	1972	1973	Average[a]
			Bales		
Altus Study Area					
Tillman	21,305	14,616	40,407	69,631	36,490
Kiowa	11,395	21,785	22,280	39,029	23,622
Jackson	25,737	13,683	36,117	54,712	32,562
Greer	8,117	9,188	16,970	23,197	14,368
Harmon	12,171	13,153	23,872	32,115	20,328
Abilene Study Area					
Fisher	37,971	25,906	44,853	59,413	42,036
Jones	52,945	32,004	59,697	77,511	55,539
Nolan	22,056	9,447	28,759	33,782	23,511
Taylor	7,903	4,190	5,217	6,791	6,025
Lubbock Study Area					
Lamb	112,718	85,721	107,308	146,797	113,136
Hale	143,410	92,073	139,599	158,291	133,343
Floyd	83,229	49,534	118,819	138,859	97,610
Crosby	113,174	74,568	151,457	177,880	129,270
Lubbock	208,366	149,944	220,748	295,352	218,603
Hockley	140,093	85,354	108,005	197,913	132,840
Terry	111,851	85,456	126,661	172,990	124,240
Lynn	135,069	88,204	207,157	274,129	176,140
Garza	24,327	15,472	37,912	48,785	31,624

[a]Simple average of 1970 to 1973 production

Source: (U. S. Department of Commerce, pp. 13-17)

Table 32. Alternative Gin Locations and Number of Gins, Estimated County and Supply Source Production, Altus Study Area, 1974

Alternative Location	Number of Gins	Production	
		County	Supply Source
County and Town	Firms	Bales	
Tillman County:		36,490	
Davidson	3		7,298
Grandfield	1		7,298
Manitou	1		7,298
Tipton	1		7,298
Frederick	3		7,298
Kiowa County:		23,622	
Mt. View	2		3,937
Hobart	1		3,937
Gotebo	1		3,937
Lone Wolf	1		3,937
Roosevelt	2		3,937
Snyder	1		3,937
Jackson County:		32,562	
Altus	5		5,427
Blair	1		5,427
Eldorado	1		5,427
Headrick	1		5,427
Martha	1		5,427
Olustee	1		5,427
Greer County:		14,368	
Mangum	3		3,592
Granite	1		3,592
Reed	1		3,592
Willow	2		3,592
Harmon County:		20,328	
Gould	1		6,776
Hollis	3		6,776
Vinson	1		6,776

Table 33. Alternative Gin Locations and Number of Gins, Estimated County and Supply Source Production, Abilene Study Area, 1974

Alternative Location	Number of Gins	Production	
		County	Supply Source
County and Town	Firms	Bales	
Fisher County:		42,036	
Rotan	3		10,509
Longworth	1		10,509
Roby	2		10,509
Sylvester	1		10,509
Jones County:		55,539	
Hamlin	1		5,049
Anson	2		5,049
Radium	1		5,049
Avoca	2		5,049
Neinda	1		5,049
Hodges	1		5,049
Stith	1		5,049
Noodle	1		5,049
Tuxedo	1		5,049
Corinth	1		5,049
Stamford	3		5,049
Nolan County:		23,511	
Roscoe	4		7,837
Nolan	1		7,837
Sweetwater	1		7,837
Taylor County:		6,025	
Abilene	1		1,205
Merkel	1		1,205
Trent	1		1,205
Tuscola	1		1,205
Lawn	1		1,205

Table 34. Alternative Gin Locations and Number of Gins, Estimated County and Supply Source Production, Lubbock Study Area, 1974

Alternative Location	Number of Gins	Production	
		County	Supply Source
County and Town	Firms	Bales	
Lamb County:		113,136	
Littlefield	7		14,142
Sudan	3		14,142
Amherst	4		14,142
Earth	4		14,142
Fieldton	2		14,142
Olton	3		14,142
Spade	3		14,142
Springlake	3		14,142
Hale County:		133,343	
Plainview	11		19,049
Abernathy	8		19,049
Cotton Center	2		19,049
Edmonson	2		19,049
Hale Center	7		19,049
Petersburg	2		19,049
Halfway	2		19,049
Floyd County:		97,610	
Floydada	6		19,522
Lockney	8		19,522
Sterley	1		19,522
Daugherty	1		19,522
Aiken	1		19,522
Crosby County:		129,270	
Ralls	8		21,545
Robertson	1		21,545
Lorenzo	6		21,545
Cone	1		21,545
Kalgary	1		21,545
Crosbyton	3		21,545
Lubbock County:		218,603	
Lubbock	16		31,229
Slaton	6		31,229
Shallowater	5		31,229
Hurlwood	1		31,229
Idalou	4		31,229
New Deal	2		31,229
Wolfforth	1		31,229

Table 34. (Continued)

Alternative Location	Number of Gins	Production County	Production Supply Source
County and Town	Firms	Bales	
Hockley County:		132,840	
Levelland	13		16,605
Anton	3		16,605
Smyer	2		16,605
Pep	1		16,605
Pettit	1		16,605
Ropesville	5		16,605
Sundown	1		16,605
Witharral	3		16,605
Terry County:		124,240	
Brownfield	14		31,060
Meadow	4		31,060
Tokio	1		31,060
Wellman	2		31,060
Lynn County:		176,140	
O'Donnell	6		35,228
Tahoka	7		35,228
Grassland	1		35,228
Wilson	4		35,228
New Home	3		35,228
Garza County:		31,624	
Post	8		15,812
Southland	1		15,812

Table 35. Alternative Cotton Warehouse Locations, Altus, Abilene and Lubbock Study Areas

Altus	Study Area Abilene	Lubbock
	Location	
Frederick	Rotan	Littlefield
Mt. View	Hamlin	Sudan
Hobart	Stamford	Plainview
Altus	Sweetwater	Abernathy
Mangum	Abilene	Floydada
		Lockney
		Ralls
		Lubbock
		Slaton
		Levelland
		Brownfield
		O'Donnell
		Tahoka

Warehouse to mill shipments were restrained such that each warehouse shipped a given percentage of its volume to each mill area. The estimated distribution shipped to each demand area, Table 36, was taken from Chandler and Glade (p. 22).

Table 36. Estimated Cotton Warehouse Shipping Distribution by Market Area, Oklahoma and West Texas, 1974

Destination	Shipments
	Percent
Group 201 Mills[a]	14.9
Group 200 Mills	0.5
New England Mills	0.8
Alabama-Georgia Mills	11.0
Other Domestic Mills[b]	1.0
Foreign Mills	71.8

[a]Group 201 and Group 200 mills are those located in the two Carolina states; generally, mills located in the western portion of these states comprise Group 201 mills

[b]Principally Texas

Source: (Chandler and Glade 1975, p. 22)

CHAPTER VI

OPTIMUM SIZE, NUMBER AND LOCATION OF COTTON GINNING AND WAREHOUSING FACILITIES

The mixed integer programming model presented earlier was used with data of the previous chapter to determine the optimum size, number and location of cotton ginning and warehouse plants for each of the three study areas. Two ginning seasons, a 14 week and 32 week operation, were considered and a study period of 1974 was assumed. The analytical model was formulated to determine the minimum cost flow of cotton from the farm to the mill. Limitations imposed on the model were held constant throughout the study areas as were conditions relating to each ginning season. Further, it was assumed the industry economic environment is one in which maximum efficiency is the objective.

Production and mill demand estimates for each area were based on historical data presented in Chapter V. The costs associated with assembly and distribution activities were also based on data presented in Chapter V.

Potential processing locations were specified for each study area, with each gin location permitted to have three plants of each size. Gin sizes were specified in bale capacity per hour, ranging between 7-and 42-bales per hour in increments of seven. These sizes represent seasonal capacities of 5,391; 10,781; 16,172; 21,563; 26,954; and 32,344 bales for gins operating 14 weeks. Seasonal capacities for the

32 week ginning season are 10,782; 21,562; 32,344; 43,126; 53,908; and 64,688 bales.

As an example of gin plant sizes, consider the 14 week ginning season and a hypothetical study area with production totaling 32,344 bales. Further, assume the existence of only one location for gin plants. This site could then have one 42-bale per hour plant or any combination of plants having a total capacity of at least 32,344 bales. However, no more than three plants of the same size could be at this site.

Warehouse locations were permitted to have one plant of a variable size, with capacity restricted to range between 22,000 and 675,000 bales. However, for potential locations presently having two or more plants, two warehouse activities were specified in the model. Further, warehouses were restricted to operate at 100 percent of capacity.[1]

The nature of the branch and bound mixed integer programming model allows for any, but not necessarily all, suboptimum integer solutions to be studied as the search for the optimum solution progresses. The computational procedure is such that after a suboptimum solution is reached, no solution with a greater objective function value is considered. Therefore, the optimum market organization may be compared with alternative suboptimum market organizations.

Given the model, data and assumptions, the mixed integer technique was utilized in determining the minimum cost of transferring the resource from an assembly point to a processing facility. The resource

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[1]A warehouse operating at 100 percent of capacity is defined as one receiving the maximum amount of cotton given the receiving and shipping distributions presented in Chapter V.

is then transformed into another resource, transshipped to a second-stage processing facility where the resource is processed into the final product and transshipped to a distribution point.

Optimum market organizations for the 14 week and 32 week ginning seasons in Altus, Abilene and Lubbock study areas are presented and discussed in this chapter.[2] Further, such market organizations are compared with the present industry organization and alternative subop-timum solutions are discussed with reference to assembly, ginning, warehousing, merchandising and transshipment activities.

Altus Study Area

The 24 potential gin sites and five warehouse locations included in the analysis are spatially dispersed throughout the primary cotton producing areas of the study area, Figure 12. Locations selected comprise the existing network of ginning and warehousing facilities. The model was specified such that both Altus (12) and Frederick (5)

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[2]In linear programming the search time required to reach an optimum solution increases exponentially as the number of constraints increases. Increasing the number of activities has very little effect. However, in mixed integer programming the reverse is true if the additional activities are integer variables. In fact, additional constraints added to mixed integer variables will decrease the search time. These observations become quite important in considering the optimum size, number and location of raw cotton processing facilities. The smallest study area formulation, Altus, had 145 integer variables and the largest, Lubbock, had 326 integer activities. Due to the size of the problems and search time required only two proven optimum solutions were obtained, these being for the Altus and Abilene study areas with the 32 week ginning season. The minimum cost solutions for other problems, although not proven optimum solutions, are presented and discussed as optimum solutions. The solutions may, in fact, be optimum solutions as they vary only slightly from associated possible best solutions not fully developed in the respective computational procedures. A comparison of the time required to obtain proven optimum solutions and the search time for other solutions is presented in Appendix Table 20.

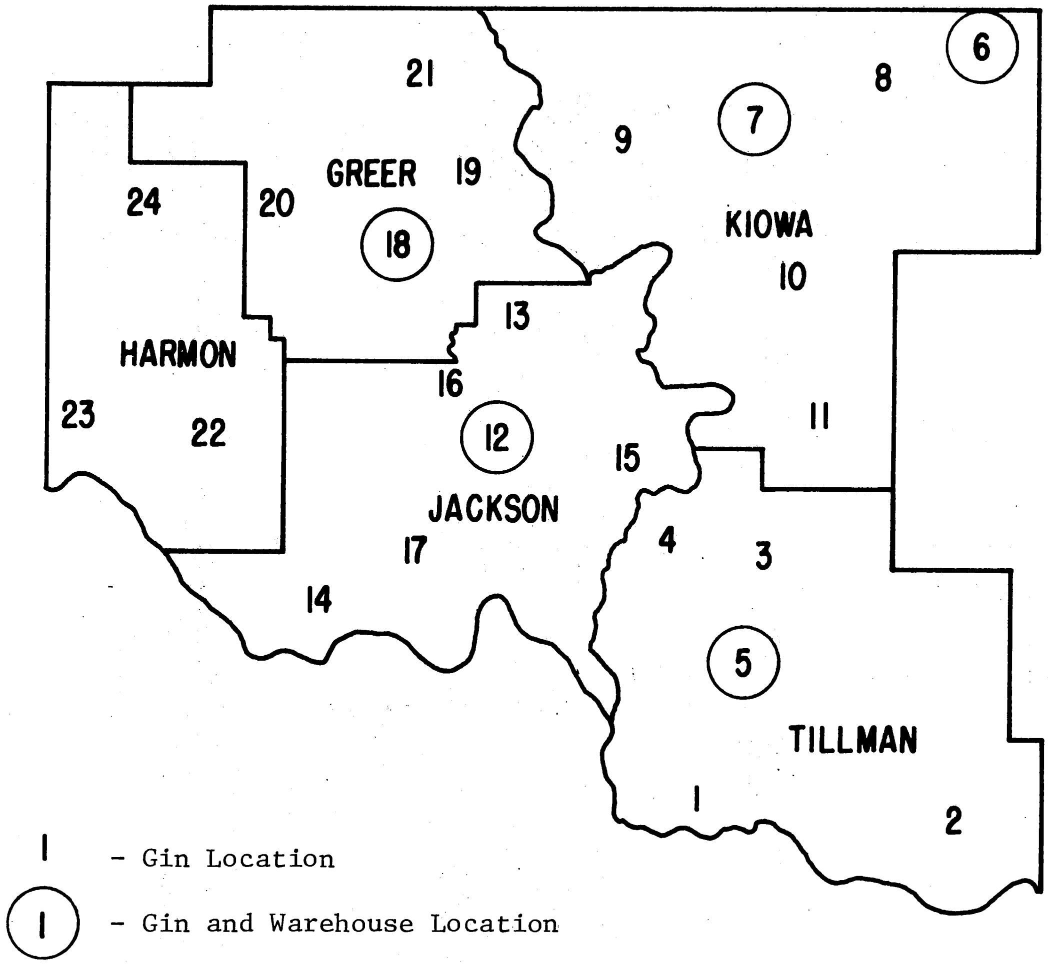

Figure 12. Ginning and Warehousing Activities of the 1974 Altus Study Area Market Organization

were permitted to have two warehouses. The locations selected consist of the following towns:

1.	Davidson	9.	Lone Wolf	17.	Olustee
2.	Grandfield	10.	Roosevelt	18.	Mangum
3.	Manitou	11.	Snyder	19.	Granite
4.	Tipton	12.	Altus	20.	Reed
5.	Frederick	13.	Blair	21.	Willow
6.	Mt. View	14.	Eldorado	22.	Gould
7.	Hobart	15.	Headrick	23.	Hollis
8.	Gotebo	16.	Martha	24.	Vinson

The numbers and town names correspond to those numbers in Figure 12.

14 Week Ginning Season

The minimum cost mix of cotton processing plants, Table 37 and Figure 13, consists of four gins and one warehouse. Gin plants, each with a seasonal capacity of 32,344 bales are located at Manitou (3), Snyder (11), Olustee (17) and Vinson (24). All operate at full capacity except for the Vinson plant which operates at a level of 2,006 bales less than capacity. Only one warehouse activity, Altus (12), is included in the optimum solution. Warehouse capacity is 98,903 bales with volume handled being 127,370 bales.

A pictorial representation of the farm to gin flow of cotton is also contained in Figure 13. Gin market areas are well defined and only three of the 23 supply sources split their production between gins. The volume and flow of shipments from production areas to gin points are also given in Table 37. The four gins transship their cotton to the Altus warehouse which is located in the center of the study area.

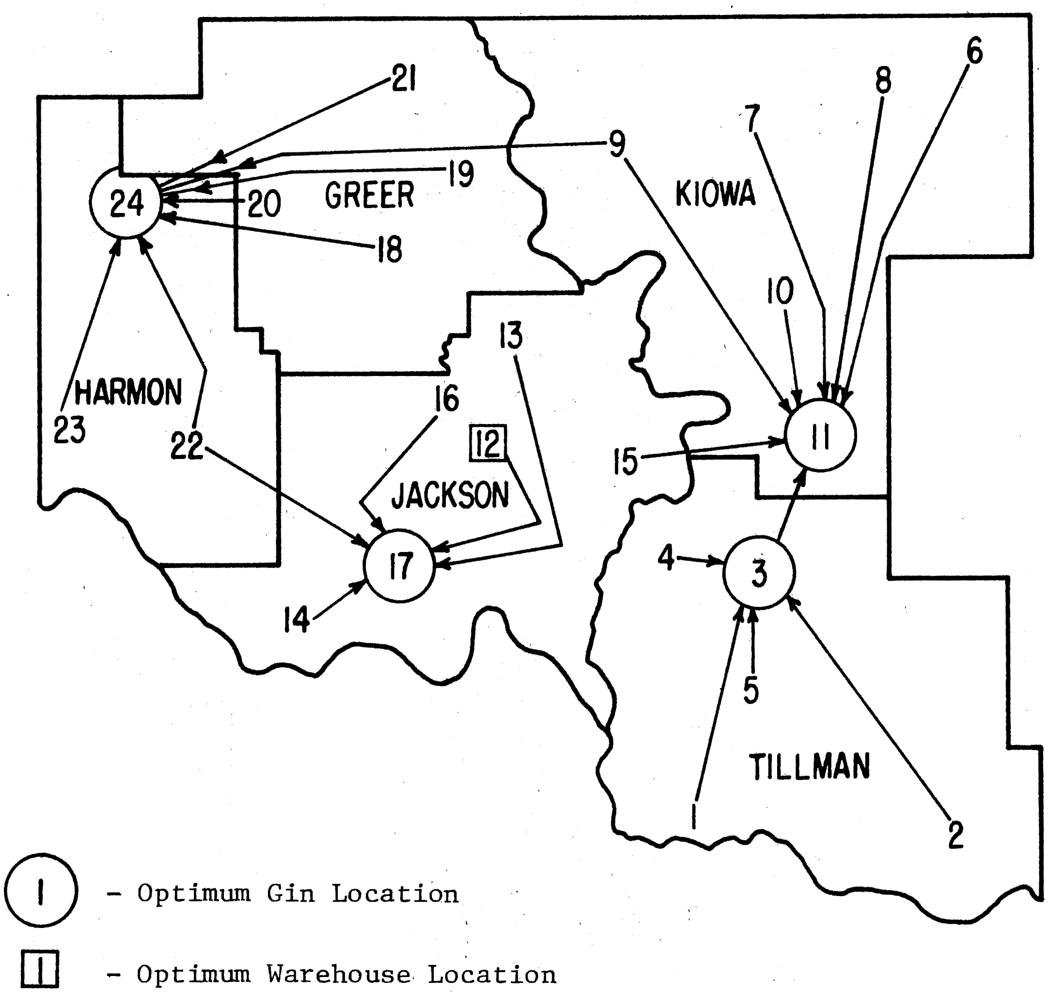

Figure 13. Ginning and Warehousing Activities in the Optimum Market Organization, Altus Study Area, 14 Week Ginning Season, 1974

Table 37. Ginning and Warehousing Activities in the Optimum Market Organization, Altus Study Area, 14 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
3-Manitou	32,344	32,344	1-Davidson, 2-Grandfield, 3-Manitou (3,152), 4-Tipton, 5-Frederick
11-Snyder	32,344	32,344	3-Manitou (4,146), 6-Mt. View, 7-Hobart, 8-Gotebo, 9-Lone Wolf (3,086), 10-Roosevelt, 11-Snyder, 15-Headrick
17-Olustee	32,344	32,344	12-Altus, 13-Blair, 14-Eldorado, 16-Martha, 17-Olustee, 22-Gould (5,209)
24-Vinson	32,344	30,338	9-Lone Wolf (851), 18-Mangum, 19-Granite, 20-Reed, 21-Willow, 22-Gould (1,567), 23-Hollis, 24-Vinson
		Warehouses:	
12-Altus	98,903	127,370	3-Manitou, 11-Snyder, 17-Olustee, 24-Vinson

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

The flow pattern of cotton from warehouse to mill was specified in the previous chapter and is the same for all warehouses within study areas. Shipments originating in the Altus study area are designated for the six mill demand points are given in Table 38.

The cost of marketing cotton as given by the optimum market organization is $8,059,418 or $63.28 per bale, Table 39. This compares with present system costs of $11,249,014 or $88.32 per bale. Therefore, a reorganization of the market could result in a savings of $25.04 per bale. This savings is delineated by major activity in Table 39 and represents a 28 percent decrease in present system costs.

The present market organization has 39 gins located at or near the 24 sites previously presented. Since the optimum includes only four gins, farm to gin assembly cost might be expected to increase.[3] This anticipation is justified since trailer cost per bale remains constant and total transfer cost varies only with respect to farm to gin distance. Assembly cost of the optimum market organization is approximately $130,000 over the present cost. This results in an average increase of $1.02 per bale. Since this is an average for the area, the impact on individual producers would vary. Some producers would incur a smaller assembly cost while the cost to others could be expected to be greater. Further, this cost would be more visible to producers whose cost is relatively near or greater than the $1.02 per bale.

The most significant savings over the present system occurs in the ginning activity and amounts to $16.70 per bale. This represents a reduction of over two million dollars, or a decrease in ginning cost of

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[3]Farm to gin assembly cost is hereafter referred to as assembly cost.

Table 38. Warehouse to Mill Shipments, Altus, Abilene and Lubbock Study Areas, 1974

Mill Area	Study Area		
	Altus	Abilene	Lubbock
		Bales	
201	18,978	18,940	172,364
200	637	636	5,784
New England	1,019	1,017	9,254
Alabama-Georgia	14,011	13,982	127,249
Other Domestic	1,274	1,271	11,568
Foreign	91,451	91,265	830,587
Total	127,370	127,111	1,156,806

Table 39. Cotton Marketing Costs of the Present System and Optimum Market Organization by Major Activity, 14 Week Ginning Season, Altus Study Area, 1974

Activity	Present Market Organization		Optimum Market Organization		Savings	
	Dollars	Dollars Per Bale	Dollars	Dollars Per Bale	Dollars	Dollars Per Bale
Assembly	1,128,498.20	8.860	1,258,507.62	9.881	-130,009.42	-1.021
Ginning	4,228,684.00	33.200	2,101,643.30	16.500	2,127,040.70	16.700
Gin-Warehouse Transportation	95,527.50	0.750	115,849.00	0.910	-20,321.50	-0.160
Warehousing	1,685,105.10	13.230	472,216.50	3.707	1,212,888.60	9.523
Merchandising	4,111,199.41	32.278	4,111,199.41	32.278	0.0	0.0
Total Cost	11,249,014,21	88.318	8,059,418.83	63.276	3,189,595.38	25.042

over 50 percent, and accounts for 67 percent of the total savings that could be realized through the optimum market organization. This reduction suggests significant economies of size exist in cotton ginning. Gins in the proposed organization are 42-bale per hour plants with a seasonal capacity of 32,344 bales, the largest and most modern operations technically feasible. Most gin plants in the present market structure have capacities under nine bales per hour. If the estimated production of 127,370 bales were distributed evenly, each gin would process only 3,266 bales. This contrasts sharply to the three gins that receive 32,344 bales and the fourth whose volume is 30,338 bales. Further, this contrasts to actual ginning records which indicate that since 1970 there have been only four times when any gin received more than 10,000 bales, the largest of which was 12,000 bales.

As a result of the proposed one warehouse market structure, as opposed to the present seven, gin to warehouse transportation cost increases \$.16 per bale. However, warehousing costs, reflecting economies of size in warehousing, decrease by \$9.52 per bale or more than 1.2 million dollars. Another factor leading to decreased warehouse cost is associated with the utilization of modern ginning equipment. Since all bales are compressed to universal density at the gin, cotton does not have to bear the expense of recompression.

Merchandising cost adds over 4.1 million dollars, \$32.28 per bale, to the cost of the farm to mill flow of cotton produced in the Altus study area. Since each study area was assumed to be a single resource point for mill areas, merchandising cost is the same for all market structures of a particular study area; and, thus does not affect market organization.

Suboptimum Market Organization. Only one alternative to the optimum market structure was generated in the solution process. This suboptimum consists of six gin plants located at five sites and is presented in Appendix Table 21 and contrasted to the optimum market structure in Figure 14. While there is only one gin site common to both solutions, the warehouse activity is identical. Like the optimum solution, a gin plant with a seasonal capacity of 32,344 is specified for Vinson (24); however, a plant size of 5,391 bales is also specified. This small plant operates at 63 percent of capacity whereas all other gins process at 100 percent. The largest capacity gins are specified for Frederick (5) and Martha (16).

Aside from locational differences, the primary difference between the two solutions is gin plant size. The existence of a small gin at Vinson was discussed. The two remaining plants are a 16,172 bale capacity plant at Gotebo (8) and one located at Headrick (15) with a seasonal capacity of 10,781 bales. These represent 21-bale per hour and 14-bale per hour plants, respectively. Economies of size are evident in the selection of gin plants; however, they are not as predominant as in the optimum market organization.

The functional value of this alternative, in excess of 8.2 million dollars ($64.48 per bale), is presented by major activity in Table 40. The cost of the alternative structure is $1.20 per bale greater than that of the optimum. Ginning and gin-warehouse transportation costs exceed those of the minimum cost solution; however, the difference in the transportation cost is only $.04 per bale. Ginning cost differs by almost $172,000 and assembly cost is $23,201 less than that of the minimum cost solution. On a per bale basis ginning cost is $1.35

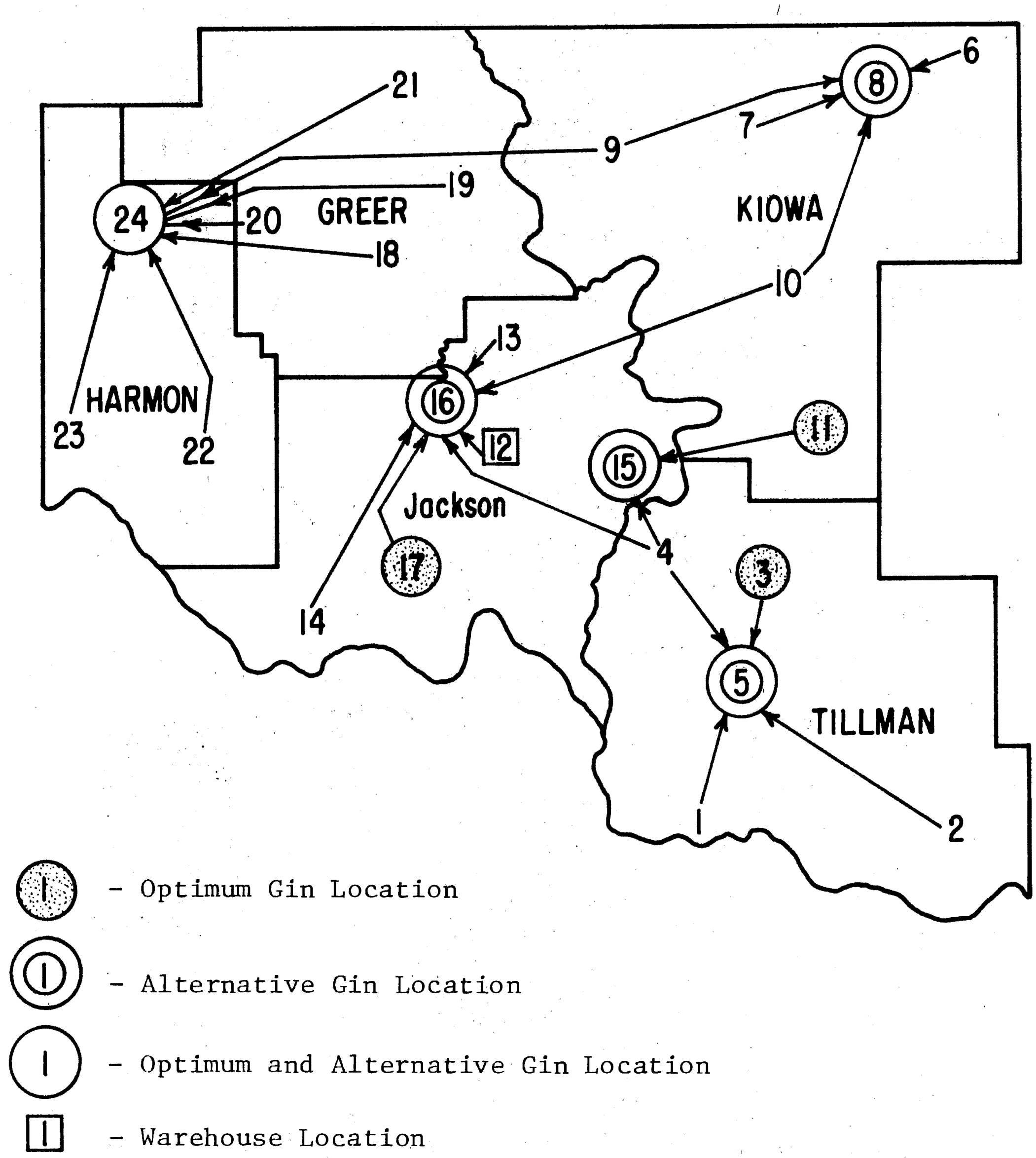


Figure 14. Ginning and Warehousing Activities in the Suboptimum Market Organization, Altus Study Area, 14 Week Ginning Season, 1974

Table 40. Functional Value of the Suboptimum Market Organization by Major Activity, 14 Week Ginning Season, Altus Study Area, 1974

Activity	Cost	
	Dollars	Dollars Per Bale
Assembly	1,235,226.85	9.698
Ginning	2,273,043.33	17.846
Gin-Warehouse Transportation	120,970.25	0.950
Warehousing	472,216.50	3.707
Merchandising	4,111,199.41	32.378
Total Cost	8,212,656.34	64.479

greater than the optimum and assembly cost is $.18 less.

32 Week Ginning Season

The adoption of new practices is a necessary industry adjustment if the present 14 week ginning season is extended. Lengthening the ginning season requires seed cotton storage and alters lint storage requirements. The industry organization discussed here, like the 14 week season, specifies the use of modern ginning equipment and the adoption of new ginning techniques such as automatic unloading, sampling and bale packaging as well as universal density compression at the gin.

Given the adoption of this extended ginning season, the optimum market organization includes gin plants at Manitou (3) and Reed (20), with warehouse facilities at Frederick (5) and Mangum (18). Both gin plants have a seasonal capacity of 64,688 bales. The Manitou plant processes at a rate equal to its capacity while the Reed plant gins 62,682 bales. Farm to gin flows and warehouse locations are presented in Figure 15 and Table 41. This solution may be compared with the present system of 39 gins and seven warehouses (Figure 12) and with the four gin plants and one warehouse minimum cost solution of the 14 week ginning system (Figure 13 and Table 37). The optimum market structure of both ginning seasons indicates a gin plant will be located at Manitou. Further, these are 42-bale per hour plants. However, these are the only similarities of the two market structures except for a portion of the Manitou plant market area. The market areas for each of the plant locations are well defined and only one production source, Gotebo, splits seed cotton between gin sites. The Mangum warehouse draws its resource from the Reed ginning facility while the Frederick

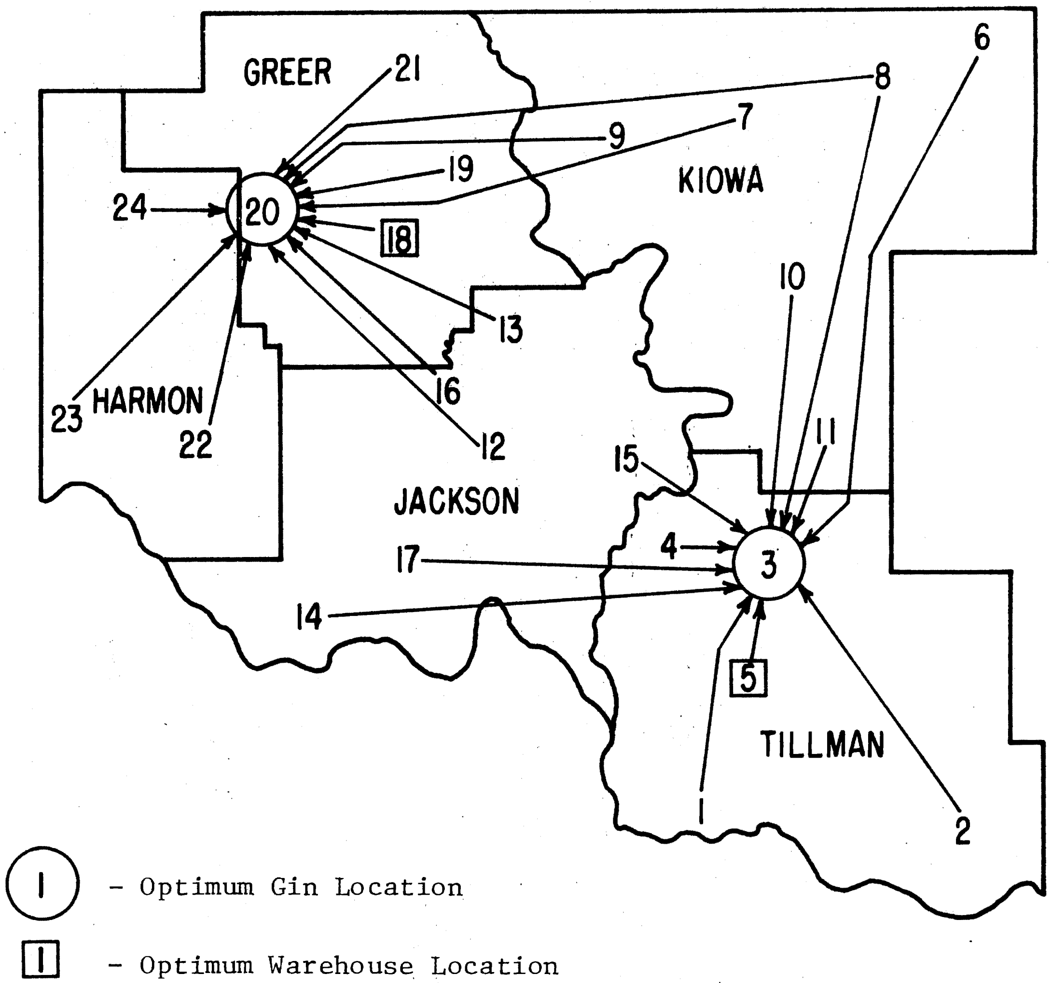


Figure 15. Ginning and Warehousing Activities in the Optimum Market Organization, Altus Study Area, 32 Week Ginning Season, 1974

Table 41. Ginning and Warehousing Activities in the Optimum Market Organization, Altus Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
3-Manitou	64,688	64,688	1-Davidson, 2-Grandfield, 3-Manitou, 4-Tipton, 5-Frederick, 6-Mt. View, 8-Gotebo (106), 10-Roosevelt, 11-Snyder, 14-Eldorado, 15-Headrick, 17-Olustee
20-Reed	64,688	62,682	7-Hobart, 8-Gotebo (3,831), 9-Lone Wolf, 12-Altus, 13-Blair, 16-Martha, 18-Mangum, 19-Granite, 20-Reed, 21-Willow, 22-Gould, 23-Hollis, 24-Vinson
		Warehouses:	
5-Frederick	24,795	64,688	5-Manitou
18-Mangum	24,027	62,682	20-Reed

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

warehouse draws from Manitou.

The cost associated with this optimum market organization is $7,647,515 and is given in Table 42 by major activity. This represents a per bale cost of $60.04. Excluding the predetermined merchandising cost of $33.28 per bale, the major cost activites are assembly and ginning. Ginning cost is $12.02 while assembly contributes $11.71 to the total per bale cost. Warehousing adds $3.25 and gin-warehouse transportation cost is nearly $.70 per bale.

The annual opportunity cost of not achieving this long run optimum, both on a per bale basis and as a total cost, for producers in the Altus area is also given in Table 42. This opportunity cost amounts to $28.28 per bale or just over 3.6 million dollars. A total savings of 32 percent could be realized if this market organization were achieved. Major cost savings are in ginning, $21.09 per bale, and warehousing, $9.99 per bale, or in excess of 2.6 and 1.2 million dollars, respectively. This reflects a decrease in present costs of 64 percent in ginning and 75 percent for warehousing. This reduction in ginning cost points to the economies possible in high ginning capacity and the extended ginning season. Again, a portion of the reduction in warehouse cost is due to universal density compression at the gin plant, but a major share of the decrease can be attributed to increased warehouse utilization. The economies in warehousing are not as great as those of ginning since the capacities of the two warehouses are only slightly greater than the constrained minimum capacity. The remaining activity, gin to warehouse transportation, is $.05 per bale less than present cost. The optimum organization increases assembly cost by $2.85 per bale and thus reflects a 32 percent increase over present costs. As might be

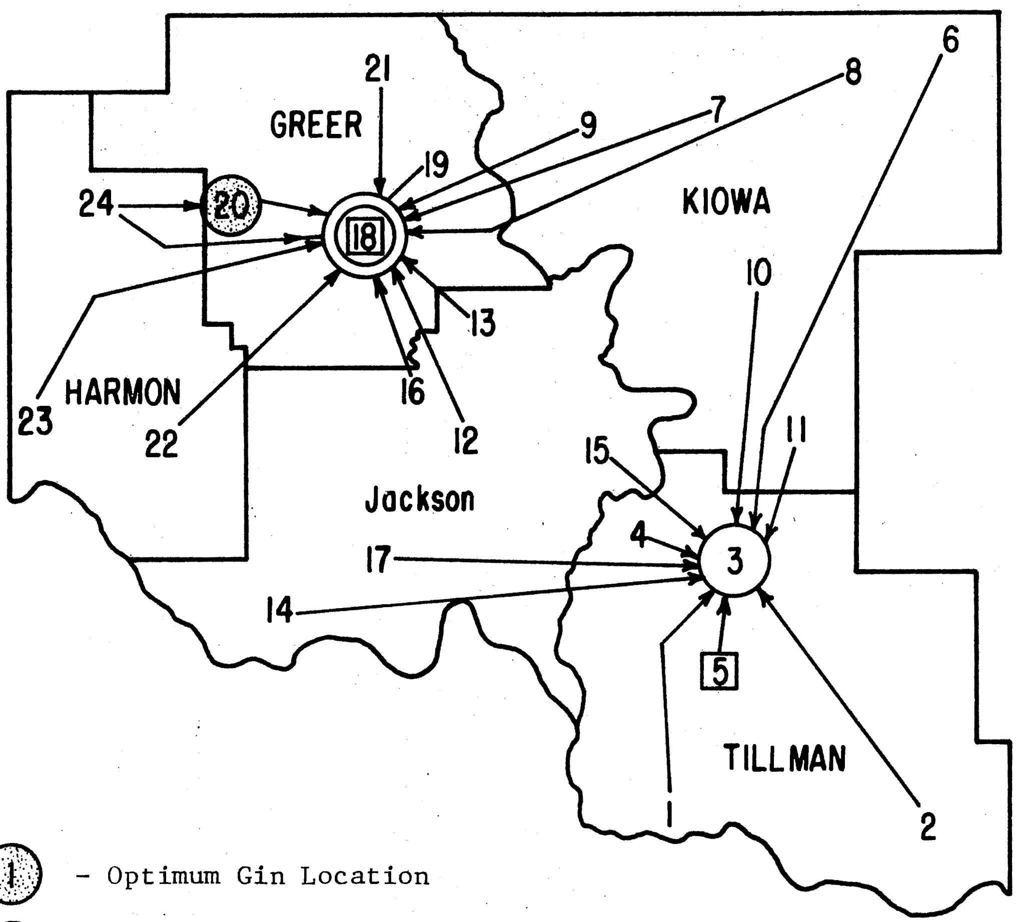
Table 42. Cotton Marketing Costs of the Present System and the Optimum Market Organization by Major Activity, 32 Week Ginning Season, Altus Study Area, 1974

Activity	Present Market Organization		Optimum Market Organization		Savings	
	Dollars	Dollars Per Bale	Dollars	Dollars Per Bale	Dollars	Dollars Per Bale
Assembly	1,128,498.20	8.860	1,491,559.50	11.710	-363,061.30	-2.850
Ginning	4,228,684.00	33.200	1,542,337.50	12.109	2,686,346.50	21.091
Gin-Warehouse Transportation	95,527.50	0.750	89,058.70	0.699	6,486.80	0.051
Warehousing	1,685,105.10	13.230	413,359.95	3.245	1,271,745.15	9.985
Merchandising	4,111,199.41	32.278	4,111,199.41	32.278	0.0	0.0
Total Cost	11,249,041.21	88.318	7,647,515.06	60.041	3,601,499.15	28.276

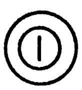
anticipated, this results indirectly from economies available in ginning.

Suboptimum Market Organizations. Five alternative suboptimum market structures were obtained in the optimum search process. The farm to gin flow of seed cotton, gin plant and warehouse plant locations for these solutions are shown in Figures 16-20. A more detailed presentation of farm to warehouse movements is given in Appendix Tables 22-26. These solutions are referred to as suboptimum market organization 1 through 5 and are presented in ascending order with respect to total marketing cost, i.e., alternative 1 represents a market structure of less total cost than alternative 2. These five alternatives suggest seven other sites for possible gin plants as well as Manitou (3), one of two locations included in the optimum market structure. However, only one additional warehouse location, Altus (12), alternative 5, is selected. Market areas for ginning and warehousing facilities are well defined in all cases.

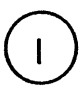
The functional values of these alternative market organizations are listed by primary activities in Table 43. The variation between the optimum structure and the least attractive, alternative 5, is \$1.26 per bale, or just under \$161,000 for the study area. The primary different between these alternatives and the optimum solution is in ginning cost. However, assembly, warehousing and the transportation activities show some variation. The lowest assembly cost of all solutions, optimum included, is in market organization 3, \$11.44 per bale. However, it also has the highest ginning cost, \$13.34 per bale. Market organization 4 is similar in these respects. While assembly cost varies among these solutions by as much as \$.38 per bale, ginning cost differs



- Optimum Gin Location



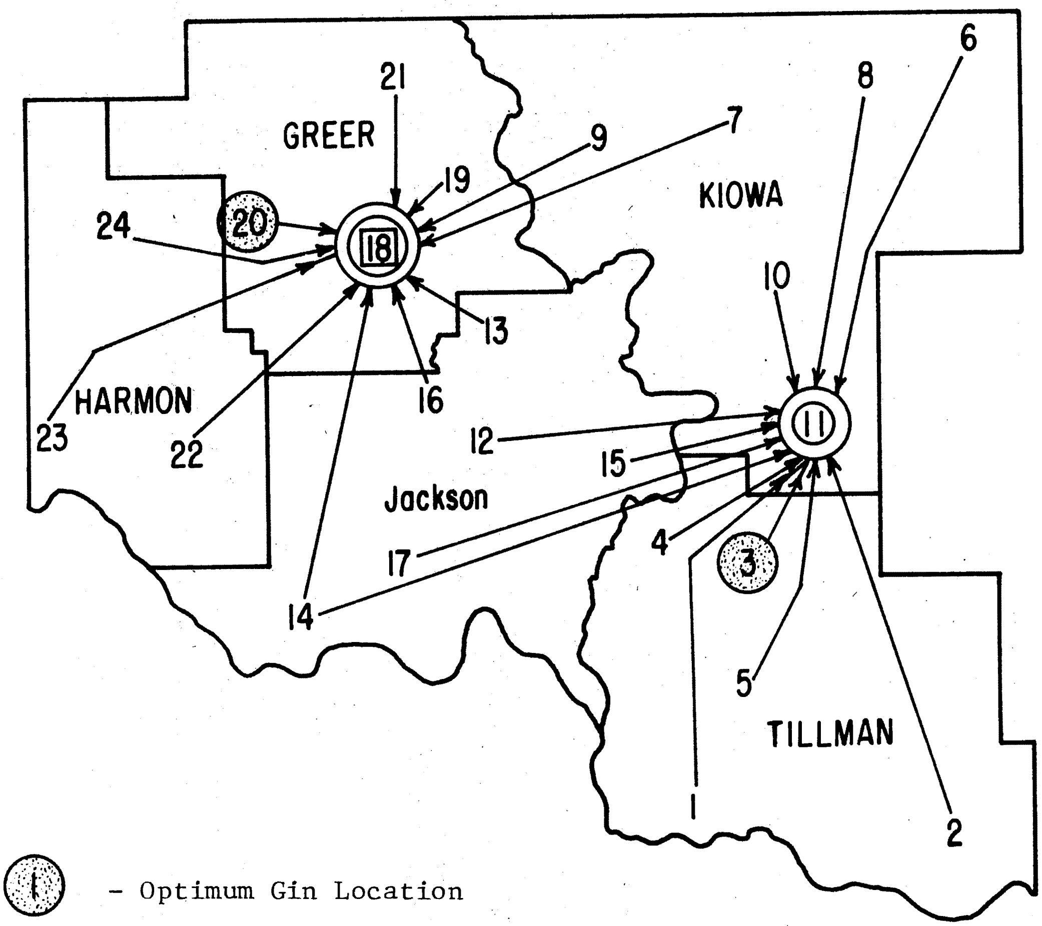
- Alternative Gin Location



- Optimum and Alternative Gin Location

- Warehouse Location

Figure 16. Ginning and Warehousing Activities in Suboptimum Market Organization 1, Altus Study Area, 32 Week Ginning Season, 1974



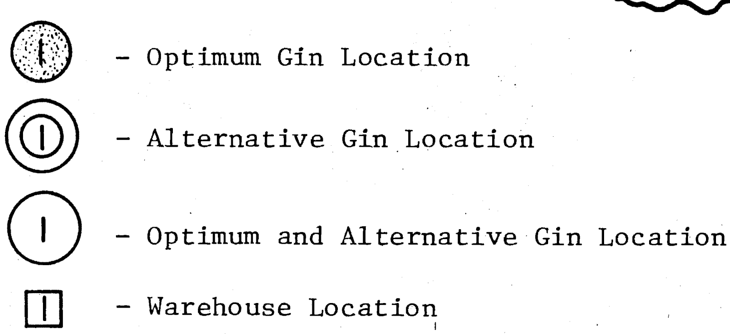


Figure 17. Ginning and Warehousing Activities in Suboptimum Market Organization 2, Altus Study Area, 32 Week Ginning Season, 1974

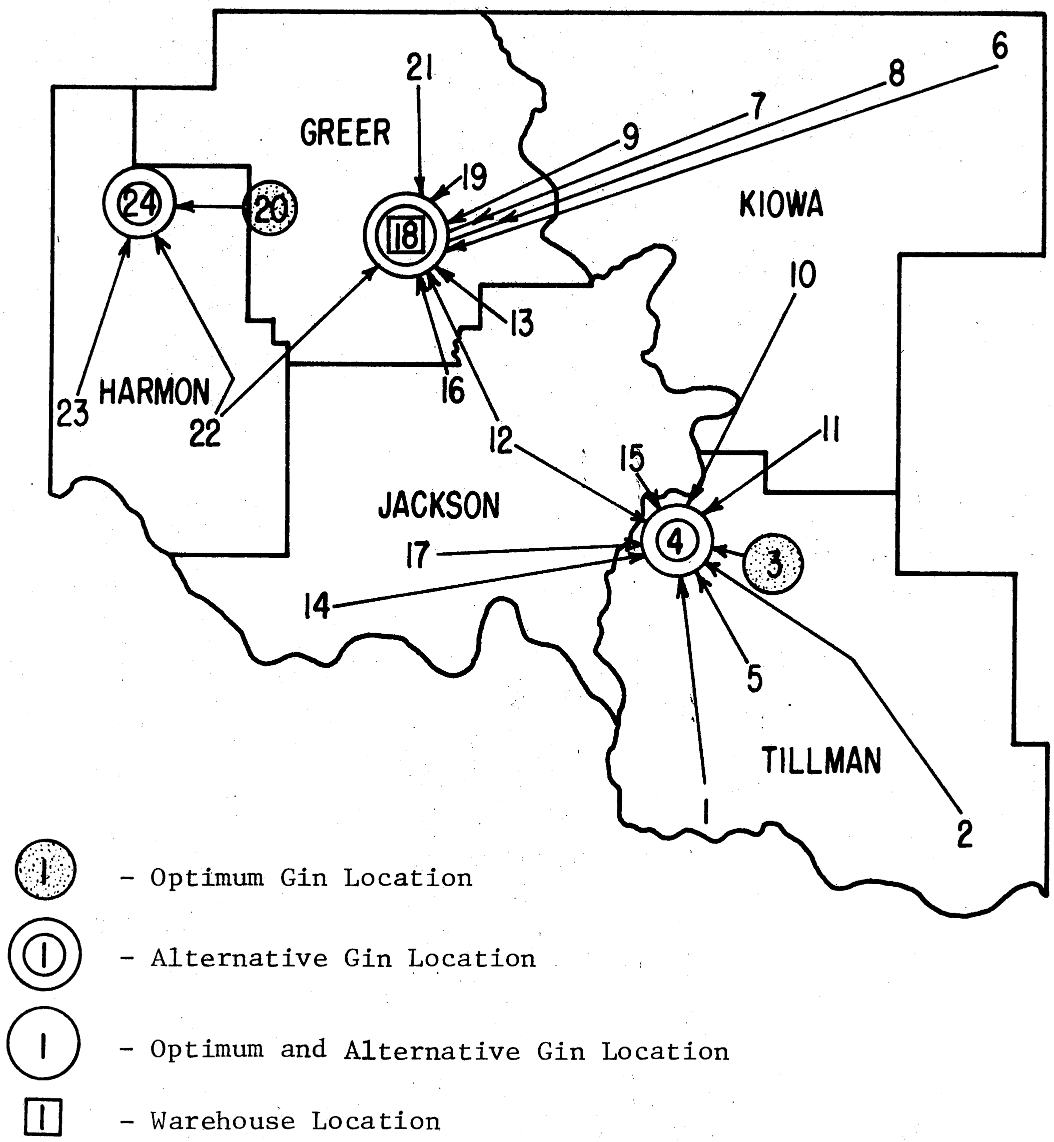
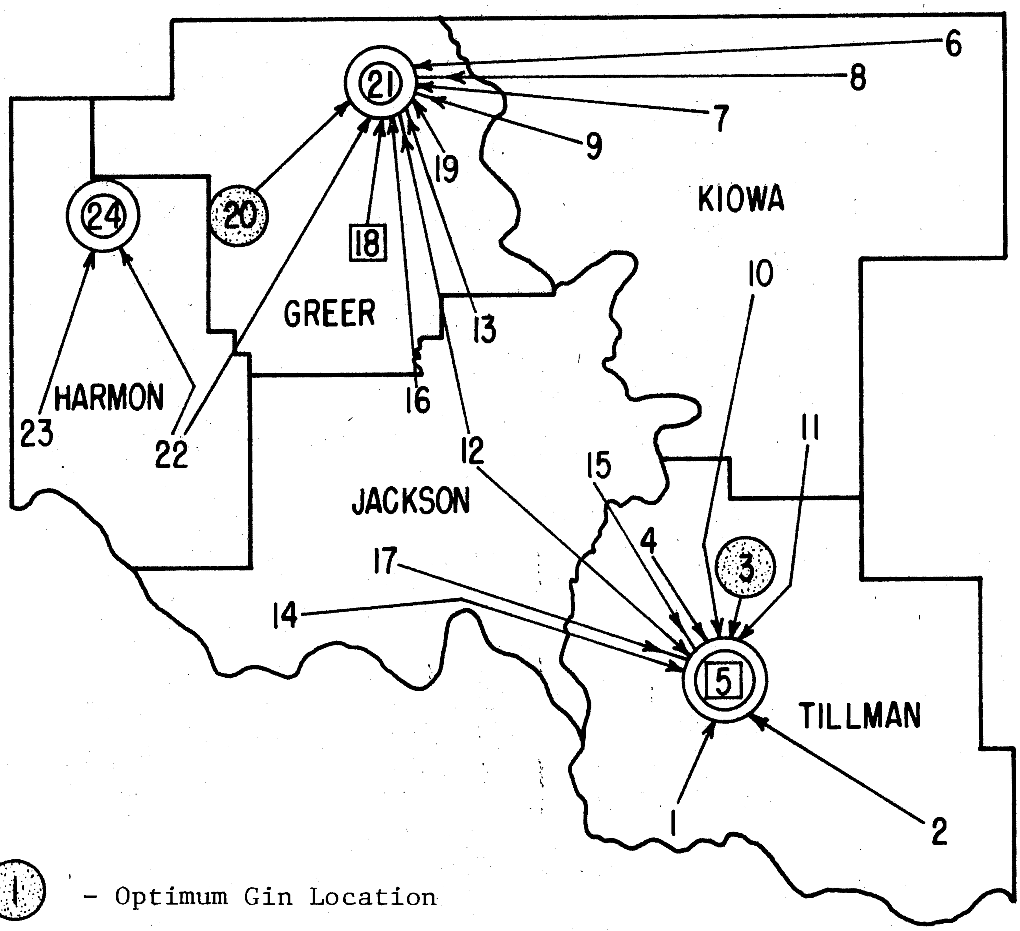


Figure 18. Ginning and Warehousing Activities in Suboptimum Market Organization 3, Altus Study Area, 32 Week Ginning Season, 1974



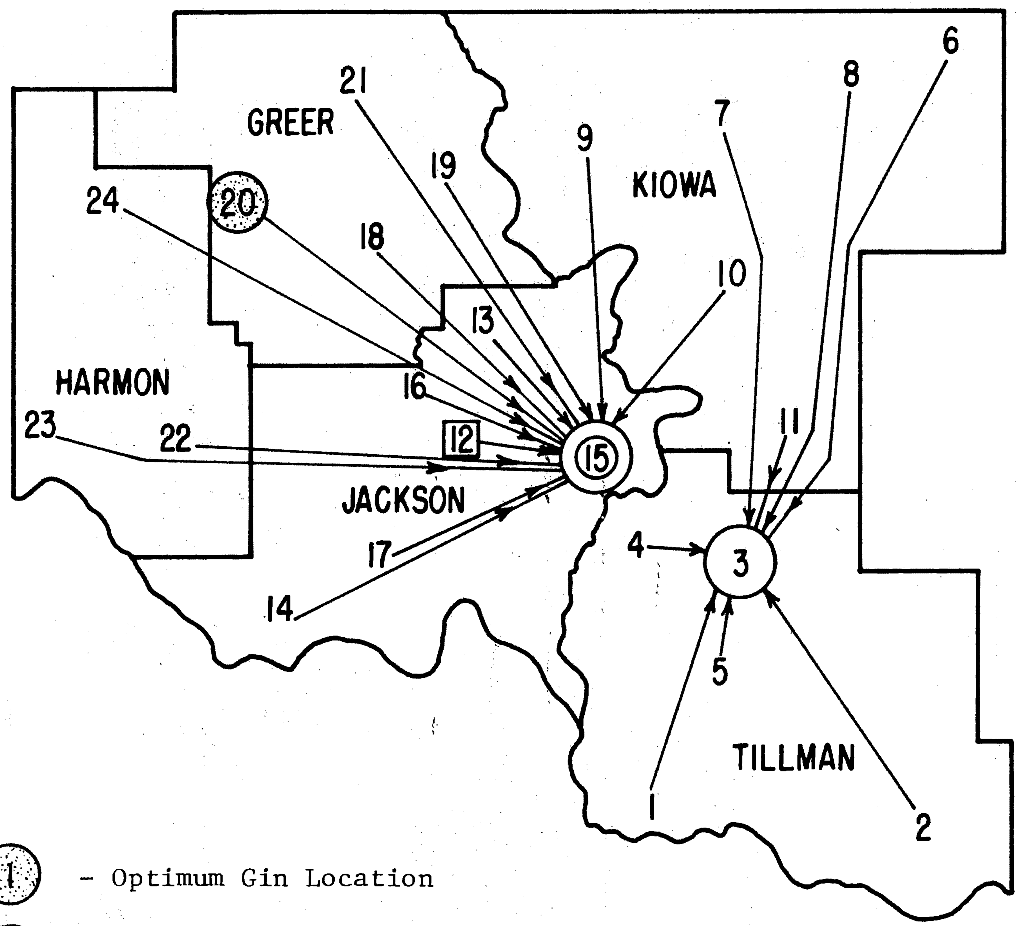
- Optimum Gin Location

- Alternative Gin Location

- Optimum and Alternative Gin Location

- Warehouse Location

Figure 19. Ginning and Warehousing Activities in Suboptimum Market Organization 4, Altus Study Area, 32 Week Ginning Season, 1974



- Optimum Gin Location

- Optimum and Alternative Gin Location

- Optimum and Alternative Gin Location

- Warehouse Location

Figure 20. Ginning and Warehousing Activities in Suboptimum Market Organization 5, Altus Study Area, 32 Week Ginning Season, 1974

Table 43. Functional Values of Suboptimum Market Organizations by Major Activity, 32 Week Ginning Season, Altus Study Area, 1974

Activity	Suboptimum Market Organization				
	1	2	3	4	5
			Dollars Per Bale		
Assembly	11.821	11.666	11.546	11.641	11.922
Ginning	12.109	13.160	13.339	13.339	13.160
Gin-Warehouse Transportation	0.650	0.851	0.917	0.722	0.813
Warehousing	3.245	3.132	3.132	3.245	3.132
Merchandising	32.278	32.278	32.278	32.278	32.278
Total Cost	60.103	61.087	61.212	61.225	61.305

by as much as $1.23 per bale. The transportation and warehousing activities vary by a maximum of $.27 and $.11 per bale, respectively.

Gin plant sites of the suboptimum solutions are generally near the two sites selected in the optimum market structure. In two cases, alternatives 1 and 5, Figures 16 and 20, the Manitou location (3) corresponds to the optimum. Other data associated with these two solutions are given in Appendix Tables 22 and 26. Three gin plant sites are specified in alternatives 3 and 4, Figures 18 and 19, respectively. A common location between these is Vinson (24). Further, a seasonal capacity of 21,562 bales for this site is part of these suboptimum market structures and represents a 14-bale per hour operation. A 28-and 42-bale per hour gin is also common in these two organizations.

Alternatives 2, 3 and 5, include only one warehouse, while the others specify two warehouses. As with gin plants, warehouse market areas are well defined. Warehouse sites in the various solutions are either Frederick (5) and Mangum (18); Altus (12); or Mangum.

Optimum Market Organizations of Both Ginning Seasons

The locations of processing facilities included in optimum market organizations for the 14 week and 32 week ginning seasons are compared in Figure 21. Manitou is depicted as part of both optimum structures and represents the only common processing site. Ginning economies are great enough that the minimum number of possible gin plants are included in both structures.

However, the inclusion of two warehouse sites in the longer ginning season operation indicates warehousing economies are not great enough to offset an increase in gin-warehouse transportation cost that

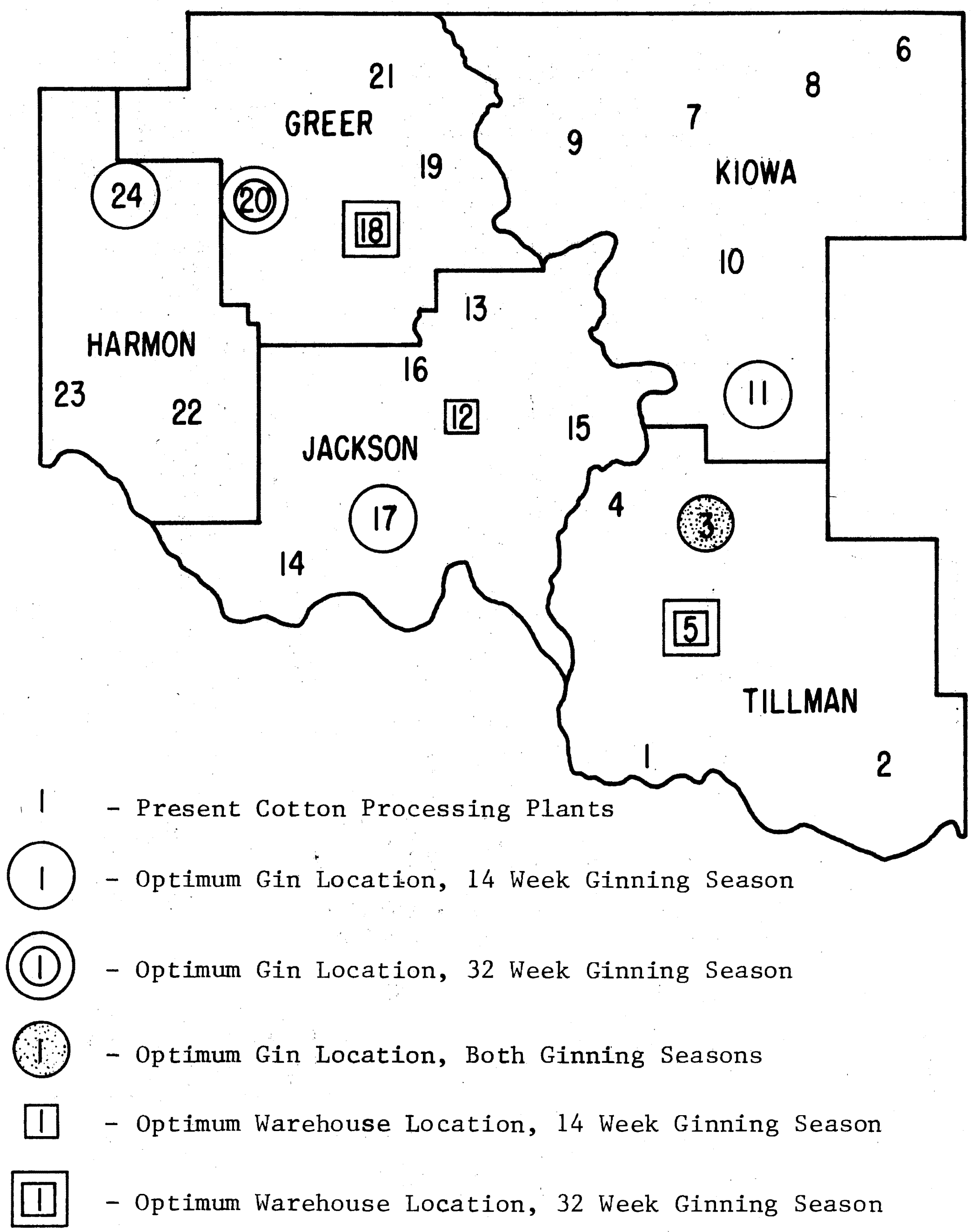


Figure 21. Ginning and Warehousing Activities of the 14 Week and 32 Week Ginning Season, Optimum Market Organizations, Altus Study Area, 1974

would occur if only one warehouse site were selected. Comparing the farm to mill transfer cost of each optimum structure, Tables 39 and 42, indicates the opportunity cost of achieving the 14 week optimum structure and not the 32 week organization is $3.34 per bale. This amounts to over $400,000 for the study area.

Abilene Study Area

The Abilene study area is a four county region located on the rolling plains of Texas. In 1974 there were 33 gins located at or near the 23 sites considered in the study. The warehousing sector included five sites and seven warehouses. Model specifications permitted Hamlin (5) and Sweetwater (18) to have two warehouses. The present gin and warehouse location pattern was used to represent the alternative sites considered in the study. These 23 gin plant locations and potential warehouse sites are spatially dispersed throughout cotton producing regions of the area and are shown in Figure 22.

The locations include sites at or near the following towns:

1. Rotan	9. Neinda	17. Nolan
2. Longworth	10. Hodges	18. Sweetwater
3. Roby	11. Stith	19. Abilene
4. Sylvester	12. Noodle	20. Merkel
5. Hamlin	13. Tuxedo	21. Trent
6. Anson	14. Corinth	22. Tuscola
7. Radium	15. Stamford	23. Lawn
8. Avoca	16. Roscoe	

The numbers correspond to the sites shown in Figure 22.

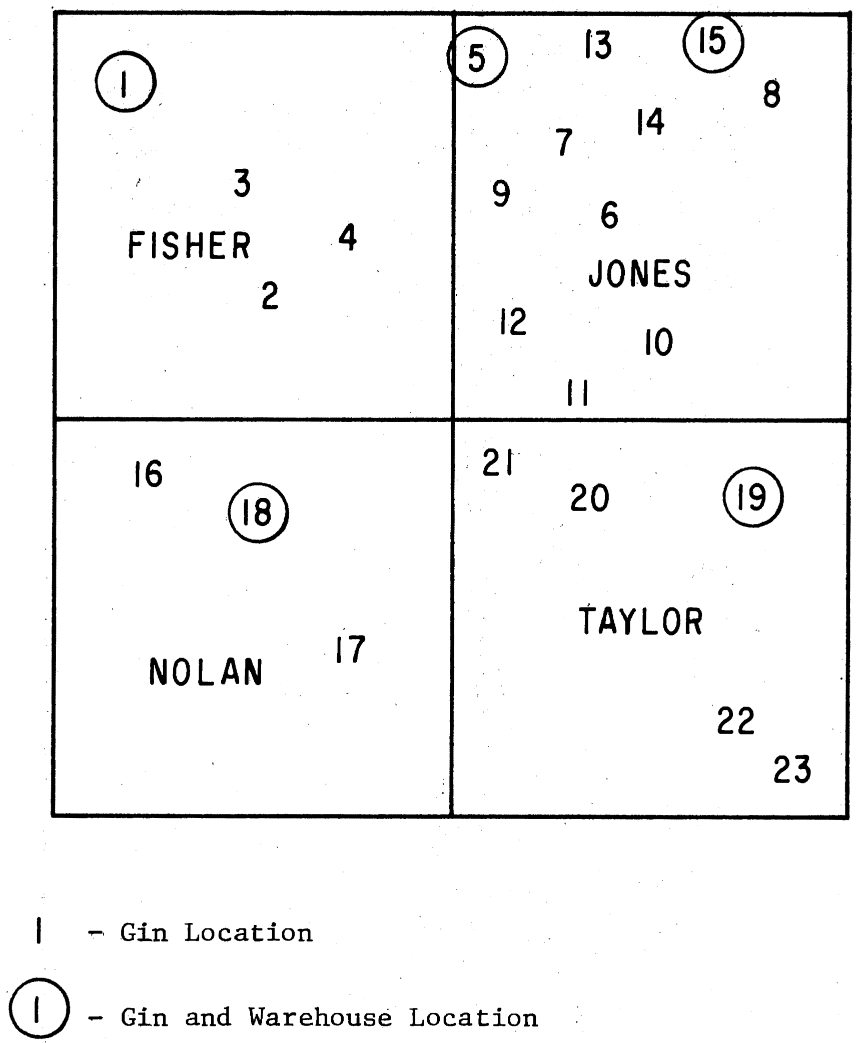


Figure 22. Ginning and Warehousing Activities of the 1974 Abilene Study Area Market Organization

14 Week Ginning Season

The optimum market structure for the 14 week ginning season includes gin plants of the maximum seasonal capacity at Roby (3), Anson (6), Neinda (9) and Sweetwater (18). Three of these plants operate at full capacity while the other, Sweetwater, processes 30,079 bales. The solution does not call for a gin site in Taylor County, an area that presently has five gins. However, given the high economies in ginning and county production of only 6,025 bales, this is not surprising. Warehouse facilities are located at Hamlin (5) and handle all bales produced in the study area. Warehouse capacity is 98,702 bales.

Gin and warehouse locations as well as farm to gin flows are listed in Table 44 and presented in Figure 23. Three farm production areas, Longworth (2), Sylvester (4) and Merkel (20), split their shipments between two ginning sites while the remaining 20 areas supply one plant site. Specific farm to gin shipments are presented in Table 44. Model specifications constrained mill demand to follow the historical patterns given in Table 38.

The total cost for marketing raw cotton as specified by the optimum market structure is $7,967,100, Table 45. This represents a cost of $62.68 per bale. This compares with the present system cost of $88.29 also given in Table 45. The opportunity cost of not achieving this optimum structure is therefore $25.62 per bale and amounts to over 3.2 million dollars for the study area. This is equivalent to a 29 percent decrease in conventional system cost.

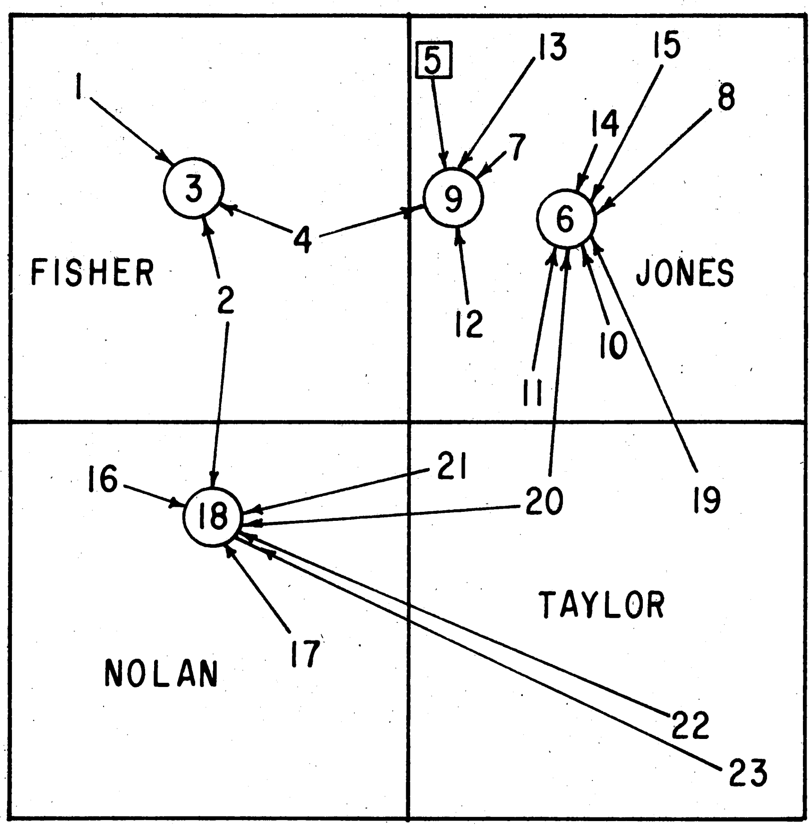
Such a market reorganization would increase assembly cost $.56 per bale or less than $71,000 for the area. This represents a 6 percent increase in cost. Costs associated with other functions decrease,

Table 44. Ginning and Warehousing Activities in the Optimum Market Organization, Abilene Study Area, 14 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
3-Roby	32,344	32,344	1-Rotan, 2-Longworth (7,916), 3-Roby, 4-Sylvester (3,410)
6-Anson	32,344	32,344	6-Anson, 8-Avoca, 10-Hodges, 11-Stith, 14-Corinth, 15-Stamford, 19-Abilene, 20-Merkel (845)
9-Neinda	32,344	32,344	4-Sylvester (7,099), 5-Hamlin, 7-Radium, 9-Neinda, 12-Noodle, 13-Tuxedo
18-Sweetwater	32,344	30,079	2-Longworth (2,593), 16-Roscoe, 17-Nolan, 18-Sweetwater, 20-Merkel (360), 21-Trent, 22-Tuscola, 23-Lawn
		Warehouses:	
5-Hamlin	98,702	127,111	3-Roby, 6-Anson, 9-Neinda, 18-Sweetwater

[a] Location is given by code number and town name

[b] Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses



1 - Optimum Gin Location

1 - Optimum Warehouse Location

Figure 23. Ginning and Warehousing Activities in the Optimum Market Organization, Abilene Study Area, 14 Week Ginning Season, 1974

Table 45. Cotton Marketing Costs of the Present System and the Optimum Market Organization by Major Activity, 14 Week Ginning Season, Abilene Study Area, 1974

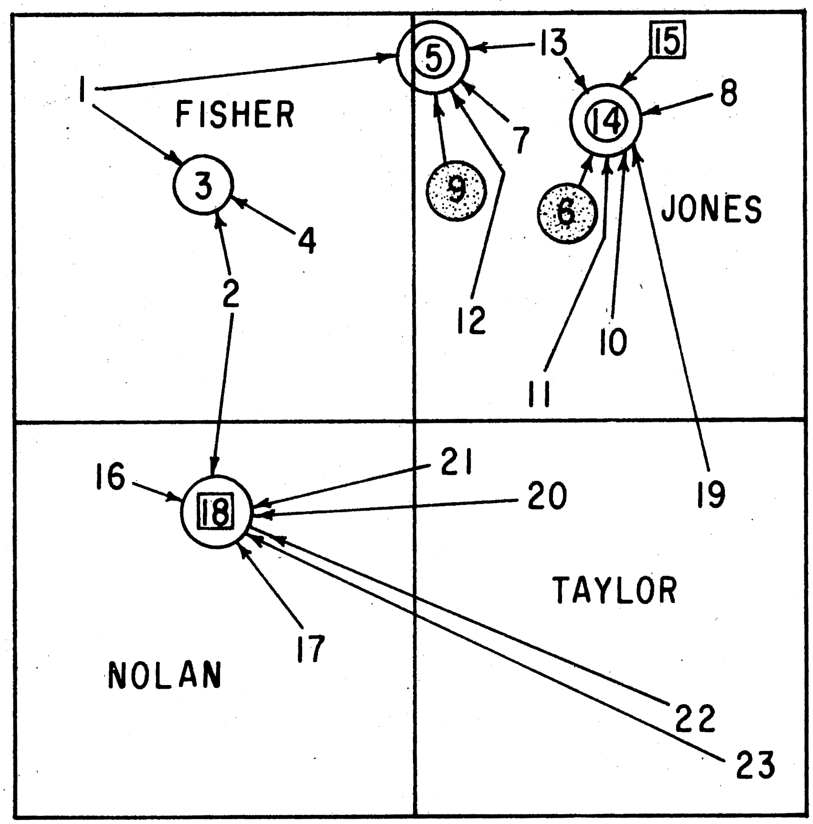
Activity	Present Market Organization		Optimum Market Organization		Savings	
	Dollars	Dollars Per Bale	Dollars	Dollars Per Bale	Dollars	Dollars Per Bale
Assembly	1,126,203.46	8.860	1,197,045.41	9.417	-70,841.95	-0.557
Ginning	4,220,085.20	33.200	2,099,369.60	16.516	2,120,715.60	16.684
Gin-Warehouse Transportation	95,333.25	0.750	99,618.60	0.784	-4,285.35	-0.034
Warehousing	1,681,678.53	13.230	471,285.66	3.708	1,210,392.87	9.522
Merchandising	4,099,781.13	32.254	4,099,781.13	32.254	0.0	0.0
Total Cost	11,223,081.57	88.294	7,967,100.40	62.679	3,255,981.17	25.615

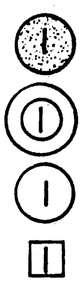
except for gin-warehouse transportation which increases by \$.03 per bale. The reduction in ginning cost of over 2.1 million dollars, \$16.68 per bale, accounts for 50 percent of the savings. Ginning cost is reduced from \$33.20 to \$16.52 per bale. Further, a major decrease is indicated in warehousing cost, from \$13.23 to \$3.71 per bale. This reduction (\$9.52) amounts to over 1.2 million dollars for the area and reflects a decline from conventional cost of 72 percent. Merchandising cost adds \$32.25 per bale and accounts for over 4 million dollars of the minimum cost solution. However, this cost is not a factor in determining the optimum market structure.

The decrease in ginning cost represents the high economies of size available in the modern high capacity gins. Warehousing economies are also evident in that gin plants located at Roby and Sweetwater bypass closer potential warehouse sites in favor of Hamlin. This optimum market structure increases the cost of the gin-warehouse flow by some \$4,000 (\$.03 per bale), but as indicated, decreases warehousing cost by more than 1.2 million dollars.

Suboptimum Market Organizations. Three suboptimum market organizations with integer solutions were found and are outlined in Appendix Tables 27-29. Figures 24-26 present these solutions in contrast to the optimum market structure. Farm to gin flows are also presented in these Figures while farm to warehouse flows are included in the Appendix Tables.

The values of these solutions are given in Table 46. Suboptimum market organization 1 is less than \$.10 per bale greater than the minimum cost solution. This alternative specified four 42-bale per hour gins with two of the plant sites, Roby (3) and Sweetwater (18),





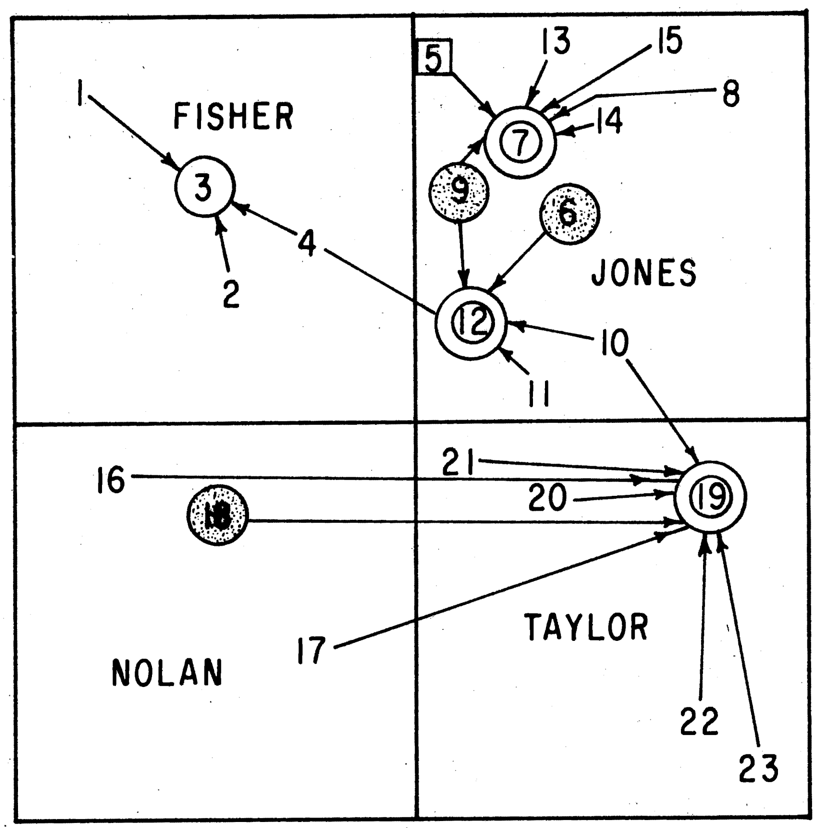
- Optimum Gin Location

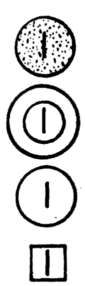
- Alternative Gin Location

- Optimum and Alternative Gin Location

- Warehouse Location

Figure 24. Ginning and Warehousing Activities in Suboptimum Market Organization 1, Abilene Study Area, 14 Week Ginning Season, 1974





- Optimum Gin Location

- Alternative Gin Location

- Optimum and Alternative Gin Location

- Warehouse Location

Figure 25. Ginning and Warehousing Activities in Suboptimum Market Organization 2, Abilene Study Area, 14 Week Ginning Season, 1974

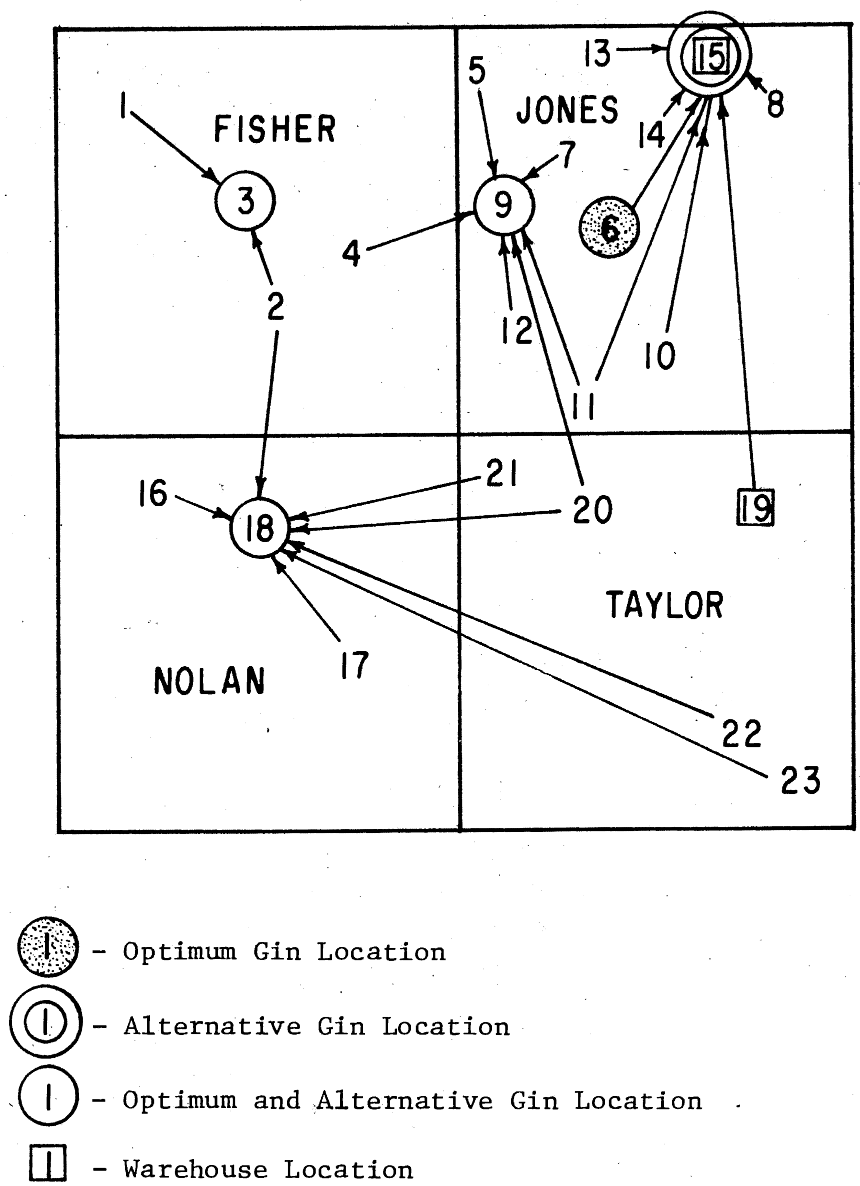


Figure 26. Ginning and Warehousing Activities in Suboptimum Market Organization 3, Abilene Study Area, 14 Week Ginning Season, 1974

Table 46. Functional Values of Suboptimum Market Organizations by Major Activity, 14 Week Ginning Season, Abilene Study Area, 1974

Activity	Suboptimum Market Organization		
	1	2	3
		Dollars Per Bale	
Assembly	9.422	9.645	9.456
Ginning	16.516	16.516	17.140
Gin-Warehouse Transportation	0.760	0.807	0.735
Warehousing	3.821	3.708	3.821
Merchandising	32.254	32.254	32.254
Total Cost	62.773	62.930	63.405[a]

[a]Total cost does not add due to rounding

identical to the optimum market structure. This alternative, Figure 24, has the other gin sites near the remaining optimum locations. In fact, the variation in assembly cost is less than \$.01 per bale. Gin-warehouse transportation cost in the optimum structure is greater by \$.02, reflecting the selection of warehouse locations. However, warehouse economies are not fully utilized in this organization as this cost is \$.11 per bale greater than that of the optimum structure. Therefore, the primary distinction between the two solutions may be explained in terms of economies of size available in warehousing.

The distinguishing feature of alternative 2, Figure 25 and Appendix Table 28, is the location of gin sites. While three sites are at or near optimum locations, one, Abilene (19) is in an area of low production. This results in an increase in assembly cost of nearly \$.30 per bale. Warehousing cost, as well as location, is the same as that of the optimum. Gin-warehouse transportation is some \$.02 per bale higher for this alternative market structure.

The solution of alternative 3 includes three optimum gin locations, Figure 26 and Appendix Table 29. However, one location, Roby (3), has a 35-rather than a 42-bale per hour plant. The fourth site, Stamford (15), has two gin plants; these have the smallest and largest capacity ratings. Assembly and gin-warehouse transportation vary slightly with the optimum. However ginning cost increases to \$17.14 per bale, \$.62 greater than optimum.

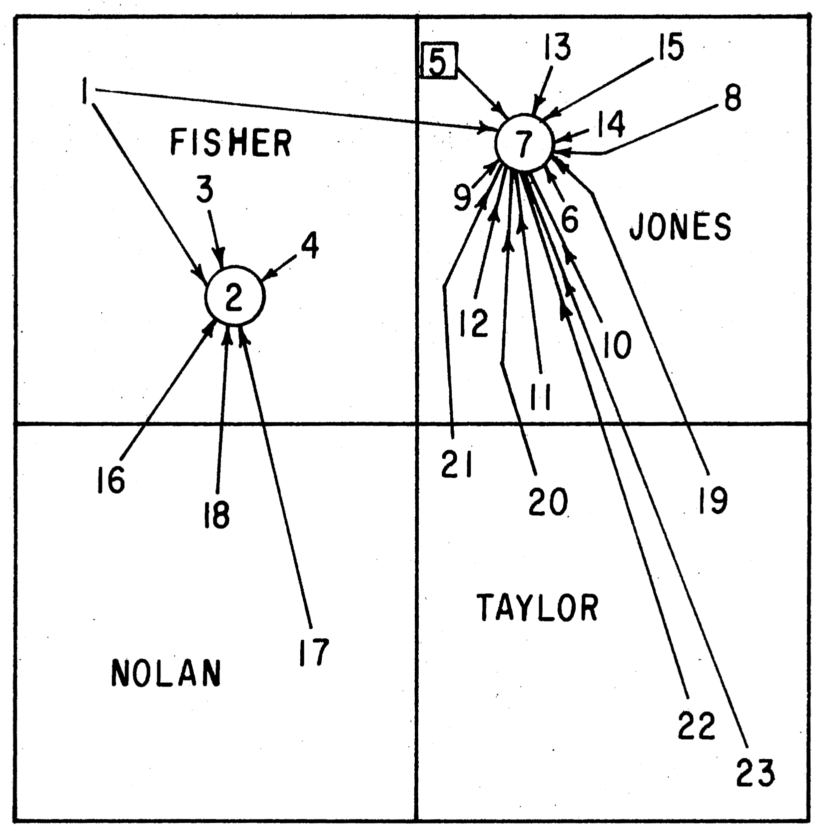
Two warehouse locations, neither corresponding to the optimum market structure, are a part of alternative 3. An increase in warehouse cost results and is not totally offset by the decrease in gin-warehouse cost. The difference in total cost between this least attractive organization and the optimum market structure is \$.73 per bale and represents over \$92,000 for the study area.

32 Week Ginning Season

The results indicate ginning economies to be so great that by extending the ginning season only two gin plants are required to process the area's 127,111 bales. As might be anticipated these plant sites are near regions of high farm production density. These plant sites, Longworth (2) and Radium (7), along with farm-gin movements are depicted in Figure 27. Plant capacities, processing levels and farm to warehouse movements may be found in Table 47. The minimum cost warehouse site is Hamlin (5). The relationship of capacity to volume allows a 48,722 bale warehouse to handle all of the study area's production.

Gin plant market areas depict the right half of the study area as the resource supplier for Radium with production in the left half going to Longworth. An exception to this flow exists in the Rotan (1) assembly region as both ginning sites draw seed cotton from the area. However, 92 percent of the Rotan farm production flows to the gin plant located at Longworth.

This market structure allows Abilene study area cotton to be marketed for approximately 7.5 million dollars. This is equivalent to \$59.40 per bale, Table 48. Potential cost reduction over the present market structure is \$28.90 per bale or almost 3.7 million dollars for the four county area. This savings, delineated by major activity, along with the optimum and present market structure costs, also in Table 48, represent 33 percent of the present cost.



(1) - Optimum Gin Location

[1] - Optimum Warehouse Location

Figure 27. Ginning and Warehousing Activities in the Optimum Market Organization, Abilene Study Area, 32 Week Ginning Season, 1974

Table 47. Ginning and Warehousing Activities in the Optimum Market Organization, Abilene Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
2-Longworth	64,688	64,688	1-Rotan (9,650), 2-Longworth, 3-Roby, 4-Sylvester, 16-Roscoe, 17-Nolan, 18-Sweetwater
7-Radium	64,688	62,423	1-Rotan (859), 5-Hamlin, 6-Anson, 7-Radium, 8-Avoca, 9-Neinda, 10-Hodges, 11-Stith, 12-Noodle, 13-Tuxedo, 14-Corinth, 15-Stamford, 19-Abilene, 20-Merkel, 21-Trent, 22-Tuscola, 23-Lawn
		Warehouses:	
5-Hamlin	48,722	127,111	2-Longworth, 7-Radium

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Table 48. Cotton Marketing Costs of the Present System and the Optimum Market Organization by Major Activity, 32 Week Ginning Season, Abilene Study Area, 1974

Activity	Present Market Organization		Optimum Market Organization		Savings	
	Dollars	Dollars Per Bale	Dollars	Dollars Per Bale	Dollars	Dollars Per Bale
Assembly	1,126,302.46	8.860	1,422,725.03	11.193	-296,521.57	-2.333
Ginning	4,220,085.20	33.200	1,540,278.45	12.117	2,679,806.75	21.083
Gin-Warehouse Transportation	95,333.25	0.750	89,090.95	0.701	6,242.30	0.049
Warehousing	1,681,678.53	13.230	398,087.18	3.132	1,283,591.35	10.098
Merchandising	4,099,781.13	32.254	4,099,781.13	32.254	0.0	0.0
Total Cost	11,223,081.57	88.294	7,549,962.74	59.397	3,673,118.83	28.897

The difference between assembly and ginning costs is $24.34 per bale in the conventional structure as compared with only $.92 in the optimum, again reflecting ginning economies. By incurring an additional $2.33 per bale assembly cost, producers, could reduce their ginning cost by $21.08, a 64 percent decrease. Total assembly cost increases by nearly $300,000 while ginning cost falls by over 2.7 million dollars, $33.20 per bale, and is reduced to $12.12 per bale. The increase in assembly cost, from $8.86 to $11.19 per bale, is 26 percent.

A small decrease, less than $.05 per bale, in gin-warehouse transportation is also available in the optimum market structure. Warehouse cost decreases by $10.10 to $3.13 per bale, 1.3 million dollars for the study area. Therefore ginning and warehousing account for nearly 4 million dollars of the 3.7 million dollar net reduction.

Suboptimum Market Organizations. Four alternatives to the optimum market structure are presented in Figures 28-31 and further detailed in Appendix Tables 30-33. These solutions, like the optimum, specify two spatially separated 42-bale per hour gins. Also identical with the optimum structure, is warehouse location, Hamlin (5), in alternatives 1 and 3. Therefore, warehouse capacity and volume are identical to those in the optimum market organization.

Alternative 1 includes the optimum Radium (7) gin plant site, but calls for the other plant to be at Roby (3). Therefore, the direction of farm-gin flow of seed cotton is generally the same. More specifically, the flow pattern for Radium is very nearly identical to the optimum.

The second alternative, Figure 29, also has Radium as a ginning site but calls for locating the other site outside of Fisher County.

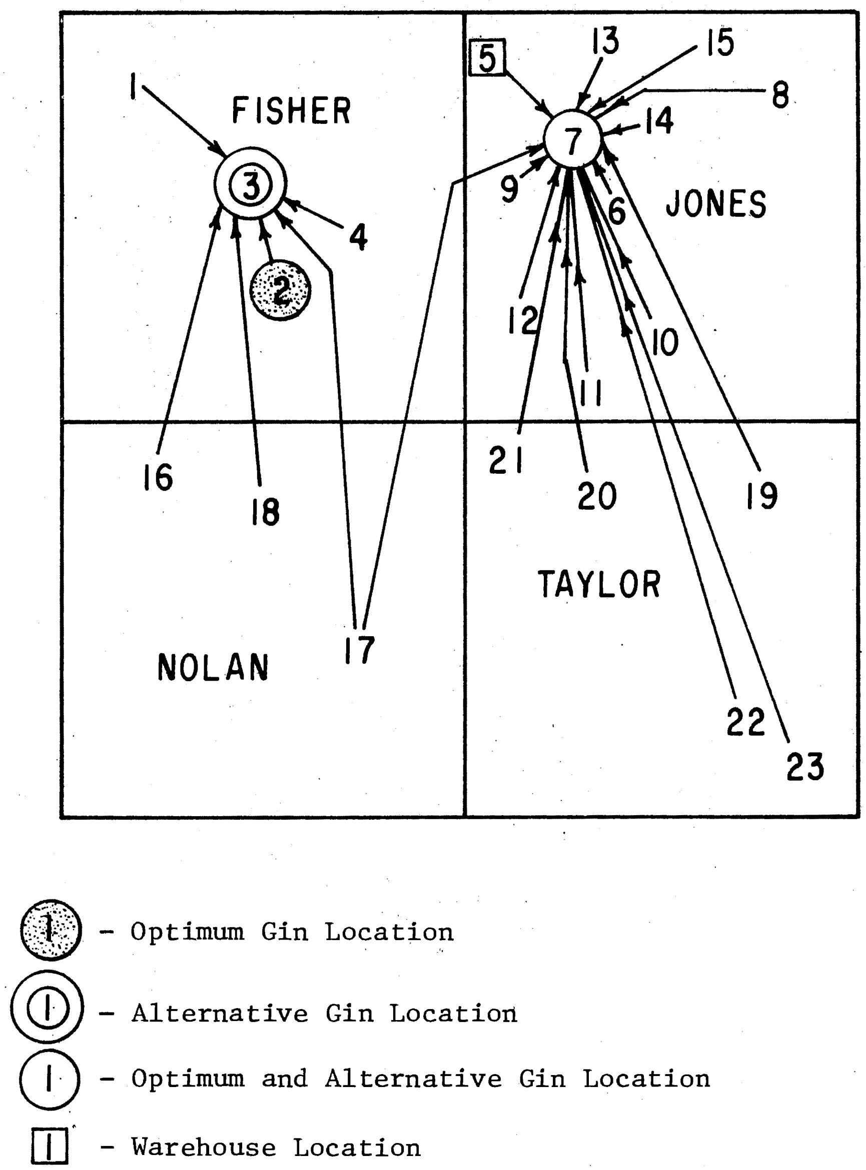
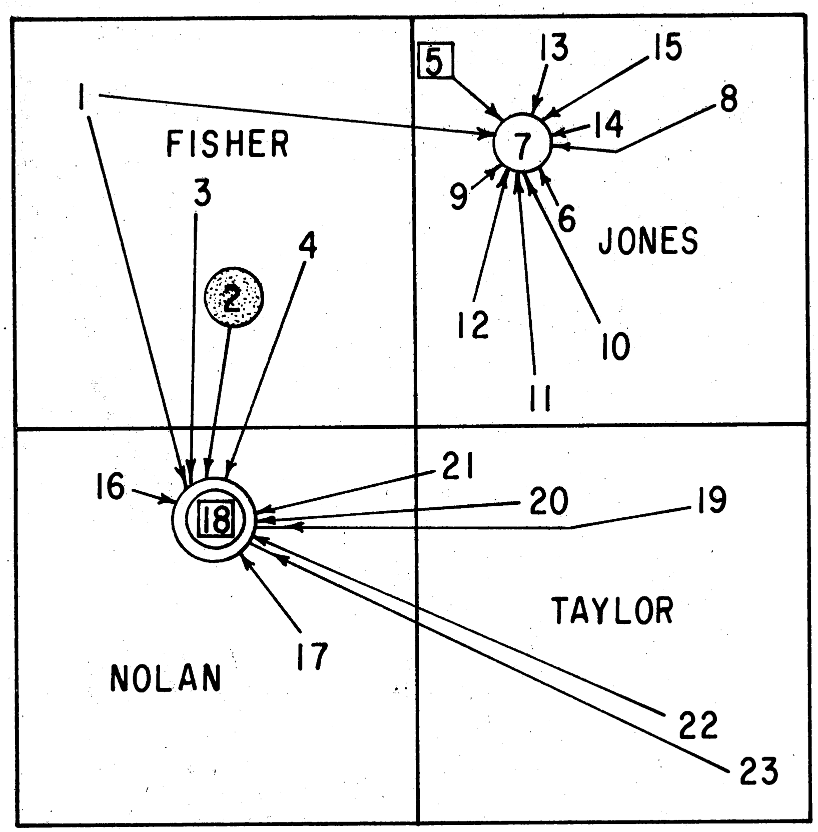


Figure 28. Ginning and Warehousing Activities in Suboptimum Market Organization 1, Abilene Study Area, 32 Week Ginning Season, 1974



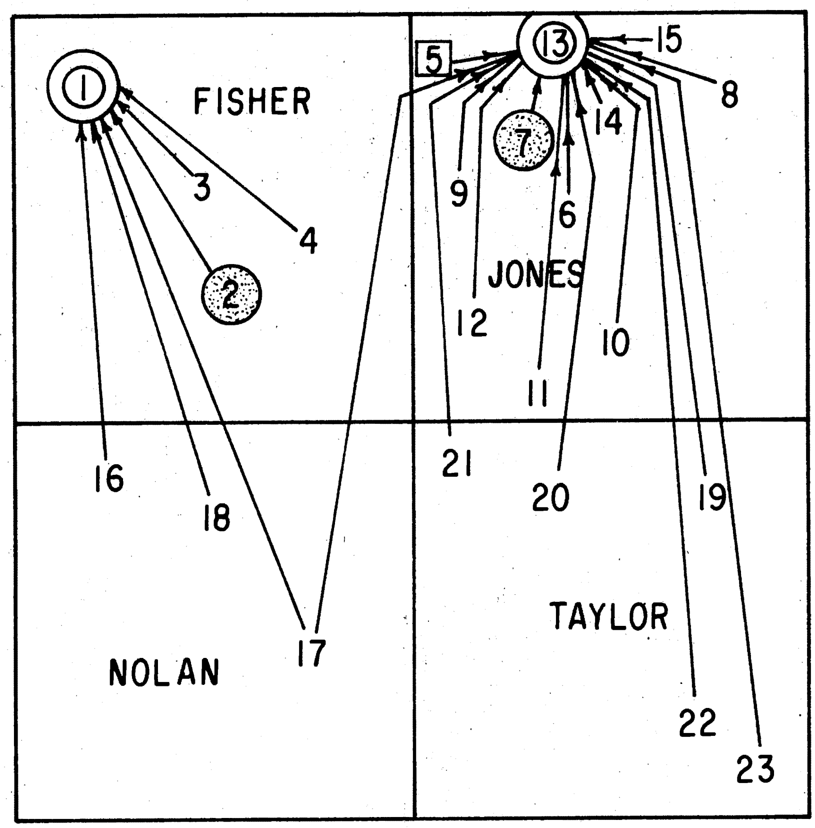
- Optimum Gin Location

- Alternative Gin Location

- Optimum and Alternative Gin Location

- Warehouse Location

Figure 29. Ginning and Warehousing Activities in Suboptimum Market Organization 2, Abilene Study Area, 32 Week Ginning Steason, 1974



- Optimum Gin Location

- Alternative Gin Location

- Optimum and Alternative Gin Location

- Warehouse Location

Figure 30. Ginning and Warehousing Activities in Suboptimum Market Organization 3, Abilene Study Area, 32 Week Ginning Season, 1974

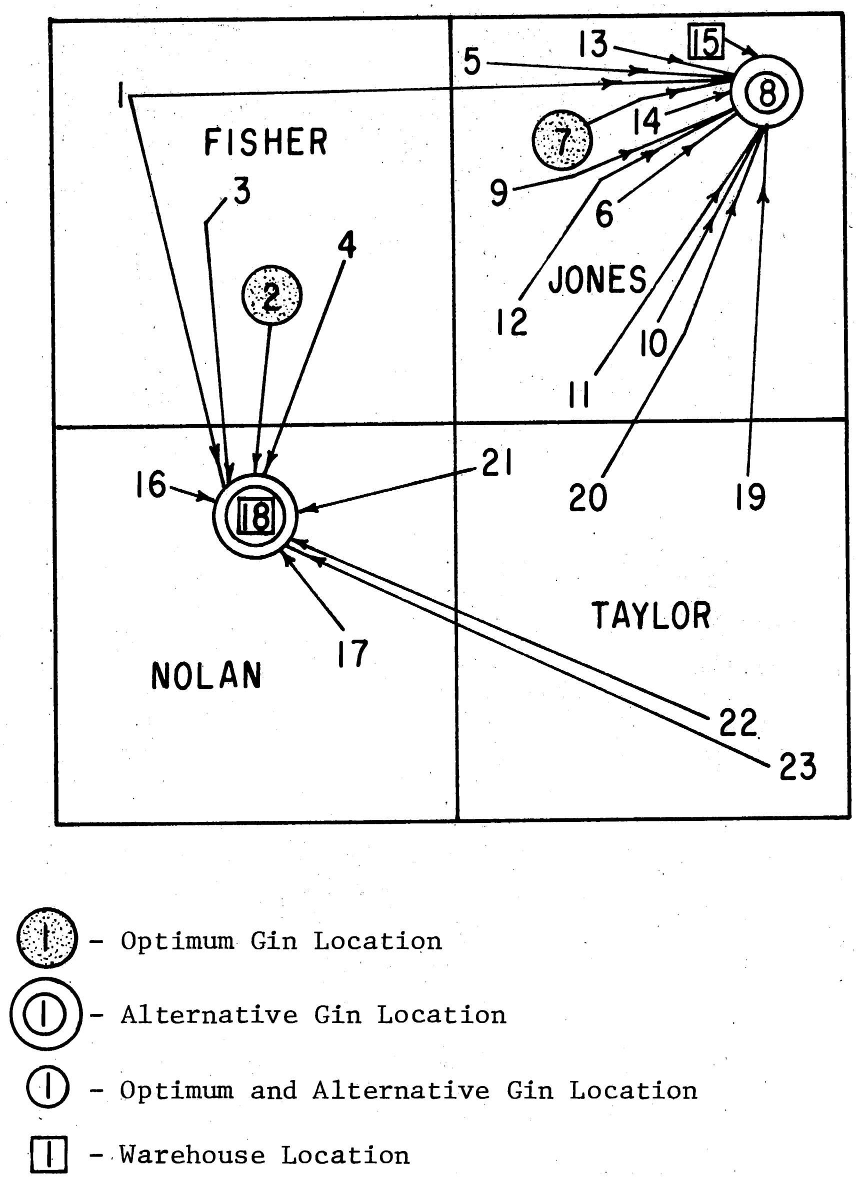


Figure 31. Ginning and Warehousing Activities in Suboptimum Market Organization 4, Abilene Study Area, 32 Week Ginning Season, 1974

Sweetwater (18) is selected as the location for this second gin plant. Hamlin and Sweetwater are included as warehouse sites.

Suboptimum market organization 3 has ginning sites in Fisher and Jones Counties; however, neither site corresponds with those of the optimum. But like the optimum, a warehouse is located at Hamlin. The gin sites are Rotan (1) and Tuxedo (13). As is the case of alternative 1, the direction of farm-gin movements are much the same as those of the optimum solution.

The final market organization, alternative 4, changes optimum farm-gin flows more than any other alternative. Gin-warehouse flows also change as two warehouse sites are utilized, Stamford (15) and Sweetwater (18). Gin plant locations are Avoca (8) and Sweetwater.

The per bale cost of these four structures is given in Table 49. Recalling that the minimum cost solution is \$59.40 per bale, it is noted that the least attractive market organization, alternative 4, is only \$.27 per bale higher. This variation amounts to just over \$35,000 for the study area. The economies available in ginning are further signified as gin cost is the same for optimum and alternative market structures. Therefore, any variation must be in assembly, gin-warehouse transportation or warehousing. Among organizations, assembly cost varies by less than \$.22 per bale while other activities vary about \$.10 per bale.

Optimum Market Organizations of Both Ginning Seasons

Economies possible with high ginning capacity are evident in that a minimum number of 42-bale per hour gin plants are included in optimum market structures of the 14 and 32 week seasons. The locations of

Table 49. Functional Values of Suboptimum Market Organizations by Major Activity, 32 Week Ginning Season, Abilene Study Area, 1974

Activity	Suboptimum Market Organization			
	1	2	3	4
	Dollars Per Bale			
Assembly	11.244	11.278	11.409	11.407
Ginning	12.117	12.117	12.117	12.117
Gin-Warehouse Transportation	0.701	0.650	0.750	0.650
Warehousing	3.132	3.246	3.132	3.246
Merchandising	32.254	32.254	32.254	32.254
Total Cost	59.448	59.545	59.662	59.674

these gin plants as well as the site of warehouse facilities specified for each market organization are compared in Figure 32.

While Hamlin (5) is the optimum site for warehousing facilities in both solutions, gin plant locations of the optimum market structures do not correspond. However, the gin plant location Radium (7) is very near two of the gin plants included in the 14 week season. The remaining gin plant in the 32 week ginning season is Longworth (2) and is centrally located between the other gin plants of the 14 week market structure.

Warehousing economies are great enough that a warehouse is not specified at Sweetwater (18) even though it is selected as a gin site. The opportunity cost of achieving the 14 week ginning season structure and not the 32 week ginning season optimum is $3.28 per bale or over $400,000 for the Abilene study area.

Lubbock Study Area

The 1974 market structure of the Lubbock study area included 217 gins located at or near 52 towns spatially dispersed throughout the major cotton producing sections of the nine county area. Most of these facilities have capacities of less than 10-bales per hour. Warehousing facilities numbered 16 with 13 towns represented. This organization is depicted in Figure 33. These sites were specified as potential locations within the framework of the model. Lubbock (27) was permitted the option of two separate warehousing facilities.

The locations selected consist of the following towns:

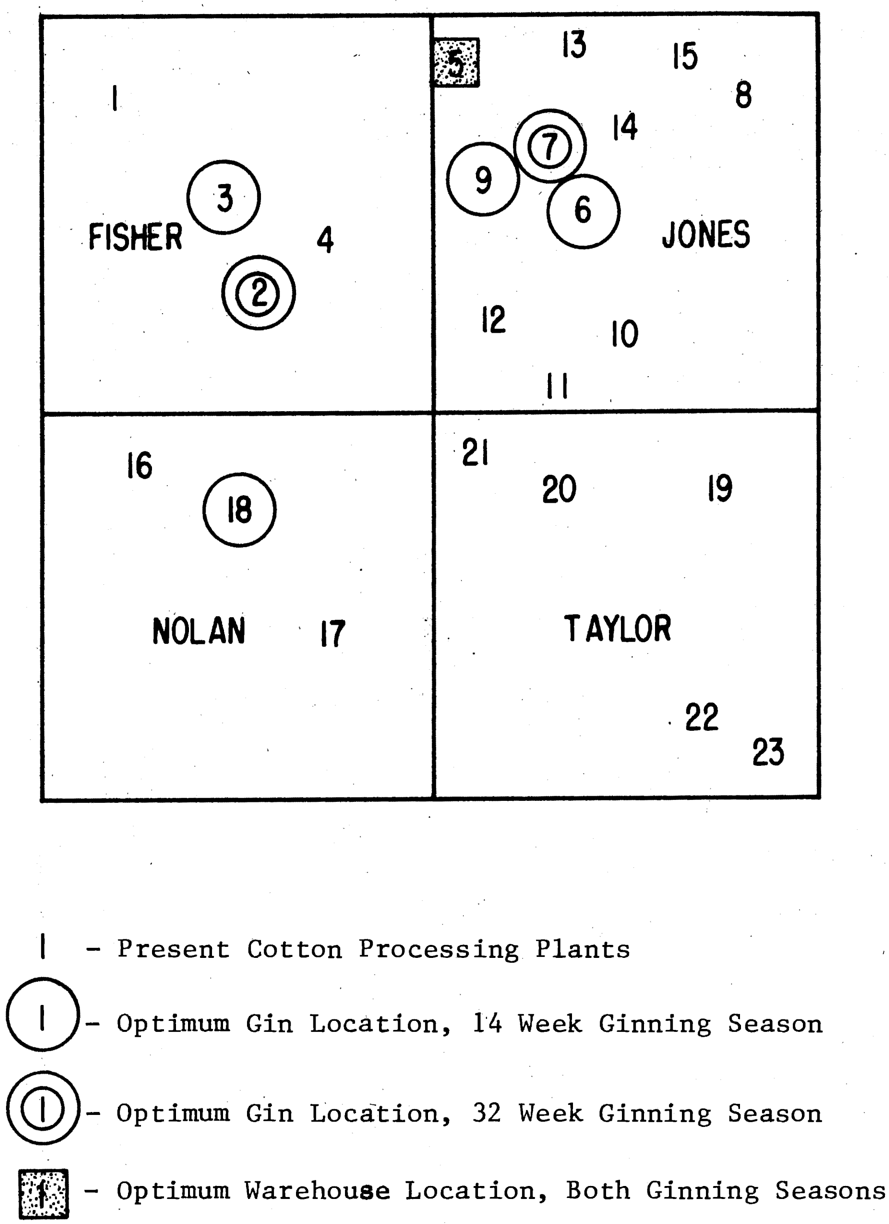
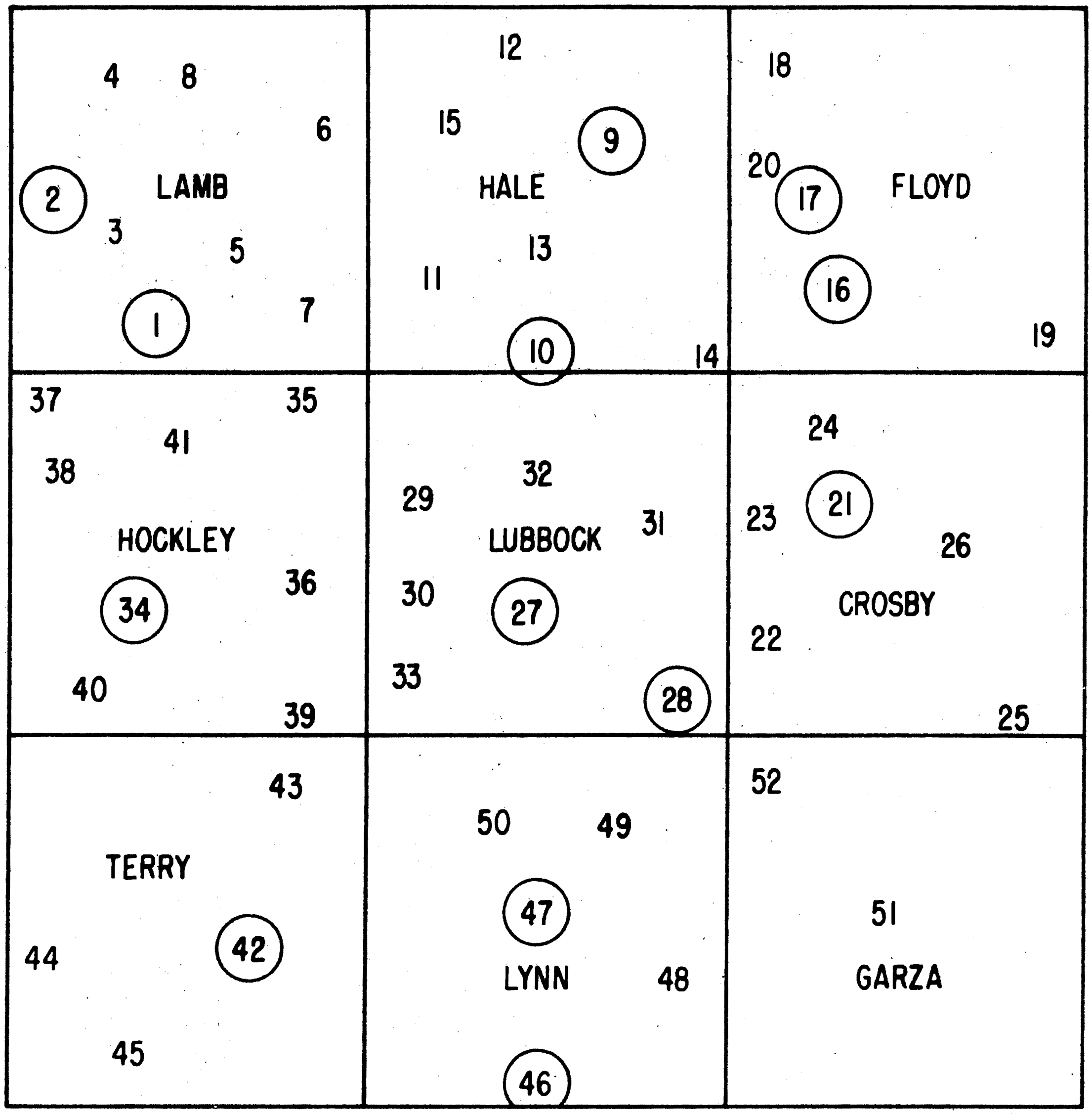


Figure 32. Ginning and Warehousing Activities of the 14 Week and 32 Week Ginning Season, Optimum Market Organizations, Abilene Study Area, 1974



1 - Gin Location

1 - Gin and Warehouse Location

Figure 33. Ginning and Warehousing Activities of the 1974 Lubbock Study Area Market Organization

1. Littlefield	19. Dougherty	37. Pep
2. Sudan	20. Aiken	38. Pettit
3. Amherst	21. Ralls	39. Ropesville
4. Earth	22. Robertson	40. Sundown
5. Fieldton	23. Lorenzo	41. Whitharral
6. Olton	24. Cone	42. Brownfield
7. Spade	25. Kalgary	43. Meadow
8. Springlake	26. Crosbyton	44. Tokio
9. Plainview	27. Lubbock	45. Wellman
10. Abernathy	28. Slaton	46. O'Donnell
11. Cotton Center	29. Shallowater	47. Tahoka
12. Edmonson	30. Hurlwood	48. Grassland
13. Hale Center	31. Idalou	49. Wilson
14. Petersburg	32. New Deal	50. New Home
15. Halfway	33. Wolfforth	51. Post
16. Floydada	34. Levelland	52. Southland
17. Lockney	35. Anton	
18. Sterley	36. Smyer	

The numbers and town names correspond with those numbers in Figure 33.

<u>14 Week Ginning Season</u>

The optimum market structure, Table 50, consists of 36 gin sites. All locations have one plant, each with a capacity of 42-bales per hour. There are eight warehouse plants which range in capacity from 75,346 to 172,920 bales. The volume handled in these facilities ranges between 97,032 and 221,692 bales. Gin plant volume is equal to processing capacity for all but five plants and capacity utilization is

Table 50. Ginning and Warehousing Activities in the Optimum Market Organization, Lubbock Study Area, 14 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
3-Amherst	32,344	32,344	1-Littlefield (8,120), 2-Sudan (10,082), 3-Amherst
4-Earth	32,344	32,344	2-Sudan (4,060), 4-Earth, 8-Springlake
7-Spade	32,344	32,344	5-Fieldton, 7-Spade, 35-Anton (4,060)
9-Plainview	32,344	32,344	9-Plainview, 12-Edmonson (12,355), 20-Aiken (940)
10-Abernathy	32,344	32,344	10-Abernathy, 11-Cotton Center (13,295)
13-Hale Center	32,344	32,344	11-Cotton Center (5,754), 12-Edmonson, (6,694), 13-Hale Center, 15-Halfway (847)
14-Petersburg	32,344	28,627	14-Petersburg, 24-Cone (9,578)
15-Halfway	32,344	32,344	6-Olton, 15-Halfway (18,202)
17-Lockney	32,344	32,344	16-Floydada (7,062), 17-Lockney, 20-Aiken (5,760)
18-Sterley	32,344	32,344	18-Sterley, 20-Aiken (12,822)
19-Dougherty	32,344	31,989	16-Floydada (12,460), 19-Dougherty
21-Ralls	32,344	32,344	21-Ralls (10,746), 22-Robertson (9,631), 24-Cone (11,967)
23-Lorenzo	32,344	32,344	22-Robertson (11,914), 23-Lorenzo (20,430)
25-Kalgary	32,344	30,547	25-Kalgary, 51-Post (9,002)
26-Crosbyton	32,344	32,344	21-Ralls (10,799), 26-Crosbyton (21,545)
27-Lubbock	32,344	32,344	27-Lubbock (30,114), 50-New Home (2,230)

Table 50. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
28-Slaton	32,344	32,344	28-Slaton, 49-Wilson (1,115)
29-Shallowater	32,344	32,344	29-Shallowater, 35-Anton (1,115)
30-Hurlwood	32,344	32,344	30-Hurlwood, 33-Wolfforth (1,115)
31-Idalou	32,344	32,344	23-Lorenzo (1,115), 31-Idalou
32-New Deal	32,344	32,344	27-Lubbock (1,115), 32-New Deal
33-Wolfforth	32,344	32,344	33-Wolfforth (30,114), 39-Ropesville (1,576), 50-New Home (654)
34-Levelland	32,344	32,344	34-Levelland, 40-Sundown (15,739)
36-Smyer	32,344	32,344	35-Anton (2,579), 36-Smyer, 39-Ropesville (13,160)
38-Pettit	32,344	32,344	37-Pep (15,739), 38-Pettit
41-Whitharral	32,344	32,344	1-Littlefield (6,022), 35-Anton (8,851), 37-Pep (866), 41-Whitharral
42-Brownfield	32,344	32,344	42-Brownfield, 43-Meadow (585), 47-Tahoka (699)
43-Meadow	32,344	32,344	39-Ropesville (1,869), 43-Meadow (30,475)
44-Tokio	32,344	31,926	40-Sundown (866), 44-Tokio
45-Wellman	32,344	31,060	45-Wellman
46-O'Donnell	32,344	32,344	46-O'Donnell (32,344)
47-Tahoka	32,344	32,344	46-O'Donnell (2,884), 47-Tahoka (29,460)
48-Grassland	32,344	32,344	48-Grassland (32,344)

Table 50. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
49-Wilson	32,344	32,344	47-Tahoka (5,069), 49-Wilson (27,275)
50-New Home	32,344	32,344	50-New Home (32,344)
52-Southland	32,344	32,344	48-Grassland (2,884), 49-Wilson (6,838), 51-Post (6,810), 52-Southland
		Warehouses:	
1-Littlefield	100,461	129,376	3-Amherst, 4-Earth, 7-Spade, 41-Whitharral
10-Abernathy	172,920	221,691	10-Abernathy, 13-Hale Center, 14-Petersburg, 27-Lubbock, 29-Shallowater, 32-New Deal, 33-Wolfforth
17-Lockney	125,295	161,358	9-Plainview, 15-Halfway, 17-Lockney, 18-Sterley, 19-Dougherty
21-Ralls	124,181	159,923	21-Ralls, 23-Lorenzo, 25-Kalgary, 26-Crosbyton, 31-Idalou
28-Slaton	75,346	97,032	28-Slaton, 49-Wilson, 52-Southland
34-Levelland	100,461	129,376	30-Hurlwood, 34-Levelland, 36-Smyer, 38-Pettit
42-Brownfield	99,139	127,674	42-Brownfield, 43-Meadow, 44-Tokio, 45-Wellman

Table 50. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Warehouses:
47-Tahoka	100,461	129,376	46-O'Donnell, 47-Tahoka, 48-Grassland, 50-New Home

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

between 88 and 100 percent. Farm to gin flows, ginning sites and warehouse locations are shown in Figure 34.

Compared with the present, the minimum cost structure represents a decrease of 181 gin plants and 16 plant sites.[4] However, optimum plant location remains unchanged in three counties, Lubbock, Terry and Lynn. Compared with the optimum, the seven site, 35 plant structure of Lubbock County is reduced to one plant at each site, a decrease of 28 gin plants. A similar reduction is also indicated for Terry and Lynn Counties, from 21 plants each to four and five, respectively. Changes in both plant numbers and locations are indicated for the remaining six counties, with plant numbers being greatly decreased.

Of the eight potential locations in Lamb County, only three are included in the optimum solution, Amherst (3), Earth (4) and Spade (7). Plant numbers totaled 29 in 1974. One of the potential sites not included, Littlefield (1), presently has eight gins. Five of the existing seven locations in Hale County are included; however, 31 fewer gin plants are required. Lockney (17), Sterley (18) and Dougherty (19) are locations selected within the boundaries of Floyd County. Of the two potential sites not included, Floydada (16), has six gin plants. The 20 ginning facilities in Crosby County are reduced to four and two sites are not part of the minimum cost solution.

The optimum market organization specifies four locations, Levelland (34), Smyer (36), Pettit (38) and Whitharral (41) in Hockley County; thus, representing a major reorganization in this region. Only one of the two present locations of Garza County is included.

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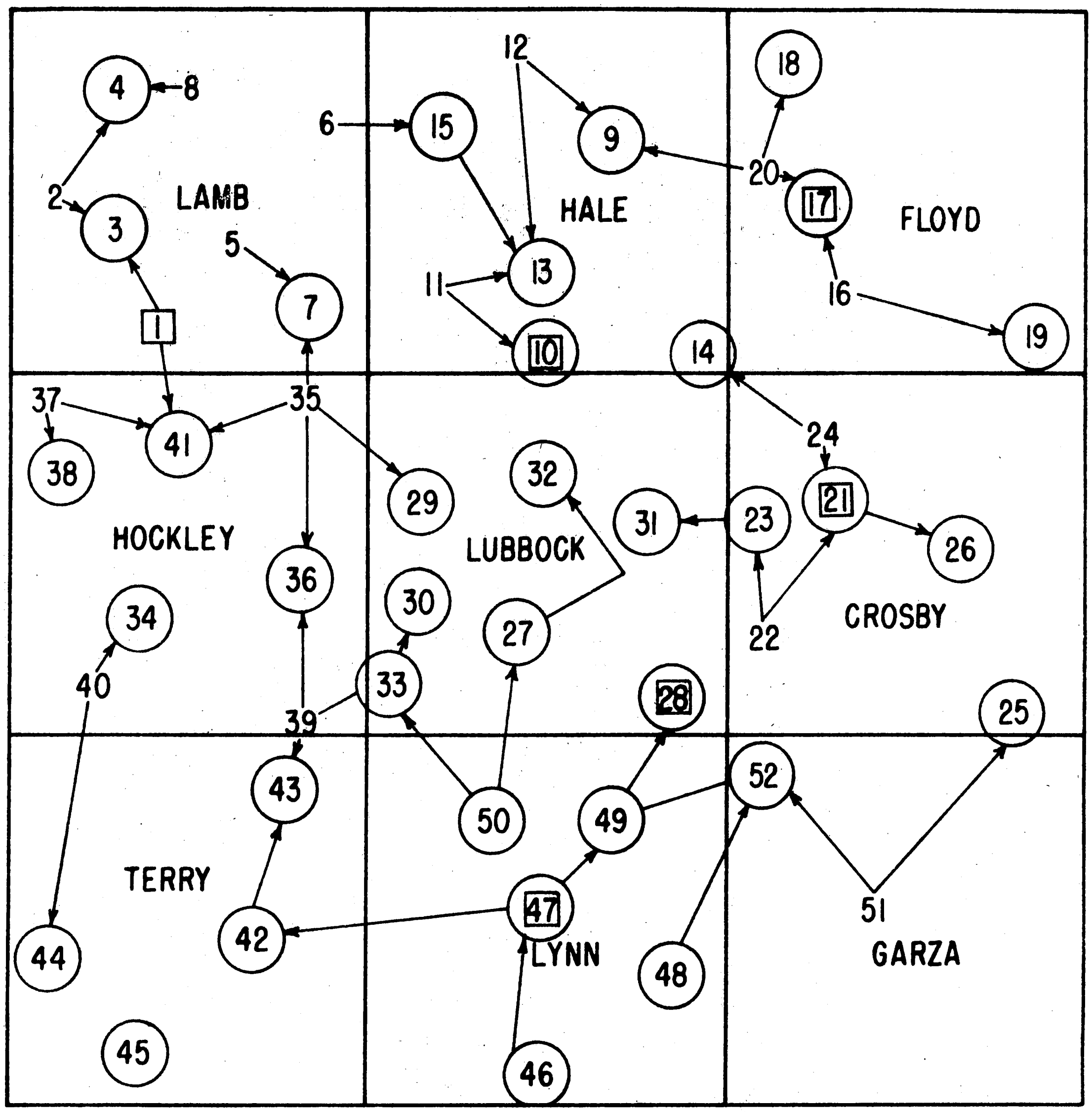
[4]The existing number of gin plants were listed by county and location in Table 34.



1 - Optimum Warehouse Location

1 - Optimum Gin Location

Figure 34. Ginning and Warehousing Activities in the Optimum Market Organization, Lubbock Study Area, 14 Week Ginning Season, 1974

Warehousing facilities of the optimum market structure are Littlefield (1), Abernathy (10), Lockney (17), Ralls (21), Slaton (28), Levelland (34), Brownfield (42) and Tahoka (47). The gin-warehouse flow of cotton is listed in Table 50. Gins are located at all these sites except for Littlefield. The relative location of warehouses is given in Figure 34. One warehouse is located in each of the eight counties presently having such facilities. However, two present warehouse sites, Plainview (9) and Lubbock (27), are not part of the optimum market structure. This change in gin-warehouse flow is significant as over half of the cotton presently ginned in the study area moves to warehousing facilities located in Lubbock. In fact, only in the case of Levelland does optimum volume correspond with the present system. For other warehouse sites, the optimum market structure specifies a much greater volume than presently received.

Costs of the present and optimum market structures, segregated by major activity, are presented in Table 51. The cost of preparing seed cotton for commercial use under the optimum structure is \$62.38 per bale. This is in comparison with the present system cost of \$88.48 and reflects a difference of \$26.11 per bale. Thus, the annual opportunity cost of not achieving the optimum is over 30 million dollars for the study area. Primary cost reductions are in ginning and warehousing. Ginning cost drops to \$16.43 per bale and amounts to a savings of \$16.77 per bale. This represents 19.4 million dollars for the nine-county Lubbock study area. Area warehousing cost decreases over 11 million dollars, to \$3.69 per bale.

A portion of the decreased ginning cost is offset by increased assembly cost. With the increased farm-gin hauling distance of the

Table 51. Cotton Marketing Costs of the Present System and the Optimum Market Organization by Major Activity, 14 Week Ginning Season, Lubbock Study Area, 1974

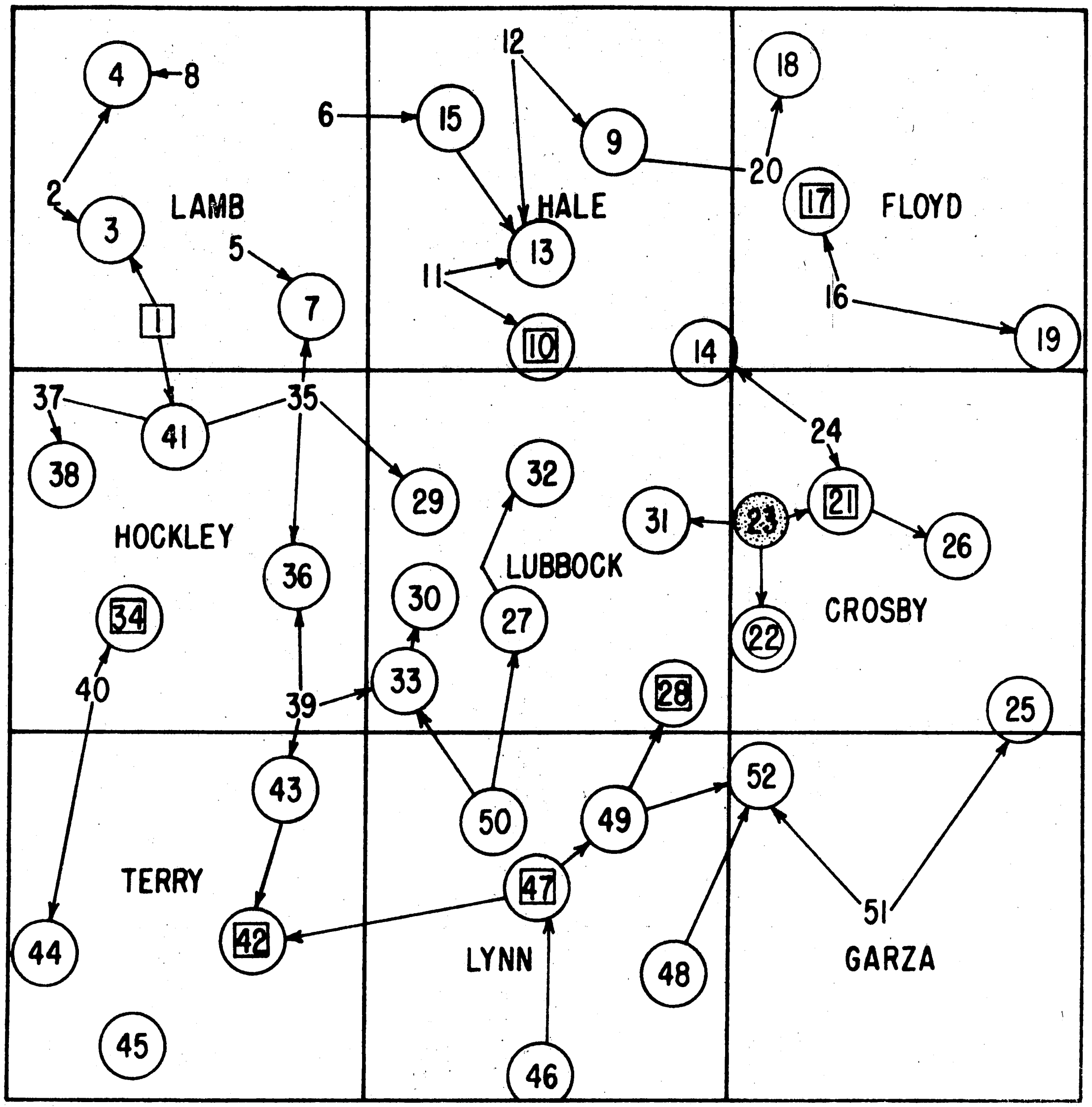
Activity	Present Market Organization		Optimum Market Organization		Savings	
	Dollars	Dollars Per Bale	Dollars	Dollars Per Bale	Dollars	Dollars Per Bale
Assembly	10,249,301.16	8.860	10,502,706.19	9.079	-253,405.03	-0.219
Ginning	38,405,959.20	33.200	19,006,900.74	16.430	19,399,058.46	16.770
Gin-Warehouse Transportation	867,604.50	0.750	844,639.85	0.730	22,964.65	0.020
Warehousing	15,304,543.38	13.230	4,273,252.54	3.694	11,031,290.84	9.536
Merchandising	37,531,231.43	32.444	37,531,231.43	32.444	0.0	0.0
Total Cost	102,358,639.67	88.484	72,158,730.75	62.377	30,185,010.53	26.107

optimum structure comes an increase in the total transfer cost at this level. This increase is from $8.86 to $9.71, or $.22 per bale, an increase of $253,405 for the area. Even though warehouse numbers decrease, gin-warehouse transportation cost of the optimum market structure is $.02 less that of the present structure. The percentage of shipments from each warehouse to each mill area was held constant in the model. The volume shipped to each of the mill points is given in Table 38.

<u>Suboptimum Market Organizations</u>. Five suboptimum market structures are depicted in Figures 35-39. More specific data relating to farm-gin and gin-warehouse flows as well as processing facility capacity and volume are given in Appendix Tables 34-38.

A comparison among the optimum and alternative structures indicates considerable stability. There are 36 gins, each at different locations in all solutions. Eight warehouses are included in the market structure of all solutions except alternative 5 which has seven. Functional values of the alternatives, Table 52, show cost per bale varies between $62.39 for alternative 1 and $62.40 for alternative 5. Compared with the optimum, alternative 5 is only $.02 greater. This variation in total cost is less than $27,000 for the study area.

Ginning costs of the optimum and alternative structures are identical except for market organization 2, which is $.01 less. This reflects the selection of a 35-bale per hour gin plant at Southland (52), Appendix Table 35. All gins in this alternative operate at full capacity except for the Crosbyton (26) gin. In other solutions, all gins are 42-bale per hour plants. Further, all but five plants in these solutions operate at full capacity. In addition to ginning, assembly, gin-warehouse



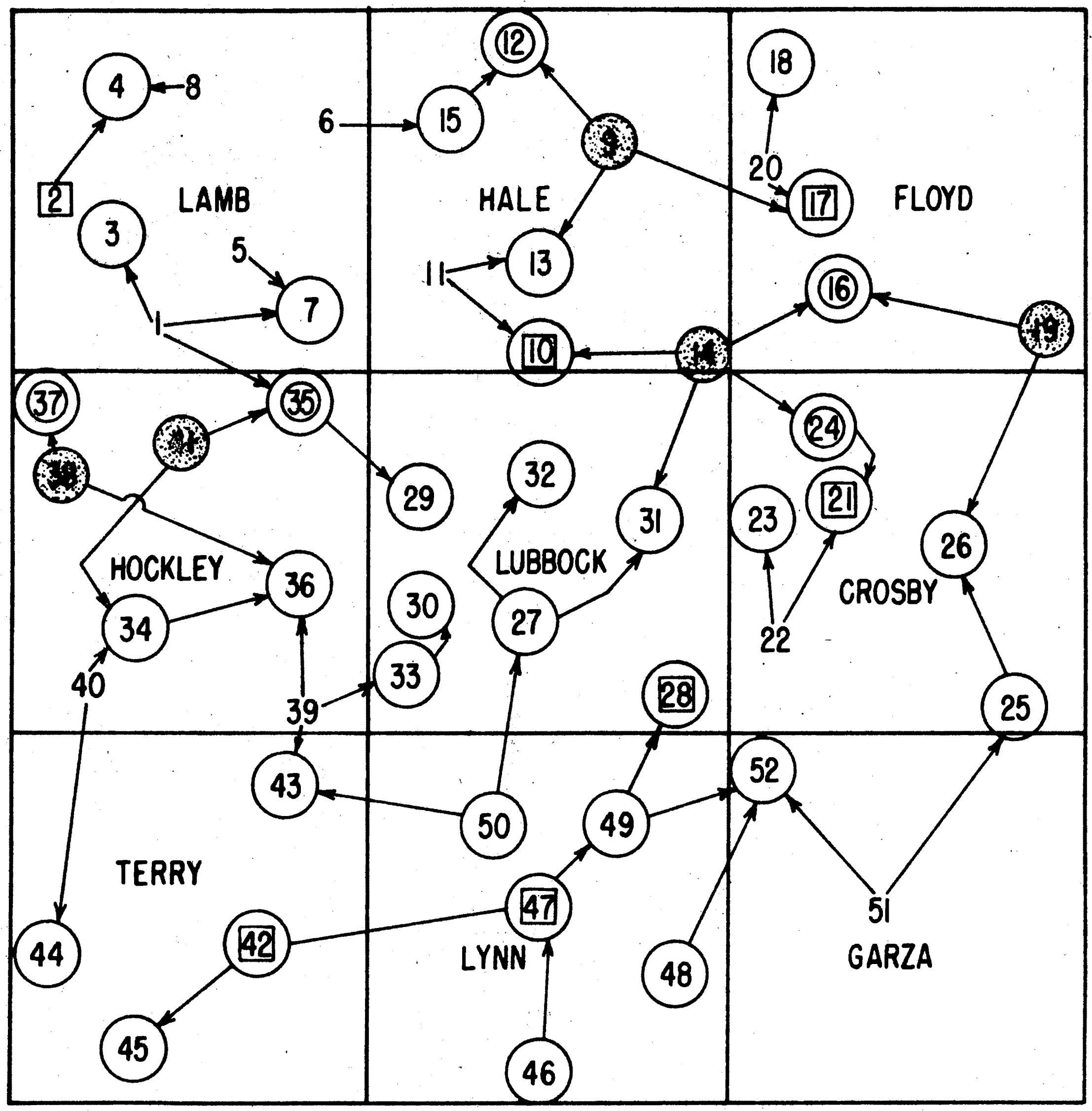
- Optimum and Alternative Gin Location

- Alternative Gin Location

- Optimum Gin Location

- Warehouse Location

Figure 35. Ginning and Warehousing Activities in Suboptimum Market Organization 1, Lubbock Study Area, 14 Week Ginning Season, 1974



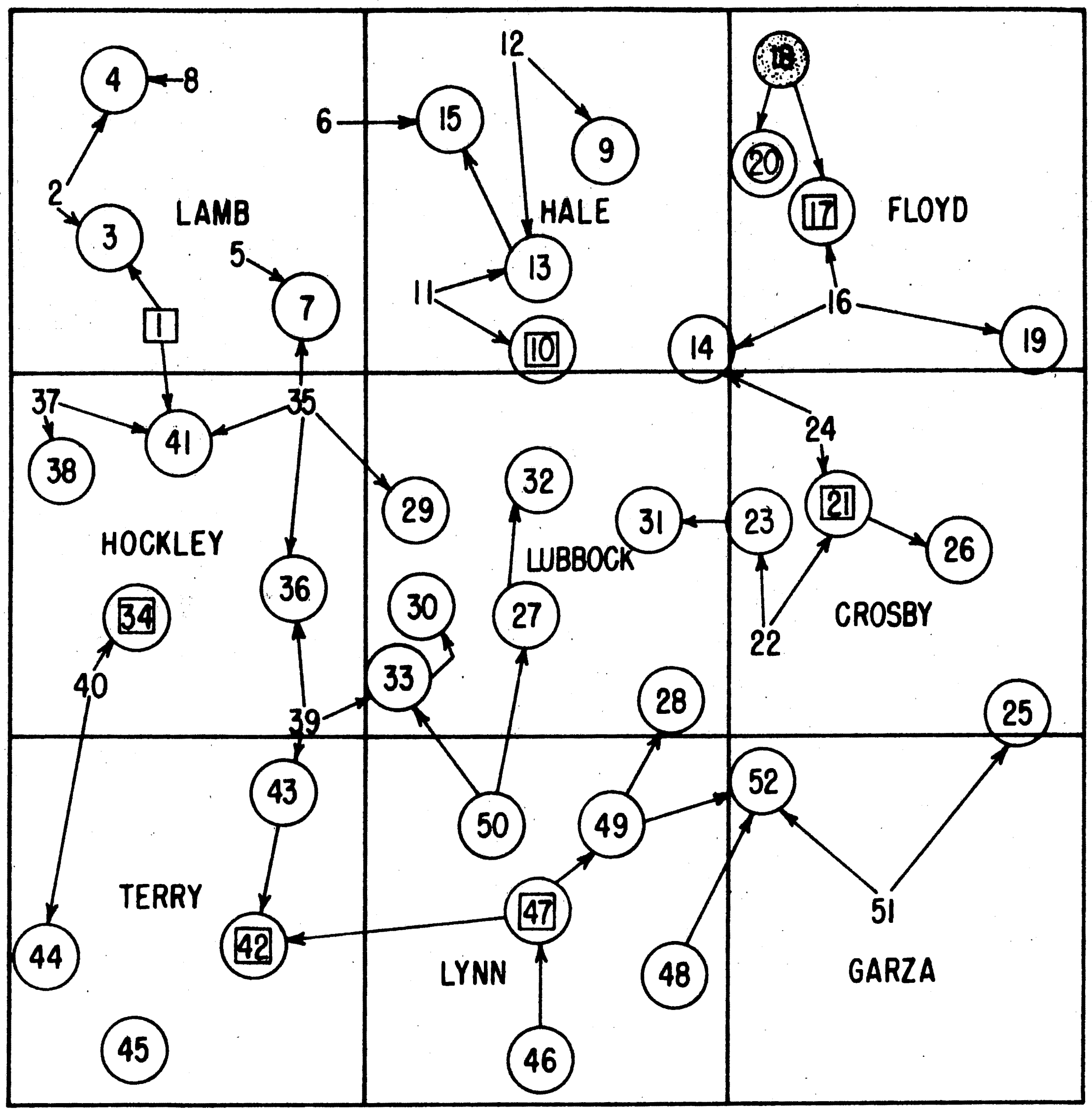
- Optimum Gin Location

- Alternative Gin Location

- Optimum and Alternative Gin Location

- Warehouse Location

Figure 36. Ginning and Warehousing Activities in Suboptimum Market Organization 2, Lubbock Study Area, 14 Week Ginning Season, 1974



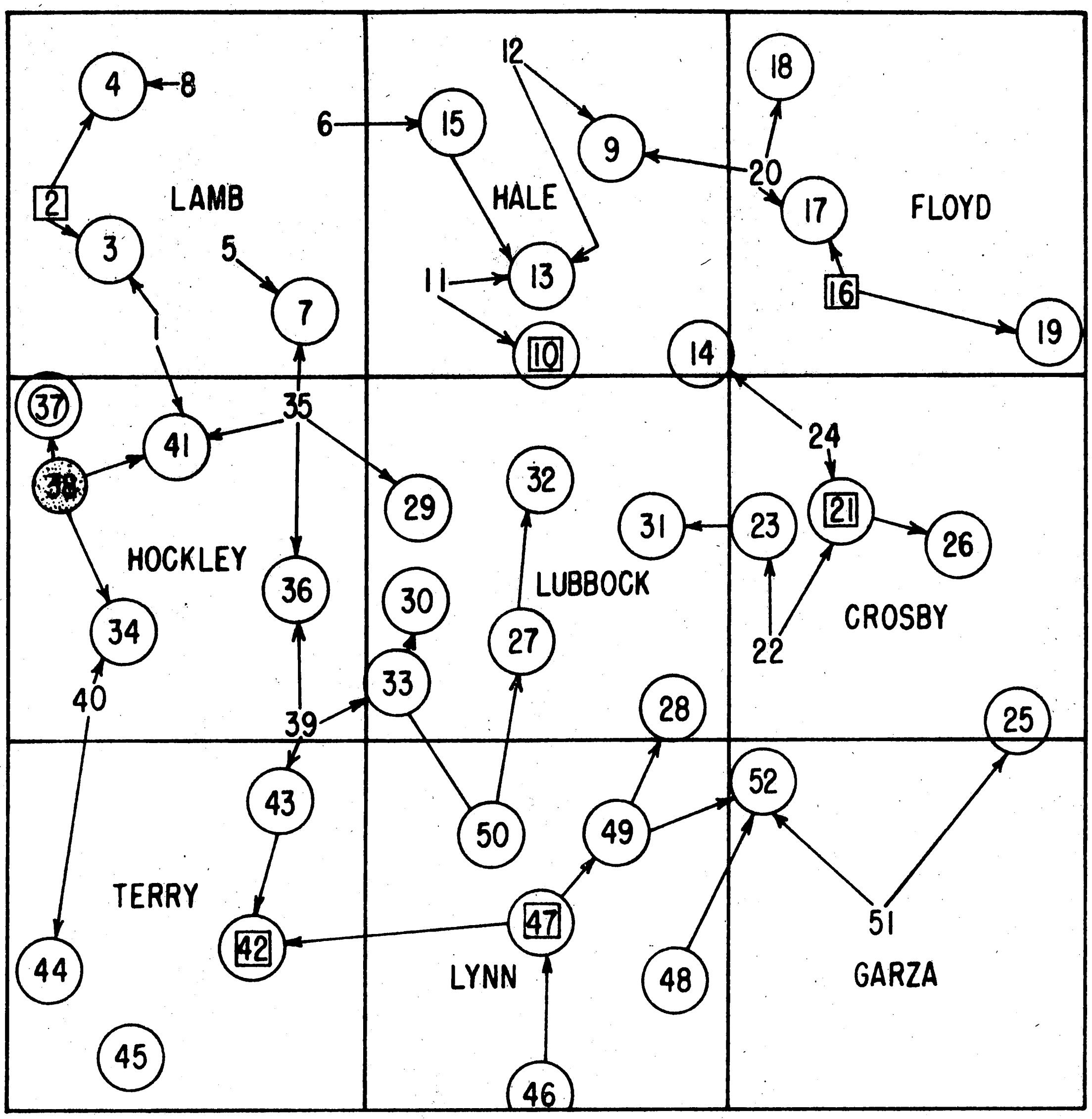
(1) - Optimum Gin Location

(1) - Alternative Gin Location

(1) - Optimum and Alternative Gin Location

[1] - Warehouse Location

Figure 37. Ginning and Warehousing Activities in Suboptimum Market Organization 3, Lubbock Study Area, 14 Week Ginning Season, 1974



- Optimum Gin Location

- Alternative Gin Location

- Optimum and Alternative Gin Location

- Warehouse Location

Figure 38. Ginning and Warehousing Activities in Suboptimum Market Organization 4, Lubbock Study Area, 14 Week Ginning Season, 1974

Table 52. Functional Values of Suboptimum Market Organizations by Major Activity, 14 Week Ginning Season, Lubbock Study Area, 1974

Activity	Suboptimum Market Organization				
	1	2	3	4	5
			Dollars Per Bale		
Assembly	9.087	9.104	9.095	9.094	9.098
Ginning	16.430	16.425	16.430	16.430	16.430
Gin-Warehouse Transportation	0.733	0.723	0.730	0.737	0.746
Warehousing	3.694	3.694	3.694	3.694	3.682
Merchandising	32.444	32.444	32.444	32.444	32.444
Total Cost	62.388	62.390	62.393	62.399	62.400

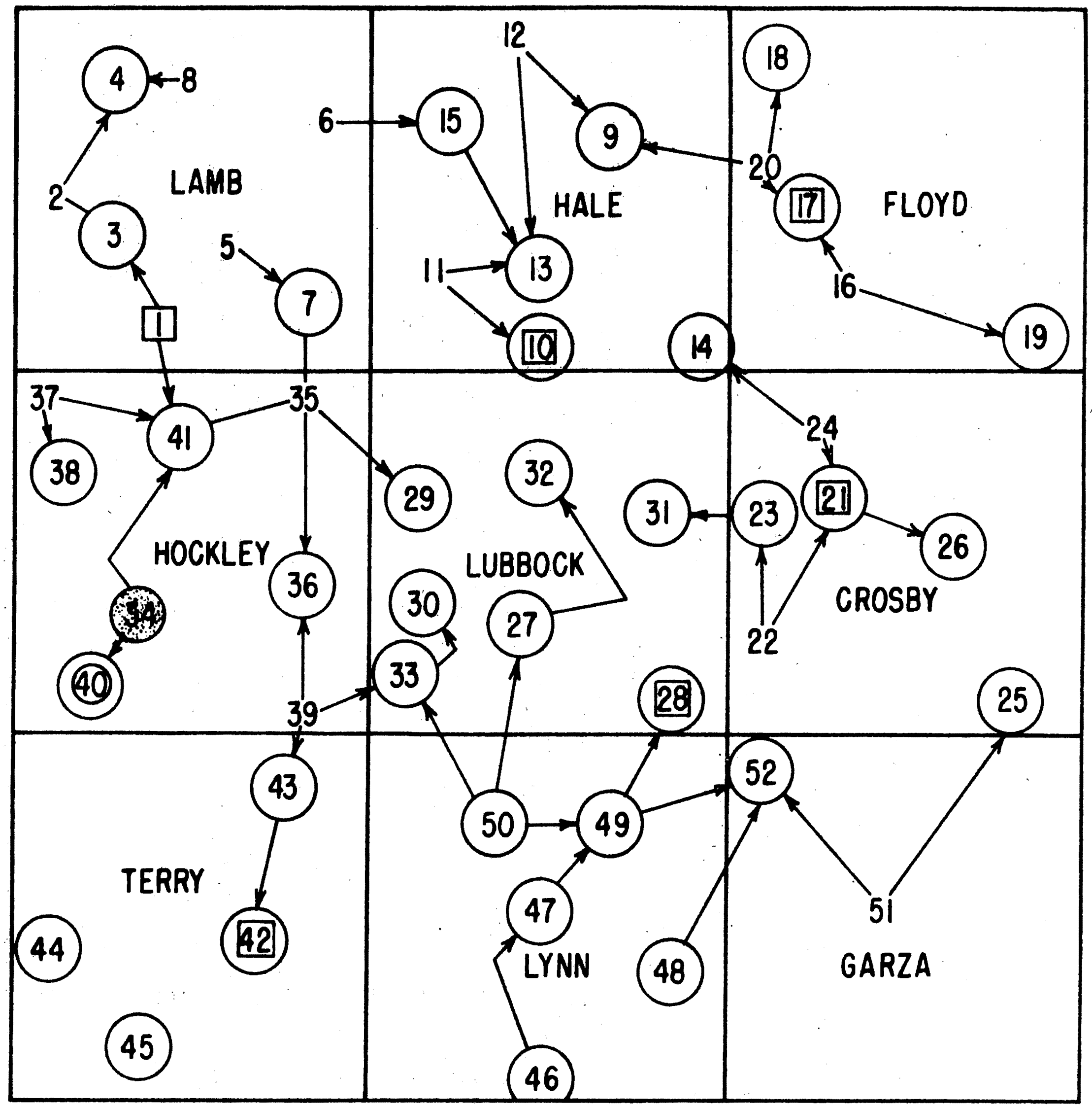
transportation and warehousing, costs show only slight differences, if any, among alternatives.

The change in optimum processing sites of alternative 1 shows only one site variation. In this alternative a gin is specified at Robertson (22) in favor of Lorenzo (23), Figure 35, and warehouse organization is that of the optimum. In alternative 2, ginning facilities are included at Edmonson (12), Floydada (16), Cone (24), Anton (35), and Pep (37) in favor of optimum structure sites, Plainview (9), Petersburg (14), Dougherty (19), Pettit (38) and Whitharral (41), Figure 36. In addition, warehouses are specified for Sudan (2) and Lubbock (27) in lieu of Littlefield (1) and Levelland (34).

Instead of having a gin plant at Sterley (18), alternative 3 includes Aiken (20); however, warehouses are located at optimum locations, Figure 37. Alternative market organization 4 includes Pep (37) in place of Pettit (38) as one of the 36 gin locations. Further, warehouses include facilities at Sudan (2) and Floydada (16) instead Littlefield (1) and Lockney (17), Figure 38. The optimum farm to mill flow of cotton is also altered in alternative 5 in that Sundown (40) replaces Levelland (34) as a gin plant location. In addition, the warehouse site at Levelland is not included, Figure 39.

32 Week Ginning Season

By taking advantage of economies associated with the 32 week ginning season, the one million plus bale production of the Lubbock study area can be processed by 18 gins and eight warehouse plants. Further, the total cost of transferring cotton from farms to mill points could be reduced by nearly 34 million dollars.



- Optimum Gin Location

- Alternative Gin Location

- Optimum and Alternative Gin Location

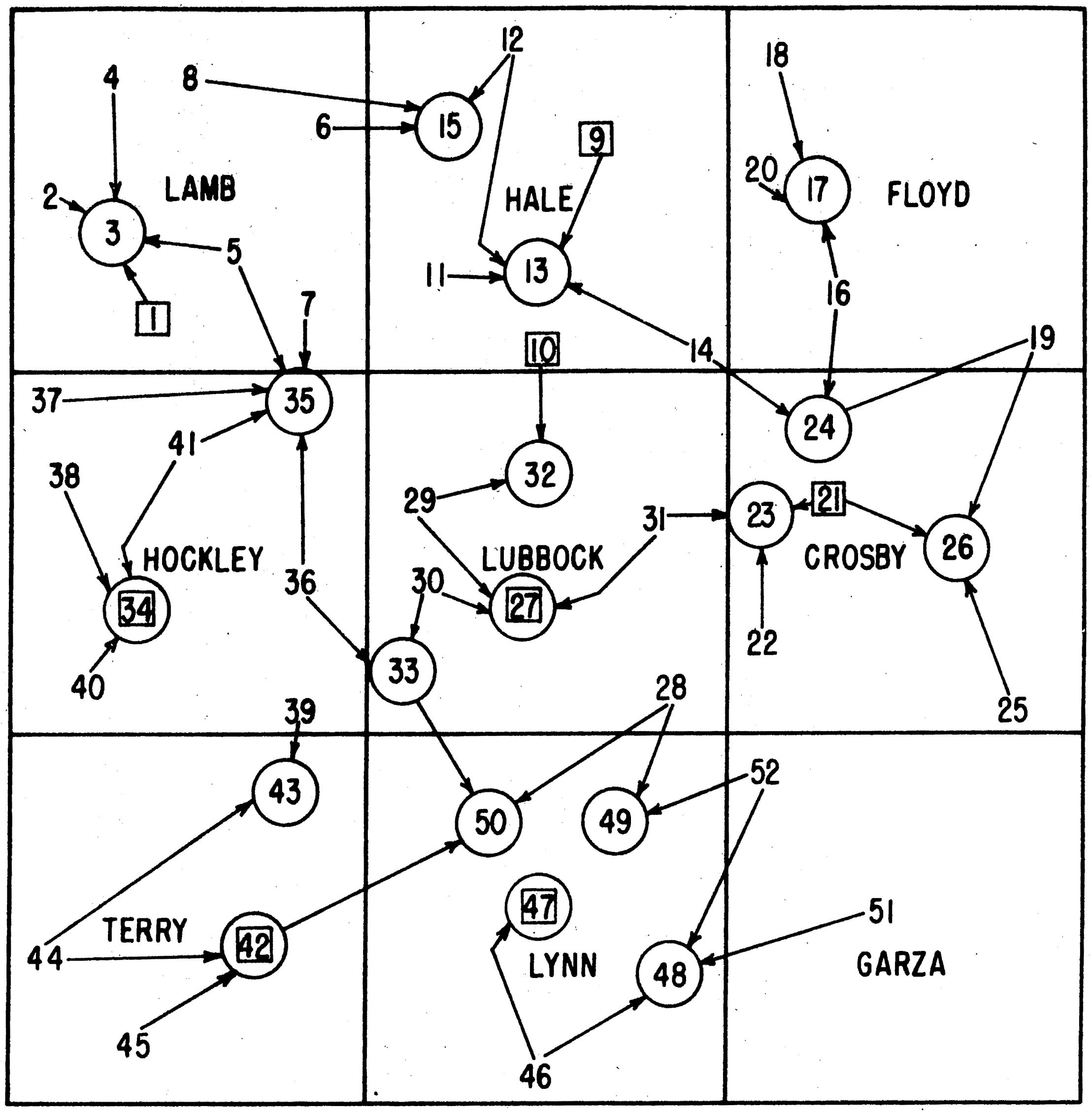
- Warehouse Location

Figure 39. Ginning and Warehousing Activities in Suboptimum Market Organization 5, Lubbock Study Area, 14 Week Ginning Season, 1974

This 32 week ginning season optimum market structure is presented in Figure 40. The direction of the farm-gin flow of cotton is also included. The quantities of farm-gin and gin-warehouse movements are outlined in Table 53. Further, both gin and warehouse capacities and volumes are included. All 18 gin plants have a capacity of 42-bales per hour and represent a seasonal ginning capacity of 64,688 bales. Only one plant, New Home (50), operates at less than seasonal capacity. Within this structure all gin plants are spatially separated. However, Hale County has two warehouse facilities while Floyd and Garza Counties have none. Warehouse capacities range between 64,688 bales at Littlefield (1) and Levelland (34) and 251,174 bales at Tahoka (47).

A primary reorganization of gin plants is required to meet this optimum market structure. Aside from the study area, marked changes are noticeable at the county level. A total of four gins are specified for the northern portion of the study area. Plant location sites are Amherst (3), Hale Center (13), Halfway (15) and Lockney (17). Presently there are 82 gins operating at or near the 20 potential sites included in this area. One-half of the present Crosby County sites are included and three of seven Lubbock County locations are represented in the optimum organization. Lubbock County locations are Lubbock (27), New Deal (32) and Wolfforth (33). Of the eight potential sites in Hockley County, only Levelland (34) and Anton (35) are included. This represents a decrease of 27 plants compared with the present structure.

Other gin sites include Brownfield (42) and Meadow (43) in Terry County as well as four of the present five sites in Lynn County. These are Tahoka (47), Grassland (48), Wilson (49) and New Home (50). O'Donnell (46) is not included. Neither Post (51), nor Southland (52),



1 - Optimum Gin Location

1 - Optimum Warehouse Location

Figure 40. Ginning and Warehousing Activities in the Optimum Market Organization, Lubbock Study Area, 32 Week Ginning Season, 1974

the only potential locations in Garza County are included, as all seed cotton from this area flows to Grassland or Wilson for ginning.

The present warehouse structure includes six plants with a capacity of less than 50,000 bales, six ranging between 50,000 and 75,000 bales, three between 75,000 and 200,000 bales and one with a capacity of 24,795 bales. These capacities are much less than facilities presently at these sites. However, the present volume handled at Littlefield is similar to the 64,688 bales specified in the optimum. Nearly twice this much volume is received at Levelland. Five warehouse plants are in the range of 49,590 and 74,385 bales. These plants are Plainview (9), Abernathy (10), Ralls (21), Lubbock (27) and Brownfield (42). For all but Abernathy, this represents a considerable decrease in capacity. The reverse is true for Abernathy. The volume of cotton stored at these warehouses is representative of the present system only in the case of Plainview. Considerably less is warehoused at Abernathy while the opposite is true for Ralls, Lubbock and Brownfield. The present facility at Tahoka is about one-half the optimum size and receives less than 20 percent of the optimum volume.

The nearly 34 million dollar cost of transferring cotton from the farm to the mill under the optimum market structure represents a cost of $59.32 per bale, Table 54. Compared with the present market structure, this is a 33 percent decrease, or $29.17 per bale. Major cost reductions are realized in ginning and warehousing, nearly 24.5 and over 11.1 million dollars, respectively. On a per bale basis these costs amount to $21.13 and $10.11. Therefore, ginning cost is $12.07 per bale and warehousing cost is $3.12 per bale. However, the increased cost of ricking over the conventional trailer system and the increased

Table 53. Ginning and Warehousing Activities in the Optimum Market Organization, Lubbock Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
3-Amherst	64,688	64,688	1-Littlefield, 2-Sudan, 3-Amherst, 4-Earth, 5-Fieldton (8,120)
13-Hale Center	64,688	64,688	9-Plainview, 11-Cotton Center, 12-Edmonson (1,654), 13-Hale Center, 14-Petersburg (5,847)
15-Halfway	64,688	64,688	6-Olton, 8-Springlake, 12-Edmonson (17,355), 15-Halfway
17-Lockney	64,688	64,688	16-Floydada (6,122), 17-Lockney, 18-Sterley, 20-Aiken
23-Lorenzo	64,688	64,688	21-Ralls (2,928), 22-Robertson, 23-Lorenzo, 31-Idalou (18,670)
24-Cone	64,688	64,688	14-Petersburg (13,202), 16-Floydada (13,400), 19-Dougherty (16,541), 24-Cone
26-Crosbyton	64,688	64,688	19-Dougherty (2,981), 21-Ralls (18,617), 25-Kalgary, 26-Crosbyton
27-Lubbock	64,688	64,688	27-Lubbock, 29-Shallowater (16,819), 30-Hurlwood (4,081), 31-Idalou (12,559)
32-New Deal	64,688	64,688	10-Abernathy, 29-Shallowater (14,410), 32-New Deal
33-Wolfforth	64,688	64,688	30-Hurlwood (27,148), 33-Wolfforth (30,517), 36-Smyer (7,023)
34-Levelland	64,688	64,688	34-Levelland, 38-Pettit, 40-Sundown, 41-Whitharral (14,873)

Table 53. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
35-Anton	64,688	64,688	5-Fieldton (6,022), 7-Spade, 35-Anton, 36-Smyer (9,582), 37-Pep, 41-Whitharral (1,732)
42-Brownfield	64,688	64,688	42-Brownfield (19,591), 44-Tokio (14,037), 45-Wellman
43-Meadow	64,688	64,688	39-Ropesville, 43-Meadow, 44-Tokio (17,023)
47-Tahoka	64,688	64,688	46-O'Donnell (29,460), 47-Tahoka
48-Grassland	64,688	64,688	46-O'Donnell (5,768), 48-Grassland, 51-Post, 52-Southland (7,880)
49-Wilson	64,688	64,688	28-Slaton (21,528), 49-Wilson, 52-Southland (7,932)
50-New Home	64,688	57,110	28-Slaton (9,701), 33-Wolfforth (712), 42-Brownfield (11,469), 50-New Home
		Warehouses:	
1-Littlefield	24,795	64,688	3-Amherst
9-Plainview	49,590	129,376	15-Halfway, 17-Lockney
10-Abernathy	74,385	194,064	13-Hale Center, 32-New Deal, 35-Anton
21-Ralls	74,385	194,064	23-Lorenzo, 24-Cone, 26-Crosbyton
27-Lubbock	49,590	129,376	27-Lubbock, 33-Wolfforth
34-Levelland	24,795	64,688	34-Levelland
42-Brownfield	49,590	129,376	42-Brownfield, 43-Meadow

Table 53. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Warehouses:	
47-Tahoka	96,275	251,174	47-Tahoka, 48-Grassland, 49-Wilson, 50-New Home

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Table 54. Cotton Marketing Costs of the Present System and the Optimum Market Organization by Major Activity, 32 Week Ginning Season, Lubbock Study Area, 1974

Activity	Present Market Organization		Optimum Market Organization		Savings	
	Dollars	Dollars Per Bale	Dollars	Dollars Per Bale	Dollars	Dollars Per Bale
Assembly	10,249,301.16	8.860	12,712,034.84	10.989	-2,462,733.68	-2.129
Ginning	38,405,959.20	33.200	13,964,321.70	12.071	24,441,637.50	21.129
Gin-Warehouse Transportation	867,604.50	0.750	802,916.50	0.694	64,688.00	0.056
Warehousing	15,304,543.38	13.230	3,606,940.70	3.118	11,167,602.68	10.112
Merchandising	37,531,231.43	32.444	37,531,231.43	32.444	0.0	0.0
Total Cost	102,358,639.67	88.484	68,617,445.17	59.316	33,741,194.50	29.168

farm-gin transportation distances result in greater assembly cost. For the study area this is nearly a 2.5 million dollar increase or $2.13 per bale. Assembly cost is $10.99 per bale. A small decrease in gin-warehouse transportation cost of $.06 is realized. These costs reflect the high economies of the ginning process and those, although not as intense, of warehousing.

Suboptimum Market Organizations. Three alternative suboptimum market structures were indicated by the optimum search process and are found to differ only slightly with the minimum cost solution. The cost of each of these alternatives is given in Table 55 and show the difference between the minimum cost organization and that of alternatives 2 and 3 to be $.14 per bale. However, alternative 1 total cost varies by only $.002 per bale from that of the optimum structure. For the study area this is about $2,000.

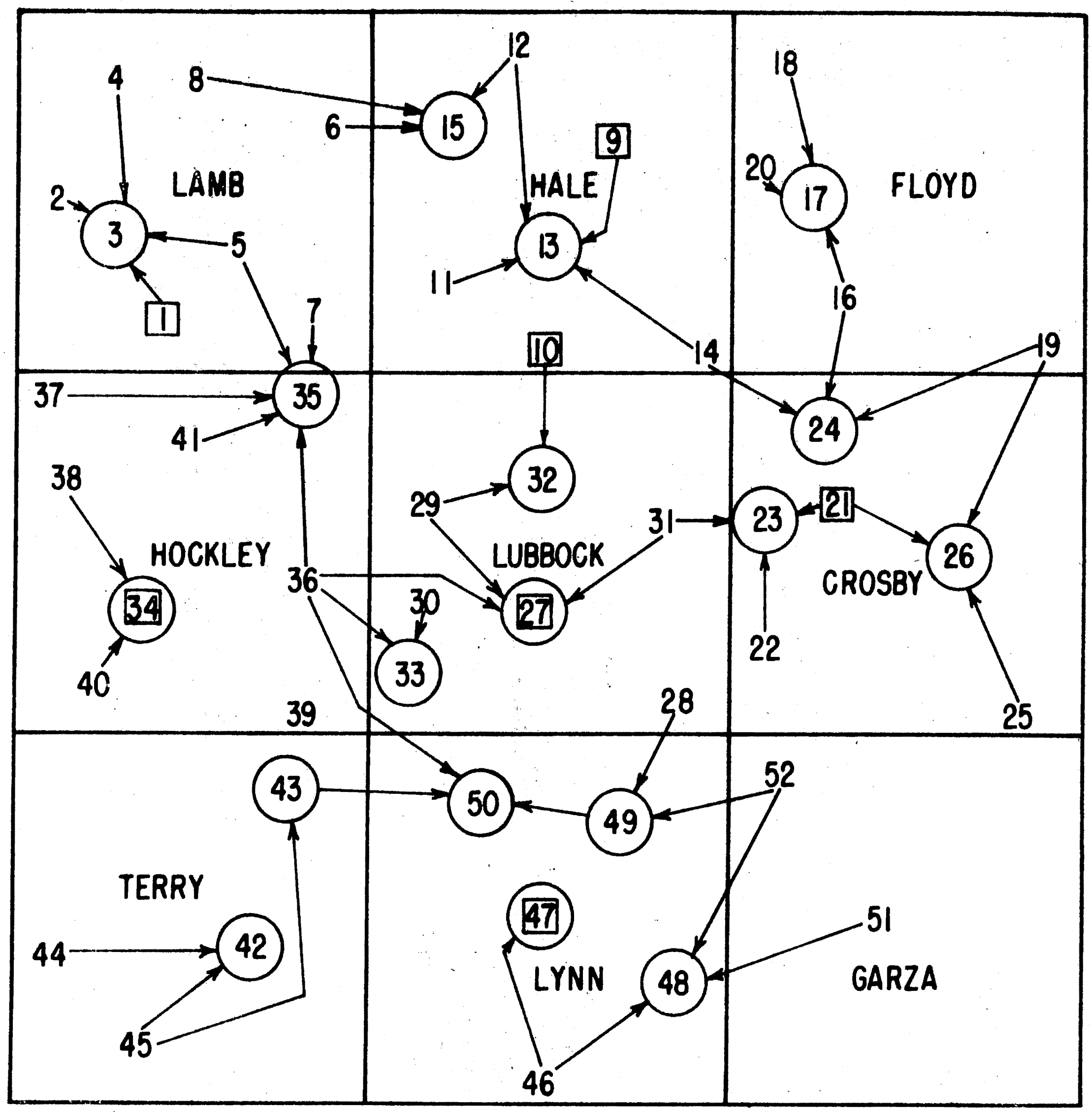
Alternative 1, Figure 41, has the same gin plant sites and ginning capacities as the optimum. However, farm-gin flows in Lubbock, Hockley, Terry and Lynn Counties show some variation. Further, Brownfield (42), in Terry County is not included as a warehouse site. Thus, this market structure has one less warehouse and the associated cost per bale is $3.11, or $.01 less than optimum structure warehouse cost. Assembly cost in this alternative is less than one cent per bale lower, but gin-warehouse transportation cost is $.02 higher. The cost of marketing cotton under this alternative is $59.32 per bale. The general flow patterns of Figure 41 are listed in more detail in Appendix Table 39. Further, gin and warehouse plant capacities and seasonal volumes are given.

Alternative structures 2 and 3, Figures 42 and 43, are identical to

Table 55. Functional Values of Suboptimum Market Organizations by Major Activity, 32 Week Ginning Season, Lubbock Study Area, 1974

Activity	Suboptimum Market Organization		
	1	2	3
		Dollars Per Bale	
Assembly	10.984	11.009	11.009
Ginning	12.107	12.159	12.159
Gin-Warehouse Transportation	0.714	0.726	0.740
Warehousing	3.105	3.118	3.105
Merchandising	32.444	32.444	32.444
Total Cost	59.318	59.456	59.456[a]

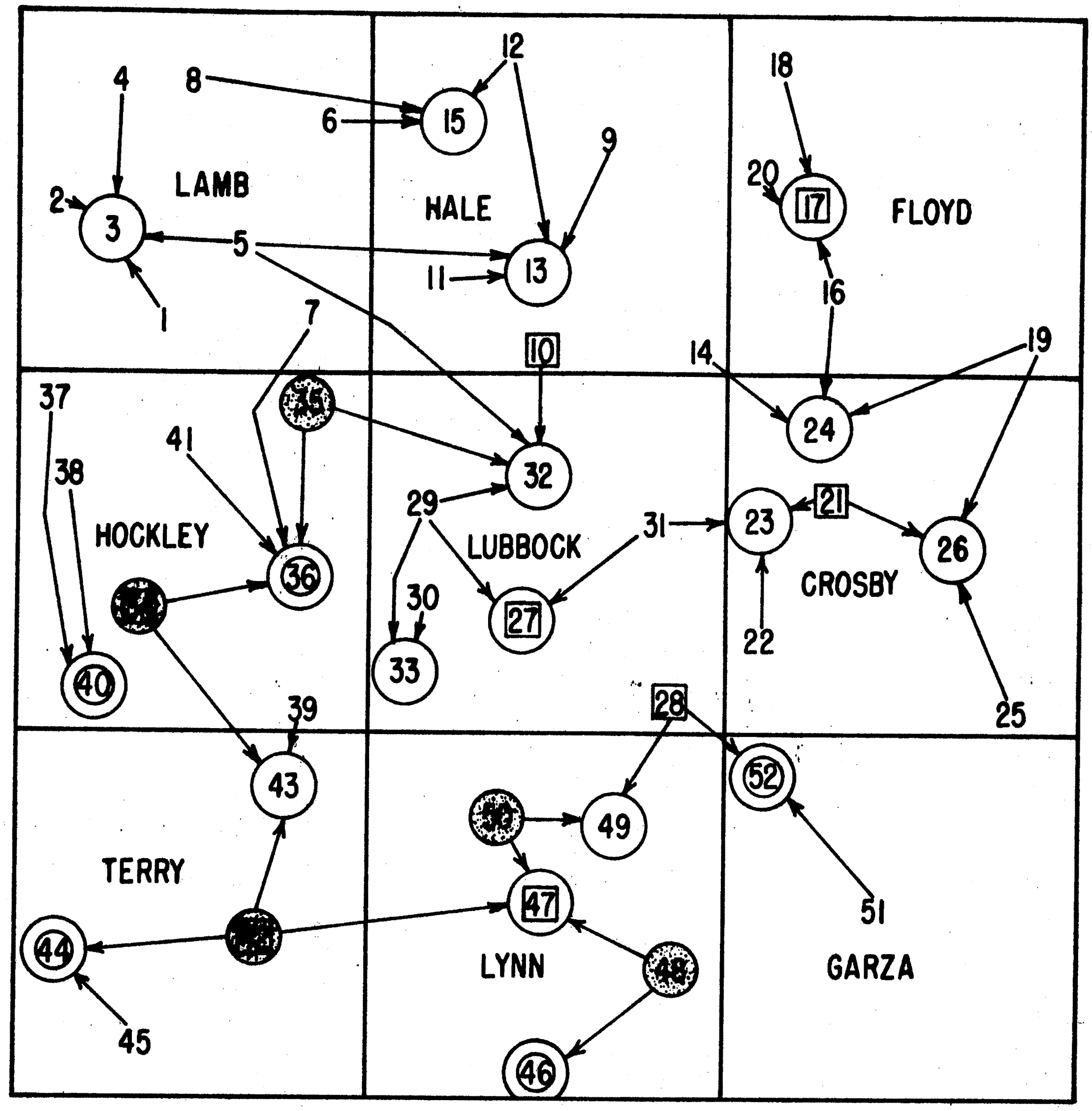
[a]Total cost does not add due to rounding



(1) - Optimum and Alternative Gin Location

[1] - Warehouse Location

Figure 41. Ginning and Warehousing Activities in Suboptimum Market Organization 1, Lubbock Study Area, 32 Week Ginning Season, 1974



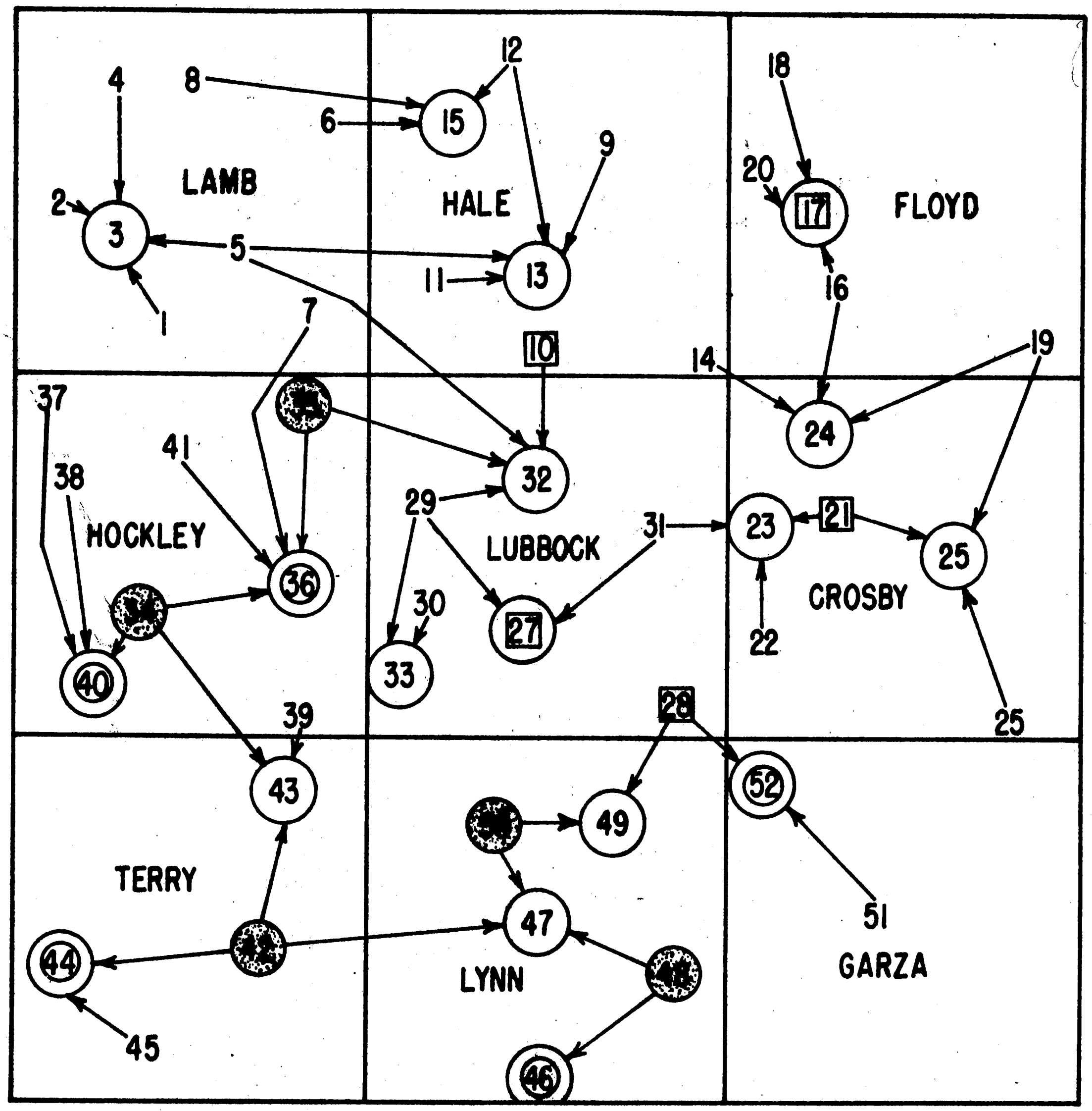
- Optimum Gin Location

- Alternative Gin Location

- Optimum and Alternative Gin Location

- Warehouse Location

Figure 42. Ginning and Warehousing Activities in Suboptimum Market Organization 2, Lubbock Study Area, 32 Week Ginning Season, 1974



- Optimum Gin Location

- Alternative Gin Location

- Optimum and Alternative Gin Location

- Warehouse Location

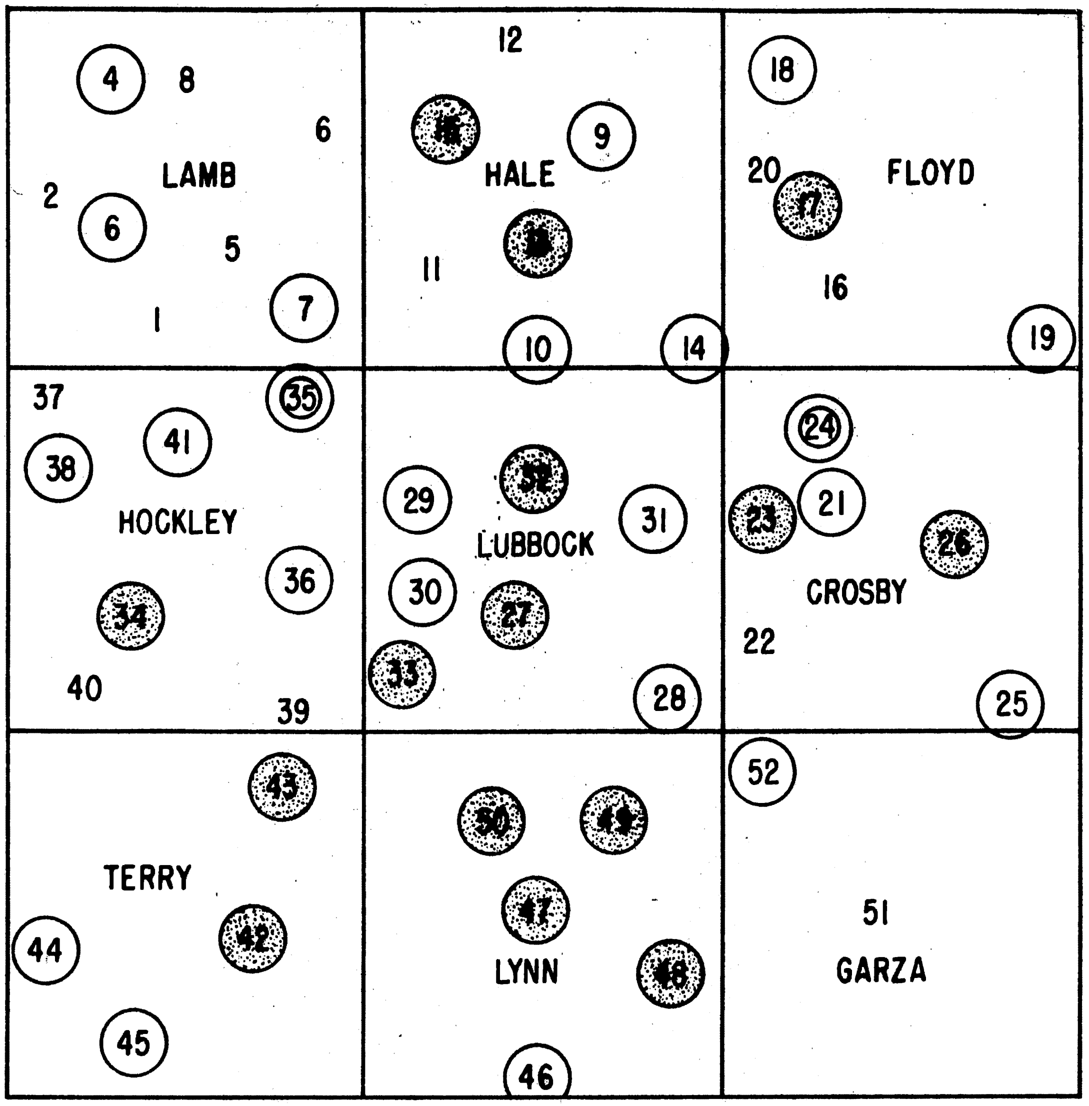
Figure 43. Ginning and Warehousing Activities in Suboptimum Market Organization 3, Lubbock Study Area, 32 Week Ginning Season, 1974

one another through the ginning stage. A warehouse facility at Tahoka (47) is part of alternative 2, but is not included in alternative 3. However, due to the variation in gin-warehouse transportation cost between the alternatives, both have the same cost of $59.46 per bale. Alternative 2 differs from the optimum structure in size and location of facilities while alternative 3 differs in size, number and location. These structures are presented in Appendix Tables 40 and 41. The optimum ginning location sites, Levelland (34), Anton (35), Brownfield (42), Grassland (48) and New Home (50) are replaced by Smyer (36), Sundown (40), Tokio (44), O'Donnell (46) and Southland (52). Further, there are two gin plants at O'Donnell. These are 7-and 42-bale per hour plants. Southland gin plant capacity is 35-bales per hour while all other plants have a capacity of 42-bales per hour. Further, the optimum warehousing sites of Littlefield (1) and Plainview (9) are not included while Lockney (17) and Slaton (28) are.

Optimum Market Organizations of Both Ginning Seasons

Achieving the 14 rather than the 32 week ginning season optimum market organization would result in an opportunity cost of $3.06 per bale. This represents over 3.5 million dollars for the nine county study area, Tables 51 and 54. The location of gin plants of these seasonal optimum market structures are presented in Figure 44.

Compared with the 14 week seasonal structure, the 32 week optimum organization ginning cost of $12.07 per bale is $4.36 lower. For the study area this difference is over five million dollars. However, assembly cost is $1.91 per bale more. Being a direct cost to the producer, this cost will be more visible, especially since it is



I - Present Gin Location

- Optimum Gin Location, 14 Week Ginning Season

- Optimum Gin Location, 32 Week Ginning Season

- Optimum Gin Location, Both Ginning Seasons

Figure 44. Ginning Activities of the 14 Week and 32 Week Ginning Season, Optimum Market Organizations, Lubbock Study Area, 1974

\$2.13 per bale larger than present assembly cost. However, given that ginning charges accurately reflect ginning costs, producers should be willing to incur this increased assembly cost so as to realize the savings in ginning and warehousing costs. Warehouse cost is \$.57 per bale lower for the 32 week season compared with the 14 week optimum market organization. Similarly, gin-warehouse transportation cost is \$.04 per bale lower.

The locational variation of warehouse facilities is shown in Figure 45. The Figure indicates warehouse sites Lockney (17) and Slaton (28) of the 14 week structure are replaced by Plainview (9) and Lubbock (27) in the 32 week operational structure. The remaining sites are common between each market structure. Economies of warehousing are evident in the organization; however, they are not as great as ginning economies.

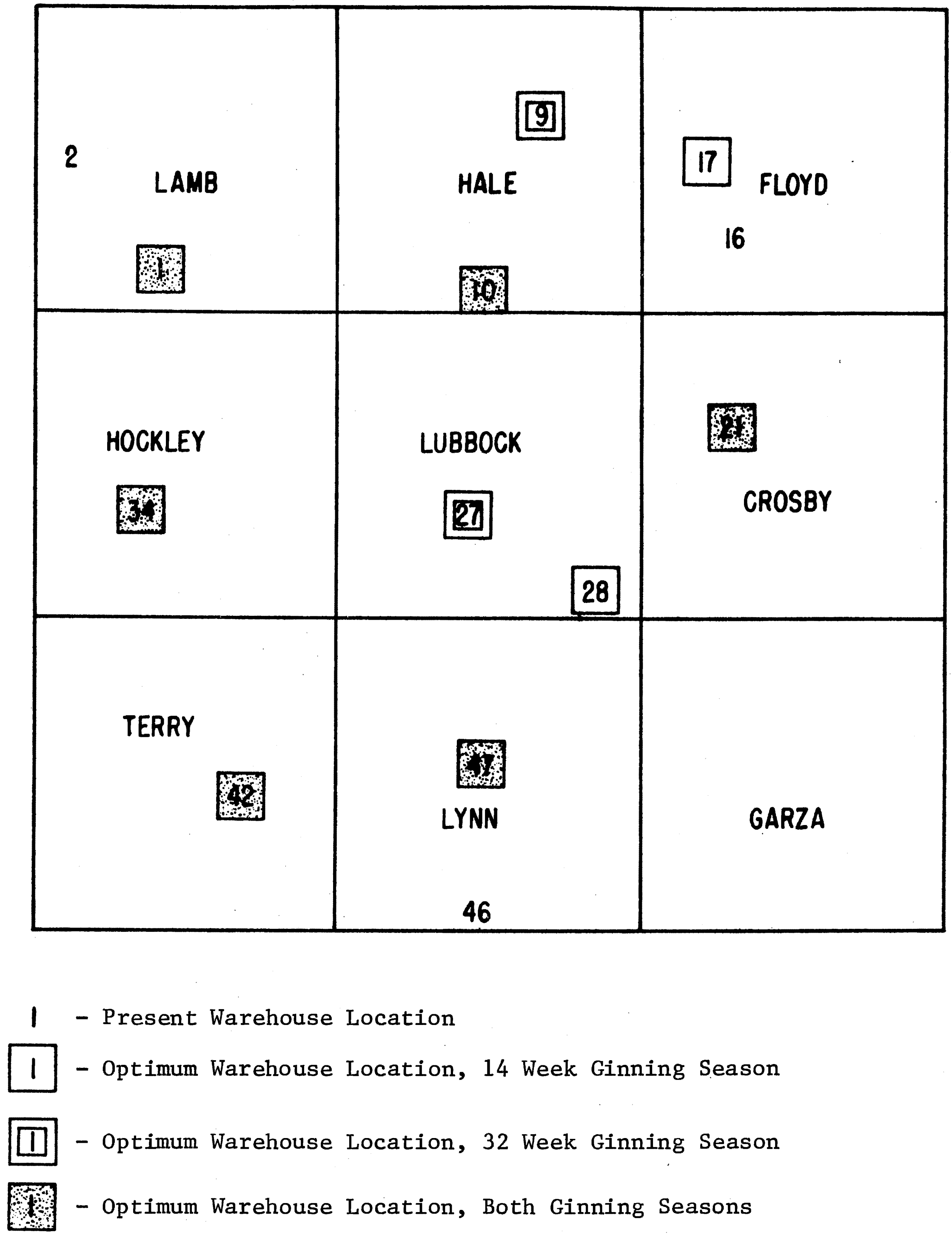


Figure 45. Warehousing Activities of the 14 Week and 32 Week Ginning Season, Optimum Market Organizations, Lubbock Study Area, 1974

CHAPTER VII

SUMMARY AND CONCLUSIONS

Summary

The cotton industry of the Oklahoma-Texas rolling plains and Texas high plains is characterized by a constantly changing economic environment. Producers are faced with a series of problems that seriously affect their future. Gin managers are traditionally faced with the problem of attempting to match the ginning rate with that of harvesting. Primary efforts in solving this problem have been: (1) store seed cotton in trailers at the gin yard and (2) add ginning capacity. However, industry members have realized the economy of long term seed cotton storage for the purpose of ginning during low periods of harvesting. One method of seed cotton storage, ricking, has become relatively wide spread in the machine stripped area.

This study investigates structural adjustments of the ginning and warehousing industries of three multi-county areas in the machine stripped region of Oklahoma and Texas. These areas are identified as Altus, Abilene and Lubbock study areas. The major objective of this study is to determine optimum market organizations for the raw cotton marketing system assuming the conventional 14 week and an extended 32 week ginning season.

Potential gin and warehouse locations are specified for each area. The longer ginning season specifies seed cotton storage in ricks while conventional methods of handling seed cotton are included in the other alternative. Consequently, farm assembly costs are developed for the conventional system and for ricked cotton.

Both alternatives assume the use of the most advanced ginning and warehousing technologies. Ginning costs are constructed for six model gin plants and for each seasonal operation. Warehousing costs associated with each ginning season are estimated from secondary data.

Six mill-export points are specified and distribution costs are estimated for each study area. Each study area is assumed to be a single point of origin for mill-export points. Further, the flow pattern of warehouse to mill-export point shipments is held fixed for each study area. Therefore, distribution (merchandising) cost does not affect the size, number and location of plants, but is included so as to estimate total marketing costs.

A mixed integer model is developed and used to determine optimum market organizations of the cotton marketing system under alternative assumptions. The model is designed to determine the least cost flow of seed cotton from sources of supply through gin plants, warehouses and then the movement of lint cotton to mill-export points. The determination of costs associated with ginning and warehousing activities utilizes the integer programming technique to account for non-linear cost functions reflecting economies of size. Further, the model determines the optimum size, number and location of gin and warehouse plants. Additionally, suboptimum market organizations are also determined.

Altus Study Area

The least cost market organization for the five county Altus study area and 14 week ginning season consists of four 42-bale per hour gins and one warehouse plant. Total marketing cost for the area is $8,059,418 or $63.28 per bale. The optimum 14 week organization shows a savings of 3.1 million dollars over the present market organization. This savings, $25.04 per bale, represents 28 percent of the present $88.32 cost per bale and results from economies available in ginning and warehousing. Ginning cost is reduced 50 percent to $16.50 per bale and warehouse cost is reduced 72 percent, to $3.71 per bale. This amounts to a savings of 2.1 and 1.2 million dollars in ginning and warehousing, respectively. Small increases over present system costs are given for farm assembly and gin-warehouse transportation activites. This four gin plant and one warehouse plant structure represents reductions in plant numbers of 90 and 86 percent, respectively.

Two 42-bale per hour gin plants and two warehouses are included in the least cost market structure for the Altus area 32 week ginning season. Compared with the present structure this is a 95 percent decrease in gin plants and a 71 percent decrease in warehouses. The cost of marketing cotton as given by the optimum solution is just over 7.6 million dollars or $60.04 per bale. This is over a 3.6 million dollar savings ($28.28 per bale) and represents a 32 percent decrease in present system costs. Primary cost reductions occur in ginning and warehousing as per bale costs are reduced to $12.11 and $3.25 per bale, respectively. These represent reduced costs for the area of nearly 2.7 and 1.3 million dollars, respectively. However, optimum organization farm assembly cost shows a significant increase over the present system cost. The present cost of $8.86 per bale is increased to $11.71 per bale, an increase in farm assembly cost of $2.85

per bale. The opportunity cost of achieving the 14 week structure and not the 32 week market structure is $3.34 per bale. This represents over $400,000 for the study area.

Abilene Study Area

The optimum market structure for the Abilene study area 14 week ginning season includes four 42-bale per hour gin plants and one warehouse facility. This is an 88 and 86 percent decrease in the present number of these respective processing facilities. The cost associated with this organization is less than 8 million dollars or $62.70 per bale, and represents a 29 percent decrease in present costs. Compared with the present market organization, the opportunity cost of not achieving the optimum is 3.2 million dollars or $25.62 per bale. Ginning cost is reduced from $33.20 to $16.52 per bale. This savings in ginning is over 2.1 million dollars for the four county area. Warehousing cost for the area is reduced 1.2 million dollars, from $13.23 to $3.71 per bale. However, movement to the optimum 14 week market structure would result in increased costs for farm assembly ($.56 per bale) and gin-warehouse transportation ($.03 per bale).

The least cost solution for the Abilene 32 week ginning season is $7,549,963; $59.40 per bale, and represents a 33 percent decrease in the present market costs. The market organization specified two 42-bale per hour gin plants and one warehouse facility. This solution reduces ginning facilities by 94 percent and indicates a possible savings of nearly 3.7 million dollars over present structure cost of 11.2 million dollars. The cost per bale of this solution is $59.40. As was the case with the 14 week ginning season, primary cost reductions are in ginning and warehousing with ginning cost being reduced to $12.12 per bale. This reduction of $21.08 per bale amounts to nearly 2.7 million dollars, a 63 percent decrease in the cost of ginning. Warehousing cost per bale is reduced $10.10 to $3.13. Contrasted to present warehouse cost of $13.23 per bale, this represents a savings of over 1.2 million dollars for the area. Achieving this optimum structure would decrease gin-warehouse transportation cost only slightly, but would increase farm assembly cost by $2.33 per bale. For the area this is less than $300,000. The opportunity cost of achieving the 14 week and not that of the 32 week ginning season is $3.28 per bale, or over $400,000 for the study area.

Lubbock Study Area

The nine county Lubbock study area differs from the other two areas in that production is about nine times greater than that of the Altus or Abilene areas. The optimum market organization for the conventional ginning season consists of 36 gin plants and 8 warehouse plants. However, this represents an 83 percent decrease in the 217 gin plants presently operating in the area. The reduction in warehouse numbers is 43 percent. All gin plant capacities are 42-bale per hour and warehouse capacities range from 75,346 to 172,920 bales. The cost of moving cotton from farm to mill as given by this optimum market organization is 72.2 million dollars ($62.38 per bale) and is 30 percent less than the current cost of 102.4 million dollars. This represents a savings of 30.2 million dollars for the area or $26.10 per bale. Ginning cost is $16.43 per bale and is 51 percent or 19.4 million dollars less than present structure cost. Warehousing cost of $3.69 per bale is 11 million dollars or $9.54 per bale less than current cost. This represents a decrease in warehouse cost of 72 percent. Gin-warehouse transportation cost remains relatively unchanged; however, farm assembly cost increases 3 percent, from $8.86 to $9.08 per bale or $253,405 for the area.

Eighteen 42-bale per hour gin plants and eight warehouse facilities are specified in the optimum market organization for the Lubbock area 32 week ginning season. Compared with the current organization, this is a 92 percent decrease in gin numbers and a 43 percent decrease in warehouse numbers. Warehouse capacity ranges from 24,795 to 96,275 bales. The functional value of the associated least cost solution is $68,617,445 and is $33,741,195 (33 percent) less than currently expended to move cotton from farm to mill-export points. The per bale costs of the optimum and present organizations are $59.32 and $88.48, respectively.

The least cost solution indicates an increase in farm assembly cost over current cost; however, significant decreases are indicated for the ginning and warehousing activities. Assembly cost increases 2.5 million dollars (24 percent) or $2.14 per bale. Therefore, farm assembly cost in the optimum structure is $10.99 per bale. Ginning cost is reduced 64 percent, to $12.07 per bale, and is 24.4 million dollars less than the 38.4 million dollar cost presently incurred. Similarly, warehouse cost is reduced 77 percent, from 15.3 to 3.6 million dollars, or 11.7 million dollars. Warehousing cost is $3.12 per bale. Gin-warehouse transportation cost decreases by six cents per bale. The opportunity cost of achieving the 14 week optimum organization as opposed to the 32 week ginning season organization is $3.06 per bale or 3.5 million dollars.

Implications

Some producers would benefit more than others. Producers located close to gin sites would incur a smaller farm assembly cost than those who have to transport their seed cotton further. Since some gin plants do not operate at full capacity, their costs will be greater than those that process at maximum capacity. However, movement to the extended ginning season optimum organization must be accompanied with research delineating who shares in the indicated cost reductions.

The analysis suggests a substantial reorganization of the industry if costs are to be minimized. Specifically, if cost efficiency is an industry goal, individual gin plant capacity must be substantially increased. Further, the analysis indicates a substantial reduction in the number of processing plants.

The four gin plant and two gin plant location pattern for the respective Altus and Abilene 14 and 32 week ginning organizations would allow each firm to increase their market areas, thereby extending their competitive advantage. This results because the opportunity for producers to secure gin services would be decreased. With only one or two warehouses in these study areas, the competitive advantage of these firms would also be enhanced since storage availability would be limited.

However, for these reasons, the present organization, or at least a large number of gin and warehouse plants might be more acceptable if least cost organization is not a primary consideration of the industry. Waugh, in writing about efficiency observed that: "...the public may prefer to keep some known inefficiencies, rather than to adopt new methods--especially if the prospective improvements in efficiency might reduce employment, decrease price competition, or lead to greater concentration of economic power" (French forthcoming, p. 3).

However, cost efficiency is an important goal of the cotton industry. The optimum market organization would allow gin plants to obtain the volume required to support high capacity facilities and a longer ginning season.

A smaller number, but greater size, of ginning facilities is associated with increased assembly cost. Therefore, the economies of ginning necessitate an increased direct cost to the producer. Consequently, if movement toward the optimum market structure is to be accomplished, the industry must also crease a means by which producers are assured that the costs of ginning and warehousing services are reflected by the charges paid for such services.

Given that considerable cost reductions are possible from a reorganization of present cotton marketing structures in each of the study areas, consideration must be given as to how to move to these optimum organizations. Many of the existing ginning and warehousing plants are producer cooperatives or corporate facilities; therefore, cooperative mergers and corporate mergers are approaches to industry reorganization. Further, individual firm ownership may be included. This approach is viewed as a relatively rapid one and would allow maximum cost saving to be achieved in a short period of time. However, immediate closing of well over half the existing processing facilities would probably be met with widespread resistance from producers, gin managers and warehouse managers. Further, any capital investment not recovered by firms ceasing operation would represent a cost to the industry.

A second alternative is that of a gradual transition. Small gin plants as well as those not optimally located would be closed over a period of several years as would warehouse facilities not included in the optimum market structure. New firms consistent with the desired market organization, would be established. The optimum industry structure could, over time, be reached; but, the realization of maximum cost savings would require a longer time period. However, it is not likely that either method would allow for the maximum cost savings because of the many industry individuals, making complex decisions independently, would probably preclude the transition to the optimum size, number and locations of gin and warehouse plants. Nevertheless, the optimum market organizations proposed can serve as the focal point for a more efficient marketing system.

Movement to the optimum market structure and the realization of associated cost savings will depend in part on how well the results of this research are disseminated to the industry. Producers must be made aware of potential cost savings that could result from an industry reorganization.

Institutional constraints such as the control of ginning charges as practiced in Oklahoma could limit competition and therefore preclude movement to the optimum market organization. However, if ginning charges accurately reflect ginning costs at near the optimum size for individual plants such insitutional constraints probably would not act to limit competition.

Limitations

Several limitations of the analysis and model development should be recognized. First, cost efficiency is used as the sole criterion in studying market performance. Other considerations of interest might have included economic concentrations, conditions of entry, price competition and the marginal efficiency of capital. Second, the mixed integer solution procedure used is a static model. Therefore, the optimum size, number and location of processing facilities may vary with changes in cost patterns. Third, a given production level was specified and variations in this level could alter optimum market organization. Due to the uncertainties involved in cotton production, the 1974 production estimates used in the study only reflect actual production levels. A fourth limitation is in the selection of potential plant locations. While an infinite number of locations can be considered as possible gin and warehouse sites, a finite set was selected for each study area. Even though potential processing facility location is based on practical considerations in plant location, the selection process is somewhat arbitrary. Consequently, another set of potential processing locations could also alter optimum market organizations.

In one model the assumption was made that conventional farm assembly methods would be used. Seed cotton storage was assumed in the other model. However, it might be anticipated that some combination of ricking and conventional trailer usage may be more economical. Further, the economic feasibility of some gin plants operating for 14 weeks while other plants operate for 32 weeks should also be recognized. These alterations to the basic model could also alter optimum market organizations.

An additional limitation of the model concerns seed cotton storage. The assumption was made that seed cotton could be stored for an extended time period. Past research has pointed to its feasibility; however, further study is required, particularly as to the best methods and techniques.

An alternative not considered in the analysis was the existence of staging areas or reload stations for seed cotton. Within the analysis presented, the transportation cost of shipping seed cotton from one producing area to another was based on that seed cotton being first moved to a central point in its area of production. Further analysis could consider this central point as a staging area for aggregating seed cotton into lots. In this respect the relative economies of aggregation must be considered.

The merchandising activity was held fixed in the analysis. Therefore, any possible cost reduction available to this activity as a result of industry reorganization are not accounted for.

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APPENDIX A

MODEL DATA

Appendix Table 1. Specifications of Processing and Materials Handling Equipment for Model Ginning Plants in Sequential Operating Order by Recommended Size, Actual Power Requirements, and Connected Load, Machine Stripped Harvest Areas, Oklahoma and West Texas, 1974

Bale Capacity Per Hour

Ginning Equipment	7			14			21			28			35			42		
	Equipment	Power Needs	Connected Load	Equipment	Power Needs	Connected Load	Equipment	Power Needs	Connected Load	Equipment	Power Needs	Connected Load	Equipment	Power Needs	Connected Load	Equipment	Power Needs	Connected Load
	Number and Size	H.P.	H.P.	Number and Size	H.P.	H.P.	Number and Size	H.P.	H.P.	Number and Size	H.P.	H.P.	Number and Size	H.P.	H.P.	Number and Size	H.P.	H.P.
Airline cleaner	1-50"	4	5.0	2-50"	8	10.0	2-72"	10	15.0	2-96"	13	15.0	2-120"	16	20.0	2-120"	18	30.0
Unloading fan	1-40	39	40.0	2-45	86	100.0	2-50	86	100.0	—	120	150.0	—	156	200.0	—	175	200.0
Feed control assembly	1-50"	4	5.0	2-50"	8	10.0	2-72"	12	15.0	—	14	20.0	--	17	23.5	—	20	23.5
Push fan, No. 1 dryer	1-35	25	30.0	2-35	30	40.0	2-35	50	60.0	2-50	75	100.0	2-50	80	100.0	2-50	90	100.0
No. 1 incline cleaner (vacuum wheel)	1-50"	4	5.0	2-50"	8	10.0	2-72"	10	15.0	2-96	13	15.0	2-120"	20	30.0	2-120"	23	30.0
Pull fan, No. 1 cleaner	1-35	26	30.0	2-35	30	40.0	2-35	52	60.0	2-50	75	100.0	2-50	90	100.0	2-50	95	100.0
Bur machine	1-10'	5	7.5	2-10'	10	15.0	2-14'	14	20.0	2-120"	12	15.0	2-120"	12	15.0	2-120"	12	15.0
Push fan, No. 2 dryer	1-35	25	30.0	1-40	30	40.0	2-35	50	60.0	2-50	70	100.0	2-50	80	100.0	2-50	90	100.0
No. 2 incline cleaner (vacuum wheel)	1-50"	4	5.0	2-50	8	10.0	2-72"	10	15.0	2-96	13	15.0	2-120"	20	30.0	2-120"	25	30.0
Pull fan, No. 2 cleaner	1-35	26	30.0	2-35	52	60.0	2-35	52	60.0	2-40	75	100.0	2-50	90	100.0	2-50	95	100.0
Stick machine	1-72"	3	5.0	2-72	6	10.0	2-96"	10	15.0	2-120"	12	15.0	2-120"	12	15.0	2-120"	15	20.0
Distributor and overflow separator	—	4	5.0	—	6	7.5	—	7	7.5	—	10	15.0	—	12	15.0	—	13	15.0
Live overflow fan	1-30	12	20.0	1-40	26	30.0	1-45	35	40.0	2-30	45	60.0	2-30	60	80.0	2-30	70	80.0
Trash fan (faders and gin stands)	1-30	12	20.0	1-40	26	30.0	1-45	35	40.0	1-50	45	60.0	1-50	55	60.0	1-50	55	60.0
Trash fan (bur machine and airline cleaner)	1-35	21	25.0	2-35	42	50.0	2-40	60	80.0	2-40	60	80.0	2-40	60	80.0	2-40	65	80.0
Feeding, ginning, doffing	—	84	37.5	—	168	175.0	--	252	262.5	—	336	350.0	—	420	437.5	—	504	525.0
1st stage lint cleaning																		
Lint cleaner	—	14	15.0	—	28	45.0	—	47	60.0	--	68	75.0	--	84	90.0	--	95	100.0
Vane-axial fan	--	9	10.0	—	18	20.0	—	36	40.0	—	45	50.0	—	54	60.0	—	64	75.0
Mote fans	1-30	12	20.0	1-35	21	25.0	1-40	30	40.0	1-40	30	40.0	1-40	40	50.0	1-40	45	50.0
2nd stage lint cleaning																		
Lint cleaner	--	14	15.0	--	28	45.0	--	47	60.0	—	68	75.0	--	84	90.0	--	95	100.0
Vane-axial fan	--	9	10.0	—	18	20.0	--	36	40.0	--	45	50.0	--	54	60.0	—	64	75.0
Mote fans	1-30	12	20.0	1-35	21	25.0	1-40	30	40.0	1-40	30	40.0	1-40	40	50.0	1-40	45	50.0
Condenser	--	1	2.0	--	1	2.0	--	1	2.0	--	2	3.0	--	2	3.0	--	2	3.0
Condenser exhaust fan (vane axial)	1-29"	8	10.0	1-29"	8	10.0	1-36"	17	20.0	1-42"	23	25.0	1-42"	30	40.0	1-42"	35	40.0
Lint fly fan	1-30	11	15.0	1-35	18	20.0	1-40	25	30.0	1-40	26	30.0	1-40	30	40.0	1-40	35	40.0
Air compressor	—	2	5.0	—	2	5.0	--	2	5.0	--	20	50.0	--	25	50.0	--	25	50.0
Kicker & tramper	--	6	15.0	--	25	30.0	--	25	50.0	--	25	50.0	—	25	50.0	--	25	50.0
Press pump	--	3	25.0	--	50	100.0	—	75	125.0	--	100	150.0	—	125	250.0	—	150	250.0
Seed belt and trash auger	--	2	3.0	--	2	3.0	—	6	7.5	--	9	15.0	—	10	15.0	—	12	15.0
Seed blower	--	8	10.0	--	12	15.0	—	12	15.0	--	17	20.0	—	21	25.0	—	23	25.0
Total	—	409	525.0	--	796	1,002.5	--	1,133	1,399.5	--	1,496	1,883.0	--	1,824	2,279.0	--	2,080	2,431.5
Total Electrical Energy[a]	(KWH)	276,322			537,781			765,460			1,010,704			1,232,302			1,405,257	
Electrical Energy (Per Bale)	(KWH)	51.25			49.88			47.33			46.87			45.72			43.45	
KW Demand[b]	--	290			564			803			1,060			1,293			1,474	

[a]Power needs multiplied by operating hours and the product multiplied by 0.7457, the ratio of HP to KWH; listed requirements are for the 14-week ginning season

[b]Power needs multiplied by 0.7457 and the product multiplied by 0.95

Appendix Table 2. Estimated Annual Depreciation and Interest Cost for Model Gins Equipped to Handle Machine Stripped Cotton, by Rated Capacity and Capital Item, Oklahoma and West Texas, 1974

Capital Item	Bale Capacity Per Hour					
	7	14	21	28	35	42
			Dollars			
Depreciation:[a]						
Gin Buildings	2,500	7,650	10,500	12,900	21,750	24,250
Gin Machinery and Equipment	15,860	26,500	35,025	44,800	47,050	49,900
Outside Equipment	1,280	2,250	3,000	3,750	5,000	5,750
Tools	100	150	150	200	250	300
Office Equipment	600	600	840	840	1,400	1,680
Total	20,340	37,150	49,515	62,490	75,450	81,880
Interest:[b]						
Land	1,080	1,260	1,620	1,800	2,700	3,600
Gin Buildings	2,250	6,885	9,450	11,610	19,575	21,825
Gin Machinery	14,274	23,850	31,523	40,343	42,345	44,910
Other	1,782	2,700	3,591	4,311	5,985	6,957
Total	19,386	34,695	46,184	58,064	70,605	77,292

[a]Depreciation calculated by straight-line method at 5 percent annually, no salvage value

[b]Interest calculated at a rate of 9 percent on land and 9 percent on one-half of other items

Appendix Table 3. Management and Permanent Personnel for Model Gins Equipped to Handle Machine Stripped Cotton, by Capacity and Length of Season, Oklahoma and West Texas, 1974

	Bale Capacity Per Hour											
	7	14	21	28	35	42	7	14	21	28	35	42
	14 Week Ginning Season						32 Week Ginning Season					
	Personnel											
Manager	1	1	1	1	1	1	1	1	1	1	1	1
Assistant Manager	–	–	1	1	1	1	–	–	1	1	1	1
Ginner	–	1	1	1	1	1	1	1	1	1	1	1
Gin Labor	–	–	–	–	–	–	1	1	2	2	2	2
Bookkeeper	–	1	1	1	1	1	1	1	1	1	1	1
Assistant Bookkeeper	–	–	–	–	–	–	–	–	–	–	1	1
Clerk	1	–	–	1	1	1	–	1	1	1	1	1
Total	2	3	4	5	5	5	4	5	7	7	8	8

Appendix Table 4. Estimated Salary of Management and Other Permanent Personnel for Model Gin Plants Equipped to Handle Machine Stripped Cotton, Oklahoma and West Texas, 1974

Function	Bale Capacity Per Hour					
	7	14	21	28	35	42
			Dollars			
Manager	9,000	11,000	13,000	15,000	19,000	23,000
Assistant Manager			9,000	10,000	11,000	12,000
Ginner	8,640	8,640	8,640	8,640	8,640	8,640
Other Crew	6,048	6,048	6,048	6,048	6,048	6,048
Bookkeeper	6,480	6,480	6,480	6,480	6,480	6,480
Assistant Bookkeeper	6,192	6,192	6,192	6,192	6,192	6,192
Clerk	6,048	6,048	6,048	6,048	6,048	6,048

Appendix Table 5. Estimation of Weekly Regular and Overtime Hours for 14 Week Ginning Season, Oklahoma and West Texas, 1974

Item	Weekly Period														Total Hours
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Day Crew:															
Regular Hours	46	46	66	66	66	66	66	66	60	60	48	48	48	48	800
Overtime Hours	2	2	6	6	6	6	6	6	12	12					64
Total Day Hours	48	48	72	72	72	72	72	72	72	72	48	48	48	48	864
Night Crew:															
Regular Hours				66	66	66	66	66	66						396
Overtime Hours				6	18	18	6	6	6						60
Total Night Hours				72	84	84	72	72	72						456
Total Hours	48	48	72	144	156	156	144	144	144	72	48	48	48	48	1,320

Appendix Table 6. Estimated Annual Fixed and Variable Costs for a 14-Bale Per Hour Model Gin Equipped to Handle Machine Stripped Cotton, by Length of Season, Oklahoma and West Texas, 1974

Cost Item	Season: 14 Weeks	Season: 32 Weeks
	Dollars	
Fixed Costs:		
Depreciation	37,150	37,150
Interest	34,695	34,695
Insurance	4,755	4,755
Taxes	7,570	7,570
Management	11,753	11,753
Permanent Gin Labor	9,232	15,634
Permanent Office Help	6,859	13,261
Total Fixed Cost	112,014	124,818
Variable Costs:		
Office Help	1,867	1,660
Plant Labor	30,503	51,869
Electrical Energy	15,757	32,912
Bagging and Ties	24,257	48,515
Repairs	32,330	48,495
Miscellaneous	21,993	42,262
Total Variable Cost	126,707	225,713
Total Fixed and Variable Cost	238,721	350,531
Seasonal Volume (Bales)	10,781	21,562
Fixed Cost Per Bale	10.39	5.79
Variable Cost Per Bale	11.75	10.47
Total Cost Per Bale	22.14	16.26

Appendix Table 7. Estimated Annual Fixed and Variable Costs for a 21-Bale Per Hour Model Gin Equipped to Handle Machine Stripped Cotton, by Length of Season, Oklahoma and West Texas, 1974

Cost Item	Season 14 Weeks	Season 32 Weeks
	Dollars	
Fixed Costs:		
Depreciation	49,515	49,515
Interest	46,184	46,184
Insurance	6,338	6,338
Taxes	10,083	10,083
Management	23,377	23,377
Permanent Gin Labor	9,232	22,035
Permanent Office Help	6,859	13,261
Total Fixed Cost	151,588	170,793
Variable Costs:		
Office Help	1,867	3,319
Plant Labor	40,471	66,332
Electrical Energy	22,428	46,693
Bagging and Ties	36,387	72,774
Repairs	42,731	64,096
Miscellaneous	32,344	60,807
Total Variable Cost	176,228	314,021
Total Fixed and Variable Cost	327,816	484,814
Seasonal Volume (Bales)	16,172	32,344
Fixed Cost Per Bale	9.37	5.28
Variable Cost Per Bale	10.90	9.71
Total Cost Per Bale	20.27	14.99

Appendix Table 8. Estimated Annual Fixed and Variable Costs for a 28-Bale Per Hour Model Gin Equipped to Handle Machine Stripped Cotton, by Length of Season, Oklahoma and West Texas, 1974

Cost Item	Season 14 Weeks	32 Weeks
	Dollars	
Fixed Costs:		
Depreciation	62,490	62,490
Interest	58,064	58,064
Insurance	8,002	8,002
Taxes	12,703	12,703
Management	26,457	26,457
Permanent Gin Labor	9,232	22,035
Permanent Office Help	13,261	13,261
Total Fixed Cost	190,209	203,012
Variable Costs:		
Office Help	1,867	3,319
Plant Labor	40,471	66,332
Electrical Energy	29,411	61,451
Bagging and Ties	48,517	97,034
Repairs	53,790	80,685
Miscellaneous	42,263	78,489
Total Variable Cost	216,319	387,310
Total Fixed and Variable Cost	406,528	590,322
Seasonal Volume (Bales)	21,563	43,126
Fixed Cost Per Bale	8.82	4.71
Variable Cost Per Bale	10.03	8.98
Total Cost Per Bale	18.85	13.69

Appendix Table 9. Estimated Annual Fixed and Variable Costs for a 35-Bale Per Hour Model Gin Equipped to Handle Machine Stripped Cotton, by Length of Season, Oklahoma and West Texas, 1974

Cost Item	Season 14 Weeks	32 Weeks
	Dollars	
Fixed Costs:		
Depreciation	75,450	75,450
Interest	70,605	70,605
Insurance	9,658	9,658
Taxes	15,390	15,390
Management	31,525	31,515
Permanent Gin Labor	9,232	22,035
Permanent Office Help	13,261	19,815
Total Fixed Cost	225,121	244,478
Variable Costs:		
Office Help	2,801	4,979
Plant Labor	43,793	72,179
Electrical Energy	35,860	74,924
Bagging and Ties	60,647	121,293
Repairs	56,460	84,690
Miscellaneous	51,752	94,878
Total Variable Cost	251,313	452,943
Total Fixed and Variable Cost	476,434	697,421
Seasonal Volume (Bales)	26,954	53,908
Fixed Cost Per Bale	8.35	4.54
Variable Cost Per Bale	9.32	8.40
Total Cost Per Bale	17.67	12.94

Appendix Table 10. Estimated Annual Fixed and Variable Costs for a 42-Bale Per Hour Model Gin Equipped to Handle Machine Stripped Cotton, by Length of Season, Oklahoma and West Texas, 1974

Cost Item	Season 14 Weeks	Season 32 Weeks
	Dollars	
Fixed Costs:		
Depreciation	81,880	81,880
Interest	77,292	77,292
Insurance	10,481	10,481
Taxes	16,776	16,776
Management	36,594	36,594
Permanent Gin Labor	9,232	22,035
Permanent Office Help	13,261	19,815
Total Fixed Cost	245,516	264,873
Variable Costs:		
Office Help	2,801	4,979
Plant Labor	47,116	78,026
Electrical Energy	40,893	85,440
Bagging and Ties	72,774	145,548
Repairs	59,880	89,820
Miscellaneous	60,807	109,970
Total Variable Cost	284,271	513,783
Total Fixed and Variable Cost	529,787	778,656
Seasonal Volume (Bales)	32,344	64,688
Fixed Cost Per Bale	7.59	4.09
Variable Cost Per Bale	8.79	7.95
Total Cost Per Bale	16.38	12.04

Appendix Table 11. Estimated Gin Machinery Repairs Cost by Gin Size and Operating Season for Gins in Machine Stripped Area, Oklahoma and West Texas, 1974

Gin Capacity	Gin Machinery Investment	Repair Rate 14 Week Season		Repair Rate 32 Week Season	
Bales Per Hour	Dollars	Percent	Dollars	Percent	Dollars
7	317,200	6.20	19,666	9.30	29,500
14	530,000	6.10	32,330	9.15	48,495
21	700,500	6.10	42,731	9.15	64,096
28	896,500	6.00	53,790	9.00	80,685
35	941,000	6.00	56,460	9.00	84,690
42	998,000	6.00	59,880	9.00	89,820

Appendix Table 12. Index Series Used to Estimate 1974 Cotton Warehouse Costs, Oklahoma and West Texas

Year	Index	1974-1969 Ratio
	1967 = 100	
Wholesale Price Index:		
1969	106.5	1.5129
1974[a]	161.125	
Labor Cost Index:		
1969	117.0	1.5299
1974[b]	179.0	

[a]Estimated, all commodities, unadjusted

[b]Estimated, Terry Crawford, U.S.D.A. ERS

Source: (U. S. Department of Labor, p. 6)
(U. S. Department of Agriculture 1974b, p. 24)

Appendix Table 13. Estimated Monthly Receiving and Shipping Distributions for Warehouses Receiving Cotton Ginned over a 32 Week Ginning Season, Oklahoma and West Texas

Month	Receipts	Shipments	Receipts In Storage	Warehouse Utilization
		Percent of Receipts		Percent of Capacity
August		4	-4	4
September		1	-5	2
October	3	2	-4	4
November	15	4	7	34
December	15	7	15	55
January	15	11	19	65
February	15	10	24	79
March	15	11	28	89
April	15	11	32	100
May	7	14	25	81
June		13	12	47
July		12	0	15

Appendix Table 14. Cost of Merchandising Cotton by Major Cost Item, Origin and Destination, Oklahoma and West Texas, 1973

Item	Mill Area					
	201	200	New England	Alabama Georgia	Other Domestic	Foreign
	Dollars Per Bale					
Buying and Local Delivery	.61	.50	1.00	.83	.58	.59
Cotton Insurance	.14	.15	.10	.12	.21	1.78
Financing	1.45	1.00	1.81	2.12	1.23	1.27
Selling	.59	.50	.91	.67	.51	1.36
Overhead	2.56	.50	3.50	2.36	2.24	2.45
Miscellaneous	.27	.25	.28	.57	.28	.32
Total Cost[a]	5.62	4.90	7.60	6.67	5.05	7.77

[a]Excluding transportation cost

Source: (Chandler and Glade, p. 22)

Appendix Table 15. Percentage Shipments of Cotton from Warehouses by Mode of Transportation and Destination, Oklahoma and West Texas, 1974

Destination	Study Area					
	Altus		Abilene		Lubbock	
	Rail	Truck	Rail	Truck	Rail	Truck
			Percent			
Group 201 Mills	98.67	1.33	99.10	.90	99.09	.91
Group 200 Mills	96.54	3.46	97.48	2.52	98.93	1.07
New England Mills	100.00		98.63	1.37	100.00	
Alabama-Georgia Mills	90.41	9.59	97.97	2.03	96.74	3.26
Other Domestic Mills[a]	94.1	5.90	88.34	11.66	78.37	21.63
Foreign Mills[b]						

[a]Principally Texas

[b]Shipped by rail and truck to Texas Gulf ports and transshipped by ocean freight

Appendix Table 16. Cost of Shipping Cotton from Warehouses by Mode of Transportation and Destination, Oklahoma and West Texas, 1974

Destination	Study Area					
	Altus		Abilene		Lubbock	
	Rail	Truck	Rail	Truck	Rail	Truck
	Dollars Per Bale					
Group 201 Mills	7.73	10.25	7.87	10.25	8.30	10.25
Group 200 Mills	8.02	12.25	8.26	12.25	8.78	12.25
New England Mills	10.94	17.00	10.90	17.00	11.38	17.00
Alabama-Georgia Mills	7.26	8.22	6.99	8.22	8.05	8.22
Other Domestic Mills[a]	5.90	5.73	5.14	5.34	5.76	5.34
Foreign Mills[b]						

[a]Principally Texas

[b]Shipped by rail and truck to Texas Gulf ports and transshipped by ocean; ocean freight cost is \$24.80 per bale, Table 29.

Appendix Table 17. Gin to Warehouse Transportation Cost by Origin and Destination, Altus Study Area, 1974[a]

Gin Location	Warehouse Location				
	Frederick	Mt. View	Hobart	Altus	Mangum
	Dollars Per Bale				
Davidson	0.75	1.40	1.25	1.10	1.40
Grandfield	0.90	1.50	1.50	1.40	1.50
Manitou	0.65	1.25	1.10	0.90	1.25
Tipton	0.75	1.25	1.10	0.90	1.10
Frederick	0.65	1.25	1.25	1.00	1.25
Mt. View	1.25	0.65	0.90	1.25	1.25
Hobart	1.25	0.90	0.65	1.00	1.00
Gotebo	1.25	0.65	0.75	1.25	1.10
Lone Wolf	1.25	1.00	0.65	0.90	0.90
Roosevelt	1.00	0.90	0.75	1.00	0.90
Snyder	0.90	1.00	1.00	0.90	1.00
Altus	1.00	1.25	1.00	0.65	0.90
Blair	1.10	1.00	0.90	0.65	0.75
Eldorado	1.25	1.50	1.25	0.90	1.00
Headrick	0.90	1.25	1.00	0.75	1.00
Martha	1.10	1.25	1.00	0.65	0.75
Olustee	1.00	1.40	1.10	0.75	0.90
Mangum	1.25	1.25	1.00	0.90	0.65
Granite	1.40	1.10	0.75	1.00	0.75
Reed	1.40	1.40	1.10	1.00	0.75
Willow	1.40	1.25	1.00	1.00	0.75
Gould	1.20	1.50	1.25	0.90	0.90
Hollis	1.40	1.50	1.40	1.00	1.00
Vinson	1.50	1.40	1.25	1.10	0.90

[a]Based on Table 25

Appendix Table 18. Gin to Warehouse Transportation Cost by Origin and Destination, Abilene Study Area, 1974[a]

Gin Location	Warehouse Location				
	Rotan	Hamlin	Stamford	Sweetwater	Abilene
	Dollars Per Bale				
Rotan	0.65	0.75	1.10	0.90	1.25
Longworth	0.75	0.75	1.10	0.75	1.25
Roby	0.65	0.75	1.10	0.75	1.25
Sylvester	0.75	0.75	1.00	0.90	1.10
Hamlin	0.75	0.65	0.90	1.00	1.10
Anson	1.00	0.75	0.75	1.10	0.90
Radium	0.90	0.65	0.90	1.10	1.00
Avoca	1.10	1.00	0.65	1.25	1.00
Neinda	0.90	0.65	0.90	1.00	1.00
Hodges	1.10	0.90	1.00	1.00	0.75
Stith	1.10	0.90	1.00	1.00	0.90
Noodle	1.00	0.75	1.00	1.00	0.90
Tuxedo	0.90	0.75	0.75	1.10	1.10
Corinth	1.00	0.90	0.75	1.10	0.90
Stamford	1.10	0.90	0.65	1.25	1.10
Roscoe	1.00	1.10	1.25	0.65	1.25
Nolan	1.10	1.25	1.40	0.90	1.00
Sweetwater	0.90	1.00	1.25	0.65	1.10
Abilene	1.25	1.10	1.10	1.10	0.65
Merkel	1.10	0.90	1.10	0.90	0.75
Trent	1.00	1.00	1.10	0.75	0.90
Tuscola	1.40	1.25	1.25	1.25	0.75
Lawn	1.50	1.40	1.40	1.25	0.90

[a]Based on Table 25

Appendix Table 19. Gin to Warehouse Transportation Cost by Origin and Destination, Lubbock Study Area, 1974[a]

GIN LOCATION	WAREHOUSE LOCATION												
	Littlefield	Sudan	Plainview	Abernathy	Floydada	Lockney	Ralls	Lubbock	Slaton	Levelland	Brownfield	O'Donnell	Tahoka
Littlefield	0.65	0.75	1.25	0.90	1.25	1.40	1.25	1.00	1.25	0.90	1.10	1.40	1.25
Sudan	0.75	0.65	1.25	1.10	1.40	1.40	1.40	1.10	1.40	1.00	1.25	1.50	1.40
Amherst	0.65	0.75	1.10	1.00	1.40	1.25	1.25	1.10	1.25	0.90	1.25	1.50	1.40
Earth	0.90	0.75	1.10	1.10	1.40	1.25	1.50	1.25	1.40	1.10	1.40	1.50	1.50
Fieldon	0.75	0.75	1.00	0.90	1.25	1.25	1.40	1.10	1.40	1.00	1.25	1.50	1.50
Olton	0.90	1.00	0.90	1.10	1.10	1.00	1.40	1.10	1.40	1.25	1.40	1.60	1.60
Spade	0.65	0.90	1.10	0.75	1.25	1.25	1.25	1.00	1.25	1.00	1.25	1.50	1.50
Springlake	0.90	0.90	1.00	1.10	1.25	1.10	1.50	1.25	1.40	1.10	1.40	1.50	1.50
Plainview	1.25	1.25	0.65	1.00	0.90	0.75	1.10	1.10	1.25	1.40	1.25	1.25	1.10
Abernathy	0.90	1.10	1.00	0.65	1.00	1.10	1.00	0.90	1.00	1.10	1.40	1.50	1.40
Cotton Center	0.90	1.00	0.90	0.75	1.10	1.10	1.25	1.00	1.25	1.10	1.25	1.40	1.25
Edmonson	1.10	1.25	0.75	1.00	1.00	0.90	1.25	1.25	1.50	1.40	1.50	1.50	1.50
Hale Center	1.00	1.10	0.75	0.75	1.00	0.90	1.25	1.00	1.25	1.25	1.40	1.40	1.25
Petersburg	1.10	1.25	0.90	0.75	0.90	0.90	0.90	1.00	1.00	1.25	1.40	1.40	1.25
Halfway	1.00	1.10	0.75	1.00	1.00	0.90	1.40	1.10	1.25	1.25	1.50	1.50	1.40
Floydada	1.25	1.40	0.90	1.00	0.65	0.65	0.90	1.10	1.25	1.10	1.40	1.50	1.40
Lockney	1.40	1.40	0.75	1.10	0.65	0.65	1.10	1.25	1.25	1.25	1.50	1.50	1.50
Sterley	1.40	1.40	0.75	1.25	0.75	0.65	1.25	1.40	1.50	1.50	1.50	1.60	1.50
Dougherty	1.40	1.50	1.10	1.25	0.75	0.90	1.00	1.25	1.40	1.25	1.50	1.60	1.50
Aiken	1.25	1.40	0.75	1.00	0.75	0.65	1.00	1.25	1.50	1.25	1.50	1.50	1.50
Ralls	1.25	1.40	1.10	1.00	0.90	1.00	0.65	0.90	0.90	1.10	1.25	1.25	1.25
Robertson	1.25	1.40	1.25	1.00	1.00	1.10	0.75	0.90	0.75	1.25	1.25	1.25	1.00
Lorenzo	1.10	1.25	1.10	0.90	0.90	1.10	0.65	0.75	0.90	1.10	1.25	1.40	1.25
Cone	1.25	1.40	1.00	1.00	0.75	0.90	0.65	1.00	1.00	1.25	1.40	1.40	1.25
Kalgary	1.50	1.60	1.40	1.40	1.10	1.25	0.90	1.00	1.25	1.50	1.50	1.40	1.25
Crosbyton	1.25	1.40	1.25	1.10	0.90	1.00	0.65	1.00	1.00	1.00	1.25	1.40	1.25
Lubbock	1.00	1.10	1.10	0.90	1.10	1.25	0.90	0.65	0.90	0.90	1.00	1.10	0.90
Slaton	1.25	1.40	1.25	1.00	1.25	1.25	0.90	0.90	0.65	1.10	1.10	1.00	0.90
Shallowater	0.90	1.00	1.10	0.75	1.25	1.25	1.00	0.75	1.00	1.00	1.25	1.25	1.00
Hurlwood	1.00	1.10	1.25	0.90	1.25	1.25	1.00	0.75	1.00	0.75	0.90	1.25	1.00
Idalou	1.10	1.25	1.00	0.90	1.00	1.00	0.75	0.75	0.90	1.00	1.50	1.25	1.10
New Deal	1.00	1.10	1.00	0.65	1.10	1.10	1.00	0.75	1.00	1.00	0.90	1.25	1.00
Wolfforth	1.00	1.10	1.25	0.90	1.25	1.25	1.00	0.75	0.90	0.90	0.90	1.25	1.00
Levelland	0.90	1.00	1.40	1.10	1.10	1.25	1.10	0.90	1.10	0.65	0.90	1.25	1.25
Anton	0.75	0.90	1.25	0.75	1.25	1.25	1.10	0.90	1.10	0.90	1.25	1.25	1.25
Smyer	1.00	1.10	1.40	1.00	1.25	1.40	1.10	0.90	1.00	0.75	0.75	1.25	1.10
Pep	0.75	0.75	1.40	1.10	1.40	1.40	1.40	1.10	1.40	0.90	1.10	1.50	1.40
Pettit	0.90	0.90	1.40	1.10	1.25	1.40	1.25	1.10	1.25	0.75	1.00	1.40	1.40
Ropesville	1.10	1.25	1.40	1.10	1.25	1.40	1.10	0.90	1.00	0.90	0.75	1.10	1.00
Sundown	0.90	1.10	1.50	1.25	1.50	1.50	1.25	1.10	1.25	0.75	0.90	1.40	1.10
Witharral	0.75	0.90	1.25	1.00	1.40	1.40	1.25	1.00	1.25	0.75	1.00	1.40	1.25
Brownfield	1.10	1.25	1.50	1.25	1.40	1.50	1.25	1.00	1.10	0.90	0.65	1.00	0.90
Meadow	1.10	1.25	1.40	1.10	1.40	1.40	1.10	0.75	1.00	0.90	0.65	1.10	1.00
Tokio	1.25	1.40	1.50	1.40	1.50	1.50	1.40	1.25	1.25	1.00	0.75	1.00	1.10
Wellman	1.25	1.40	1.25	1.50	1.50	1.50	1.40	1.10	1.25	1.00	0.75	1.00	1.25
O'Donnell	1.40	1.50	1.50	1.25	1.50	1.50	1.25	1.10	1.00	1.25	1.00	0.65	0.75
Tahoka	1.25	1.40	1.40	1.10	1.40	1.50	1.25	0.90	0.90	1.25	0.90	0.75	0.65
Grassland	1.40	1.50	1.50	1.25	1.25	1.40	1.10	1.10	0.90	1.40	1.10	0.90	0.75
Wilson	1.40	1.50	1.40	1.10	1.25	1.40	1.00	1.00	0.65	1.40	1.00	0.90	0.75
New Home	1.25	1.40	1.40	1.00	1.25	1.40	1.10	0.90	0.90	1.00	0.90	1.00	0.75
Post	1.40	1.50	1.50	1.25	1.25	1.40	1.00	1.00	0.90	1.40	1.10	1.00	0.90
Southland	1.25	1.40	1.40	1.10	1.25	1.40	1.00	0.90	0.65	1.10	1.10	1.00	0.90

[a]Based on Table 25

APPENDIX B

TIME REQUIREMENTS OF THE MIXED INTEGER MODEL

Appendix Table 20. Time Requirements and Functional Values of the Mixed Integer Search by Study Area and Ginning Season

Item	Altus Ginning Season 14 Week	Altus Ginning Season 32 Week	Abilene Ginning Season 14 Week	Abilene Ginning Season 32 Week	Lubbock Ginning Season 14 Week	Lubbock Ginning Season 32 Week
Time of Search (Hr.)	2.25	1.72	4.29	.58	2.32	2.48
Time of Search (Iterations)	22,919	18,012	45,300	6,152	6,189	5,432
Minimum Cost Solution at Iteration	2,863	17,510	9,664	5,249	8,966	10,856
Proven Optimum Solution	No	Yes	No	Yes	No	No
Functional Value of Minimum Cost Solution ($)	8,059,418	7,647,515	7,967,100	7,549,962	72,158,730	68,617,445
Continuation of Search Could Reduce Objective Function Value by No More Than ($)	103,704	a	55,774	a	195,962	616,421
Difference Between Best Solution and Possible Reduction in Objective Value (%)	1.28	a	0.70	a	0.27	0.90

[a]Proven optimum solution

APPENDIX C

SUBOPTIMUM MARKET ORGANIZATIONS,

ALTUS STUDY AREA

Appendix Table 21. Ginning and Warehousing Activities in the Suboptimum Market Organization, Altus Study Area, 14 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
5-Frederick	32,344	32,344	1-Davidson, 2-Grandfield, 3-Manitou, 4-Tipton (3,152), 5-Frederick
8-Gotebo	16,172	16,172	6-Mt. View, 7-Hobart, 8-Gotebo, 9-Lone Wolf (2,904), 10-Roosevelt (1,457)
15-Headrick	10,781	10,781	4-Tipton (1,417), 11-Snyder, 15-Headrick
16-Martha	32,344	32,344	4-Tipton (2,729), 10-Roosevelt (2,480), 12-Altus, 13-Blair, 14-Eldorado, 16-Martha, 17-Olustee
24-Vinson	5,391 32,344	3,385 32,344	9-Lone Wolf (1,033), 18-Mangum, 19-Granite, 20-Reed, 21-Willow, 22-Gould, 23-Hollis, 24-Vinson
			Warehouses:
12-Altus	98,903	127,370	5-Frederick, 8-Gotebo, 15-Headrick, 16-Martha, 24-Vinson

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 22. Ginning and Warehousing Activities in Suboptimum Market Organization 1, Altus Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
3-Manitou	64,688	64,582	1-Davidson, 2-Grandview, 3-Manitou, 4-Tipton, 5-Frederick, 6-Mt. View, 10-Roosevelt, 11-Snyder, 14-Eldorado, 15-Headrick, 17-Olustee
18-Mangum	64,688	62,788	7-Hobart, 8-Gotebo, 9-Lone Wolf, 12-Altus, 13-Blair, 16-Martha, 18-Mangum, 19-Granite, 20-Reed, 21-Willow, 22-Gould, 23-Hollis, 24-Vinson
			Warehouses:
5-Frederick	24,755	64,582	3-Manitou
18-Mangum	24,067	62,788	18-Mangum

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 23. Ginning and Warehousing Activities in Suboptimum Market Organization 2, Altus Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
11-Snyder	10,871	8,774	1-Davidson, 2-Grandfield, 3-Manitou, 4-Tipton,
	64,688	64,688	5-Frederick, 6-Mt. View, 8-Gotebo, 10-Roosevelt, 11-Snyder, 12-Altus, 14-Eldorado (4,943), 15-Headrick, 17-Olustee
18-Mangum	53,908	53,908	7-Hobart, 9-Lone Wolf, 13-Blair, 14-Eldorado (484), 16-Martha, 18-Mangum, 19-Granite, 20-Reed, 21-Willow, 22-Gould, 23-Hollis, 24-Vinson
			Warehouses:
18-Mangum	48,821	127,370	11-Snyder, 18-Mangum

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 24. Ginning and Warehousing Activities in Suboptimum Market Organization 3, Altus Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
4-Tipton	64,688	64,688	1-Davidson, 2-Grandfield, 3-Manitou, 4-Tipton, 5-Frederick, 10-Roosevelt, 11-Snyder, 12-Altus (4,043), 14-Eldorado, 15-Headrick, 17-Olustee
18-Mangum	43,126	43,126	6-Mt. View, 7-Hobart, 8-Gotebo, 9-Lone Wolf, 12-Altus (1,384), 13-Blair, 16-Martha, 18-Mangum, 19-Granite, 21-Willow, 22-Gould (4,364)
24-Vinson	21,562	19,556	20-Reed, 22-Gould (2,412), 23-Hollis, 24-Vinson
		Warehouses:	
18-Mangum	48,821	127,370	4-Tipton, 18-Mangum, 24-Vinson

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 25. Ginning and Warehousing Activities in Suboptimum Market Organization 4, Altus Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
5-Frederick	64,688	64,688	1-Davidson, 2-Grandfield, 3-Manitou, 4-Tipton, 5-Frederick, 10-Roosevelt, 11-Snyder, 12-Altus (4,043), 14-Eldorado, 15-Headrick, 17-Olustee
21-Willow	43,126	43,126	6-Mt. View, 7-Hobart, 8-Gotebo, 9-Lone Wolf, 12-Altus (1,384), 13-Blair, 16-Martha, 18-Mangum, 19-Granite, 20-Reed, 21-Willow, 22-Gould (772)
24-Vinson	21,562	19,556	22-Gould (6,004), 23-Hollis, 24-Vinson
		Warehouses:	
5-Frederick	24,795	64,688	5-Frederick
18-Mangum	24,027	62,682	21-Willow, 24-Vinson

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 26. Ginning and Warehousing Activities in Suboptimum Market Organization 5, Altus Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
3-Manitou	53,908	53,908	1-Davidson, 2-Grandfield, 3-Manitou, 4-Tipton, 5-Frederick, 6-Mt. View, 7-Hobart, 8-Gotebo, 10-Roosevelt (1,670), 11-Snyder
15-Headrick	10,781 64,688	8,774 64,688	9-Lone Wolf, 10-Roosevelt (2,267), 12-Altus, 13-Blair, 14-Eldorado, 15-Headrick, 16-Martha, 17-Olustee, 18-Mangum, 19-Granite, 20-Reed, 21-Willow, 22-Gould, 23-Hollis, 24-Vinson
		Warehouses:	
12-Altus	48,821	127,370	3-Manitou, 15-Headrick

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

APPENDIX D

SUBOPTIMUM MARKET ORGANIZATIONS,

ABILENE STUDY AREA

Appendix Table 27. Ginning and Warehousing Activities in Suboptimum Market Organization 1, Abilene Study Area, 14 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
3-Roby	32,344	32,344	1-Rotan (4,830), 2-Longworth (6,496), 3-Roby, 4-Sylvester
5-Hamlin	32,344	30,079	1-Rotan (5,679), 5-Hamlin, 7-Radium, 9-Neinda, 12-Noodle, 13-Tuxedo (4,204)
14-Corinth	32,344	32,344	6-Anson, 8-Avoca, 10-Hodges, 11-Stith, 13-Tuxedo (845), 14-Corinth, 15-Stamford, 19-Abilene
18-Sweetwater	32,344	32,344	2-Longworth (4,013), 16-Roscoe, 17-Nolan, 18-Sweetwater, 20-Merkel, 21-Trent, 22-Tuscola, 23-Lawn
		Warehouses:	
15-Stamford	48,472	62,423	5-Hamlin, 14-Corinth
18-Sweetwater	50,213	64,688	3-Roby, 18-Sweetwater

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 28. Ginning and Warehousing Activities in Suboptimum Market Organization 2, Abilene Study Area, 14 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
3-Roby	32,344	32,344	1-Rotan, 2-Longworth, 3-Roby, 4-Sylvester (817)
7-Radium	32,344	32,344	5-Hamlin, 7-Radium, 8-Avoca, 9-Neinda (2,050), 13-Tuxedo, 14-Corinth, 15-Stamford
12-Noodle	32,344	32,344	4-Sylvester (9,692), 6-Anson, 9-Neinda (2,999), 10-Hodges (4,506), 11-Stith, 12-Noodle
19-Abilene	32,344	30,079	10-Hodges (543), 16-Roscoe, 17-Nolan, 18-Sweetwater, 19-Abilene, 20-Merkel, 21-Trent, 22-Tuscola, 23-Lawn
		Warehouses:	
5-Hamlin	98,702	127,111	3-Roby, 7-Radium, 12-Noodle, 19-Abilene

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 29. Ginning and Warehousing Activities in Suboptimum Market Organization 3, Abilene Study Area, 14 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
3-Roby	26,954	26,954	1-Rotan, 2-Longworth (5,936), 3-Roby
9-Neinda	32,344	32,344	4-Sylvester, 5-Hamlin, 7-Radium, 9-Neinda, 11-Stith (1,079), 12-Noodle, 20-Merkel (560)
15-Stamford	5,391 32,344	3,125 32,344	6-Anson, 8-Avoca, 10-Hodges, 11-Stith (3,970), 13-Tuxedo, 14-Corinth, 15-Stamford, 19-Abilene
18-Sweetwater	32,344	32,344	2-Longworth (4,573), 16-Roscoe, 17-Nolan, 18-Sweetwater, 20-Merkel (645), 21-Trent, 22-Tuscola, 23-Lawn
		Warehouses:	
15-Stamford	52,657	67,813	9-Neinda, 15-Stamford
19-Abilene	46,045	59,298	3-Roby, 18-Sweetwater

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 30. Ginning and Warehousing Activities in Suboptimum Market Organization 1, Abilene Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
3-Roby	64,688	64,688	1-Rotan, 2-Longworth, 3-Roby, 4-Sylvester, 16-Roscoe, 17-Nolan (6,978), 18-Sweetwater
7-Radium	64,688	62,688	5-Hamlin, 6-Anson, 7-Radium, 8-Avoca, 9-Neinda, 10-Hodges, 11-Stith, 12-Noodle, 13-Tuxedo, 14-Corinth, 15-Stamford, 17-Nolan (859), 19-Abilene, 20-Merkel, 21-Trent, 22-Tuscola, 23-Lawn
		Warehouses:	
5-Hamlin	48,722	127,111	3-Roby, 7-Radium

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 31. Ginning and Warehousing Activities in Suboptimum Market Organization 2, Abilene Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
3-Roby	64,688	64,688	1-Rotan (9,149), 5-Hamlin, 6-Anson, 7-Radium 8-Avoca, 9-Neinda, 10-Hodges, 11-Stith, 12-Noodle, 13-Tuxedo, 14-Corinth, 15-Stamford
18-Sweetwater	64,688	62,423	1-Rotan (1,360), 2-Longworth, 3-Roby, 4-Sylvester, 16-Roscoe, 17-Nolan, 18-Sweetwater, 19-Abilene, 20-Merkel, 21-Trent, 22-Tuscola, 23-Lawn
		Warehouses:	
5-Hamlin	24,795	64,688	7-Radium
18-Sweetwater	23,927	62,423	18-Sweetwater

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 32. Ginning and Warehousing Activities in Suboptimum Market Organization 3, Abilene Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
1-Rotan	64,688	64,688	1-Rotan, 2-Longworth, 3-Roby, 4-Sylvester, 16-Roscoe, 17-Nolan (6,978), 18-Sweetwater
13-Tuxedo	64,688	62,423	5-Hamlin, 6-Anson, 7-Radium, 8-Avoca, 9-Neinda, 10-Hodges, 11-Stith, 12-Noodle, 13-Tuxedo, 14-Corinth, 15-Stamford, 17-Nolan (859), 19-Abilene, 20-Merkel, 21-Trent, 22-Tuscola, 23-Lawn
		Warehouses:	
5-Hamlin	48,722	127,111	1-Rotan, 13-Tuxedo

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 33. Ginning and Warehousing Activities in Suboptimum Market Organization 4, Abilene Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
8-Avoca	64,688	62,423	1-Rotan (4,474), 5-Hamlin, 6-Anson, 7-Radium, 8-Avoca, 9-Neinda, 10-Hodges, 11-Stith, 12-Noodle, 13-Tuxedo, 14-Corinth, 15-Stamford, 19-Abilene, 20-Merkel
18-Sweetwater	64,688	64,688	1-Rotan (6,035), 2-Longworth, 3-Roby, 4-Sylvester, 16-Roscoe, 17-Nolan, 18-Sweetwater, 21-Trent, 22-Tuscola, 23-Lawn
			Warehouses:
15-Stamford	23,927	62,423	8-Avoca
18-Sweetwater	24,795	64,688	18-Sweetwater

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

APPENDIX E

SUBOPTIMUM MARKET ORGANIZATIONS,

LUBBOCK STUDY AREA

Appendix Table 34. Ginning and Warehousing Activities in Suboptimum Market Organization 1, Lubbock Study Area, 14 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
3-Amherst	32,344	32,344	1-Littlefield (8,120), 2-Sudan (10,082), 3-Amherst
4- Earth	32,344	32,344	2-Sudan (4,060), 4-Earth, 8-Springlake
7-Spade	32,344	32,344	5-Fieldton, 7-Spade, 35-Anton (4,060)
9-Plainview	32,344	32,344	9-Plainview, 12-Edmonson (12,355), 20-Aiken (940)
10-Abernathy	32,344	32,344	10-Abernathy, 11-Cotton Center (13,295)
13-Hale Center	32,344	32,344	11-Cotton Center (5,754), 12-Edmonson (6,694), 13-Hale Center, 15-Halfway (847)
14-Petersburg	32,344	28,627	14-Petersburg, 24-Cone (9,578)
15-Halfway	32,344	32,344	6-Olton, 15-Halfway (18,202)
17-Lockney	32,344	32,344	16-Floydada (7,062), 17-Lockney, 20-Aiken (5,760)
18-Sterley	32,344	32,344	18-Sterley, 20-Aiken (12,822)
19-Dougherty	32,344	31,982	16-Floydada (12,460), 19-Dougherty
21-Ralls	32,344	32,344	21-Ralls (10,746), 23-Lorenzo (9,631), 24-Cone (11,967)
22-Robertson	32,344	32,344	22-Robertson, 23-Lorenzo (10,799)
25-Kalgary	32,344	30,547	25-Kalgary, 51-Post (9,002)
26-Crosbyton	32,344	32,344	21-Ralls (10,799), 26-Crosbyton
27-Lubbock	32,344	32,344	27-Lubbock (30,114), 50-New Home (2,230)

Appendix Table 34. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
28-Slaton	32,344	32,344	28-Slaton, 49-Wilson (1,115)
29-Shallowater	32,344	32,344	29-Shallowater, 35-Anton (1,115)
30-Hurlwood	32,344	32,344	30-Hurlwood, 33-Wolfforth (1,115)
31-Idalou	32,344	32,344	23-Lorenzo (1,115), 31-Idalou
32-New Deal	32,344	32,344	27-Lubbock (1,115), 32-New Deal
33-Wolfforth	32,344	32,344	33-Wolfforth (30,114), 39-Ropesville (1,576), 50-New Home (654)
34-Levelland	32,344	32,344	34-Levelland, 40-Sundown (15,739)
36-Smyer	32,344	32,344	35-Anton (2,579), 36-Smyer, 39-Ropesville (13,160)
38-Pettit	32,344	32,344	37-Pep (15,739), 38-Pettit
41-Whitharral	32,344	32,344	1-Littlefield (6,022), 35-Anton (8,851), 37-Pep (866), 41-Whitharral
42-Brownfield	32,344	32,344	42-Brownfield, 43-Meadow (585), 47-Tahoka (699)
43-Meadow	32,344	32,344	39-Ropesville (1,869), 43-Meadow (30,475)
44-Tokio	32,344	31,926	40-Sundown (866), 44-Tokio
45-Wellman	32,344	31,060	45-Wellman
46-O'Donnell	32,344	32,344	46-O'Donnell (32,344)
47-Tahoka	32,344	32,344	46-O'Donnell (2,884), 47-Tahoka (29,460)

Appendix Table 34. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
48-Grassland	32,344	32,344	48-Grassland (32,344)
49-Wilson	32,344	32,344	47-Tahoka (5,069), 49-Wilson (27,275)
50-New Home	32,344	32,344	50-New Home (32,344)
52-Southland	32,344	32,344	48-Grassland (2,884), 49-Wilson (6,838), 51-Post (6,810), 52-Southland
		Warehouses:	
1-Littlefield	100,461	129,376	3-Amherst, 4-Earth, 7-Spade, 41-Whitharral
10-Abernathy	172,920	222,691	10-Abernathy, 13-Hale Center, 14-Petersburg, 27-Lubbock, 29-Shallowater, 32-New Deal, 33-Wolfforth
17-Lockney	125,295	161,358	9-Plainview, 15-Halfway, 17-Lockney, 18-Sterley, 19-Dougherty
21-Ralls	124,181	159,923	21-Ralls, 22-Robertson, 25-Kalgary, 26-Crosbyton, 31-Idalou
28-Slaton	75,346	97,032	28-Slaton, 49-Wilson, 52-Southland
34-Levelland	100,461	129,376	30-Hurlwood, 34-Levelland, 36-Smyer, 38-Pettit
42-Brownfield	99,139	127,674	42-Brownfield, 43-Meadow, 44-Tokio, 45-Wellman

Appendix Table 34. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Warehouses:	
47-Tahoka	100,461	129,376	46-O'Donnell, 47-Tahoka, 48-Grassland, 50-New Home

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 35. Ginning and Warehousing Activities in Suboptimum Market Organization 2, Lubbock Study Area, 14 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
3-Amherst	32,344	32,344	1-Littlefield (8,120), 2-Sudan (10,082), 3-Amherst
4-Earth	32,344	32,344	2-Sudan (4,060), 4-Earth, 8-Springlake
7-Spade	32,344	32,344	1-Littlefield (4,060), 5-Fieldton, 7-Spade
10-Abernathy	32,344	32,344	10-Abernathy, 11-Cotton Center (6,233), 14-Petersburg
12-Edmonson	32,344	32,344	9-Plainview (12,448), 12-Edmonson, 15-Halfway (847)
13-Hale Center	32,344	32,344	9-Plainview (479), 11-Cotton Center (12,816), 13-Hale Center
15-Halfway	32,344	32,344	6-Olton, 15-Halfway (18,202)
16-Floydada	32,344	32,344	14-Petersburg (187), 16-Floydada, 19-Dougherty (12,635)
17-Lockney	32,344	32,344	9-Plainview (6,122), 17-Lockney, 20-Aiken (6,700)
18-Sterley	32,344	32,344	18-Sterley, 20-Aiken (12,822)
21-Ralls	32,344	32,344	21-Ralls, 22-Robertson (10,746), 24-Cone (53)
23-Lorenzo	32,344	32,344	22-Robertson (10,799), 23-Lorenzo
24-Cone	32,344	32,344	14-Petersburg (10,852), 24-Cone (21,492)
25-Kalgary	32,344	32,344	25-Kalgary (19,821), 51-Post (12,523)
26-Crosbyton	32,344	30,156	19-Dougherty (6,887), 25-Kalgary (1,724), 26-Crosbyton

Appendix Table 35. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
27-Lubbock	32,344	32,344	27-Lubbock (29,947), 50-New Home (2,397)
28-Slaton	32,344	32,344	28-Slaton, 49-Wilson (1,115)
29-Shallowater	32,344	32,344	29-Shallowater, 35-Anton (1,115)
30-Hurlwood	32,344	32,344	30-Hurlwood, 33-Wolfforth (1,115)
31-Idalou	32,344	32,344	14-Petersburg (948), 27-Lubbock (167), 31-Idalou
32-New Deal	32,344	32,344	27-Lubbock (1,115), 32-New Deal
33-Wolfforth	32,344	32,344	33-Wolfforth (30,114), 39-Ropesville (2,230)
34-Levelland	32,344	32,344	34-Levelland (15,310), 40-Sundown (15,321), 41-Whitharral (1,713)
35-Anton	32,344	32,344	1-Littlefield (1,962), 35-Anton (15,490), 41-Whitharral (14,892)
36-Smyer	32,344	32,344	34-Levelland (1,295), 36-Smyer, 38-Pettit (866), 39-Ropesville (13,578)
37-Pep	32,344	32,344	37-Pep, 38-Pettit (15,739)
42-Brownfield	32,344	32,344	42-Brownfield (29,776), 47-Tahoka (2,568)
43-Meadow	32,344	32,344	39-Ropesville (797), 43-Meadow, 50-New Home (487)
44-Tokio	32,344	32,344	40-Sundown (1,284), 44-Tokio
45-Wellman	32,344	32,344	42-Brownfield (1,284), 45-Wellman
46-O'Donnell	32,344	32,344	46-O'Donnell (32,344)

Appendix Table 35. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
47-Tahoka	32,344	32,344	46-O'Donnell (2,884), 47-Tahoka (29,460)
48-Grassland	32,344	32,344	48-Grassland (32,344)
49-Wilson	32,344	32,344	47-Tahoka (3,200), 49-Wilson (29,144)
50-New Home	32,344	32,344	50-New Home (32,344)
52-Southland	26,954	26,954	48-Grassland (2,884), 49-Wilson (4,969), 51-Post (3,289), 52-Southland
		Warehouses:	
2-Sudan	75,346	97,032	3-Amherst, 4-Earth, 37-Pep
10-Abernathy	150,691	194,064	7-Spade, 10-Abernathy, 13-Hale Center, 29-Shallowater, 32-New Deal, 35-Anton
17-Lockney	125,576	161,720	12-Edmonson, 15-Halfway, 16-Floydada, 17-Lockney, 18-Sterley
21-Ralls	148,992	191,876	21-Ralls, 23-Lorenzo, 24-Cone, 25-Kalgary, 26-Crosbyton, 31-Idalou
27-Lubbock	100,461	129,376	27-Lubbock, 30-Hurlwood, 33-Wolfforth, 34-Levelland
28-Slaton	71,161	91,642	28-Slaton, 49-Wilson, 52-Southland
42-Brownfield	125,576	161,720	36-Smyer, 42-Brownfield, 43,Meadow, 44-Tokio, 45-Wellman

Appendix Table 35. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Warehouses:	
47-Tahoka	100,461	129,376	46-O'Donnell, 47-Tahoka, 48-Grassland, 50-New Home

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 36. Ginning and Warehousing Activities in Suboptimum Market Organization 3, Lubbock Study Area, 14 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
3-Amherst	32,344	32,344	1-Littlefield (8,120), 2-Sudan (10,082), 3-Amherst
4-Earth	32,344	32,344	2-Sudan (4,060), 4-Earth, 8-Springlake
7-Spade	32,344	32,344	5-Fieldton, 7-Spade, 35-Anton (4,060)
9-Plainview	32,344	31,404	9-Plainview, 12-Edmonson (13,295)
10-Abernathy	32,344	32,344	10-Abernathy, 11-Cotton Center (12,355)
13-Hale Center	32,344	32,344	11-Cotton Center (6,694), 12-Edmonson (5,754), 13-Hale Center, 15-Halfway (847)
14-Petersburg	32,344	29,205	14-Petersburg, 16-Floydada (578), 24-Cone (9,578)
15-Halfway	32,344	32,344	6-Olton, 15-Halfway (18,202)
17-Lockney	32,344	32,344	16-Floydada (6,122), 17-Lockney, 18-Sterley (6,700)
19-Dougherty	32,344	32,344	16-Floydada (12,822), 19-Dougherty
20-Aiken	32,344	32,344	18-Sterley (12,822), 20-Aiken
21-Ralls	32,344	32,344	21-Ralls (10,746), 22-Robertson (9,631), 24-Cone (11,967)
23-Lorenzo	32,344	32,344	22-Robertson (11,914), 23-Lorenzo (20,430)
25-Kalgary	32,344	30,547	25-Kalgary, 51-Post (9,002)
26-Crosbyton	32,344	32,344	21-Ralls (10,799), 26-Crosbyton

Appendix Table 36. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
27-Lubbock	32,344	32,344	27-Lubbock (30,114), 50-New Home (2,230)
28-Slaton	32,344	32,344	28-Slaton, 49-Wilson (1,115)
29-Shallowater	32,344	32,344	29-Shallowater, 35-Anton (1,115)
30-Hurlwood	32,344	32,344	30-Hurlwood, 33-Wolfforth (1,115)
31-Idalou	32,344	32,344	23-Lorenzo (1,115), 31-Idalou
32-New Deal	32,344	32,344	27-Lubbock (1,115), 32-New Deal
33-Wolfforth	32,344	32,344	33-Wolfforth (30,114), 39-Ropesville (1,576), 50-New Home (654)
34-Levelland	32,344	32,344	34-Levelland, 40-Sundown (15,739)
36-Smyer	32,344	32,344	35-Anton (2,579), 36-Smyer, 39-Ropesville (13,160)
38-Pettit	32,344	32,344	37-Pep (15,739), 38-Pettit
41-Whitharral	32,344	32,344	1-Littlefield (6,022), 35-Anton (8,851), 37-Pep (866), 41-Whitharral
42-Brownfield	32,344	32,344	42-Brownfield, 43-Meadow (585), 47-Tahoka (699)
43-Meadow	32,344	32,344	39-Ropesville (1,869), 43-Meadow (30,475)
44-Tokio	32,344	31,926	40-Sundown (866), 44-Tokio
45-Wellman	32,344	31,060	45-Wellman
46-O'Donnell	32,344	32,344	46-O'Donnell (32,344)

Appendix Table 36. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
		Bales	
			Gins:
47-Tahoka	32,344	32,344	46-O'Donnell (2,884), 47-Tahoka (29,460)
48-Grassland	32,344	32,344	48-Grassland (32,344)
49-Wilson	32,344	32,344	47-Tahoka (5,069), 49-Wilson (27,275)
50-New Home	32,344	32,344	50-New Home (32,344)
52-Southland	32,344	32,344	48-Grassland (2,884), 49-Wilson (6,838), 51-Post (6,810), 52-Southland
			Warehouses:
1-Littlefield	100,461	129,376	3-Amherst, 4-Earth, 7-Spade, 41-Whitharral
10-Abernathy	172,639	222,329	10-Abernathy, 13-Hale Center, 14-Petersburg, 27-Lubbock, 29-Shallowater, 32-New Deal, 33-Wolfforth
17-Lockney	125,576	161,720	9-Plainview, 15-Halfway, 17-Lockney, 19-Dougherty, 20-Aiken
21-Ralls	124,181	159,923	21-Ralls, 23-Lorenzo, 25-Kalgary, 26-Crosbyton, 31-Idalou
28-Slaton	75,346	97,032	28-Slaton, 49-Wilson, 52-Southland
34-Levelland	100,461	129,376	30-Hurlwood, 34-Levelland, 36-Smyer, 38-Pettit
42-Brownfield	99,139	127,674	42-Brownfield, 43-Meadow, 44-Tokio, 45-Wellman

Appendix Table 36. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Warehouses:
47-Tahoka	100,461	129,376	46-O'Donnell, 47-Tahoka, 48-Grassland, 50-New Deal

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 37. Ginning and Warehousing Activities in Suboptimum Market Organization 4, Lubbock Study Area, 14 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
3-Amherst	32,344	32,344	1-Littlefield (8,102), 2-Sudan (10,008), 3-Amherst
4-Earth	32,344	32,344	2-Sudan (4,060), 4-Earth, 8-Springlake
7-Spade	32,344	32,344	5-Fieldton, 7-Spade, 35-Anton (4,060)
9-Plainview	32,344	31,982	9-Plainview, 12-Edmonson (12,355), 20-Aiken (578)
10-Abernathy	32,344	32,344	10-Abernathy, 11-Cotton Center (13,295)
13-Hale Center	32,344	32,344	11-Cotton Center (5,754), 12-Edmonson (6,694), 13-Hale Center, 15-Halfway (847)
14-Petersburg	32,344	28,627	14-Petersburg, 24-Cone (9,578)
15-Halfway	32,344	32,344	6-Spade, 15-Halfway (18,202)
17-Lockney	32,344	32,344	16-Floydada (6,700), 17-Lockney, 20-Aiken (6,122)
18-Sterley	32,344	32,344	18-Sterley, 20-Aiken (12,822)
19-Dougherty	32,344	32,344	16-Floydada (12,822), 19-Dougherty
21-Ralls	32,344	32,344	21-Ralls (10,746), 22-Robertson (9,631), 24-Cone (11,967)
23-Lorenzo	32,344	32,344	22-Robertson (11,914), 23-Lorenzo (20,430)
25-Kalgary	32,344	30,129	25-Kalgary, 51-Post (8,584)
26-Crosbyton	32,344	32,344	21-Ralls (10,799), 26-Crosbyton
27-Lubbock	32,344	32,344	27-Lubbock (30,114), 50-New Home (2,230)

Appendix Table 37. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
28-Slaton	32,344	32,344	28-Slaton, 49-Wilson (1,115)
29-Shallowater	32,344	32,344	29-Shallowater, 35-Anton (1,115)
30-Hurlwood	32,344	32,344	30-Hurlwood, 33-Wolfforth (1,115)
31-Idalou	32,344	32,344	23-Lorenzo (1,115), 31-Idalou
32-New Deal	32,344	32,344	27-Lubbock (1,115), 32-New Deal
33-Wolfforth	32,344	32,344	33-Wolfforth (30,114), 39-Ropesville (1,576), 50-New Home (654)
34-Levelland	32,344	32,344	34-Levelland, 38-Pettit (418), 40-Sundown (15,321)
36-Smyer	32,344	32,344	35-Anton (2,161), 36-Smyer, 39-Ropesville (13,578)
37-Pep	32,344	32,344	37-Pep, 38-Pettit (15,739)
41-Whitharral	32,344	32,344	1-Littlefield (6,022), 35-Anton (9,269), 38-Pettit (448), 41-Whitharral
42-Brownfield	32,344	32,344	42-Brownfield, 43-Meadow (167), 47-Tahoka (1,117)
43-Meadow	32,344	32,344	39-Ropesville (1,451), 43-Meadow (30,893)
44-Tokio	32,344	32,344	40-Sundown (1,284), 44-Tokio
45-Wellman	32,344	31,060	45-Wellman
46-O'Donnell	32,344	32,344	46-O'Donnell (32,344)
47-Tahoka	32,344	32,344	46-O'Donnell (2,884), 47-Tahoka (29,460)

Appendix Table 37. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
48-Grassland	32,344	32,344	48-Grassland (32,344)
49-Wilson	32,344	32,344	47-Tahoka (4,651), 49-Wilson (27,693)
50-New Home	32,344	32,344	50-New Home (32,344)
52-Southland	32,344	32,344	48-Grassland (2,884), 49-Wilson (6,420), 51-Post (7,228), 52-Southland
		Warehouses:	
2-Sudan	75,346	97,032	3-Amherst, 4-Earth, 37-Pep
10-Abernathy	223,150	287,379	7-Spade, 10-Abernathy, 13-Hale Center, 14-Petersburg, 15-Halfway, 27-Lubbock, 29-Shallowater, 32-New Deal, 33-Wolfforth
16-Floydada	100,180	129,014	9-Plainview, 17-Lockney, 18-Sterley, 19-Dougherty
21-Ralls	123,856	159,505	21-Ralls, 23-Lorenzo, 25-Kalgary, 26-Crosbyton, 31-Idalou
28-Slaton	75,346	97,032	28-Slaton, 49-Wilson, 52-Southland
34-Levelland	100,461	129,376	30-Hurlwood, 34-Levelland, 36-Smyer, 41-Whitharral
42-Brownfield	99,464	128,092	42-Brownfield, 43-Meadow, 44-Tokio, 45-Wellman

Appendix Table 37. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Warehouses:
47-Tahoka	100,461	129,376	46-O'Donnell, 47-Tahoka, 48-Grassland, 50-New Home

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 38. Ginning and Warehousing Activities in Suboptimum Market Organization 5, Lubbock Study Area, 14 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
3-Amherst	32,344	32,344	1-Littlefield (8,120), 2-Sudan (10,082), 3-Amherst
4-Earth	32,344	32,344	2-Sudan (4,060), 4-Earth, 8-Springlake
7-Spade	32,344	32,344	5-Fieldton, 7-Spade, 35-Anton (4,060)
9-Plainview	32,344	32,344	9-Plainview, 12-Edmonson, 20-Aiken (940)
10-Abernathy	32,344	32,344	10-Abernathy, 11-Cotton Center (13,295)
13-Hale Center	32,344	32,344	11-Cotton Center (5,754), 12-Edmonson (6,694) 13-Hale Center, 15-Halfway (847)
14-Petersburg	32,344	28,627	14-Petersburg, 24-Cone (9,578)
15-Halfway	32,344	32,344	6-Olton, 15-Halfway (18,802)
17-Lockney	32,344	32,344	16-Floydada (7,062), 17-Lockney, 20-Aiken (5,760)
18-Sterley	32,344	32,344	18-Sterley, 20-Aiken (12,822)
19-Dougherty	32,344	31,982	16-Floydada (12,460), 19-Dougherty
21-Ralls	32,344	32,344	21-Ralls (10,746), 22-Robertson (9,631), 24-Cone (11,967)
23-Lorenzo	32,344	32,344	22-Robertson (11,914), 23-Lorenzo (20,430)
25-Kalgary	32,344	31,413	25-Kalgary, 51-Post (9,868)
26-Crosbyton	32,344	32,344	21-Ralls (10,799), 26-Crosbyton
27-Lubbock	32,344	32,344	27-Lubbock (30,114), 50-New Home (2,230)

Appendix Table 38. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
28-Slaton	32,344	32,344	28-Slaton, 49-Wilson (2,230)
29-Shallowater	32,344	32,344	29-Shallowater, 35-Anton (1,115)
30-Hurlwood	32,344	32,344	30-Hurlwood, 33-Wolfforth (1,115)
31-Idalou	32,344	32,344	23-Lorenzo (1,115), 31-Idalou
32-New Deal	32,344	32,344	27-Lubbock (1,115), 32-New Deal
33-Wolfforth	32,344	32,344	33-Wolfforth (30,114), 39-Ropesville (1,743), 50-New Home (487)
36-Smyer	32,344	32,344	35-Anton (3,445), 36-Smyer, 39-Ropesville (12,294)
38-Pettit	32,344	32,344	37-Pep (15,739), 38-Pettit
40-Sundown	32,344	32,344	34-Levelland (15,739), 40-Sundown
41-Whitharral	32,344	32,344	1-Littlefield (6,022), 34-Levelland (866), 35-Anton (7,985), 37-Pep (866), 41-Whitharral
42-Brownfield	32,344	32,344	42-Brownfield, 43-Meadow (1,284)
43-Meadow	32,344	32,344	39-Ropesville (2,568), 43-Meadow (29,776)
44-Tokio	32,344	31,060	44-Tokio
45-Wellman	32,344	31,060	45-Wellman
46-O'Donnell	32,344	32,344	46-O'Donnell (32,344)
47-Tahoka	32,344	32,344	46-O'Donnell (2,884), 47-Tahoka (29,460)

Appendix Table 38. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
48-Grassland	32,344	32,344	48-Grassland (32,344)
49-Wilson	32,344	32,344	47-Tahoka (5,768), 49-Wilson (26,409), 50-New Home (167)
50-New Home	32,344	32,344	50-New Home (32,344)
52-Southland	32,344	32,344	48-Grassland (2,884), 49-Wilson (7,704), 51-Post (5,944), 52-Southland
		Warehouses:	
1-Littlefield	150,691	194,064	3-Amherst, 4-Earth, 7-Spade, 38-Pettit, 40-Sundown, 41-Whitharral
10-Abernathy	198,035	255,035	10-Abernathy, 13-Hale Center, 14-Petersburg, 27-Lubbock, 29-Shallowater, 30-Hurlwood, 32-New Deal, 33-Wolfforth
17-Lockney	125,295	161,358	9-Plainview, 15-Halfway, 17-Lockney, 18-Sterley, 19-Dougherty
21-Ralls	124,853	160,789	21-Ralls, 23-Lorenzo, 25-Kalgary, 26-Crosbyton, 31-Idalou
28-Slaton	75,346	97,032	28-Slaton, 49-Wilson, 52-Southland
42-Brownfield	123,582	159,152	36-Smyer, 42-Brownfield, 43-Meadow, 44-Tokio, 45-Wellman

Appendix Table 38. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Warehouses:
47-Tahoka	100,461	129,376	46-O'Donnell, 47-Tahoka, 48-Grassland, 50-New Home

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 39. Ginning and Warehousing Activities in Suboptimum Market Organization 1, Lubbock Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
3-Amherst	64,688	64,688	1-Littlefield, 2-Sudan, 3-Amherst, 4-Earth, 5-Fieldton (8,120)
13-Hale Center	64,688	64,688	9-Plainview, 11-Cotton Center, 12-Edmonson (1,694), 13-Hale Center, 14-Petersburg (5,847)
15-Halfway	64,688	64,688	6-Olton, 8-Springlake, 12-Edmonson (17,355), 15-Halfway
17-Lockney	64,688	64,688	16-Floydada (6,122), 17-Lockney, 18-Sterley, 20-Aiken
23-Lorenzo	64,688	64,688	21-Ralls (2,928), 22-Robertson, 23-Lorenzo, 31-Idalou (18,670)
24-Cone	64,688	64,688	14-Petersburg (13,202), 16-Floydada (13,400), 19-Dougherty (16,541), 24-Cone
26-Crosbyton	64,688	64,688	19-Dougherty (2,981), 21-Ralls (18,617), 25-Kalgary, 26-Crosbyton
27-Lubbock	64,688	64,688	27-Lubbock, 29-Shallowater (16,819), 31-Idalou (12,559), 36-Smyer (4,081)
32-New Deal	64,688	64,688	10-Abernathy, 29-Shallowater (14,410), 32-New Deal
33-Wolfforth	64,688	64,688	30-Hurlwood, 33-Wolfforth, 36-Smyer (2,230)
34-Levelland	64,688	64,688	34-Levelland, 38-Pettit, 40-Sundown, 41-Whitharral (14,873)

Appendix Table 39. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
35-Anton	64,688	64,688	5-Fieldton (6,022), 7-Spade, 35-Anton, 36-Smyer (9,582), 37-Pep, 41-Whitharral (1,732)
42-Brownfield	64,688	64,688	42-Brownfield, 44-Tokio, 45-Wellman (2,568)
43-Meadow	64,688	64,688	39-Ropesville, 43-Meadow (19,591), 45-Wellman (28,492)
47-Tahoka	64,688	64,688	46-O'Donnell (29,460), 47-Tahoka
48-Grassland	64,688	64,688	46-O'Donnell (5,768), 48-Grassland, 51-Post, 52-Southland (7,880)
49-Wilson	64,688	64,688	28-Slaton, 49-Wilson (25,527), 52-Southland (7,932)
50-New Home	64,688	57,110	36-Smyer (712), 43-Meadow (11,469), 49-Wilson (9,701), 50-New Home
		Warehouses:	
1-Littlefield	24,795	64,688	3-Amherst
9-Plainview	49,590	129,376	15-Halfway, 17-Lockney
10-Abernathy	74,385	194,064	13-Hale Center, 32-New Deal, 35 Anton
21-Ralls	74,385	194,064	23-Lorenzo, 24-Cone, 26-Crosbyton
27-Lubbock	74,385	194,064	27-Lubbock, 33-Wolfforth, 43-Meadow
34-Levelland	49,590	129,376	34-Levelland, 42-Brownfield

Appendix Table 39. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Warehouses:	
47-Tahoka	96,275	251,174	47-Tahoka, 48-Grassland, 49-Wilson, 50-New Home

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

Appendix Table 40. Ginning and Warehousing Activities in Suboptimum Market Organization 2, Lubbock Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
3-Amherst	64,688	64,688	1-Littlefield, 2-Sudan, 3-Amherst, 4-Earth, 5-Fieldton (8,120)
13-Hale Center	64,688	64,688	5-Fieldton (5,847), 9-Plainview, 11-Cotton Center, 12-Edmonson (1,694), 13-Hale Center
15-Halfway	64,688	64,688	6-Olton, 8-Springlake, 12-Edmonson (17,355), 15-Halfway
17-Lockney	64,688	64,688	16-Floydada (6,122), 17-Lockney, 18-Sterley, 20-Aiken
23-Lorenzo	64,688	64,688	21-Ralls (8,775), 22-Robertson, 23-Lorenzo, 31-Idalou (12,823)
24-Cone	64,688	64,688	14-Petersburg, 16-Floydada (13,400), 19-Dougherty (10,694), 24-Cone
26-Crosbyton	64,688	64,688	19-Dougherty (8,828), 21-Ralls (12,770), 25-Kalgary, 26-Crosbyton
27-Lubbock	64,688	64,688	27-Lubbock, 29-Shallowater (15,053), 31-Idalou (18,406)
32-New Deal	64,688	64,688	5-Fieldton (175), 10-Abernathy, 29-Shallowater (13,946), 32-New Deal, 35-Anton (289)
33-Wolfforth	64,688	64,688	29-Shallowater (2,230), 30-Hurlwood, 33-Wolfforth
36-Smyer	64,688	64,688	7-Spade, 34-Levelland (1,020), 35-Anton (16,316), 36-Smyer, 41-Whitharral

Appendix Table 40. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Gins:
40-Sundown	64,688	64,688	34-Levelland (14,873), 37-Pep, 38-Pettit, 40-Sundown
43-Meadow	64,688	64,688	34-Levelland (712), 39-Ropesville, 42-Brownfield (16,311), 43-Meadow
44-Tokio	64,688	64,688	42-Brownfield (2,568), 44-Tokio, 45-Wellman
46-O'Donnell	10,782 64,688	3,202 64,688	46-O'Donnell, 48-Grassland (32,662)
47-Tahoka	64,688	64,688	42-Brownfield (12,181), 47-Tahoka, 48-Grassland (2,566), 50-New Home (14,713)
49-Wilson	64,688	64,688	28-Slaton (8,945), 49-Wilson, 50-New Home (20,515)
52-Southland	53,908	53,908	28-Slaton (22,284), 51-Post, 52-Southland
			Warehouses:
10-Abernathy	49,590	129,376	13-Hale Center, 32-New Deal
17-Lockney	49,590	129,376	15-Halfway, 17-Lockney
21-Ralls	74,385	194,064	23-Lorenzo, 24-Cone, 26-Crosbyton
27-Lubbock	49,590	129,376	27-Lubbock, 33-Wolfforth
28-Slaton	45,458	118,596	49-Wilson, 52-Southland
34-Levelland	49,590	129,376	3-Amherst, 40-Sundown
42-Brownfield	74,385	194,064	36-Smyer, 43-Meadow, 44-Tokio

Appendix Table 40. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Warehouses:
47-Tahoka	50,818	132,578	46-O'Donnell, 47-Tahoka

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed, for areas with split shipments the volume is in parentheses

Appendix Table 41. Ginning and Warehousing Activities in Suboptimum Market Organization 3, Lubbock Study Area, 32 Week Ginning Season, 1974

Location[a]	Capacity	Volume	Supply Source
	Bales		
			Gins:
3-Amherst	64,688	64,688	1-Littlefield, 2-Sudan, 3-Amherst, 4-Earth, 5-Fieldton (8,120)
13-Hale Center	64,688	64,688	5-Fieldton (5,847), 9-Plainview, 11-Cotton Center, 12-Edmonson (1,694), 13-Hale Center
15-Halfway	64,688	64,688	6-Olton, 8-Springlake, 12-Edmonson (17,355), 15-Halfway
17-Lockney	64,688	64,688	16-Floydada (6,122), 17-Lockney, 18-Sterley, 20-Aiken
23-Lorenzo	64,688	64,688	21-Ralls (8,775), 22-Robertson, 23-Lorenzo, 31-Idalou (12,823)
24-Cone	64,688	64,688	14-Petersburg, 16-Floydada (13,400), 19-Dougherty (10,694), 24-Cone
26-Crosbyton	64,688	64,688	19-Dougherty (8,828), 21-Ralls (12,770), 25-Kalgary, 26-Crosbyton
27-Lubbock	64,688	64,688	27-Lubbock, 29-Shallowater (15,053), 31-Idalou (18,406)
32-New Deal	64,688	64,688	5-Fieldton (175), 10-Abernathy, 29-Shallowater (13,946), 32-New Deal, 35-Anton (289)
33-Wolfforth	64,688	64,688	29-Shallowater (2,230), 30-Hurlwood, 33-Wolfforth
36-Smyer	64,688	64,688	7-Spade, 34-Levelland (1,020), 35-Anton (16,316), 36-Smyer, 41-Whitharral

Appendix Table 41. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
		Gins:	
40-Sundown	64,688	64,688	34-Levelland (14,873), 37-Pep, 38-Pettit, 40-Sundown
43-Meadow	64,688	64,688	34-Levelland (712), 39-Ropesville, 42-Brownfield (16,311), 43-Meadow
44-Tokio	64,688	64,688	42-Brownfield (2,568), 44-Tokio, 45-Wellman
46-O'Donnell	10,782 64,688	3,202 64,688	46-O'Donnell, 48-Grassland (32,662)
47-Tahoka	64,688	64,688	42-Brownfield (12,181), 47-Tahoka, 48-Grassland (2,566), 50-New Home (14,713)
49-Wilson	64,688	64,688	28-Slaton (8,945), 49-Wilson, 50-New Home (20,515)
52-Southland	53,908	53,908	28-Slaton (22,284), 51-Post, 52-Southland
		Warehouses:	
10-Abernathy	49,590	129,376	13-Hale Center, 32-New Deal
17-Lockney	49,590	129,376	15-Halfway, 17-Lockney
21-Ralls	74,385	194,064	23-Lorenzo, 24-Cone, 26-Crosbyton
27-Lubbock	74,385	194,064	27-Lubbock, 33-Wolfforth, 47-Tahoka
28-Slaton	71,486	186,486	46-O'Donnell, 49-Wilson, 52-Southland
34-Levelland	49,590	129,376	3-Amherst, 40-Sundown

Appendix Table 41. (Continued)

Location[a]	Capacity	Volume	Supply Source[b]
	Bales		
			Warehouses:
42-Brownfield	74,385	194,064	36-Smyer, 43-Meadow, 44-Tokio

[a]Location is given by code number and town name

[b]Supply source is given by code number and supply area; if a supply area transports all of its production to a given point then only the location is listed; for areas with split shipments the volume is in parentheses

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VITA

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